SEMESTER I

MAT 101	LINEAR ALGEBRA AND CALCULUS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: This course introduces students to some basic mathematical ideas and tools which are at the core of any engineering course. A brief course in Linear Algebra familiarises students with some basic techniques in matrix theory which are essential for analysing linear systems. The calculus of functions of one or more variables taught in this course are useful in modelling and analysing physical phenomena involving continuous change of variables or parameters and have applications across all branches of engineering.

Prerequisite: A basic course in one-variable calculus and matrix theory**.**

Course Outcomes: After the completion of the course the student will be able to

CO 1	solve systems of linear equations, diagonalize matrices and characterise quadratic forms
CO 2	compute the partial and total derivatives and maxima and minima of multivariable functions
CO 3	compute multiple integrals and apply them to find areas and volumes of geometrical shapes, mass and centre of gravity of plane laminas
CO 4	perform various tests to determine whether a given series is convergent, absolutely convergent or conditionally convergent
CO 5	determine the Taylor and Fourier series expansion of functions and learn their applications.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	2	1			1	2		2
CO 2	3	3	3	3	2	1			1	2		2
CO 3	3	3	3	3	2	1			1	2		2
CO 4	3	2	3	2	1	1			1	2		2
CO 5	3	3	3	3	2	1			1	2		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks
Assignments: Assignment should include specific problems highlighting the applications of the methods introduced in this course in science and engineering.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Solve systems of linear equations, diagonalize matrices and characterise quadratic forms

1. A is a real matrix of order $3 \times 3$and $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$. What can you say about the solution of $AX = 0$if rank of A is 1? 2 ?3?
2. Given$A = \begin{bmatrix} 3 & 0 & 2 \\ 0 & 2 & 0 \\ -2 & 0 & 0 \end{bmatrix}$, find an orthogonal matrix Pthat diagonalizes A.
3. Find out what type of conic section the following quadratic form represents

$$17x^2 - 30x_1x_2 + 17x_2^2 = 128$$

4. The matrix $A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$has an eigen value5 with corresponding Eigen vector$X = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$. Find A^5X

Course Outcome 2 (CO2): compute the partial and total derivatives and maxima and minima of multivariable functions

1. Find the slope of the surface $z = x^2y + 5y^3$in the x-direction at the point (1,-2)

2. Given the function $w = xy + z$, use chain rule to find the instantaneous rate of change of $w$at each point along the curve $x = cost, y = sint, z = t$

3. Determine the dimension of rectangular box open at the top , having a volume 32 cubic ft and requiring the least amount of material for it's construction.

Course Outcome 3(CO3): compute multiple integrals and apply them to find areas and volumes of geometrical shapes, mass and centre of gravity of plane laminas.

1. Evaluate $\iint_D (x + 2y)\, DA$where D is the region bounded by the parabolas $y = 2x^2$and $y = 1 + x^2$

2. Explain how you would find the volume under the surface $z = f(x, y)$and over a specific region Din the xyplane using (i) double integral (ii) triple integral?

3. Find the mass and centre of gravity of a triangular lamina with vertices (0,0), (2,1), (0,3) if the density function is $f(x, y) = x + y$

4. Use spherical coordinates to evaluate $\iiint_B (x^2 + y^2 + z^2)^3\, dV$where B is the unit ball defined by $B = \{(x, y, z): x^2 + y^2 + z^2 \leq 1\}$

Course Outcome 4 (CO4): perform various tests to determine whether a given series is convergent, absolutely convergent or conditionally convergent.

1. What is the difference between a sequence and a series and when do you say that they are convergent? Divergent?

2. Determine whether the series $\sum_{n=1}^{n=\infty} \frac{5}{2n^2+4n+3}$converges or diverges.

3. Is the series $\sum_{n=1}^{n=\infty} \frac{(-1)^{n-1}}{n}$convergent? Absolutely convergent? Conditionally convergent?

Course Outcome 5 (CO5): determine the Taylor and Fourier series expansion of functions and learn their applications.

1. Assuming the possibility of expansion find the Maclaurin series expansion of

   $f(x) = (1 + x)^k$for$|x| < 1$where $k$is any real number. What happens if $k$is a positive

   integer?

2. Use Maclaurin series of $ln(1 + x), -1 < x \leq 1$to find an approximate value of$ln2$.

3. Find the Fourier series of the function$f(x) = x^2, -2 \leq x < 2, f(x + 4) = f(x)$. Hence using Parseval's identity prove that $1 + \frac{1}{2^4} + \frac{1}{3^4} + \ \dots\ = \frac{\pi^4}{90}$

4. Expand the function $f(x) = x\ (0 < x < 1/2)$ into a (i) Fourier sine series (ii) Fourier cosine series.

Model Question paper

QP CODE: PAGES:3

Reg No:_______________

Name :_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: **MAT 101**

Max. Marks: 100 **Duration: 3 Hours**

LINEAR ALGEBRA AND CALCULUs

(2019-Scheme)

(Common to all branches)

PART A

(Answer **all** questions, **each** question carries 3 marks)

1. Determine the rank of the matrix $A = \begin{bmatrix} 1 & 2 & -1 \\ -2 & -4 & 2 \\ 3 & 6 & -3 \end{bmatrix}$.
2. Write down the eigen values of $= \begin{bmatrix} 2 & 0 \\ 0 & -1 \end{bmatrix}$. What are the eigen values of $P^{-1}AP$ where $P = \begin{bmatrix} -4 & 2 \\ 3 & -1 \end{bmatrix}$?
3. Find $f_x(1,3)$ and $f_y(1,3)$ for the function $f(x,y) = 2x^3y^2 + 2y + 4x$.
4. Show that the function $u(x,t) = \sin(x - ct)$ is a solution of the equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$.
5. Use double integral to find the area of the region enclosed between the parabolas $y = \frac{1}{2}x^2$ and the line $y = 2x$.
6. Use polar coordinates to evaluate the area of the region bounded by $x^2 + y^2 = 4$, the line $y = x$ and the y axis in the first quadrant
7. Test the convergence of the series $\sum_{k=1}^{\infty} \frac{k}{k+1}$.
8. Test the convergence of the alternating series $\sum_{k=1}^{\infty} (-1)^{k+1} \frac{1}{k}$ using Leibnitz test.
9. Find the Taylor series expansion of $sin\pi x$ about $x = \frac{1}{2}$.
10. Find the values to which the Fourier series of

$f(x) = x$ for $-\pi < x < \pi$, with $f(x + 2\pi) = f(x)$ converges (10x3=30)

PART B

(Answer **one full** question from each module, each question carries **14** marks)

Module -I

11. (a) Solve the following system of equations

$$y + z - 2w = 0$$
$$2x - 3y - 3z + 6w = 2$$
$$4x + y + z - 2w = 4$$

(b) Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$

12. (a) Diagonalize the matrix $\begin{bmatrix} -1 & 2 & -2 \\ 2 & 4 & 1 \\ 2 & 1 & 4 \end{bmatrix}$

(b) What kind of conic section the quadratic form$3x_1^2 + 22x_1x_2 + 3x_2^2 = 0$ represents? Transform it to principal axes.

Module - II

13. (a) Find the local linear approximation to $f(x, y) = \sqrt{x^2 + y^2}$ at the point $(3, 4)$.Use it to approximate $f(3.04,3.98)$

(b) Let $w = \sqrt{x^2 + y^2 + z^2}$, $x = cos\theta, y = sin\theta, z = tan\theta$. Use chain rule to find $\frac{dw}{d\theta}$when $\theta = \frac{\pi}{4}$.

14. (a) Let $z = f(x, y)$ where $x = rcos\theta, y = rsin\theta$, prove that $\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial r}\right)^2 + \frac{1}{r^2}\left(\frac{\partial z}{\partial \theta}\right)^2$.

(b) Locate all relative maxima, relative minima and saddle points $f(x, y) = xy + \frac{a^3}{x} + \frac{b^3}{y}(a \neq 0, b \neq 0)$.

Module - III

15. (a) Evaluate$\iint_D (2x^2y + 9y^3)\, dxdy$ where D is the region bounded by $y = \frac{2}{3}x$ and $y = 2\sqrt{x}$

(b) Evaluate $\int_0^4 \int_{\sqrt{y}}^2 e^{x^3}\, dxdy$ changing the order of integration.

16. (a) Find the volume of the solid bounded by the cylinder $x^2 + y^2 = 4$ and the planes $y + z = 4$ and $z = 0$..

(b) Evaluate $\iiint \sqrt{1 - x^2 - y^2 - z^2}\, dxdydz$, taken throughout the volume of the sphere $x^2 + y^2 + z^2 = 1$, by transforming to spherical polar coordinates

Module - IV

17. (a) Test the convergence of the series

(i) $\sum_{k=1}^{\infty} \frac{k^k}{k!}$ (ii) $\sum_{k=2}^{\infty} \left(\frac{4k-5}{2k+1}\right)^k$

(b) Determine the convergence or divergence of the series $\sum_{k=1}^{\infty}(-1)^k \frac{(2k-1)!}{3^k}$

18. (a) Check whether the series $\sum_{k=1}^{\infty}(-1)^{k+1} \frac{(2k)!}{(3k-2)!}$is absolutely convergent, conditionally convergent or divergent.

(b) Test the convergence of the series $1 + \frac{1.2}{1.3} + \frac{1.2.3}{1.3.5} + \frac{1.2.3.4}{1.3.5.7} + \cdots$

Module - V

19. (a) Obtain the Fourier series of for$f(x) = e^{-x}$, in the interval $0 < x < 2\pi$.with $f(x + 2\pi) = f(x)$. Hence deduce the value of$\sum_{n=2}^{\infty} \frac{(-1)^n}{1+n^2}$.

(b) Find the half range sine series of $f(x) = \begin{cases} \frac{2kL}{x} & if\ 0 < x < \frac{L}{2} \\ \frac{2k(L-x)}{L} & if\ \frac{L}{2} < x < L \end{cases}$

20. (a)Expand $(1 + x)^{-2}$.as a Taylor series about $x = 0$and state the region of convergence of the series.

(b) Find the Fourier series for $f(x) = x^2$ in the interval $-\pi < x < \pi$

with $f(x + 2\pi) = f(x)$.Hence show that $\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \cdots = \frac{\pi^4}{90}$. (14X5=70)

Syllabus

Module 1 (Linear algebra)

(Text 2: Relevant topics from sections 7.3, 7.4, 7.5, 8.1,8.3,8.4)

Systems of linear equations, Solution by Gauss elimination, row echelon form and rank of a matrix, fundamental theorem for linear systems (homogeneous and non-homogeneous, without proof), Eigen values and eigen vectors. Diagonaliztion of matrices, orthogonal transformation, quadratic forms and their canonical forms.

Module 2 (multivariable calculus-Differentiation)

(Text 1: Relevant topics from sections 13.3, 13.4, 13.5, 13.8)

Concept of limit and continuity of functions of two variables, partial derivatives, Differentials, Local Linear approximations, chain rule, total derivative, Relative maxima and minima, Absolute maxima and minima on closed and bounded set.

Module 3(multivariable calculus-Integration)

(Text 1: Relevant topics from sections 14.1, 14.2, 14.3, 14.5, 14.6, 14.8)

Double integrals (Cartesian), reversing the order of integration, Change of coordinates (Cartesian to polar), finding areas and volume using double integrals, mass and centre of gravity of inhomogeneous laminas using double integral. Triple integrals, volume calculated as triple integral, triple integral in cylindrical and spherical coordinates (computations involving spheres, cylinders).

Module 4 (sequences and series)

(Text 1: Relevant topics from sections 9.1, 9.3, 9.4, 9.5, 9.6)

Convergence of sequences and series, convergence of geometric series and p-series(without proof), test of convergence (comparison, ratio and root tests without proof); Alternating series and Leibnitz test, absolute and conditional convergence.

Module 5 (Series representation of functions)

(Text 1: Relevant topics from sections 9.8, 9.9. Text 2: Relevant topics from sections 11.1, 11.2, 11.6)

Taylor series (without proof, assuming the possibility of power series expansion in appropriate domains), Binomial series and series representation of exponential, trigonometric, logarithmic functions (without proofs of convergence); Fourier series, Euler formulas, Convergence of Fourier series (without proof), half range sine and cosine series, Parseval's theorem (without proof).

Text Books

1. H. Anton, I. Biven,S.Davis, "Calculus", Wiley, 10th edition, 2015.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10thEdition, John Wiley & Sons, 2016.

Reference Books

1. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9 th Edition, Pearson, Reprint, 2002.
3. Peter V. O'Neil, Advanced Engineering Mathematics , Cengage, 7th Edition, 2012
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36 Edition, 2010.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Linear Algebra (10 hours)**	
1.1	Systems of linear equations, Solution by Gauss elimination	1
1.2	Row echelon form, finding rank from row echelon form, fundamental theorem for linear systems	3
1.3	Eigen values and eigen vectors	2
1.4	Diagonaliztion of matrices, orthogonal transformation, quadratic forms	4

	and their canonical forms.	
2	**Multivariable calculus-Differentiation (8 hours)**	
2.1	Concept of limit and continuity of functions of two variables, partial derivatives	2
2.2	Differentials, Local Linear approximations	2
2.3	Chain rule, total derivative	2
2.4	Maxima and minima	2
3	**Multivariable calculus-Integration (10 hours)**	
3.1	Double integrals (Cartesian)-evaluation	2
3.2	Change of order of integration in double integrals, change of coordinates (Cartesian to polar),	2
3.3	Finding areas and volumes, mass and centre of gravity of plane laminas	3
3.4	Triple integrals	3
4	**Sequences and series (8 hours)**	
4.1	Convergence of sequences and series, geometric and p-series	2
4.2	Test of convergence(comparison, ratio and root)	4
4.3	Alternating series and Leibnitz test, absolute and conditional convergence	2
5	**Series representation of functions (9 hours)**	
5.1	Taylor series, Binomial series and series representation of exponential, trigonometric, logarithmic functions;	3
5.2	Fourier series, Euler formulas, Convergence of Fourier series(Dirichlet's conditions)	3
5.3	Half range sine and cosine series, Parseval's theorem.	3

PHT 100	ENGINEERING PHYSICS A (FOR CIRCUIT BRANCHES)	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	3	1	0	4	2019

Preamble: The aim of the Engineering Physics Program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes

Prerequisite: Higher secondary level Physics, Mathematical course on vector calculus, differential equations and linear algebra

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.
CO 2	Apply the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.
CO 3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices.
CO 4	Classify the properties of magnetic materials and apply vector calculus to static magnetic fields and use Maxwell's equations to diverse engineering problems
CO 5	Analyze the principles behind various superconducting applications, explain the working of solid state lighting devices and fibre optic communication system

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2						1	2			1
CO 2	3	2						1	2			1
CO 3	3	2						1	2			1
CO 4	3	1						1	2			1
CO 5	3	1						1	2			1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20

Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the effect of damping force on oscillators.
2. Distinguish between transverse and longitudinal waves.
3. (a) Derive an expression for the fundamental frequency of transverse vibration in a stretched string.

   (b) Calculate the fundamental frequency of a string of length 2 m weighing 6 g kept stretched by a load of 600 kg.

Course Outcome 2 (CO2):

1. Explain colours in thin films.
2. Distinguish between Fresnel and Fraunhofer diffraction.
3. (a) Explain the formation of Newton's rings and obtain the expression for radii of bright and dark rings in reflected system. Also explain how it is used to determine the wavelength of a monochromatic source of light.

   (b) A liquid of refractive index μ is introduced between the lens and glass plate.

What happens to the fringe system? Justify your answer.

Course Outcome 3 (CO3):

1. Give the physical significance of wave function ?

2. What are excitons ?

3. (a) Solve Schrodinger equation for a particle in a one dimensional box and obtain its energy eigen values and normalised wave functions.

   (b) Calculate the first three energy values of an electron in a one dimensional box of width 1 A^0 in electron volt.

Course Outcome 4 (CO4):

1. Compare displacement current and conduction current.

2. Mention any four properties of ferro magnetic materials.

3. (a) Starting from Maxwell's equations, derive the free space electromagnetic wave equation and show that velocity of electromagnetic wave is $1/(\mu_o \varepsilon_o)^{1/2}$

   (b) An electromagnetic wave is described by $E = 100 \exp 8\pi i [10^{14} t - (10^6 z / 3)]$ V/m. Find the direction of propagation of the wave,speed of the wave and magnetic flux density in the wave.

Course Outcome 5 (CO5):

1. Explain the working of a solar cell.

2. Distinguish between Type I and Type II super conductors.

3. (a) Define numerical aperture and derive an expression for it.

   (b) Explain the working of intensity modulated fibre optic sensor.

Model Question paper

QP CODE: PAGES:3

Reg No:_______________

Name :_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: PHT 100

Course Name: Engineering Physics A

Max. Marks: 100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Compare electrical and mechanical oscillators

2. Distinguish between longitudinal and transverse waves

3. Write a short note on antireflection coating.

4. Diffraction of light is not as evident in daily experience as that of sound waves. Give reason.

5. State and explain Heisenberg's Uncertainty principle. With the help of it explain natural line broadening.

6. Explain surface to volume ratio of nanomaterials.

7. State Faraday's laws of electromagnetic induction.

8. Compare displacement current and conduction current

9. List four important applications of superconductors.

10. Give the working principle of LED. (10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. (a) Derive the differential equation of damped harmonic oscillator and deduce its solution.Discuss the cases of over damped, critically damped and under damped cases. (10)

(b) The frequency of a tuning fork is 500 Hz and its Q factor is 7×10^{4}. Find the relaxation time. Also calculate the time after which its energy becomes 1/10 of its initial undamped value.(4)

12. (a) Derive an expression for the velocity of propagation of a transverse wave in a stretched string. Deduce laws of transverse vibrations. (10)

(b) The equation of transverse vibration of a stretched string is given by y =0.00327 sin (72.1x-2.72t)m, in which the numerical constants are in S.I units. Evaluate (i) Amplitude (ii) Wavelength (iii) Frequency and (iv)Velocity of the wave. (4)

Module 2

13.(a)Explain the formation of Newton's rings and show that the radius of dark ring is proportional to the square root of natural numbers. How can we use Newton's rings experiment to determine the refractive index of a liquid. (10)

(b) Two pieces of plane glass are placed together with a piece of paper between two at one end. Find the angle of the wedge in seconds if the film is viewed with a monochromatic light of wavelength 4800Å. Given β = 0.0555 cm. (4)

14. (a) Explain the diffraction due to a plane transmission grating. Obtain the grating equation. (10)

(b) A grating has 6000 lines per cm. Find the angular separation of the two yellow lines of mercury of wavelengths 577 nm and 579 nm in the second order. (4)

Module 3

15.(a) Derive time dependent and independent Schrodinger equations. (10)

(b) An electron is confined to one dimensional potential box of length 2Å. Calculate the energies corresponding to the first and second quantum states in eV. (4)

16.(a) Classify nanomaterials based on dimensionality of quantum confinement and explain the following nanostructures. (i) nano sheets (ii) nano wires (iii) quantum dots. (10)

(b) Find the de Broglie wavelength of electron whose kinetic energy is 15 eV. (4)

Module 4

17.(a) State Poynting's Theorem. Calculate the value of Poynting vector at the surface of the sun if the power radiated by the sun is 3.8×10^{26} W and its radius is 7×10^{8} m. (5)

(b) Distinguish between paramagnetic, diamagnetic and ferromagnetic materials. (9)

18.(a) Starting from Maxwell's Equations, derive electromagnetic wave equations in free space. (10)

(b) If the magnitude of **H** in a plane wave is 1 A/m, find the magnitude of **E** in free space. (4)

Module 5

19.(a) Show that superconductors are perfect diamagnets. Distinguish between Type I and Type II superconductors with suitable examples. (10)

(b) Write a short note on high temperature superconductors. (4)

20.(a) Define numerical aperture of an optic fibre and derive an expression for the NA of a step index fibre with a neat diagram. (10)

(b) Calculate the numerical aperture and acceptance angle of a fibre with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fibre is inside water of refractive index 1.33. (4)

(14x5=70)

Syllabus

ENGINEERING PHYSICS A
(FOR CIRCUIT BRANCHES)

Module 1

Oscillations and Waves

Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression, Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators

Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation), Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration

Module 2

Wave Optics

Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference, Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings

Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation, Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)

Module 3

Quantum Mechanics & Nanotechnology

Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism, Formulation of time dependent and independent Schrodinger wave equations-Physical meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)

Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots, Properties of nanomaterials-mechanical, electrical and optical, Applications of nanotechnology (qualitative ideas)

Module 4

Magnetism & Electro Magnetic Theory

Magnetic field and Magnetic flux density, Gauss's law for Magnetic flux density, Ampere's Circuital law, Faraday's law in terms of EMF produced by changing magnetic flux, Magnetic permeability and susceptibility, Classification of magnetic materials-para, dia and ferromagnetic materials

Fundamentals of vector calculus, concept of divergence, gradient and curl along with physical significance, Line, Surface and Volume integrals, Gauss divergence theorem & Stokes' theorem, Equation of continuity, Derivation of Maxwell's equations in vacuum, Comparison of displacement current with conduction current. Electromagnetic waves, Velocity of Electromagnetic waves in free space, Flow of energy and Poynting's vector (no derivation)

Module 5

Superconductivity & Photonics

Superconducting phenomena, Meissner effect and perfect diamagnetism, Types of superconductors-Type I and Type II, BCS Theory (Qualitative), High temperature superconductors-Applications of super conductivity

Introduction to photonics-Photonic devices-Light Emitting Diode, Photo detectors -Junction and PIN photodiodes, Solar cells-I-V Characteristics, Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications of optical fibre, Fibre optic sensors-Intensity Modulated and Phase modulated sensors.

Text Books

1. M.N.Avadhanulu, P.G.Kshirsagar,TVS Arun Murthy "A Text book of Engineering Physics", S.Chand &Co., Revised Edition 2019

2. H.K.Malik , A.K. Singh, "Engineering Physics" McGraw Hill Education, Second Edition 2017

Reference Books

1. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003

2. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015

3. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016

4. Aruldhas G., "Engineering Physics", PHI Pvt. Ltd., 2015

5. Ajoy Ghatak, "Optics", Mc Graw Hill Education, Sixth Edition, 2017

6. T. Pradeep, "Nano:The Essentials'', McGraw Hill India Ltd, 2007

7. Halliday, Resnick, Walker, "Fundamentals of Physics'', John Wiley & Sons.Inc, 2001

8. David J Griffiths, "Introduction to Electrodynamics'', Addison-Wesley publishing, 3rd Edition, 1999

9. Premlet B., "Advanced Engineering Physics", Phasor Books,10th edition,2017

10. I. Dominic and. A. Nahari, "A Text Book of Engineering physics", Owl Books Publishers, Revised edition, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Oscillations and Waves (9 hours)**	
1.1	Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression	2 hrs
1.2	Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators	3hrs
1.3	Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation)	2 hrs
1.4	Distinction between transverse and longitudinal waves. Transverse vibration in a stretched string, Statement of laws of vibration	2 hrs
2	**Wave Optics (9 hours)**	
2.1	Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference	2 hrs
2.2	Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings	4 hr
2.3	Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation	2 hrs
2.4	Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)	1 hr
3	**Quantum Mechanics &Nanotechnology (9hours)**	
3.1	Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism	2 hrs
3.2	Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)	4 hrs
3.3	Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots	2 hrs
3.4	Properties of nanomaterials-mechanical, electrical and optical Applications of nanotechnology (qualitative ideas)	1 hr
4	**Magnetism & Electro Magnetic Theory (9 hours)**	
4.1	Magnetic field and Magnetic flux density, Gauss's law for Magnetic flux	2 hrs

	density, Ampere's Circuital law, Faraday's law in terms of EMF produced by changing magnetic flux	
4.2	Explanation for Magnetic permeability and susceptibility Classification of magnetic materials- para, dia and ferromagnetic materials	1 hr
4.3	Fundamentals of vector calculus, concept of divergence, gradient and curl along with physical significance, Line, Surface and Volume integrals, Gauss divergence theorem & Stokes' theorem	2 hrs
4.4	Equation of continuity, Derivation of Maxwell's equations in vacuum, Comparison of displacement current with conduction current. Electromagnetic waves, Velocity of Electromagnetic waves in free space, Flow of energy and Poynting's vector (no derivation)	4 hrs
5	**Superconductivity &Photonics (9hours)**	
5.1	Super conducting Phenomena, Meissner effect and perfect diamagnetism, Types of superconductors-Type I and Type II	2 hrs
5.2	BCS Theory (Qualitative), High temperature superconductors, Applications of super conductivity	2 hrs
5.3	Introduction to photonics-Photonic devices-Light Emitting Diode, Photo detectors -Junction and PIN photodiodes, Solar cells-I-V Characteristics	2 hrs
5.4	Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications of optical fibre, Fibre optic sensors-Intensity Modulated and Phase modulated sensors	3 hrs

PHT 110	ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)	Category	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: The aim of the Engineering Physics program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes

Prerequisite: Higher secondary level Physics, Mathematical course on vector calculus, differential equations and linear algebra

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.
CO 2	Apply the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.
CO 3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices.
CO 4	Apply the knowledge of ultrasonics in non-destructive testing and use the principles of acoustics to explain the nature and characterization of acoustic design and to provide a safe and healthy environment
CO 5	Apply the comprehended knowledge about laser and fibre optic communication systems in various engineering applications

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2						1	2			1
CO 2	3	2						1	2			1
CO 3	3	2						1	2			1
CO 4	3							1	2			1
CO 5	3	2						1	2			1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	25	25	50

Apply	10	10	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE MARKS	ESE MARKS	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the effect of damping force on oscillators.
2. Distinguish between transverse and longitudinal waves.
3. (a) Derive an expression for the fundamental frequency of transverse vibration in a stretched string.
   (b) Calculate the fundamental frequency of a string of length 2 m weighing 6 g kept stretched by a load of 600 kg.

Course Outcome 2 (CO2):

1. Explain colours in thin films.
2. Distinguish between Fresnel and Fraunhofer diffraction.
3. (a) Explain the formation of Newton's rings and obtain the expression for radii of bright and dark rings in reflected system. Also explain how it is used to determine the wavelength of a monochromatic source of light.
   (b) A liquid of refractive index μ is introduced between the lens and glass plate. What happens to the fringe system? Justify your answer.

Course Outcome 3 (CO3):

1. Give the physical significance of wave function?

2. What are excitons ?
3. (a) Solve Schrodinger equation for a particle in a one dimensional box and obtain its energy eigen values and normalised wave functions.
   (b) Calculate the first three energy values of an electron in a one dimensional box of width 1 A^0 in electron volt.

Course Outcome 4 (CO4):

1. Explain reverberation and reverberation time.
2. How ultrasonic waves are used in non-destructive testing.
3. (a) With a neat diagram explain how ultrasonic waves are produced by a piezoelectric oscillator.
   (b) Calculate frequency of ultrasonic waves that can be produced by a nickel rod of length 4 cm. (Young's Modulus = 207 G Pa, Density = 8900 Kg /m^3)

Course Outcome 5 (CO 5):

1. Distinguish between spontaneous emission and stimulated emission.
2. Explain optical resonators.
3. (a) Explain the construction and working of Ruby Laser.
   (b) Calculate the numerical aperture and acceptance angle of a fibre with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fibre is inside water of refractive index 1.33.

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Model Question paper

QP CODE: PAGES:3

Reg No:_______________

Name :_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: PHT 110

Course Name: Engineering Physics B

Max.Marks: 100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Compare electrical and mechanical oscillators.

2. Distinguish between longitudinal and transverse waves.

3. Write a short note on antireflection coating.

4. Diffraction of light is not as evident in daily experience as that of sound waves. Give reason.

5. State and explain Heisenberg's Uncertainty principle. With the help of it explain natural line broadening.

6. Explain surface to volume ratio of nanomaterials.

7. Define sound intensity level. Give the values of threshold of hearing and threshold of pain.

8. Describe the method of non-destructive testing using ultra sonic waves

9. Explain the condition of population inversion

10. Distinguish between step index and graded index fibre. (10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. (a) Derive the differential equation of damped harmonic oscillator and deduce its solution. Discuss the cases of over damped, critically damped and under damped cases. (10)

(b) The frequency of a tuning fork is 500 Hz and its Q factor is $7\times10^{4.}$ Find the relaxation time. Also calculate the time after which its energy becomes 1/10 of its initial undamped value. (4)

12. (a) Derive an expression for the velocity of propagation of a transverse wave in a stretched string. Deduce laws of transverse vibrations. (10)

(b) The equation of transverse vibration of a stretched string is given by y =0.00327 sin (72.1x-2.72t) m, in which the numerical constants are in S.I units. Evaluate (i) Amplitude (ii) Wavelength (iii) Frequency and (iv) Velocity of the wave. (4)

Module 2

13. (a) Explain the formation of Newton's rings and show that the radius of dark ring is proportional to the square root of natural numbers. How can we use Newton's rings experiment to determine the refractive index of a liquid? (10)

(b) Two pieces of plane glass are placed together with a piece of paper between two at one end. Find the angle of the wedge in seconds if the film is viewed with a monochromatic light of wavelength 4800Å. Given β = 0.0555 cm. (4)

14. (a) Explain the diffraction due to a plane transmission grating. Obtain the grating equation. (10)

(b) A grating has 6000 lines per cm. Find the angular separation of the two yellow lines of mercury of wavelengths 577 nm and 579 nm in the second order. (4)

Module 3

15. (a) Derive time dependent and independent Schrodinger equations. (10)

(b) An electron is confined to one dimensional potential box of length 2Å. Calculate the energies corresponding to the first and second quantum states in eV. (4)

16. (a) Classify nanomaterials based on dimensionality of quantum confinement and explain the following nanostructures. (i) nano sheets (ii) nano wires (iii) quantum dots. (10)

(b) Find the de Broglie wavelength of electron whose kinetic energy is 15 eV. (4)

Module 4

17. (a) Explain reverberation and reverberation time? What is the significance of Reverberation time. Explain the factors affecting the acoustics of a building and their corrective measures? (10)

(b) The volume of a hall is 3000 m^3. It has a total absorption of 100m^2 sabine. If the hall is filled with audience who add another 80 m^2sabine, then find the difference in reverberation time. (4)

18. (a) With a neat diagram explain how ultrasonic waves are produced by piezoelectric oscillator. Also discuss the piezoelectric method of detection of ultrasonic waves. (10)

(b) An ultrasonic source of 0.09 MHz sends down a pulse towards the sea bed which returns after 0.55 sec. The velocity of sound in sea water is 1800 m/s. Calculate the depth of the sea and the wavelength of the pulse. (4)

Module 5

19. (a) Outline the construction and working of Ruby laser. (8)

(b) What is the principle of holography? How is a hologram recorded? (6)

20. (a) Define numerical aperture of an optic fibre and derive an expression for the NA of a step index fibre with a neat diagram. (10)

(b) An optical fibre made with core of refractive index 1.5 and cladding with a fractional index difference of 0.0006. Find refractive index of cladding and numerical aperture. (4)

(14x5=70)

SYLLABUS

ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)

Module 1

Oscillations and Waves

Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression, Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators

Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation), Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration

Module 2

Wave Optics

Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference, Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings

Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation, Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)

Module 3

Quantum Mechanics & Nanotechnology

Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening Mechanism, Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)

Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots, Properties of nanomaterials-mechanical, electrical and optical, Applications of nanotechnology (qualitative ideas)

Module 4

Acoustics & Ultrasonics

Acoustics, Classification of sound-Musical sound-Noise, Characteristics of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation), Factors affecting architectural acoustics and their remedies

Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator –Working, Detection of ultrasonic waves - Thermal and Piezoelectric methods, Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid , Applications of ultrasonic waves -SONAR,NDT and Medical

Module 5

Laser and Fibre optics

Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein's coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle, Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) ,Applications of laser, Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications

Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors

Text Books

1. M.N.Avadhanulu, P.G.Kshirsagar,TVS Arun Murthy "A Text book of Engineering Physics", S.Chand &Co., Revised Edition, 2019.

2. H.K.Malik , A.K. Singh, "Engineering Physics" McGraw Hill Education, Second Edition, 2017.

Reference Books

1. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003
2. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015
3. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016
4. Aruldhas G., "Engineering Physics", PHI Pvt. Ltd., 2015
5. Ajoy Ghatak, "Optics", Mc Graw Hill Education, Sixth Edition, 2017
6. T. Pradeep, "Nano:The Essentials'', McGraw Hill India Ltd, 2007
7. B. B. Laud, "Lasers and Non linear optics", New age International Publishers, 2nd Edition ,2005
8. Premlet B., "Advanced Engineering Physics", Phasor Books,10th edition ,2017
9. I. Dominic and. A. Nahari, "A Text Book of Engineering physics", Owl Books Publishers, Revised edition, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Oscillations and Waves (9 hours)**	
1.1	Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression	2 hrs
1.2	Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators	3hrs
1.3	Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation)	2 hrs
1.4	Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration	2 hrs
2	**Wave Optics (9 hours)**	
2.1	Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference	2 hrs
2.2	Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings	4 hrs
2.3	Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation	2 hrs
2.4	Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)	1 hr
3	**Quantum Mechanics &Nanotechnology (9hours)**	
3.1	Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism	2 hrs
3.2	Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)	4 hrs
3.3	Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots	2 hrs
3.4	Properties of nanomaterials-mechanical, electrical and optical Applications of nanotechnology (qualitative ideas)	1 hr
4	**Acoustics & Ultrasonics (9hrs)**	
4.1	Acoustics, Classification of sound-Musical sound-Noise, Characteristics	3 hrs

	of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation)	
4.2	Factors affecting architectural acoustics and their remedies	1 hr
4.3	Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator – Working, Detection of ultrasonic waves - Thermal and Piezoelectric methods	3hrs
4.4	Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid ,Applications of ultrasonic waves -SONAR,NDT and Medical.	2 hr
5	**Laser and Fibre optics (9hours)**	
5.1	Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein's coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle	2 hrs
5.2	Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) Applications of laser	3 hrs
5.3	Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications	1 hr
5.4	Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors	3 hrs

CYT 100	ENGINEERING CHEMISTRY	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	3	1	0	4	2019

Preamble: To enable the students to acquire knowledge in the concepts of chemistry for engineering applications and to familiarize the students with different application oriented topics like spectroscopy, electrochemistry, instrumental methods etc. Also familiarize the students with topics like mechanism of corrosion, corrosion prevention methods, SEM, stereochemistry, polymers, desalination etc., which enable them to develop abilities and skills that are relevant to the study and practice of chemistry.

Prerequisite: Concepts of chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Apply the basic concepts of electrochemistry and corrosion to explore its possible applications in various engineering fields.
CO 2	Understand various spectroscopic techniques like UV-Visible, IR, NMR and its applications.
CO 3	Apply the knowledge of analytical method for characterizing a chemical mixture or a compound. Understand the basic concept of SEM for surface characterisation of nanomaterials.
CO 4	Learn about the basics of stereochemistry and its application. Apply the knowledge of conducting polymers and advanced polymers in engineering.
CO 5	Study various types of water treatment methods to develop skills for treating wastewater.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2	1									
CO 2	1	1		1	2							
CO 3	1	1		1	2							
CO 4	2	1										
CO 5	1			1			3					

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			
Create			

End Semester Examination Pattern: There will be two parts- **Part A** and **Part B. Part A** contains **10** questions (**2** questions from each module), having **3** marks for each question. Students should answer **all** questions. **Part B** contains **2** questions from each module, of which student should answer any one. Each question can have maximum **2** subdivisions and carries **14** marks.

Course Level Assessment Questions

Course Outcome 1 (CO 1):

1. What is calomel electrode? Give the reduction reaction (3 Marks)

2. List three important advantages of potentiometric titration (3 Marks)

3. (a) Explain how electroless plating copper and nickel are carried out (10 Marks)

(b) Calculate the emf of the following cell at 30°C, Z n / Zn $^{2+}$ (0.1M) // Ag^{+} (0.01M) // Ag.

Given E^0 Zn^{2+}/Zn = -0.76 V, E^0 Ag^{+}/Ag = 0.8 V. (4 Marks)

Course Outcome 2 (CO 2)

1. State Beer Lambert's law (3 Marks)

2. List the important applications of IR spectroscopy (3 Marks)

3. (a) What is Chemical shift? What are factors affecting Chemical shift? How ^1H NMR spectrum of CH_3COCH_2Cl interpreted using the concept of chemical shift. (10 Marks)

(b) Calculate the force constant of HF molecule, if it shows IR absorption at 4138 cm^{-1}. Given that atomic masses of hydrogen and fluorine are 1u and 19u respectively. (4 Marks)

Course Outcome 3 (CO 3):

1. Distinguish between TGA and DTA (3 Marks)

2. Give two differences between GSC and GLC (3 Marks)

3. (a) Explain the principle, instrumentation and procedure of HPLC (10 Marks)

(b) Interpret TGA of $CaC_2O_4 . H_2O$ (4 Marks)

Course Outcome 4 (CO 4):

1. Explain the geometrical isomerism in double bonds (3 Marks)

2. What are the rules of assigning R-S notation? (3 Marks)

3. (a) What are conducting polymers? How it is classified? Give the preparation of polyaniline (10 Marks)

(b) Draw the stereoisomers possible for CH_3-$(CHOH)_2$-COOH (4 Marks)

Course Outcome 5 (CO 5):

1. What is degree of hardness? (3 Marks)

2. Define BOD and COD (3 Marks)

3. (a) Explain the EDTA estimation of hardness (10 Marks)

(b) Standard hard water contains 20 g of CaCO3 per liter,50 mL of this required 30mL of EDTA solution, 50mL of sample water required 20mL of EDTA solution. 50mL sample water after boiling required 14 mL EDTA solution. Calculate the temporary hardness of the given sample of water, in terms of ppm. (4 Marks)

MODEL QUESTION PAPER

Total Pages:

Reg No.:________________ Name:____________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER B.TECH DEGREE EXAMINATION

Course Code: CYT100,

Course Name: ENGINEERING CHEMISTRY

Max. Marks: 100 Duration: 3 Hours

PART A

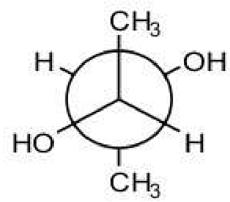
Answer all questions, each carries 3 marks Marks

1	What is potentiometric titration? How the end point is determined graphically?	(3)
2	What is Galvanic series? How is it different from electrochemical series?	(3)
3	Which of the following molecules can give IR absorption? Give reason? (a) O_2 (b) H_2O (c) N_2 (d) HCl	(3)
4	Which of the following molecules show UV-Visible absorption? Give reason. (a) Ethane (b) Butadiene (c) Benzene	(3)

5 What are the visualization techniques used in TLC? (3)

6 Write the three important applications of nanomaterials. (3)

7 Draw the Fischer projection formula and find R-S notation of (3)



8 Write the structure of a) Polypyrroleb) Kevlar. (3

9 What is break point chlorination? (3)

10 What is reverse osmosis? (3)

PART B

Answer any one full question from each module, each question carries 14 marks

Module 1

11 a) Give the construction of Li-ion cell. Give the reactions that take place at the electrodes during charging and discharging. What happens to anodic material when the cell is 100% charged. (10)

b) Calculate the standard electrode potential of Cu, if its electrode potential at 25 °C is 0.296 V and the concentration of Cu^{2+} is 0.015 M. (4)

OR

12 a) Explain the mechanism of electrochemical corrosion of iron in oxygen rich and oxygen deficient acidic and basic environments. (10)

b) Given below are reduction potentials of some species (4)

$MnO_4^- + 8H^+ + 5e \rightarrow Mn^{2+} + 4H_2O$; $E^0 = +1.51$ V

$Cl_2 + 2e \rightarrow 2Cl^-$; $E^0 = +1.36$ V

$S_2O_8^{2-} + 2e \rightarrow 2SO_4^{2-}$; $E^0 = +1.98$ V

Use the above data to examine whether the acids, dil. HCl and dil. H_2SO_4 , can be used to provide acid medium in redox titrations involving $KMnO_4$.

Module 2

13 a) What is spin-spin splitting? Draw the NMR spectrum of (i) CH_3 CH_2CH_2 Br (ii) $CH_3CH(Br)CH_3$ Explain how NMR spectrum can be used to identify the two isomers. (10)

b) A dye solution of concentration 0.08M shows absorbance of 0.012 at 600 nm; while a test solution of same dye shows absorbance of 0.084 under same conditions. Find the concentration of the test solution. (4)

OR

14 a) Explain the basic principle of UV-Visible spectroscopy. What are the possible electronic transitions? Explain with examples. (10)

b) Sketch the vibrational modes of CO_2 and H_2O. Which of them are IR active? (4)

Module 3

15	a)	Explain the principle, instrumentation and procedure involved in gas chromatography.	(10)
	b)	Explain the DTA of $CaC_2O_4.H_2O$ with a neat sketch.	(4)
		OR	
16	a)	Explain the various chemical methods used for the synthesis of nanomaterial	(10)
	b)	How TGA is used to analyse the thermal stability of polymers?	(4)

Module 4

17	a)	What are conformers? Draw the*cis* and *trans*isomers of 1, 3-dimethylcylohexane. Which conformer (chair form) is more stable in each case?	(10)
	b)	What is ABS? Give properties and applications.	(4)
		OR	
18	a)	Explain the various structural isomers with suitable example.	(10)
	b)	What is OLED? Draw a labelled diagram.	(4)

Module 5

19	a)	What are ion exchange resins? Explain ion exchange process for removal of hardness of water? How exhausted resins are regenerated?	(10)
	b)	50 mL sewage water is diluted to 2000 mL with dilution water; the initial dissolved oxygen was 7.7 ppm. The dissolved oxygen level after 5 days of incubation was 2.4 ppm. Find the BOD of the sewage.	(4)
		OR	
20	a)	What are the different steps in sewage treatment? Give the flow diagram. Explain the working of trickling filter.	(10)
	b)	Calculate the temporary and permanent hardness of a water sample which contains $[Ca^{2+}]$ = 160 mg/L, $[Mg^{2+}]$ = 192 mg/L and $[HCO_3^-]$ = 122 mg/L.	(4)

Syllabus

Module 1

Electrochemistry and Corrosion

Introduction - Differences between electrolytic and electrochemical cells - Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes - SHE - Calomel electrode - Glass Electrode - Construction and Working. Single electrode potential - definition - Helmholtz electrical double layer -Determination of E^0 using calomel electrode.Determination of pH using glass electrode.Electrochemical series and its applications. Free energy and EMF - Nernst Equation - Derivation - single electrode and cell (Numericals) -Application - Variation of emf with temperature. Potentiometric titration - Introduction -Redox titration only.Lithiumion cell - construction and working.Conductivity- Measurement of conductivity of a solution (Numericals).

Corrosion-Electrochemicalcorrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.

Module 2

Spectroscopic Techniques and Applications

Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals). UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.IR-Spectroscopy – Principle - Number of vibrational modes - Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications. ^{1}H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).

Module 3

Instrumental Methods and Nanomaterials

Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $CaC_2O_4.H_2O$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $CaC_2O_4.H_2O$. Chromatographic methods - Basic principles and applications of column and TLC-Retention factor. GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.

Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).

Module 4

Stereochemistry and Polymer Chemistry

Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations). R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples.Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.

Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications.Kevlar-preparation, properties and applications.Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.

Module 5

Water Chemistry and Sewage Water Treatment

Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. Municipal water treatment (brief) - Disinfection methods - chlorination, ozone andUV irradiation.

Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD-definition, estimation (only brief procedure) and significance (Numericals). Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process.

Text Books

1. B. L. Tembe, Kamaluddin, M. S. Krishnan, "Engineering Chemistry (NPTEL Web-book)", 2018.

2. P. W. Atkins, "Physical Chemistry", Oxford University Press, 10th edn., 2014.

Reference Books

1. C. N. Banwell, "Fundamentals of Molecular Spectroscopy", McGraw-Hill, 4thedn., 1995.
2. Donald L. Pavia, "Introduction to Spectroscopy", Cengage Learning India Pvt. Ltd., 2015.
3. B. R. Puri, L. R. Sharma, M. S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., 47th Edition, 2017.
4. H. H. Willard, L. L. Merritt, "Instrumental Methods of Analysis", CBS Publishers, 7th Edition, 2005.
5. Ernest L. Eliel, Samuel H. Wilen, "Stereo-chemistry of Organic Compounds", WILEY, 2008.
6. Raymond B. Seymour, Charles E. Carraher, "Polymer Chemistry: An Introduction", Marcel Dekker Inc; 4th Revised Edition, 1996.
7. MuhammedArif, Annette Fernandez, Kavitha P. Nair "Engineering Chemistry", Owl Books, 2019.
8. Ahad J., "Engineering Chemistry", Jai Publication, 2019.
9. Roy K. Varghese, "Engineering Chemistry", Crownplus Publishers, 2019.
10. Soney C. George,RinoLaly Jose, "Text Book of Engineering Chemistry", S. Chand & Company Pvt Ltd, 2019.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures (hrs)
1	**Electrochemistry and Corrosion**	9
1.1	Introduction - Differences between electrolytic and electrochemical cells- Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes- SHE - Calomel electrode - Glass Electrode - Construction and Working.	2
1.2	Single electrode potential – definition - Helmholtz electrical double layer - Determination of E^0 using calomel electrode. Determination of pH using glass electrode. Electrochemical series and its applications. Free energy and EMF - Nernst Equation – Derivation - single electrode and cell (Numericals) -Application -Variation of emf with temperature.	3
1.3	Potentiometric titration - Introduction -Redox titration only. Lithiumion cell - construction and working. Conductivity- Measurement of conductivity of a solution (Numericals).	2
1.4	Corrosion-Electrochemicalcorrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.	2
2	**Spectroscopic Techniques and Applications**	9
2.1	Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals).	2
2.2	UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.	2
2.3	IR-Spectroscopy – Principle - Number of vibrational modes -Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications.	2
2.4	^1H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).	3
3	**Instrumental Methods and Nanomaterials**	9
3.1	Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $CaC_2O_4.H_2O$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $CaC_2O_4.H_2O$.	2

3.2	Chromatographic methods - Basic principles and applications of column and TLC-Retention factor.	**2**
3.3	GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.	**2**
3.4	Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).	**3**
4	**Stereochemistry and Polymer Chemistry**	**9**
4.1	Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations).	**2**
4.2	R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples.	**1**
4.3	Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.	**2**
4.4	Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications. Kevlar-preparation, properties and applications. Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.	**4**
5	**Water Chemistry and Sewage Water Treatment**	**9**
5.1	Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages.	**3**
5.2	Municipal water treatment (brief) - Disinfection methods - chlorination, ozone andUV irradiation.	**2**
5.3	Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD-definition, estimation (only brief procedure) and significance (Numericals).	**2**
5.4	Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram - Trickling filter and UASB process.	**2**

EST 100	ENGINEERING MECHANICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	1	0	3	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts of mechanics and enhance their problem-solving skills. It introduces students to the influence of applied force system and the geometrical properties of the rigid bodies while stationary or in motion. After this course students will be able to recognize similar problems in real-world situations and respond accordingly.

Prerequisite: Nil

Course Outcomes: After completion of the course the student will be able to:

CO 1	Recall principles and theorems related to rigid body mechanics
CO 2	Identify and describe the components of system of forces acting on the rigid body
CO 3	Apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	Choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	Solve problems involving rigid bodies, applying the properties of distributed areas and masses

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	-	-	-	-	-	-	-	-	-
CO 4	3	3	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	15
Understand	10	10	15
Apply	30	30	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions:

Part A

Course Outcome 1 (CO1): (One question from each module to meet the course objective 1: *To recall principles and theorems related to rigid body mechanics***)**

1. Explain D'Alembert's principle

2. Distinguish static and dynamic friction

3. State and explain perpendicular axis theorem

Course Outcome 2 (CO2) (One question from each module to meet the course objective 2: *To identify and describe the components of system of forces acting on the rigid body***)**

1. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.

2. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar

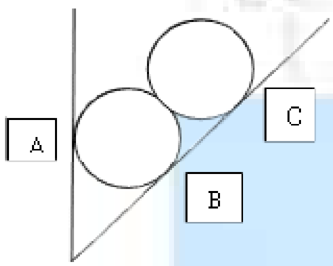
3. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

Part B

All the questions under this section shall assess the learning levels corresponding to the course outcomes listed below.

CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses

1. Two rollers each of weight 100 N are supported by an inclined plane and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth.

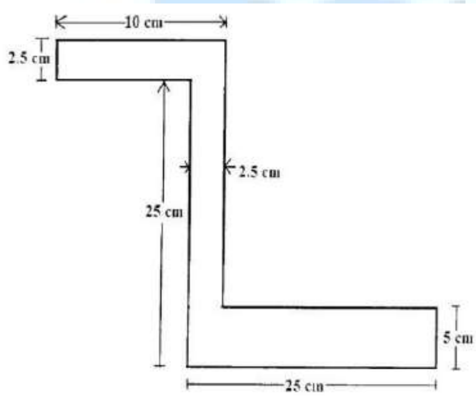


Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent equilibrium state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

2. A cylindrical disc, 50 cm diameter and cm thickness, is in contact with a horizontal conveyor belts running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s. Also compute the moment acting about the axis of the disc in both cases.

Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
	Total		14

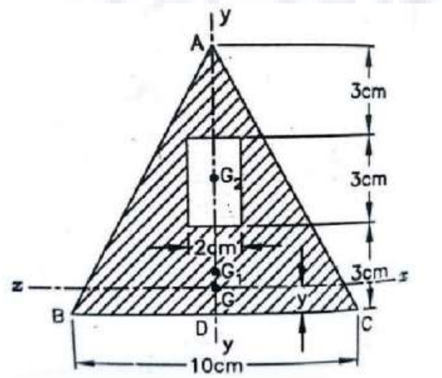
3. Determine the centroid of the given section



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of centroid for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed	Applying (Solve the problem based on the descriptions	6

	areas and masses	given in CO3 and CO4)	
Total			14

4. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC.



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of moment of inertia for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

Model Question Paper

QP CODE:

Reg No.:_______________

Name:___________________________ ___

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EST 100

ENGINEERING MECHANICS

Max. Marks: 100 Duration: 3 hours

Part A

(Answer all questions; each question carries 3 marks)

1. Explain D'Alembert's principle

2. Distinguish static and dynamic frictioni.

3. State and explain perpendicular axis theorem.

4. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.

5. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar

6. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

7. Compare damped and undamped free vibrations.

8. State the equation of motion of a rotating rigid body, rotating about its fixed axis.

9. Illustrate the significance of instantaneous centre in the analysis of rigid body undergoing rotational motion.

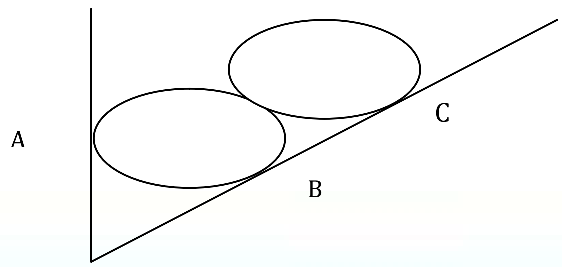
10. Highlight the principles of mechanics applied in the evaluation of elastic collusion of rigid bodies.

PART B

(Answer **one full** question from each module, each question carries **14** marks)

Module -I

11. Two identical rollers each of weight 100 N are supported by an inclined plane, making an angle of 30^{o} with the vertical, and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth. (14 marks)

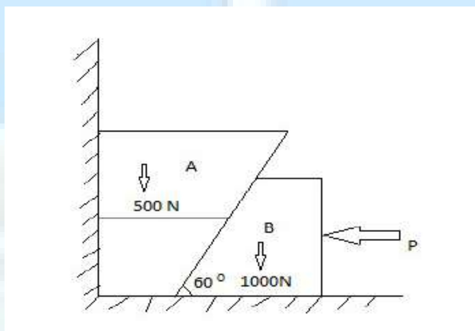


12. A string tied to a wall is made to pass over a pulley placed 2m away from it. A weight P is attached to the string such that the string stretches by 2m from the support on the wall to the location of attachment of weight. Determine the force P required to maintain 200 kg body in position for $\theta = 30^{o}$, The diameter of pulley B is negligible. (14 marks)

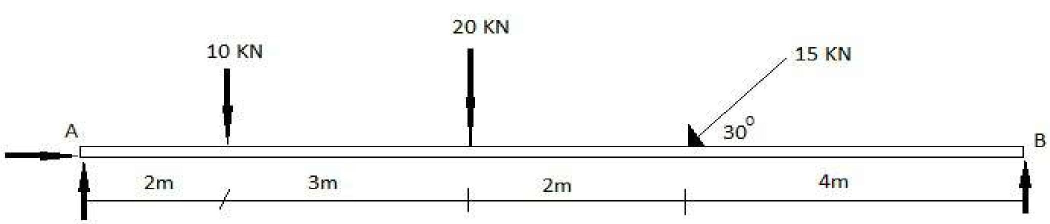
Module – 2

13. Two blocks A & B are resting against a wall and the floor as shown in figure below. Find the value of horizontal force P applied to the lower block that will hold the system in equilibrium. Coefficient of friction are : 0.25 at the floor, 0.3 at the wall and 0.2 between the blocks.

(14 marks)

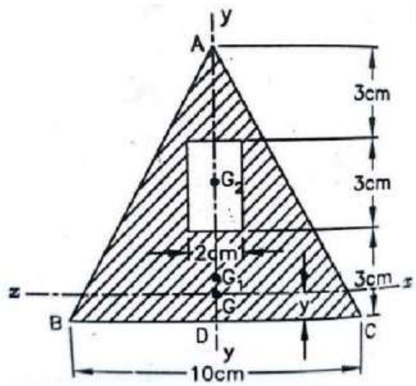


14. A beam is hinged at A and roller supported at B. It is acted upon by loads as shown below.
Find the reactions at A & B. (14 marks)

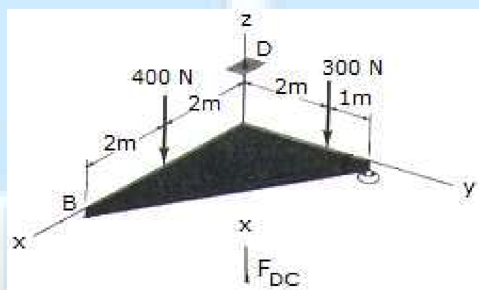


Module – 3

15. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC. (14 marks)



16. Support A has ball and socket connection. Roller support at B prevents motion in the —z direction. Corner *C* is tied to *D* by a rope. The triangle is weightless. Determine the unknown force components acting at *A*, *B*, and *C*. (14 marks)



Module - 4

17. A cricket ball is thrown by a fielder from a height of 2m at an angle of 30^0 to the horizontal with an initial velocity of 20 m/s , hits the wickets at a height of 0.5 m from the ground. How far was the fielder from the wicket? (14 marks)

18. An engine of weight 500 kN pull a train weighing 1500 kN up an incline of 1 in 100. The train starts from rest and moves with constant acceleration against a resistance of 5 N/kN. It attains a maximum speed of 36 kmph in 1 km distance. Determine the tension in the coupling between train and engine and the traction force developed by the engine. (14marks)

Module – 5

19. A cylindrical disc, 50 cm diameter and 10 cm thickness having mass of 10 kg, is in contact with a horizontal conveyor belt running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s in 10 seconds. Also compute the moment acting about the axis of the disc in both cases. (14 marks)

20. A wheel rotating about fixed axis at 20 rpm is uniformly accelerated for 70 seconds during which time it makes 50 revolutions. Find the (i) angular velocity at the end of this interval and (ii) time required for the velocity to reach 100 revolutions per minute. (14 marks)

SYLLABUS

Module 1

Introduction to Engineering Mechanics-statics-basic principles of statics-Parallelogram law, equilibrium law, principles of superposition and transmissibility, law of action and reaction(review) free body diagrams.

Concurrent coplanar forces-composition and resolution of forces-resultant and equilibrium equations – methods of projections – methods of moments – Varignon's Theorem of moments.

Module 2

Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –wedges, ladder-analysis of connected bodies .

Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads. General coplanar force system - resultant and equilibrium equations.

Module 3

Centroid of composite areas- – moment of inertia-parallel axis and perpendicular axis theorems. Polar moment of inertia,radius of gyration,mass moment of inertia-ring,cylinder and disc.

Theorem of Pappus Guldinus(demonstration only)

Forces in space - vectorial representation of forces, moments and couples –resultant and equilibrium equations – concurrent forces in space (simple problems only)

Module 4

Dynamics – rectilinear translation - equations of kinematics(review)

kinetics – equation of motion – D'Alembert's principle. – motion on horizontal and inclined surfaces, motion of connected bodies. Impulse momentum equation and work energy equation (concepts only).

Curvilinear translation - equations of kinematics –projectile motion(review), kinetics – equation of motion. Moment of momentum and work energy equation (concepts only).

Module 5

Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – rotation under a constant moment.

Plane motion of rigid body – instantaneous centre of rotation (concept only).

Simple harmonic motion – free vibration –degree of freedom- undamped free vibration of spring mass system-effect of damping(concept only)

Text Books

1. Timoshenko and Young, Engineering Mechanics, McGraw Hill Publishers
2. Shames, I. H., Engineering Mechanics - Statics and Dynamics, Prentice Hall of India.
3. R. C. Hibbeler and Ashok Gupta, Engineering Mechanics, Vol. I statics, Vol II Dynamics, Pearson Education.

References

1. Merriam J. L and Kraige L. G., Engineering Mechanics - Vols. 1 and 2, John Wiley.
2. Tayal A K, Engineering Mechanics – Statics and Dynamics, Umesh Publications
3. Bhavikkatti, S.S., Engineering Mechanics, New Age International Publishers
4. F.P.Beer abd E.R.Johnston (2011), Vector Mechanics for Engineers, Vol.I-Statics, Vol.II-Dynamics, 9th Ed, Tata McGraw Hill
5. Rajasekaran S and Sankarasubramanian G, Engineering Mechanics - Statics and Dynamics, Vikas Publishing House Pvt Ltd.

Course Contents and Lecture Schedule:

Module	Topic	Course outcomes addressed	No. of Hours
1	**Module 1**		**Total: 7**
1.1	Introduction to engineering mechanics – introduction on statics and dynamics - Basic principles of statics – Parellogram law, equilibrium law – Superposition and transmissibility, law of action and reaction (review the topics)	CO1 and CO2	1
1.2	Free body diagrams. Degree of freedom-types of supports and nature of reactions - exercises for free body diagram preparation – composition and resolution of forces, resultant and equilibrium equations (review the topics) - numerical exercises for illustration.	CO1 and CO2	1
1.3	Concurrent coplanar forces - analysis of concurrent forces -methods of projections – illustrative numerical exercise – teacher assisted problem solving.	CO1 and CO2	1
1.4	Analysis of concurrent forces -methods of moment-Varignon's Theorem of Moments - illustrative numerical exercise– teacher assisted problem solving.	CO1 and CO2	1
1.5	Analysis of concurrent force systems – extended problem solving - Session I.	CO3,CO4 and CO5	1
1.6	Analysis of concurrent force systems – extended problem solving - Session II – learning review quiz.	CO3,CO4 and CO5	1
1.7	Analysis of concurrent force systems – extended problem solving - Session III.	CO3,CO4 and CO5	1
2	**Module 2**		**Total: 7**
2.1	Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –illustrative examples on wedges and ladder-teacher	CO1 and CO2	1

	assisted problem solving tutorials using problems from wedges and ladder.		
2.2	Problems on friction - analysis of connected bodies. illustrative numerical exercise– teacher assisted problem solving.	CO3, CO4 and CO5	1
2.3	Problems on friction-extended problem solving	CO3,C04 and CO5	1
2.4	Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads.	CO1 and CO2	1
2.5	General coplanar force system - resultant and equilibrium equations - illustrative examples- teacher assisted problem solving.	CO1 and CO2	1
2.6	General coplanar force system-resultant and equilibrium equations - illustrative examples	CO3, CO4 and CO5	1
2.7	General coplanar force system - Extended problem solving - Quiz to evaluate learning level.	CO3, CO4 and CO5	1
3	**Module 3**		**Total: 7**
3.1	Centroid of simple and regular geometrical shapes – centroid of figures in combination - composite areas- examples for illustration – problems for practice to be done by self.	CO1 and CO2	1
3.2	Moment of inertia- parallel axis theorem –examples for illustration - problems for practice to be done by self.	CO1 and CO2	1
3.3	Moment of inertia - perpendicular axis theorem - example for illustration to be given as hand out and discussion on the solved example.	CO1 and CO2	1
3.4	Solutions to practice problems – problems related to centroid and moment of inertia - problems for practice to be done by self.	CO3, CO4 and CO5	1
3.5	Polar moment of inertia, Radius of gyration. Mass moment of inertia of ring, cylinder and uniform disc. Theorem of Pappus Guldinus - Demonstration	CO1 and CO2	1
3.6	Introduction to forces in space – vectorial representation of forces, moments and couples – simple problems to illustrate vector representations of forces, moments and couples to be done in class.	CO1,and CO2	1
3.7	Solution to practice problems - resultant and equilibrium equations for concurrent forces in space – concurrent forces in space - 2 simple problems to illustrate the application of resultant and equilibrium equations for concurrent forces in space.	CO3,CO4 and CO5	1
4	**Module 4**		**Total: 7**

4.1	Introduction to dynamics – review of rectilinear translation - equations of kinematics – problems to review the concepts – additional problems involving extended application as exercises .	CO1 and CO2	1
4.2	Solutions to exercises with necessary explanation given as hand out – introduction to kinetics – equation of motion – D'Alembert's principle – illustration of the concepts using one numerical exercise from motion on horizontal and inclined surfaces.	CO1 and CO2	1
4.3	Motion of connected bodies - example for illustration to be given as hand out and discussion on the solved example – problems for practice to be done by self.	CO3, CO4 and CO5	1
4.4	Motion of connected bodies-extended problem solving.	CO3, CO4 & CO5	1
4.5	Curvilinear translation - Review of kinematics –projectile motion – simple problems to review the concepts – introduction to kinetics – equation of motion – illustration of the concepts using numerical exercises.	CO3, CO4 & CO5	1
4.6	Extended problem solving – rectilinear and curvilinear translation.	CO3, CO4 & CO5	1
4.7	Concepts on Impulse momentum equation and work energy equation (rectilinear translation – discussions to bring out difference between elastic and inelastic collusions). Concepts on Moment of momentum and work energy equation (curvilinear translation).	CO1 and CO2	1
5	**Module 5**		**Total: 7**
5.1	Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – simple problems for illustration.	CO1 and CO2	1
5.2	Rotation under a constant moment – teacher assisted problem solving.	CO3,CO4 and CO5	1
5.3	Rotation under a constant moment - extended problem solving.	CO3, CO4 and CO5	1
5.4	Plane motion of rigid body- instantaneous centre of rotation (concept only).	CO1 and CO2	1
5.5	Introduction to harmonic oscillation –free vibrations - simple harmonic motion – differential equation and solution. Degree of freedom – examples of single degree of freedom (SDOF) systems – Idealisation of mechanical systems as spring-mass systems (concept only).	CO1 and CO2	1

5.6	SDOF spring mass system –equation of motion – undamped free vibration response - concept of natural frequency. Free vibration response due to initial conditions. Simple problems on determination of natural frequency and free vibration response to test the understanding level.	CO1 and CO2	1
5.7	Free vibration analysis of SDOF spring-mass systems – Problem solving Effect of damping on free vibration response (concept only).	CO1and CO2	1

EST 110	ENGINEERING GRAPHICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	0	2	3	2019

Preamble: To enable the student to effectively perform technical communication through graphical representation as per global standards.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Draw the projection of points and lines located in different quadrants
CO 2	Prepare multiview orthographic projections of objects by visualizing them in different positions
CO 3	Draw sectional views and develop surfaces of a given object
CO 4	Prepare pictorial drawings using the principles of isometric and perspective projections to visualize objects in three dimensions.
CO 5	Convert 3D views to orthographic views
CO 6	Obtain multiview projections and solid models of objects using CAD tools

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3											
CO 2	3											
CO 3	3	1										
CO 4	3									1		
CO 5	3									2		
CO 6	3				3					3		

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (100 Marks)
	Test 1 (15 Marks)	Test 2 (15 Marks)	
Remember			
Understand	5		20
Apply	10	10	80
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

CIA for section A carries 25 marks (15 marks for 1 test and Class work 10 marks)

CIA for section B carries 15 marks (10 marks for 1 test and Class work 5 marks)

End Semester Examination Pattern:

ESE will be of 3 hour duration on A4 size answer booklet and will be for 100 marks. The question paper shall contain two questions from each module of Section A only. Student has to answer any one question from each module. Each question carries 20 marks.

Course Level Assessment Questions

(Questions may be framed based on the outline given under each course outcome)

Course Outcome 1 (CO1):

1. Locate points in different quadrants as per given conditions.
2. Problems on lines inclined to both planes .
3. Find True length, Inclinations and Traces of lines.

Course Outcome 2 (CO2)

1. Draw orthographic views of solids and combination solids
2. Draw views of solids inclined to any one reference plane.
3. Draw views of solids inclined to both reference planes.

Course Outcome 3 (CO3):

1. Draw views of solids sectioned by a cutting plane
2. Find location and inclination of cutting plane given true shape of the section
3. Draw development of lateral surface of solids and also its sectioned views

Course Outcome 4 (CO4):

1. Draw Isometric views/projections of soilds
2. Draw Isometric views/projections of combination of soilds
3. Draw Perspective views of Soilds

Course Outcome 5 (CO5):

1. Draw Orthographic views of solids from given three dimensional view

Course Outcome 6 (CO6):

1. Draw the given figure including dimensions using 2D software
2. Create 3D model using modelling software from the given orthographic views or 3D figure or from real 3D objects

Model Question paper

QP CODE: PAGES:3

Reg No:______________

Name :______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EST 110

ENGINEERING GRAPHICS

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

Instructions: Retain necessary Construction lines
Show necessary dimensions
Answer any ONE question from each module
Each question carries 20 marks

MODULE I

1. The end point A of a line is 20mm above HP and 10mm in front of VP. The other end of the line is 50mm above HP and 15mm behind VP. The distance between the end projectors is 70mm. Draw the projections of the line. Find the true length and true inclinations of the line with the principal planes. Also locate the traces of the line.
2. One end of a line is 20mm from both the principal planes of projection. The other end of the line is 50mm above HP and 40mm in front of VP. The true length of the line is 70mm. Draw the projections of the line. Find its apparent inclinations, elevation length and plan length. Also locate its traces.

MODULE II

3. A pentagonal pyramid of base side 25mm and height 40mm, is resting on the ground on one of its triangular faces. The base edge of that face is inclined 30^{o} to VP. Draw the projections of the solid.

4. A hexagonal prism has side 25mm and height 50mm has a corner of its base on the ground and the long edge containing that corner inclined at 30^o to HP and 45^o to VP. Draw the projections of the solid.

MODULE III

5. A triangular prism of base side 40mm and height 70mm is resting with its base on the ground and having an edge of the base perpendicular to VP. Section the solid such that the true shape of the section is a trapezium of parallel sides 30mm and 10mm. Draw the projections showing the true shape. Find the inclination of the cutting plane with the ground plane.

6. Draw the development of a pentagonal pyramid of base side 30mm and height 50mm. A string is wound from a corner of the base round the pyramid and back to the same point through the shortest distance. Show the position of the string in the elevation and plan.

MODULE IV

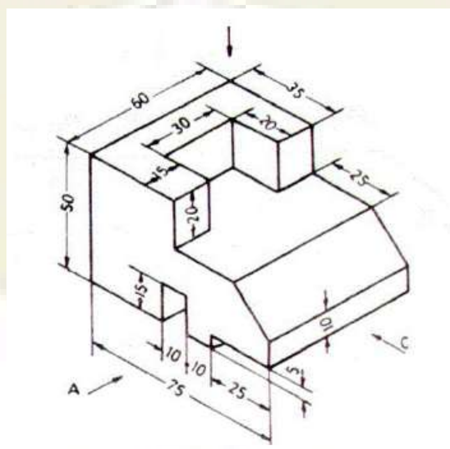
7. The frustum of a cone has base diameter 50mm and top diameter 40mm has a height of 60mm. It is paced centrally on top of a rectangular slab of size 80x60mm and of thickness 20mm. Draw the isometric view of the combination.

8. A hexagonal prism has base side 35mm and height 60mm. A sphere of diameter 40mm is placed centrally on top of it. Draw the isometric projection of the combination.

MODULE V

9. Draw the perspective view of a pentagonal prism, 20mm side and 45mm long lying on one of its rectangular faces on the ground and having its axis perpendicular to picture plane. One of its pentagonal faces touches the picture plane and the station point is 50mm in front of PP, 25mm above the ground plane and lies in a central plane, which is 70mm to the left of the center of the prism.

10. Draw three orthographic views with dimensions of the object shown in figure below.



(20X5=100)

Time : 3 hours **EST110 ENGINEERING GRAPHICS** **Max. Marks: 100**

SCHEME OF VALUATION

1. Locating the points and drawing the projections of the line – 4 marks
   Finding true length by any one method – 6 marks
   Finding true inclination with VP – 2 marks
   Finding true inclination with HP – 2 marks
   Locating horizontal trace – 2 marks
   Locating vertical trace – 2 marks
   Dimensioning and neatness – 2 marks
   Total = 20 marks
2. Locating the points and drawing true length of the line – 4 marks
   Finding projections by any method – 6 marks
   Finding length of elevation and plan – 2 marks
   Finding apparent inclinations – 2 marks
   Locating horizontal trace – 2 marks
   Locating vertical trace – 2 marks
   Dimensioning and neatness – 2 marks
   Total = 20 marks
3. Drawing initial position plan and elevation – 4 marks
   First inclination views – 4 marks
   Second inclination views -8 marks
   Marking invisible edges – 2 marks
   Dimensioning and neatness – 2 marks
   Total = 20 marks
   (Any one method or combination of methods for solving can be used.
   If initial position is wrong then maximum 50% marks may be allotted for the answer)
4. Drawing initial position plan and elevation – 4 marks
   First inclination views – 4 marks
   Second inclination views -8 marks
   Marking invisible edges – 2 marks
   Dimensioning and neatness – 2 marks
   Total = 20 marks
   (Any one method or combination of methods for solving can be used
   If initial position is wrong then maximum 50% marks may be allotted for the answer)
5. Drawing initial position plan and elevation – 4 marks
   Locating section plane as per given condition – 5 marks
   Drawing true shape -5 marks
   Finding inclination of cutting plane – 2 marks
   Dimensioning and neatness – 2 marks
   Total = 20 marks
6. Drawing initial position plan and elevation – 4 marks
   Development of the pyramid – 6 marks

Locating string in development -2 marks
Locating string in elevation – 3 marks
Locating string in plan – 3 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

7. Drawing initial positions – 4 marks
   Isometric View of Slab -6 marks
   Isometric View of Frustum – 10 marks
   Dimensioning and neatness – 2 marks

Total = 20 marks

(Initial position is optional, hence redistribute if needed.
Reduce 4 marks if Isometric scale is taken)

8. Drawing initial positions – 4 marks
   Isometric scale – 4 marks
   Isometric projection of prism -5 marks
   Isometric projection of sphere – 5 marks
   Dimensioning and neatness – 2 marks

Total = 20 marks

(Initial position is optional, hence redistribute if needed.

9. Drawing the planes and locating the station point – 4 marks
   Locating elevation points – 2 marks
   Locating plan points – 2 marks
   Drawing the perspective view – 10 marks
   Dimensioning and neatness – 2 marks

Total = 20 marks

10. Drawing the elevation – 8marks
    Drawing the plan – 4 marks
    Drawing the side view – 4 marks
    Marking invisible edges – 2 marks
    Dimensioning and neatness – 2 marks

Total = 20 marks

SYLLABUS

General Instructions:

- First angle projection to be followed
- Section A practice problems to be performed on A4 size sheets
- Section B classes to be conducted on CAD lab

SECTION A

Module 1

Introduction : Relevance of technical drawing in engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing.

Orthographic projection of Points and Lines: Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Trace of line. Inclination of lines with reference planes True length of line inclined to both the reference planes.

Module 2

Orthographic projection of Solids: Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone and Cylinder. Projection of solids in simple position including profile view. Projection of solids with axis inclined to one of the reference planes and with axis inclined to both reference planes.

Module 3

Sections of Solids: Sections of Prisms, Pyramids, Cone, Cylinder with axis in vertical position and cut by different section planes. True shape of the sections. Also locating the section plane when the true shape of the section is given.

Development of Surfaces: Development of surfaces of the above solids and solids cut by different section planes. Also finding the shortest distance between two points on the surface.

Module 4

Isometric Projection: Isometric View and Projections of Prisms, Pyramids, Cone , Cylinder, Frustum of Pyramid, Frustum of Cone, Sphere, Hemisphere and their combinations.

Module 5

Perspective Projection: Perspective projection of Prisms and Pyramids with axis perpendicular to the ground plane, axis perpendicular to picture plane.

Conversion of Pictorial Views: Conversion of pictorial views into orthographic views.

SECTION B

(To be conducted in CAD Lab)

Introduction to Computer Aided Drawing: Role of CAD in design and development of new products, Advantages of CAD. Creating two dimensional drawing with dimensions using suitable software. (Minimum 2 exercises mandatory)

Introduction to Solid Modelling: Creating 3D models of various components using suitable modelling software. (Minimum 2 exercises mandatory)

Text Books

1. Bhatt, N.D., Engineering Drawing, Charotar Publishing House Pvt. Ltd.
2. John, K.C. Engineering Graphics, Prentice Hall India Publishers.

Reference Books

1. Anilkumar, K.N., Engineering Graphics, Adhyuth narayan Publishers
2. Agrawal, B. And Agrawal, C.M., Engineering Darwing, Tata McGraw Hill Publishers.
3. Benjamin, J., Engineering Graphics, Pentex Publishers- 3rd Edition, 2017
4. Duff, J.M. and Ross, W.A., Engineering Design and Visualisation, Cengage Learning.
5. Kulkarni, D.M., Rastogi, A.P. and Sarkar, A.K., Engineering Graphics with AutoCAD, PHI.
6. Luzaddff, W.J. and Duff, J.M., Fundamentals of Engineering Drawing, PHI.
7. Varghese, P.I., Engineering Graphics, V I P Publishers
8. Venugopal, K., Engineering Drawing and Graphics, New Age International Publishers.

Course Contents and Lecture Schedule

No	**SECTION A**	No. of Hours
1	**MODULE I**	
1.1	Introduction to graphics, types of lines, Dimensioning	1
1.2	Concept of principle planes of projection, different quadrants, locating points on different quadrants	2
1.3	Projection of lines, inclined to one plane. Lines inclined to both planes, trapezoid method of solving problems on lines.	2
1.4	Problems on lines using trapezoid method	2
1.5	Line rotation method of solving, problems on line rotation method	2
2	**MODULE II**	
2.1	Introduction of different solids, Simple position plan and elevation of solids	2
2.2	Problems on views of solids inclined to one plane	2
2.3	Problems on views of solids inclined to both planes	2
2.4	Practice problems on solids inclined to both planes	2

3	**MODULE III**	
3.1	Introduction to section planes. AIP and AVP. Principle of locating cutting points and finding true shape	2
3.2	Problems on sections of different solids	2
3.3	Problems when the true shape is given	2
3.4	Principle of development of solids, sectioned solids	2
4	**MODULE IV**	
4.1	Principle of Isometric View and Projection, Isometric Scale. Problems on simple solids	2
4.2	Isometric problems on Frustum of solids, Sphere and Hemisphere	2
4.3	Problems on combination of different solids	2
5	**MODULE V**	
5.1	Introduction to perspective projection, different planes, station point etc. Perspective problems on pyramids	2
5.2	Perspective problems on prisms	2
5.3	Practice on conversion of pictorial views into orthographic views	2
	SECTION B *(To be conducted in CAD lab)*	
1	Introduction to CAD and software. Familiarising features of 2D software. Practice on making 2D drawings	2
2	Practice session on 2D drafting	2
3	Introduction to solid modelling and software	2
4	Practice session on 3D modelling	2

EST 120	BASICS OF CIVIL & MECHANICAL ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:

Objective of this course is to provide an insight and inculcate the essentials of Civil Engineering discipline to the students of all branches of Engineering and to provide the students an illustration of the significance of the Civil Engineering Profession in satisfying the societal needs.

To introduce the students to the basic principles of mechanical engineering

Prerequisite: NIL

Course Outcomes: After completion of the course, the student will be able to

CO 1	Recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.
CO 2	Explain different types of buildings, building components, building materials and building construction
CO 3	Describe the importance, objectives and principles of surveying.
CO 4	Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps
CO 5	Discuss the Materials, energy systems, water management and environment for green buildings.
CO 6	Analyse thermodynamic cycles and calculate its efficiency
CO 7	Illustrate the working and features of IC Engines
CO 8	Explain the basic principles of Refrigeration and Air Conditioning
CO 9	Describe the working of hydraulic machines
CO 10	Explain the working of power transmission elements
CO 11	Describe the basic manufacturing, metal joining and machining processes

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	3	2	2	-	-	-	-
CO2	3	2	-	1	3	-	-	3	-	-	-	-
CO3	3	2	-	-	3	-	-	-	2	-	-	-

CO4	3	2	-	-	3	-	-	-	2	-	-	-
CO5	3	2	-	-	3	2	3	-	2	-	-	-
CO6	3	2										
CO7	3	1										
CO8	3	1										
CO9	3	2										
CO10	3	1										
CO11	3											

Assessment Pattern

	Basic Civil Engineering			**Basic Mechanical Engineering**		
Bloom's Category	**Continuous Assessment**		**End Semester Examination (marks)**	**Continuous Assessment**		**End Semester Examination (marks)**
	Test 1 marks	**Test 2 marks**		**Test 1 marks**	**Test 2 marks**	
Remember	5	5	10	7.5	7.5	15
Understand	20	20	40	12.5	12.5	25
Apply				5	5	10
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	**CIE (Marks)**	**ESE (Marks)**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern:

There will be two parts; Part I – Basic Civil Engineering and Part II – Basic Mechanical Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts -

Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions:

Course Outcome CO1: *To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.*

1.Explain relevance of Civil engineering in the overall infrastructural development of the country.
Course outcome 2 (CO2) (One question from each module and not more than two)

Explain different types of buildings, building components, building materials and building construction

1. Discuss the difference between plinth area and carpet area.

Course outcome 3 (CO3) (One question from each module and not more than two)

Describe the importance, objectives and principles of surveying.

1. Explain the importance of surveying in Civil Engineering

Course outcome 4 (CO4) (One question from each module and not more than two)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps

1. Explain the civil engineering aspects of elevators, escalators and ramps in buildings

Course outcome 5 (CO5) (One question from each module and not more than two)

Discuss the Materials, energy systems, water management and environment for green buildings.

1. Discuss the relevance of Green building in society

<u>Section II</u> *Answer any 1 full question from each module. Each full question carries 10 marks*

Course Outcome 1 (CO1) (Two full question from each module and each question can have maximum 2 sub-divisions)

To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering
<u>CO Questions</u>

1. a List out the types of building as per occupancy. Explain any two, each in about five sentences.
b. Discuss the components of a building with a neat figure.
2. a. What are the major disciplines of civil engineering and explain their role in the infrastructural framework.

b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country.

Course Outcome 2 (CO2) & Course Outcome 3 (CO3) (Two full question from each module and each question can have maximum 2 sub-divisions)

Explain different types of buildings, building components, building materials and building construction & Describe the importance, objectives and principles of surveying.

CO Questions

1. **a.** What are the different kinds of cement available and what is their use.
   b. List the properties of good building bricks. Explain any five.
2. a. List and explain any five modern construction materials used for construction.
   b. Explain the objectives and principles of surveying

Course outcome 4 (CO4) & Course outcome 5 (CO5) (Two full question from each module and each question can have maximum 2 sub-divisions)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps & Discuss the Materials, energy systems, water management and environment for green buildings.

CO Questions

1. **a**. Draw the elevation and plan of one brick thick wall with English bond
   b. Explain the energy systems and water management in Green buildings

2. **a.** Draw neat sketch of the following foundations: (i) Isolated stepped footing; (ii) Cantilever footing; and (iii) Continuous footing.

   b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building

Course Outcome 6 (CO6):

1. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35^{o}C, 0.1 MPa. The maximum temperature of the cycle is 1100^{o}C. Find
   i) Heat supplied per kg of air,
   ii) Work done per kg of air,
   iii) Cycle efficiency
   Take Cp = 1.005 kJ/kgK and Cv=0.718 kJ/kgK
2. A Carnot cycle works with adiabatic compression ratio of 5 and isothermal expansion ratio of 2. The volume of air at the beginning of isothermal expansion is 0.3 m^3. If the maximum temperature and pressure is limited to 550K and 21 bar, determine the minimum temperature in the cycle and efficiency of the cycle.
3. In an ideal diesel cycle, the temperature at the beginning and end of compression is 65^{o}C and 620^{o}C respectively. The temperature at the beginning and end of the expansion is 1850^{o}C and 850^{o}C. Determine the ideal efficiency of the cycle.

4. Explain the concepts of CRDI and MPFI in IC Engines.

Course Outcome 7 (CO7)

1. With the help of a neat sketch explain the working of a 4 stroke SI engine
2. Compare the working of 2 stroke and 4 stroke IC engines
3. Explain the classification of IC Engines.

Course Outcome 8(CO8):

1. Explain the working of vapour compression refrigeration system.
2. With the help of suitable sketch explain the working of a split air conditioner.
3. Define: COP, specific humidity, relative humidity and dew point temperature.

Course Outcome 9 (CO9):

1. Explain the working of a single stage centrifugal pump with sketches.
2. With the help of a neat sketch, explain the working of a reciprocating pump.
3. A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 m^3/s. If the overall efficiency of the turbine is 90%. Determine the power developed by the turbine.

Course Outcome 10 (CO10):

1. Explain the working of belt drive and gear drive with the help of neat sketches
2. Explain a single plate clutch.
3. Sketch different types of gear trains and explain.

Course Outcome 11 (CO11):

1. Describe the operations which can be performed using drilling machine.
2. Explain the functions of runners and risers used in casting.
3. With a neat sketch, explain the working and parts of a lathe.

Model Question Paper

QP CODE: **EST120** page:3

Reg No:___________________

Name:_____________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EST 120

Course Name: BASICS OF CIVIL AND MECHANICAL ENGINEERING

Max. Marks: 100 Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

PART I: BASIC CIVIL ENGINEERING

PART A

(Answer all questions. Each question carries 4 marks)

1. Explain relevance of Civil engineering in the overall infrastructural development of the country.
2. Discuss the difference between plinth area and carpet area.
3. Explain different types of steel with their properties.
4. What are the different kinds of cement available and what is their use?
5. Define bearing capacity of soil.

(5 x 4 = 20)

Part B

Answer one full question from each module.

MODULE I

6a. List out the types of building as per occupancy. Explain any two, each in about five sentences. (5)

b. Discuss the components of a building with a neat figure. (5)

OR

7a. What are the major disciplines of civil engineering and explain their role in the infrastructural framework. (5)

b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country. (5)

MODULE II

8a. What are the different kinds of cement available and what is their use. (5)

b. List the properties of good building bricks. Explain any five. (5)

OR

9a. List and explain any five modern construction materials used for construction. (5)

b. Explain the objectives and principles of surveying (5)

MODULE III

10a. Draw the elevation and plan of one brick thick wall with English bond (5)

b. Explain the energy systems and water management in Green buildings (5)

OR

11a. Draw neat sketch of the following foundations: (i) Isolated stepped footing; (ii) Cantilever footing; and (iii) Continuous footing. (5)

b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building (5)

[10 x 3 = 30]

PART II: BASIC MECHANICAL ENGINEERING

PART A

Answer all questions. Each question carries 4 marks

1. Sketch the P-v and T-s diagram of a Carnot cycle and List the processes.
2. Illustrate the working of an epicyclic gear train.
3. Explain cooling and dehumidification processes.
4. Differentiate between soldering and brazing.
5. Explain the principle of Additive manufacturing.

4 x 5 = 20 marks

Part B

Answer one full question from each module.

MODULE I

6. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35^oC, 0.1MPa. The maximum temperature of the cycle is 1100^oC. Find
   i) Heat supplied per kg of air,
   ii) Work done per kg of air,
   iii)Cycle efficiency
   Take C_p = 1.005 kJ/kgK and C_v=0.718 kJ/kgK — 10 marks

OR

7. a) Explain the working of a 4 stroke SI engine with neat sketches. — 7 marks
   b) Explain the fuel system of a petrol engine. — 3 marks

MODULE II

8. a) Explain the working of a vapour compression system with help of a block diagram. — 7 marks
   b) Define: Specific humidity, relative humidity and dew point temperature. — 3 marks

OR

9. With the help of a neat sketch, explain the working of a centrifugal pump. — 10 marks

MODULE III

10. Explain the two high, three high, four high and cluster rolling mills with neat sketches. — 10 marks

OR

11. a) Describe the arc welding process with a neat sketch. — 6 marks
    b) Differentiate between up-milling and down-milling operations. — 4 marks

SYLLABUS

Module 1

General Introduction to Civil Engineering: Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment. Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.

Introduction to buildings: Types of buildings, selection of site for buildings, components of a residential building and their functions.

Building rules and regulations: Relevance of NBC, KBR & CRZ norms (brief discussion only).

Building area: Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.

Module 2

Surveying: Importance, objectives and principles.

Construction materials, Conventional construction materials**:** types, properties and uses of building materials: bricks, stones, cement, sand and timber

Cement concrete: Constituent materials, properties and types.

Steel: Steel sections and steel reinforcements, types and uses.

Modern construction materials:- Architectural glass, ceramics, Plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials. Modern uses of gypsum, pre-fabricated building components (brief discussion only).

Module 3

Building Construction: Foundations: Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Load bearing and framed structures (concept only).

Brick masonry: - Header and stretcher bond, English bond & Flemish bond random rubble masonry.

Roofs and floors: - Functions, types; flooring materials (brief discussion only).

Basic infrastructure services: MEP, HVAC, elevators, escalators and ramps (Civil Engineering aspects only), fire safety for buildings.

Green buildings:- Materials, energy systems, water management and environment for green buildings. (brief discussion only).

Module 4

Analysis of thermodynamic cycles: Carnot, Otto, Diesel cycles, Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency. IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines. Efficiencies of IC Engines(Definitions only), Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines.

Module 5

Refrigeration: Unit of refrigeration, reversed Carnot cycle,COP, vapour compression cycle (only description and no problems); Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.

Description about working with sketches of: Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)

Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches.

Module 6

Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.

Metal Joining Processes: List types of welding, Description with sketches of Arc Welding, Soldering and Brazing and their applications

Basic Machining operations: Turning, Drilling, Milling and Grinding.

Description about working with block diagram of: Lathe, Drilling machine, Milling machine, CNC Machine. Principle of CAD/CAM, Rapid and Additive manufacturing.

Text Books:

1. Rangwala, S. C., Essentials of Civil Engineering, Charotar Publishing House
2. Mckay, W.B. and Mckay, J. K., Building Construction, Volumes 1 to 4, Pearson India Education Services

References Books:

1. Chen W.F and Liew J Y R (Eds), The Civil Engineering Handbook. II Edition CRC Press (Taylor and Francis)
2. Chudley, R and Greeno R, Building construction handbook, Addison Wesley, Longman group, England
3. Chudley, R, Construction Technology, Vol. I to IV, Longman group, England Course Plan
4. Kandya A A, Elements of Civil Engineering, Charotar Publishing house
5. Mamlouk, M. S., and Zaniewski, J. P., Materials for Civil and Construction Engineering, Pearson Publishers
6. Rangwala S.C and Dalal K B Building Construction Charotar Publishing house
7. Clifford, M., Simmons, K. and Shipway, P., An Introduction to Mechanical Engineering Part I - CRC Press
8. Roy and Choudhary, Elements of Mechanical Engineering, Media Promoters &Publishers Pvt. Ltd., Mumbai.
9. Sawhney, G. S., Fundamentals of Mechanical Engineering, PHI
10. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018
11. Benjamin,J.,Basic Mechanical Engineering,Pentex Books,9th Edition,2018
12. Balachandran, P.Basic Mechanical Engineering,Owl Books

Course Contents and Lecture Schedule:

No	Topic	Course outcomes addressed	No. of Lectures
1	**Module I**		**Total: 7**
1.1	*General Introduction to Civil Engineering*: Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment.	CO1	1
1.2	Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.	CO1	2
1.3	*Introduction to buildings:* Types of buildings, selection of site for buildings, components of a residential building and their functions.	CO2	2
1.4	*Building rules and regulations:* Relevance of NBC, KBR & CRZ norms (brief discussion only)	CO2	1
1.5	*Building area:* Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.	CO2	1
2	**Module 2**		**Total: 7**
2.1	*Surveying:* Importance, objectives and principles.	CO3	1
2.2	Bricks: - Classification, properties of good bricks, and tests on bricks	CO2	1
2.3	Stones: - *Qualities* of good stones, types of stones and their uses. Cement: - Good qualities of cement, types of cement and their uses.	CO2	1
2.4	Sand: - Classification, qualities of good sand and sieve analysis (basics only). Timber: - Characteristics, properties and uses.	CO2	1
2.5	Cement concrete: - Constituent materials, properties and types, Steel: - Steel sections and steel reinforcements, types and uses.	CO2	1

2.6	Modern construction materials: - Architectural glass, ceramics, plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials, modern uses of gypsum, pre-fabricated building components (brief discussion only)	CO2	2
3	**Module 3**		**Total: 7**
3.1	Foundations: - Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Brick masonry: - Header and stretcher bond, English bond & Flemish bond– elevation and plan (one & one and a half brick wall only). Random rubble masonry.	CO2	2
3.2	Roofs: Functions, types; roofing materials (brief discussion only) Floors: Functions, types; flooring materials (brief discussion only)	CO2	2
3.3	*Basic infrastructure services:* MEP, HVAC, Elevators, escalators and ramps (Civil Engineering aspects only) fire safety for buildings	CO4	2
3.4	*Green buildings:*- Materials, energy systems, water management and environment for green buildings. (brief discussion only)	CO5	1
4	**MODULE 4**		
4.1	Analysis of thermodynamic cycles: Carnot, Otto, and Diesel cycle-Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency	4	
4.2	IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines, efficiencies of IC Engines(Description only)	2	
4.3	Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines	2	
5	**MODULE 5**		
5.1	Refrigeration: Unit of refrigeration, reversed Carnot cycle, COP, vapour compression cycle (only description and no problems)	1	
5.2	Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.	1	

5.3	Description about working with sketches : Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)	4
5.4	Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches	3
6	**MODULE 6**	
6.1	Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.	2
6.2	Metal Joining Processes :List types of welding, Description with sketches of Arc Welding, Soldering and Brazing, and their applications	1
6.3	Basic Machining operations: Turning, Drilling, Milling and Grinding Description about working with block diagrams of: Lathe, Drilling machine, Milling machine, CNC Machine	3
6.4	Principle of CAD/CAM, Rapid and Additive manufacturing	1

EST 130	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:

This course aims to (1) equip the students with an understanding of the fundamental principles of electrical engineering(2) provide an overview of evolution of electronics, and introduce the working principle and examples of fundamental electronic devices and circuits (3) provide an overview of evolution of communication systems, and introduce the basic concepts in radio communication.

Prerequisite: Physics and Mathematics (Pre-university level)

Course Outcomes: After the completion of the course the student will be able to

CO 1	Apply fundamental concepts and circuit laws to solve simple DC electric circuits
CO 2	Develop and solve models of magnetic circuits
CO 3	Apply the fundamental laws of electrical engineering to solve simple ac circuits in steady state
CO 4	Describe working of a voltage amplifier
CO 5	Outline the principle of an electronic instrumentation system
CO 6	Explain the principle of radio and cellular communication

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	-	-	-	-	-	-	-	-	-	2
CO 2	3	1	-	-	-	-	-	-	-	-	-	2
CO 3	3	1	-	-	-	-	-	-	-	-	-	2
CO 4	2	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	2
CO 6	2	-	-	-	-	-	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Basic Electrical Engineering			Basic Electronics Engineering		
	Continuous Assessment Tests		End Semester Examination (Marks)	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)		Test 1 (Marks)	Test 2 (Marks)	
Remember	0	0	10	10	10	20
Understand	12.5	12.5	20	15	15	30
Apply	12.5	12.5	20			
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part I – Basic Electrical Engineering and Part II – Basic Electronics Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts - Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Solve problems based on current division rule.

2. Solve problems with Mesh/node analysis.

3. Solve problems on Wye-Delta Transformation.

Course Outcome 2 (CO2):

1. Problems on series magnetic circuits

2. Problems on parallel magnetic circuits

3. Problems on composite magnetic ciruits

4. **Course Outcome 3 (CO3):**

1. problems on self inductance, mutual inductance and coefficient of coupling

2. problems on rms and average values of periodic waveforms

3. problems on series ac circuits

4. Compare star and Delta connected 3 phase AC systems.

Course Outcome 4 (CO4): Describe working of a voltage amplifier

1.What is the need of voltage divider biasing in an RC coupled amplifier?

2. Define operating point in the context of a BJT amplifier.

3. Why is it required to have a voltage amplifier in a public address system?

Course Outcome 5 (CO5): Outline the principle of an electronic instrumentation system

1. Draw the block diagram of an electronic instrumentation system.

2. What is a transducer?

3. Explain the working principle of operation of digital multimeter.

Course Outcome 6 (CO6): Explain the principle of radio and cellular communication

1. What is the working principle of an antenna when used in a radio transmitter?

2. What is the need of two separate sections RF section and IF section in a super heterodyne receiver?

3. What is meant by a cell in a cellular communication?

Model Question Paper

QP CODE: Pages: 3

Reg No.:_______________

Name:_________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EST 130

Course Name: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Max. Marks: 100 Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

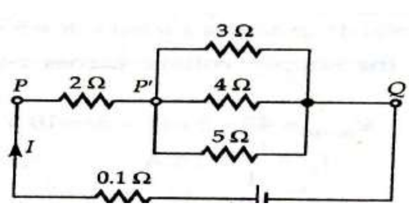
PART I

BASIC ELECTRICAL ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Calculate the current through the 4Ω resistor in the circuit shown, applying current division rule:



2. Calculate the RMS and average values of a purely sinusoidal current having peak value 15A.

3. An alternating voltage of (80+j60)V is applied to an RX circuit and the current flowing through the circuit is (-4+j10)A. Calculate the impedance of the circuit in rectangular and polar forms. Also determine if X is inductive or capacitive.

4. Derive the relation between line and phase values of voltage in a three phase star connected system.

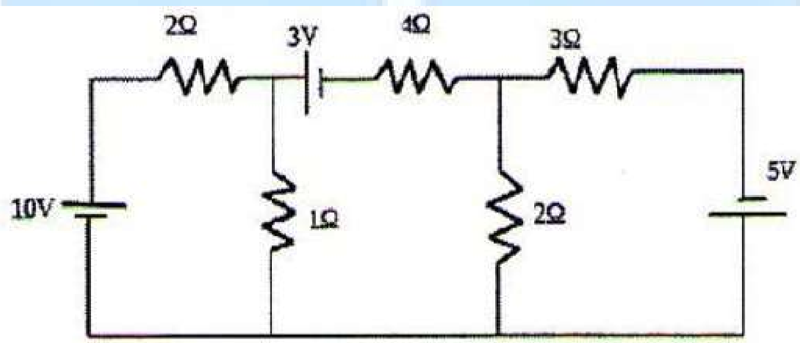
5. Compare electric and magnetic circuits. *(5x4=20)*

PART B

Answer one question from each module; each question carries 10 marks.

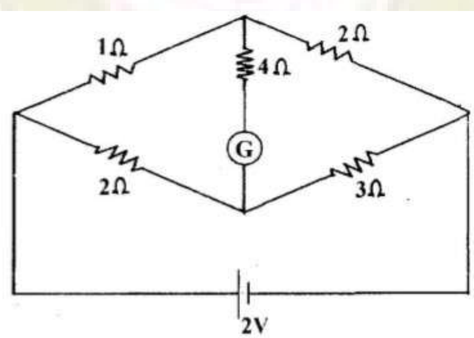
Module 1

6. . Calculate the node voltages in the circuit shown, applying node analysis:



7. (a) State and explain Kirchhoff's laws. (4 marks)

(b) Calculate the current through the galvanometer (G) in the circuit shown:



(6 marks)

Module 2

8. (a) State and explain Faraday's laws of electromagnetic induction with examples. (4 marks)

(b) Differentiate between statically and dynamically induced emf. A conductor of length 0.5m moves in a uniform magnetic field of flux density 1.1T at a velocity of 30m/s. Calculate the emf induced in the conductor if the direction of motion of the conductor is inclined at 60^0 to the direction of field. (6 marks)

9. (a) Derive the amplitude factor and form factor of a purely sinusoidal waveform. (5 marks)

(b) A current wave is made up of two components-a 5A dc component and a 50Hz ac component, which is a sinusoidal wave with a peak value of 5A. Sketch the resultant waveform and determine its RMS and average values. (5 marks)

Module 3

10. Draw the power triangle and define active, reactive and apparent powers in ac circuits. Two coils A and B are connected in series across a 240V, 50Hz supply. The resistance of A is 5Ω and the inductance of B is 0.015H. If the input from the supply is 3kW and 2kVAR, find the inductance of A and the resistance of B. Also calculate the voltage across each coil.

11. A balanced three phase load consists of three coils each having resistance of 4Ω and inductance 0.02H. It is connected to a 415V, 50Hz, 3-phase ac supply. Determine the phase voltage, phase current, power factor and active power when the loads are connected in (i) star (ii) delta.

(3x10=30)

PART II

BASIC ELECTRONICS ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Give the specifications of a resistor. The colour bands marked on a resistor are Blue, Grey, Yellow and Gold. What are the minimum and maximum resistance values expected from that resistance?
2. What is meant by avalanche breakdown?
3. Explain the working of a full-wave bridge rectifier.
4. Discuss the role of coupling and bypass capacitors in a single stage RC coupled amplifier.
5. Differentiate AM and FM communication systems.

(5x4=20)

PART B

Answer one question from each module; each question carries 10 marks.

Module 4

6. a) Explain with diagram the principle of operation of an NPN transistor. (5)

   b) Sketch and explain the typical input-output characteristics of a BJT when connected in common emitter configuration. (5)

OR

7. a) Explain the formation of a potential barrier in a P-N junction diode. (5)

   b) What do you understand by Avalanche breakdown? Draw and explain the V-I characteristics of a P-N junction and Zener diode. (5)

Module 5

8. a) With a neat circuit diagram, explain the working of an RC coupled amplifier. (6)

   b) Draw the frequency response characteristics of an RC coupled amplifier and state the reasons for the reduction of gain at lower and higher frequencies. (4)

OR

9. a) With the help of block diagram, explain how an electronic instrumentation system. (6)

   b) Explain the principle of an antenna. (4)

Module 6

10. a) With the help of a block diagram, explain the working of Super hetrodyne receiver. (6)

    b) Explain the importance of antenna in a communication system. (4)

OR

11. a) With neat sketches explain a cellular communication system. (5)

    b) Explain GSM communication with the help of a block diagram. (5)

(3x10=30)

SYLLABUS

MODULE 1: Elementary Concepts of Electric Circuits

Elementary concepts of DC electric circuits: Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)-problems.

Analysis of DC electric circuits: Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.

MODULE 2: Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals

Magnetic Circuits: Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.

Electromagnetic Induction: Faraday's laws, problems, Lenz's law- statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling

Alternating Current fundamentals: Generation of alternating voltages-Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.

MODULE 3: AC Circuits

AC Circuits: Phasor representation of sinusoidal quantities. Trignometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.

Three phase AC systems: Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems

MODULE 4

Introduction to Semiconductor devices: Evolution of electronics – Vacuum tubes to nano electronics. Resistors, Capacitors and Inductors (constructional features not required): types, specifications. Standard values, color coding. PN Junction diode: Principle of operation, V-I characteristics, principle of avalanche breakdown. Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration.

MODULE 5

Basic electronic circuits and instrumentation: Rectifiers and power supplies: Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

MODULE 6

Introduction to Communication Systems: Evolution of communication systems – Telegraphy to 5G. Radio communication: principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge. Mobile communication: basic principles of cellular communications, principle and block diagram of GSM.

Text Books

1. D P Kothari and I J Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D C Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
3. ChinmoySaha, Arindham Halder and Debarati Ganguly, Basic Electronics - Principles and Applications, Cambridge University Press, 2018.
4. M.S.Sukhija and T.K.Nagsarkar, Basic Electrical and Electronics Engineering, Oxford University Press, 2012.
5. Wayne Tomasi and Neil Storey, A Textbook On Basic Communication and Information Engineering, Pearson, 2010.

Reference Books

1. Del Toro V, "Electrical Engineering Fundamentals", Pearson Education.
2. T. K. Nagsarkar, M. S. Sukhija, "Basic Electrical Engineering", Oxford Higher Education.
3. Hayt W H, Kemmerly J E, and Durbin S M, "Engineering Circuit Analysis", Tata McGraw-Hill
4. Hughes, "Electrical and Electronic Technology", Pearson Education.
5. V. N. Mittle and Arvind Mittal, "Basic Electrical Engineering," Second Edition, McGraw Hill.
6. Parker and Smith, "Problems in Electrical Engineering", CBS Publishers and Distributors.
7. S. B. Lal Seksena and Kaustuv Dasgupta, "Fundamentals of Electrical Engineering", Cambridge University Press.
8. Anant Agarwal, Jeffrey Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann Publishers, 2005.
9. Bernard Grob, Ba sic Electronics, McGraw Hill.
10. A. Bruce Carlson, Paul B. Crilly, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, Tata McGraw Hill, 5th Edition.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lectures
1	***Elementary Concepts of Electric Circuits***	
1.1	**Elementary concepts of DC electric circuits:** Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)-problems.	1 2 1
1.2	**Analysis of DC electric circuits:** Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.	1 1 2
2	**Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals**	
2.1	**Magnetic Circuits:** Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.	1 2
2.2	**Electromagnetic Induction:** Faraday's laws, problems, Lenz's law-statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling	1 2
2.3	**Alternating Current fundamentals:** Generation of alternating voltages-Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.	2
3	**AC Circuits**	

3.1	**AC Circuits:** Phasor representation of sinusoidal quantities. Trigonometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power, Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.	1 2 1 2
3.2	**Three phase AC systems:** Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems.	2
4	**Introduction to Semiconductor devices**	
4.1	Evolution of electronics – Vacuum tubes to nano electronics (In evolutional perspective only)	1
4.2	Resistors, Capacitors and Inductors: types, specifications. Standard values, color coding (No constructional features)	2
4.3	**PN Junction diode**: Principle of operation, V-I characteristics, principle of avalanche breakdown	2
4.4	**Bipolar Junction Transistors:** PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration	3
5	**Basic electronic circuits and instrumentation**	
5.1	**Rectifiers and power supplies:** Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator	3
5.2	**Amplifiers:** Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing	4
5.3	**Electronic Instrumentation:** Block diagram of an electronic instrumentation system	2
6	**Introduction to Communication Systems**	
6.1	Evolution of communication systems – Telegraphy to 5G	1

6.2	**Radio communication:** principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge	4
6.3	**Mobile communication:** basic principles of cellular communications, principle and block diagram of GSM.	2

Suggested Simulation Assignments for Basic Electronics Engineering

1. Plot V-I characteristics of Si and Ge diodes on a simulator
2. Plot Input and Output characteristics of BJT on a simulator
3. Implementation of half wave and full wave rectifiers
4. Simulation of RC coupled amplifier with the design supplied
5. Generation of AM signal

Note: The simulations can be done on open tools such as QUCS, KiCad, GNURadio or similar software to augment the understanding.

HUN 101	LIFE SKILLS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		MNC	2	0	2	---	**2019**

Preamble: Life skills are those competencies that provide the means for an individual to be resourceful and positive while taking on life's vicissitudes. Development of one's personality by being aware of the self, connecting with others, reflecting on the abstract and the concrete, leading and generating change, and staying rooted in time-tested values and principles is being aimed at. This course is designed to enhance the employability and maximize the potential of the students by introducing them to the principles that underly personal and professional success, and help them acquire the skills needed to apply these principles in their lives and careers.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to

CO 1	Define and Identify different life skills required in personal and professional life
CO 2	Develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.
CO 3	Explain the basic mechanics of effective communication and demonstrate these through presentations.
CO 4	Take part in group discussions
CO 5	Use appropriate thinking and problem solving techniques to solve new problems
CO 6	Understand the basics of teamwork and leadership

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2		1	2	2	1	3
CO 2									3			2
CO 3						1			1	3		
CO 4										3		1
CO 5		3	2	1								
CO 6						1			3			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation
Total Marks: 50

Attendance	: 10 marks
Regular assessment	: 15 marks
Series test (one test only, should include first three modules)	: 25 marks

Regular assessment

- Group Discussion (Marks: 9)

  Create groups of about 6 students each and engage them on a GD on a suitable topic for about 20 minutes. Parameters to be used for evaluation are as follows:

  - Communication Skills : 3 marks
  - Subject Clarity : 2 marks
  - Group Dynamics : 2 marks
  - Behaviours & Mannerisms : 2 marks

- Presentation Skills (Marks: 6)

  Identify a suitable topic and ask the students to prepare a presentation (preferably a power point presentation) for about 10 minutes. Parameters to be used for evaluation are as follows:

  - Communication Skills : 2 marks
  - Platform Skills : 2 marks
  - Subject Clarity/Knowledge : 2 marks

End Semester Examination
Total Marks: 50 **Time: 2 hrs.**

Part A: Short answer question (25 marks)
There will be one question from each MODULE (five questions in total, five marks each). Each question should be written in about maximum of 400 words. Parameters to be used for evaluation are as follows:
(i) Content Clarity/Subject Knowledge
(ii) Presentation style
(iii) Organization of content

Part B: Case Study (25 marks)
The students will be given a case study with questions at the end. The students have to analyze the case and answer the question at the end. Parameters to be used for evaluation are as follows:
(i) Analyze the case situation
(ii) Key players/characters of the case
(iii) Identification of the problem (both major & minor if exists)
(iv) Bring out alternatives
(v) Analyze each alternative against the problem
(vi) Choose the best alternative
(vii) Implement as solution
(viii) Conclusion

(ix) Answer the question at the end of the case

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. List 'life skills' as identified by WHO
2. What do you mean by effective communication?
3. What are the essential life skills required by a professional?

Course Outcome 2 (CO2)

1. Identify an effective means to deal with workplace stress.
2. How can a student apply journaling to stress management?
3. What is the PATH method? Describe a situation where this method can be used effectively.

Course Outcome 3(CO3):

1. Identify the communication network structure that can be observed in the given situations. Describe them.

   (a) A group discussion on development.

   (b) An address from the Principal regarding punctuality.

   (c) A reporter interviewing a movie star.

   (d) Discussing the answers of a test with a group of friends.

2. Elucidate the importance of non-verbal communication in making a presentation
3. Differentiate between kinesics, proxemics, and chronemics with examples.

Course Outcome 4 (CO4):

1. How can a participant conclude a group discussion effectively?
2. 'Listening skills are essential for effectively participating in a group discussion.' Do you agree? Substantiate your answer.

Course Outcome 5 (CO5):

1. Illustrate the creative thinking process with the help of a suitable example
2. Translate the following problem from verbal to graphic form and find the solution : *In a quiz, Ananth has 50 points more than Bimal, Chinmay has 60 points less than Ananth, and Dharini is 20 points ahead of Chinmay. What is the difference in points between Bimal and Dharini?*

3. List at least five ways in which the problem "How to increase profit?" can be redefined

Course Outcome 6 (CO6):

1. A group of engineers decided to brainstorm a design issue on a new product. Since no one wanted to disagree with the senior members, new ideas were not flowing freely. What group dynamics technique would you suggest to avoid this 'groupthink'? Explain the procedure.
2. “A group focuses on individual contribution, while a team must focus on synergy.” Explain.
3. Identify the type of group formed / constituted in each of the given situations

    a) A Police Inspector with subordinates reporting to him

    b) An enquiry committee constituted to investigate a specific incident

    c) The Accounts Department of a company

    d) A group of book lovers who meet to talk about reading

Syllabus

Module 1

Overview of Life Skills: Meaning and significance of life skills, Life skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision making, problem solving, Effective communication, interpersonal relationship, coping with stress, coping with emotion.

Life skills for professionals: positive thinking, right attitude, attention to detail, having the big picture, learning skills, research skills, perseverance, setting goals and achieving them, helping others, leadership, motivation, self-motivation, and motivating others, personality development, IQ, EQ, and SQ

Module 2

Self-awareness: definition, need for self-awareness; Coping With Stress and Emotions, Human Values, tools and techniques of SA: questionnaires, journaling, reflective questions, meditation, mindfulness, psychometric tests, feedback.

Stress Management: Stress, reasons and effects, identifying stress, stress diaries, the four A's of stress management, techniques, Approaches: action-oriented, emotion-oriented, acceptance-oriented, resilience, Gratitude Training,

Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method and relaxation techniques.

Morals, Values and Ethics: Integrity, Civic Virtue, Respect for Others, Living Peacefully. Caring, Sharing, Honesty, Courage, Valuing Time, Time management, Co operation, Commitment, Empathy, Self-Confidence, Character, Spirituality, Avoiding Procrastination, Sense of Engineering Ethics.

Module 3

21st century skills: Creativity, Critical Thinking, Collaboration, Problem Solving, Decision Making, Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.

Steps in problem solving: Problem Solving Techniques, Six Thinking Hats, Mind Mapping, Forced Connections. Analytical Thinking, Numeric, symbolic, and graphic reasoning. Scientific temperament and Logical thinking.

Module 4

Group and Team Dynamics: Introduction to Groups: Composition, formation, Cycle, thinking, Clarifying expectations, Problem Solving, Consensus, Dynamics techniques, Group vs Team, Team Dynamics, Virtual Teams. Managing team performance and managing conflicts, Intrapreneurship.

Module 5

Leadership: Leadership framework, entrepreneurial and moral leadership, vision, cultural dimensions. Growing as a leader, turnaround leadership, managing diverse stakeholders, crisis management. Types of Leadership, Traits, Styles, VUCA Leadership, Levels of Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders.

Lab Activities

Verbal

Effective communication and Presentation skills.
Different kinds of communication; Flow of communication; Communication networks, Types of barriers; Miscommunication
Introduction to presentations and group discussions.
Learning styles: visual, aural, verbal, kinaesthetic, logical, social, solitary; Previewing, KWL table, active listening, REAP method
Note-taking skills: outlining, non-linear note-taking methods, Cornell notes, three column note taking.
Memory techniques: mnemonics, association, flashcards, keywords, outlines, spider diagrams and mind maps, spaced repetition.
Time management: auditing, identifying time wasters, managing distractions, calendars and checklists; Prioritizing - Goal setting, SMART goals; Productivity tools and apps, Pomodoro technique.

Non Verbal:
Non-verbal Communication and Body Language: Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language, Communication in a multi cultural environment.

Reference Books

1. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
2. Barun K. Mitra, “Personality Development & Soft Skills”, Oxford Publishers, Third impression, 2017.
3. ICT Academy of Kerala, "Life Skills for Engineers", McGraw Hill Education (India) Private Ltd., 2016.
4. Caruso, D. R. and Salovey P, “The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership”, John Wiley & Sons, 2004.
5. Kalyana, “Soft Skill for Managers”; First Edition; Wiley Publishing Ltd, 2015.
6. Larry James, “The First Book of Life Skills”; First Edition, Embassy Books, 2016.
7. Shalini Verma, “Development of Life Skills and Professional Practice”; First Edition; Sultan Chand (G/L) & Company, 2014.
8. Daniel Goleman, "Emotional Intelligence"; Bantam, 2006.
9. Remesh S., Vishnu R.G., "Life Skills for Engineers", Ridhima Publications, First Edition, 2016.
10. Butterfield Jeff, “Soft Skills for Everyone”, Cengage Learning India Pvt Ltd; 1 edition, 2011.
11. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India; 6 edition, 2015.
12. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013.

PHL 120	ENGINEERING PHYSICS LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	0	0	2	1	2019

Preamble: The aim of this course is to make the students gain practical knowledge to co-relate with the theoretical studies and to develop practical applications of engineering materials and use the principle in the right way to implement the modern technology.

Prerequisite: Higher secondary level Physics

Course Outcomes: After the completion of the course the student will be able to

CO 1	Develop analytical/experimental skills and impart prerequisite hands on experience for engineering laboratories
CO 2	Understand the need for precise measurement practices for data recording
CO 3	Understand the principle, concept, working and applications of relevant technologies and comparison of results with theoretical calculations
CO 4	Analyze the techniques and skills associated with modern scientific tools such as lasers and fiber optics
CO 5	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				3			1	2			1
CO 2	3				3			1	2			1
CO 3	3				3			1	2			1
CO 4	3				3			1	2			1
CO 5	3				3			1	2			1

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

LIST OF EXPERIMENTS

(Minimum 8 experiments should be completed)

1. CRO-Measurement of frequency and amplitude of wave forms
2. Measurement of strain using strain gauge and wheatstone bridge
3. LCR Circuit – Forced and damped harmonic oscillations
4. Melde's string apparatus- Measurement of frequency in the transverse and longitudinal mode
5. Wave length measurement of a monochromatic source of light using Newton's Rings method.
6. Determination of diameter of a thin wire or thickness of a thin strip of paper using air wedge method.
7. To measure the wavelength using a millimeter scale as a grating.
8. Measurement of wavelength of a source of light using grating.
9. Determination of dispersive power and resolving power of a plane transmission grating
10. Determination of the particle size of lycopodium powder
11. Determination of the wavelength of He-Ne laser or any standard laser using diffraction grating
12. Calculate the numerical aperture and study the losses that occur in optical fiber cable.
13. I-V characteristics of solar cell.
14. LED Characteristics.
15. Ultrasonic Diffractometer- Wavelength and velocity measurement of ultrasonic waves in a liquid
16. Deflection magnetometer-Moment of a magnet- Tan A position.

Reference books

1. S.L.Gupta and Dr.V.Kumar, "Practical physics with viva voice", Pragati PrakashanPublishers, Revised Edition, 2009
2. M.N.Avadhanulu, A.A.Dani and Pokely P.M, "Experiments in Engineering Physics", S.Chand&Co,2008
3. S. K. Gupta, "Engineering physics practicals", Krishna Prakashan Pvt. Ltd., 2014
4. P. R. Sasikumar "Practical Physics", PHI Ltd., 2011.

CYL 120	ENGINEERING CHEMISTRY LAB	CATEGORY	L	T	P	CREDIT
		BSC	0	0	2	1

Preamble: To impart scientific approach and to familiarize with the experiments in chemistry relevant for research projects in higher semesters

Prerequisite: Experiments in chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Understand and practice different techniques of quantitative chemical analysis to generate experimental skills and apply these skills to various analyses
CO 2	Develop skills relevant to synthesize organic polymers and acquire the practical skill to use TLC for the identification of drugs
CO 3	Develop the ability to understand and explain the use of modern spectroscopic techniques for analysing and interpreting the IR spectra and NMR spectra of some organic compounds
CO 4	Acquire the ability to understand, explain and use instrumental techniques for chemical analysis
CO 5	Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments
CO 6	Function as a member of a team, communicate effectively and engage in further learning. Also understand how chemistry addresses social, economical and environmental problems and why it is an integral part of curriculum

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				2							3
CO 2	3				3							3
CO 3	3				3							3
CO 4	3				3							3
CO 5	3				1							3
CO 6	3				1							3

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance : 20 marks
Class work/ Assessment /Viva-voce : 50 marks
End semester examination (Internally by college) : 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

LIST OF EXPERIMENTS (MINIMUM 8 MANDATORY)

1. Estimation of total hardness of water-EDTA method
2. Potentiometric titration
3. Determination of cell constant and conductance of solutions.
4. Calibration of pH meter and determination of pH of a solution
5. Estimation of chloride in water
6. Identification of drugs using TLC
7. Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution
8. Determination of molar absorptivity of a compound ($KMnO_4$ or any water soluble food colorant)
9. Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
10. Estimation of iron in iron ore
11. Estimation of copper in brass
12. Estimation of dissolved oxygen by Winkler's method
13. (a) Analysis of IR spectra (minimum 3 spectra) (b) Analysis of ^1H NMR spectra (minimum 3 spectra)
14. Flame photometric estimation of Na^+ to find out the salinity in sand
15. Determination of acid value of a vegetable oil
16. Determination of saponification of a vegetable oil

Reference Books

1. G. Svehla, B. Sivasankar, "Vogel's Qualitative Inorganic Analysis", Pearson, 2012.
2. R. K. Mohapatra, "Engineering Chemistry with Laboratory Experiments", PHI Learning, 2017.
3. Muhammed Arif, "Engineering Chemistry Lab Manual", Owl publishers, 2019.
4. Ahad J., "Engineering Chemistry Lab manual", Jai Publications, 2019.
5. Roy K Varghese, "Engineering Chemistry Laboratory Manual", Crownplus Publishers, 2019.
6. Soney C George, Rino Laly Jose, "Lab Manual of Engineering Chemistry", S. Chand & Company Pvt Ltd, New Delhi, 2019.

ESL 120	CIVIL & MECHANICAL WORKSHOP	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
			0	0	2	1	2019

Preamble: The course is designed to train the students to identify and manage the tools, materials and methods required to execute an engineering project. Students will be introduced to a team working environment where they develop the necessary skills for planning, preparing and executing an engineering project.

To enable the student to familiarize various tools, measuring devices, practices and different methods of manufacturing processes employed in industry for fabricating components.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to:

Course Outcome	Course Outcome Description
CO 1	Name different devices and tools used for civil engineering measurements
CO 2	Explain the use of various tools and devices for various field measurements
CO 3	Demonstrate the steps involved in basic civil engineering activities like plot measurement, setting out operation, evaluating the natural profile of land, plumbing and undertaking simple construction work.
CO 4	Choose materials and methods required for basic civil engineering activities like field measurements, masonry work and plumbing.
CO 5	Compare different techniques and devices used in civil engineering measurements
CO 6	Identify Basic Mechanical workshop operations in accordance with the material and objects
CO 7	Apply appropriate Tools and Instruments with respect to the mechanical workshop trades
CO 8	Apply appropriate safety measures with respect to the mechanical workshop trades

Mapping of course outcomes with program outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	-	-	-	1	1	-	-	2	2	-	-
CO 2	1	-	-	-	1	1	-	-	2	2	-	-
CO 3	1	-	-	-	1	1	-	2	2	2	1	-
CO 4	1	-	-	-	1	1	-	2	2	2	1	1
CO 5	1	-	-	-	1	1	-	-	2	2		1
CO 6	2											

CO 7	2											
CO 8	2											

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	70	30	1 hour

Assessment Procedure: Total marks allotted for the course is 100 marks. CIE shall be conducted for 70 marks and ESE for 30 marks. CIE should be done for the work done by the student and also viva voce based on the work done on each practical session. ESE shall be evaluated by written examination of one hour duration conducted internally by the institute.

Continuous Internal Evaluation Pattern:

Attendance : 20 marks
Class work/ Assessment /Viva-voce : 50 marks
End semester examination (Internally by college) : 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

PART 1

CIVIL WORKSHOP

Exercise 1. Calculate the area of a built-up space and a small parcel of land- Use standard measuring tape and digital distance measuring devices

Exercise 2. (a) Use screw gauge and vernier calliper to measure the diameter of a steel rod and thickness of a flat bar

(b) Transfer the level from one point to another using a water level

(c) Set out a one room building with a given plan and measuring tape

Exercise 3. Find the level difference between any two points using dumpy level

Exercise 4. (a) Construct a $1\frac{1}{2}$ thick brick wall of 50 cm height and 60 cm length using English bond. Use spirit level to assess the tilt of walls.

(b) Estimate the number of different types of building blocks to construct this wall.

Exercise 5. (a) Introduce the students to plumbing tools, different types of pipes, type of connections, traps, valves ,fixtures and sanitary fittings.

(b) Install a small rainwater harvesting installation in the campus

Reference Books:

1. Khanna P.N, “Indian Practical Civil Engineering Handbook”, Engineers Publishers.
2. Bhavikatti. S, "Surveying and Levelling (Volume 1)", I.K. International Publishing House
3. Arora S.P and Bindra S.P, " Building Construction", Dhanpat Rai Publications
4. S. C. Rangwala, “Engineering Materials,” Charotar Publishing House.

PART II

MECHANICAL WORKSHOP

LIST OF EXERCISES

(Minimum EIGHT units mandatory and FIVE models from Units 2 to 8 mandatory)

UNIT 1:- General : Introduction to workshop practice, Safety precautions, Shop floor ethics, Basic First Aid knowledge.

Study of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc.

UNIT 2:- Carpentry : Understanding of carpentry tools

Minimum any one model

1. T –Lap joint 2. Cross lap joint 3. Dovetail joint 4. Mortise joints

UNIT 3:- Foundry : Understanding of foundry tools

Minimum any one model

1.Bench Molding 2. Floor Molding 3. Core making 4. Pattern making

UNIT 4: - Sheet Metal : Understanding of sheet metal working tools

Minimum any one model

1. Cylindrical shape
2. Conical shape
3. Prismatic shaped job from sheet metal

UNIT 5: - Fitting : Understanding of tools used for fitting

Minimum any one model

1. Square Joint
2. V- Joint
3. Male and female fitting

UNIT 6: - Plumbing : Understanding of plumbing tools, pipe joints

Any one exercise on joining of pipes making use of minimum three types of pipe joints

UNIT 7: - Smithy: Understanding of tools used for smithy.

Demonstrating the forge-ability of different materials (MS, Al, alloy steel and cast steels) in cold and hot states.

Observing the qualitative difference in the hardness of these materials

Minimum any one exercise on smithy

1. Square prism
2. Hexagonal headed bolt
3. Hexagonal prism
4. Octagonal prism

UNIT 8: -Welding: Understanding of welding equipments

Minimum any one welding practice

Making Joints using electric arc welding. bead formation in horizontal, vertical and over head positions

UNIT 9: - Assembly: Demonstration only

Dissembling and assembling of

1. Cylinder and piston assembly
2. Tail stock assembly
3. Bicycle
4. Pump or any other machine

UNIT 10: - Machines: Demonstration and applications of the following machines

Shaping and slotting machine; Milling machine; Grinding Machine; Lathe; Drilling Machine.

UNIT 11: - Modern manufacturing methods: Power tools, CNC machine tools, 3D printing, Glass cutting.

Course Contents and Lecture Schedule:

No	Topic	No of Sessions
1	**INTRODUCTION**	
1.1	Workshop practice, shop floor precautions, ethics and First Aid knowledge. Studies of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc	1
2	**CARPENTRY**	
2.1	Understanding of carpentry tools and making minimum one model	2

3	**FOUNDRY**	
3.1	Understanding of foundry tools and making minimum one model	2
4	**SHEET METAL**	
4.1	Understanding of sheet metal working tools and making minimum one model	2
5	**FITTING**	
5.1	Understanding of fitting tools and making minimum one model	2
6	**PLUMBING**	
6.1	Understanding of pipe joints and plumbing tools and making minimum one model	2
7	**SMITHY**	
7.1	Understanding of smithy tools and making minimum one model	2
8	**WELDING**	
8.1	Understanding of welding equipments and making minimum one model	2
9	**ASSEMBLY**	
9.1	Demonstration of assembly and dissembling of multiple parts components	1
10	**MACHINES**	
10.1	Demonstration of various machines	1
11	**MODERN MANUFACTURING METHODS**	
11.1	Demonstrations of: power tools, CNC Machine tools, 3D printing, Glass cutting	1

ESL 130	ELECTRICAL & ELECTRONICS WORKSHOP	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	0	0	2	1	2019

Preamble: Electrical Workshop is intended to impart skills to plan and carry out simple electrical wiring. It is essential for the practicing engineers to identify the basic practices and safety measures in electrical wiring.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Demonstrate safety measures against electric shocks.
CO 2	Identify the tools used for electrical wiring, electrical accessories, wires, cables, batteries and standard symbols
CO 3	Develop the connection diagram, identify the suitable accessories and materials necessary for wiring simple lighting circuits for domestic buildings
CO 4	Identify and test various electronic components
CO 5	Draw circuit schematics with EDA tools
CO 6	Assemble and test electronic circuits on boards
CO 7	Work in a team with good interpersonal skills

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	3	-	-	-	-	-	1
CO 2	2	-	-	-	-	-	-	-	-	1	-	-
CO 3	2	-	-	1	-	1	-	1	2	2	-	2
CO 4	3	-	-	-	-	-	-	-	-	-	-	2
CO 5	3	-	-	-	2	-	-	-	-	-	-	2
CO 6	3	-	-	-	2	-	-	-	-	-	-	1
CO 7	-	-	-	-	-	-	-	-	3	2	-	2

Mark distribution

Total Marks	CIE	ESE	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

Syllabus

PART 1

ELECTRICAL

List of Exercises / Experiments

1. a) Demonstrate the precautionary steps adopted in case of Electrical shocks.

   b)Identify different types of cables, wires, switches, fuses, fuse carriers, MCB, ELCB and MCCB with ratings.
2. Wiring of simple light circuit for controlling light/ fan point (PVC conduit wiring)
3. Wiring of light/fan circuit using Two way switches . (Staircase wiring)
4. Wiring of Fluorescent lamps and light sockets (6A) with a power circuit for controlling power device. (16A socket)
5. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and Energy meter.
6. a)Identify different types of batteries with their specifications.

   b)Demonstrate the Pipe and Plate Earthing Schemes using Charts/Site Visit.

PART II

ELECTRONICS

List of Exercises / Experiments (Minimum of 7 mandatory)

1. Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.)

2. Drawing of electronic circuit diagrams using BIS/IEEE symbols and introduction to EDA tools (such as Dia or XCircuit), Interpret data sheets of discrete components and IC's, Estimation and costing.

3. Familiarization/Application of testing instruments and commonly used tools. [Multimeter, Function generator, Power supply, DSO etc.] [Soldering iron, De-soldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de- soldering station etc.]

4. Testing of electronic components [Resistor, Capacitor, Diode, Transistor and JFET using multimeter.]

5. Inter-connection methods and soldering practice. [Bread board, Wrapping, Crimping, Soldering - types - selection of materials and safety precautions, soldering practice in connectors and general purpose PCB, Crimping.]

6. Printed circuit boards (PCB) [Types, Single sided, Double sided, PTH, Processing methods, Design and fabrication of a single sided PCB for a simple circuit with manual etching (Ferric chloride) and drilling.]
7. Assembling of electronic circuits using SMT (Surface Mount Technology) stations.
8. Assembling of electronic circuit/system on general purpose PCB, test and show the functioning (**Any Two circuits).**

    1. Fixed voltage power supply with transformer, rectifier diode, capacitor filter, zener/IC regulator.
    2. Square wave generation using IC 555 timer in IC base.
    3. Sine wave generation using IC 741 OP-AMP in IC base.
    4. RC coupled amplifier with transistor BC107.

SEMESTER II

MAT 102	VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND TRANSFORMS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: This course introduces the concepts and applications of differentiation and integration of vector valued functions, differential equations, Laplace and Fourier Transforms. The objective of this course is to familiarize the prospective engineers with some advanced concepts and methods in Mathematics which include the Calculus of vector valued functions, ordinary differential equations and basic transforms such as Laplace and Fourier Transforms which are invaluable for any engineer's mathematical tool box. The topics treated in this course have applications in all branches of engineering.

Prerequisite: Calculus of single and multi variable functions.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the derivatives and line integrals of vector functions and learn their applications
CO 2	Evaluate surface and volume integrals and learn their inter-relations and applications.
CO 3	Solve homogeneous and non-homogeneous linear differential equation with constant coefficients
CO 4	Compute Laplace transform and apply them to solve ODEs arising in engineering
CO 5	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	2	1			1	2		2
CO 2	3	3	3	3	2	1			1	2		2
CO 3	3	3	3	3	2	1			1	2		2
CO 4	3	3	3	3	2	1			1	2		2
CO 5	3	3	3	3	2	1			1	2		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks	Test 2 (Marks)	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			

Create			

Mark distribution

Total Marks	**CIE** (Marks)	**ESE** (Marks)	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks
Assignments: Assignment should include specific problems highlighting the applications of the methods introduced in this course in science and engineering.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Compute the derivatives and line integrals of vector functions and learn their applications

1. How would you calculate the speed, velocity and acceleration at any instant of a particle moving in space whose position vector at time $t$is $\boldsymbol{r}(t)$?

2. Find the work done by the force field $F = (e^x - y^3)\boldsymbol{i} + (\cos y + x^3)$on a particle that travels once around the unit circle centred at origin having radius 1.

3. When do you say that a vector field is conservative? What are the implications if a vector field is conservative?

Course Outcome 2 (CO2): Evaluate surface and volume integrals and learn their inter-relations and applications

1. Write any one application each of line integral, double integral and surface integral.

2. Use the divergence theorem to find the outward flux of the vector field $F(x, y, z) = z\boldsymbol{k}$across the

$$x^2 + y^2 + z^2 = a^2$$

3. State Greens theorem. Use Green's theorem to express the area of a plane region bounded by a curve as a line integral.

Course Outcome 3 (CO3): Solve homogeneous and non-homogeneous linear differential equation with constant coefficients

1. If $y_1(x)$ and $y_2(x)$ are solutions of $y'' + py' + qy = 0$, where p, q are constants, show that

   $y_1(x) + y_2(x)$ is also a solution.

2. Solve the differential equation $y'' + y = 0.001x^2$ using method of undetermined coefficient.

3. Solve the differential equation of $y''' - 3y'' + 3y' - y = e^x - x - 1$.

Course Outcome 4 (CO4): Compute Laplace transform and apply them to solve ODEs arising in engineering

1. What is the inverse Laplace Transformof $(s) = \frac{3s-137}{s^2+2s+4}$?

2. Find Laplace Transform of Unit step function.

3. Solve the differential equation of $y'' + 9y = \delta\left(t - \frac{\pi}{2}\right)$? Given $y(0) = 2,\ y'(0) = 0$

Course Outcome 5(CO5): Determine the Fourier transforms of functions and apply them to solve problems arising in engineering

1. Find the Fourier integral representation of function defined by $f(x) = e^{-x}$ for $x > 0$ and $f(x) = 0$ for $x < 0$.

2. What are the conditions for the existence of Fourier Transform of a function $f(x)$?

3. Find the Fourier transform of $f(x) = 1$ for $|x| < 1$ and $f(x) = 0$ otherwise.

Model Question paper

QP CODE: PAGES:3

Reg No:_______________

Name :_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MAT 102

Max. Marks: 100 **Duration: 3 Hours**

VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND TRANSFORMS

(2019-Scheme)

(Common to all branches)

PART A

(Answer all questions. Each question carries 3 marks)

1. Is the vector $\boldsymbol{r}$ **where** $\boldsymbol{r} = x\boldsymbol{i} + y\boldsymbol{j} + z\boldsymbol{k}$ conservative. Justify your answer.
2. State Greens theorem including all the required hypotheses
3. What is the outward flux of $\boldsymbol{F}(\boldsymbol{x},\boldsymbol{y},\boldsymbol{z}) = x\boldsymbol{i} + y\boldsymbol{j} + z\boldsymbol{k}$ across any unit cube**.**
4. What is the relationship between Green's theorem and Stokes theorem?
5. Solve $y'' + 4y' + 2.5y = 0$
6. Does the function $y = C_1 \cos x + C_2\, sinx$form a solution of$y'' + y = 0$?. Is it the general solution? Justify your answer.
7. Find the Laplace transform of $e^{-t}\sinh 4t$
8. Find the Laplace inverse transform of $\frac{1}{s\,(s^2+\omega^2)}$.
9. Given the Fourier transform $\frac{1}{\sqrt{2}}e^{-\frac{\omega^2}{4}}$ of $f(x) = e^{-x^2}$, find the Fourier transform of xe^{-x^2}
10. State the convolution theorem for Fourier transform

PART B

(Answer one full question from each module. Each full question carries 14 marks)

MODULE 1

11a) Prove that the force field $\boldsymbol{F} = e^y\boldsymbol{i} + xe^y\boldsymbol{j}$is conservative in the entire xy-plane

b**)** Use Greens theorem to find the area enclosed by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

12 a) Find the divergence of the vector field$\boldsymbol{F} = \frac{c}{(\boldsymbol{x^2+y^2+z^2})^{3/2}}(x\boldsymbol{i} + y\boldsymbol{j} + z\boldsymbol{k})$

b) Find the work done by the force field$\boldsymbol{F}(x,y,z) = xy\boldsymbol{i} + yz\boldsymbol{j} + xz\boldsymbol{k}$along C where

C is the curve$\boldsymbol{r}(t) = t\boldsymbol{i} + t^2\boldsymbol{j} + t^3\boldsymbol{k}$

MODULE II

13 a) Use divergence theorem to find the outward flux of the vector field

$\boldsymbol{F} = 2x\boldsymbol{i} + 3y\boldsymbol{j} + z^3\boldsymbol{k}$acrossthe unit cube bounded by or $x = 0$, $y = 0$,$z = 0$,$x = 1$,$y = 1$,$z = 1$

b) Find the circulation of $\boldsymbol{F} = (x-z)\boldsymbol{i} + (y-x)\boldsymbol{j} + (\boldsymbol{z} - \boldsymbol{xy})\boldsymbol{k}$ using Stokes theorem around the triangle with vertices $A(1,0,0)$, $B(0,2,0)$and $C(0,0,1)$

14 a**)** Use divergence theorem to find the volume of the cylindrical solid bounded by $x^2 + 4x + y^2 = 7$, $z = -1$, $z = 4$, given the vector field $\boldsymbol{F} = \boldsymbol{x}i + \boldsymbol{y}j + \boldsymbol{z}k$ across surfaceof the cylinder

b) Use Stokes theorem to evaluate$\int_C \boldsymbol{F}.\boldsymbol{dr}$where$\boldsymbol{F} = x^2\boldsymbol{i} + 3x\boldsymbol{j} - y^3\boldsymbol{k}$where Cis the circle $x^2 + y^2 = 1$ in the xy- plane with counterclockwise orientation looking down the positive z-axis

MODULE III

15 a) Solve $y'' + 4y' + 4y = x^2 + e^{-x}\cos x$

b) Solve $y''' - 3y'' + 3y' - y = e^x - x - 1$

16 a) Solve $\boldsymbol{y}''' + \boldsymbol{3}y'' + 3y' + y = 30e^{-x}$ given $y(0) = 3, y'(0) = -3\,,\quad y''(0) = -47$

b) Using method of variation of parameters, solve $y'' + y = sec\, x$

MODULE IV

17 a) Find the inverse Laplace transform of $F(s) = \frac{2(e^{-s} - e^{-3s})}{s^2 - 4}$

b) Solve the differential equation $y'' + 16y = 4\delta(t - 3\pi);\ y(0) = 2, y'(0) = 0$ using Laplace transform

18 a) Solve $y'' + 3y' + 2y = f(t)$ where $f(t) = 1$ for $0 < t < 1$ and $f(t) = 1$ for $t > 1$ using Laplace transform

b) Apply convolution theorem to find the Laplace inverse transform of $\frac{1}{s^2(s^2+\omega^2)}$

MODULE V

19 a) Find the Fourier cosine integral representation for $f(x) = e^{-kx}$ for $x > 0$ and $k > 0$ and hence evaluate $\int_0^\infty \frac{\cos wx}{k^2+w^2}$ the function

b) Does the Fourier sine transform $f(x) = x^{-1}\sin x$ for $0 < x < \infty$ exist? Justify your answer

20 a) Find the Fourier transform of $f(x) = |x|$ for $|x| < 1$ and $f(x) = 0$ otherwise

b) Find the Fourier cosine transform of $f(x) = e^{-ax}$ for a> 0

Syllabus

Module 1 (Calculus of vector functions)

(Text 1: Relevant topics from sections 12.1, 12.2, 12.6, 13.6, 15.1, 15.2, 15.3)

Vector valued function of single variable, derivative of vector function and geometrical interpretation, motion along a curve-velocity, speed and acceleration. Concept of scalar and vector fields , Gradient and its properties, directional derivative , divergence and curl, Line integrals of vector fields, work as line integral, Conservative vector fields , independence of path and potential function(results without proof).

Module 2 (Vector integral theorems)

(Text 1: Relevant topics from sections 15.4, 15.5, 15.6, 15.7, 15.8)

Green's theorem (for simply connected domains, without proof) and applications to evaluating line integrals and finding areas. Surface integrals over surfaces of the form z = g(x, y), y = g(x, z) or x = g(y, z) , Flux integrals over surfaces of the form z = g(x, y), y = g(x, z) or x = g(y, z), divergence theorem (without proof) and its applications to finding flux integrals, Stokes' theorem (without proof) and its applications to finding line integrals of vector fields and work done.

Module- 3 (Ordinary differential equations)

(Text 2: Relevant topics from sections 2.1, 2.2, 2.5, 2.6, 2.7, 2.10, 3.1, 3.2, 3.3)

Homogenous linear differential equation of second order, superposition principle,general solution, homogenous linear ODEs with constant coefficients-general solution. Solution of Euler-Cauchy equations (second order only).Existence and uniqueness (without proof). Non homogenous linear ODEs-general solution, solution by the method of undetermined coefficients (for the right hand side of the form x^n,e^{kx},$sinax$,$cosax$,$e^{kx}sinaxe^{kx}cosax$and their linear combinations), methods of variation of parameters. Solution of higher order equations-homogeneous and non-homogeneous with constant coefficient using method of undetermined coefficient.

Module- 4 (Laplace transforms)

(Text 2: Relevant topics from sections 6.1,6.2,6.3,6.4,6.5)

Laplace Transform and its inverse ,Existence theorem (without proof) , linearity,Laplace transform of basic functions, first shifting theorem, Laplace transform of derivatives and integrals, solution of differential equations using Laplace transform, Unit step function, Second shifting theorems. Dirac delta function and its Laplace transform, Solution of ordinary differential equation involving unit step function and Dirac delta functions. Convolution theorem(without proof)and its application to finding inverse Laplace transform of products of functions.

Module-5 (Fourier Tranforms)

(Text 2: Relevant topics from sections 11.7,11.8, 11.9)

Fourier integral representation, Fourier sine and cosine integrals. Fourier sine and cosine transforms, inverse sine and cosine transform. Fourier transform and inverse Fourier transform, basic properties. The Fourier transform of derivatives. Convolution theorem (without proof)

Text Books

1. H. Anton, I. Biven S.Davis, "Calculus", Wiley, 10th edition, 2015.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley, 10th edition, 2015.

Reference Books

1. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9 th Edition, Pearson,Reprint, 2002.
3. Peter O Neil, Advanced Engineering Mathematics, 7th Edition, Thomson, 2007.
4. Louis C Barret, C Ray Wylie, "Advanced Engineering Mathematics", Tata McGraw Hill, 6th edition, 2003.
5. VeerarajanT."Engineering Mathematics for first year", Tata McGraw - Hill, 2008.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th edition , 2010.
7. Srimanta Pal, Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, 2015.
8. Ronald N. Bracewell, "The Fourier Transform and its Applications", McGraw – Hill International Editions, 2000.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Calculus of vector functions (9 hours)**	
1.1	Vector valued function of a scalar variable - derivative of vector valued function of scalar variable t-geometrical meaning	2
1.2	Motion along a curve-speed , velocity, acceleration	1
1.3	Gradient and its properties, directional derivative , divergent and curl	3
1.4	Line integrals with respect to arc length, line integrals of vector fields. Work done as line integral	2
1.5	Conservative vector field, independence of path, potential function	1

2	**Vector integral theorems(9 hours)**	
2.1	Green’s theorem and it’s applications	2
2.2	Surface integrals , flux integral and their evaluation	3
2.3	Divergence theorem and applications	2
2.4	Stokes theorem and applications	2
3	**Ordinary Differential Equations (9 hours)**	
3.1	Homogenous linear equation of second order, Superposition principle, general solution	1
3.2	Homogenous linear ODEs of second order with constant coefficients	2
3.3	Second order Euler-Cauchy equation	1
3.4	Non homogenous linear differential equations of second order with constant coefficient-solution by undetermined coefficients, variation of parameters.	3
3.5	Higher order equations with constant coefficients	2
4	**Laplace Transform (10 hours)**	
4.1	Laplace Transform , inverse Transform, Linearity, First shifting theorem, transform of basic functions	2
4.2	Transform of derivatives and integrals	1
4.3	Solution of Differential equations, Initial value problems by Laplace transform method.	2
4.4	Unit step function --- Second shifting theorem	2
4.5	Dirac Delta function and solution of ODE involving Dirac delta function	2
4.6	Convolution and related problems.	1
5	**Fourier Transform (8 hours)**	
5.1	Fourier integral representation	1
5.2	Fourier Cosine and Sine integrals and transforms	2
5.3	Complex Fourier integral representation, Fourier transform and its inverse transforms, basic properties	3
5.4	Fourier transform of derivatives, Convolution theorem	2

PHT 100	ENGINEERING PHYSICS A (FOR CIRCUIT BRANCHES)	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	3	1	0	4	2019

Preamble: The aim of the Engineering Physics Program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes

Prerequisite: Higher secondary level Physics, Mathematical course on vector calculus, differential equations and linear algebra

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.
CO 2	Apply the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.
CO 3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices.
CO 4	Classify the properties of magnetic materials and apply vector calculus to static magnetic fields and use Maxwell's equations to diverse engineering problems
CO 5	Analyze the principles behind various superconducting applications, explain the working of solid state lighting devices and fibre optic communication system

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2						1	2			1
CO 2	3	2						1	2			1
CO 3	3	2						1	2			1
CO 4	3	1						1	2			1
CO 5	3	1						1	2			1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20

Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the effect of damping force on oscillators.
2. Distinguish between transverse and longitudinal waves.
3. (a) Derive an expression for the fundamental frequency of transverse vibration in a stretched string.

   (b) Calculate the fundamental frequency of a string of length 2 m weighing 6 g kept stretched by a load of 600 kg.

Course Outcome 2 (CO2):

1. Explain colours in thin films.
2. Distinguish between Fresnel and Fraunhofer diffraction.
3. (a) Explain the formation of Newton's rings and obtain the expression for radii of bright and dark rings in reflected system. Also explain how it is used to determine the wavelength of a monochromatic source of light.

   (b) A liquid of refractive index μ is introduced between the lens and glass plate.

What happens to the fringe system? Justify your answer.

Course Outcome 3 (CO3):

1. Give the physical significance of wave function ?

2. What are excitons ?

3. (a) Solve Schrodinger equation for a particle in a one dimensional box and obtain its energy eigen values and normalised wave functions.

   (b) Calculate the first three energy values of an electron in a one dimensional box of width 1 A^0 in electron volt.

Course Outcome 4 (CO4):

1. Compare displacement current and conduction current.

2. Mention any four properties of ferro magnetic materials.

3. (a) Starting from Maxwell's equations, derive the free space electromagnetic wave equation and show that velocity of electromagnetic wave is $1/ (\mu_o \varepsilon_o)^{½}$

   (b) An electromagnetic wave is described by $E = 100 \exp 8\pi i [10^{14} t - (10^{6} z / 3)]$ V/m. Find the direction of propagation of the wave,speed of the wave and magnetic flux density in the wave.

Course Outcome 5 (CO5):

1. Explain the working of a solar cell.

2. Distinguish between Type I and Type II super conductors.

3. (a) Define numerical aperture and derive an expression for it.

   (b) Explain the working of intensity modulated fibre optic sensor.

Model Question paper

QP CODE: PAGES:3

Reg No:_______________

Name :_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: PHT 100

Course Name: Engineering Physics A

Max. Marks: 100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Compare electrical and mechanical oscillators

2. Distinguish between longitudinal and transverse waves

3. Write a short note on antireflection coating.

4. Diffraction of light is not as evident in daily experience as that of sound waves. Give reason.

5. State and explain Heisenberg's Uncertainty principle. With the help of it explain natural line broadening.

6. Explain surface to volume ratio of nanomaterials.

7. State Faraday's laws of electromagnetic induction.

8. Compare displacement current and conduction current

9. List four important applications of superconductors.

10. Give the working principle of LED. (10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. (a) Derive the differential equation of damped harmonic oscillator and deduce its solution.Discuss the cases of over damped, critically damped and under damped cases. (10)

(b) The frequency of a tuning fork is 500 Hz and its Q factor is 7×10^{4}. Find the relaxation time. Also calculate the time after which its energy becomes 1/10 of its initial undamped value.(4)

12. (a) Derive an expression for the velocity of propagation of a transverse wave in a stretched string. Deduce laws of transverse vibrations. (10)

(b) The equation of transverse vibration of a stretched string is given by y =0.00327 sin (72.1x-2.72t)m, in which the numerical constants are in S.I units. Evaluate (i) Amplitude (ii) Wavelength (iii) Frequency and (iv)Velocity of the wave. (4)

Module 2

13.(a)Explain the formation of Newton's rings and show that the radius of dark ring is proportional to the square root of natural numbers. How can we use Newton's rings experiment to determine the refractive index of a liquid. (10)

(b) Two pieces of plane glass are placed together with a piece of paper between two at one end. Find the angle of the wedge in seconds if the film is viewed with a monochromatic light of wavelength 4800Å. Given β = 0.0555 cm. (4)

14. (a) Explain the diffraction due to a plane transmission grating. Obtain the grating equation. (10)

(b) A grating has 6000 lines per cm. Find the angular separation of the two yellow lines of mercury of wavelengths 577 nm and 579 nm in the second order. (4)

Module 3

15.(a) Derive time dependent and independent Schrodinger equations. (10)

(b) An electron is confined to one dimensional potential box of length 2Å. Calculate the energies corresponding to the first and second quantum states in eV. (4)

16.(a) Classify nanomaterials based on dimensionality of quantum confinement and explain the following nanostructures. (i) nano sheets (ii) nano wires (iii) quantum dots. (10)

(b) Find the de Broglie wavelength of electron whose kinetic energy is 15 eV. (4)

Module 4

17.(a) State Poynting's Theorem. Calculate the value of Poynting vector at the surface of the sun if the power radiated by the sun is 3.8×10^{26} W and its radius is 7×10^{8} m. (5)

(b) Distinguish between paramagnetic, diamagnetic and ferromagnetic materials. (9)

18.(a) Starting from Maxwell's Equations, derive electromagnetic wave equations in free space. (10)

(b) If the magnitude of **H** in a plane wave is 1 A/m, find the magnitude of **E** in free space. (4)

Module 5

19.(a) Show that superconductors are perfect diamagnets. Distinguish between Type I and Type II superconductors with suitable examples. (10)

(b) Write a short note on high temperature superconductors. (4)

20.(a) Define numerical aperture of an optic fibre and derive an expression for the NA of a step index fibre with a neat diagram. (10)

(b) Calculate the numerical aperture and acceptance angle of a fibre with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fibre is inside water of refractive index 1.33. (4)

(14x5=70)

Syllabus

ENGINEERING PHYSICS A
(FOR CIRCUIT BRANCHES)

Module 1
Oscillations and Waves
Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression, Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators

Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation), Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration

Module 2
Wave Optics
Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference, Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings

Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation, Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)

Module 3
Quantum Mechanics & Nanotechnology
Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism, Formulation of time dependent and independent Schrodinger wave equations-Physical meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)

Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots, Properties of nanomaterials-mechanical, electrical and optical, Applications of nanotechnology (qualitative ideas)

Module 4
Magnetism & Electro Magnetic Theory
Magnetic field and Magnetic flux density, Gauss's law for Magnetic flux density, Ampere's Circuital law, Faraday's law in terms of EMF produced by changing magnetic flux, Magnetic permeability and susceptibility, Classification of magnetic materials-para, dia and ferromagnetic materials

Fundamentals of vector calculus, concept of divergence, gradient and curl along with physical significance, Line, Surface and Volume integrals, Gauss divergence theorem & Stokes' theorem, Equation of continuity, Derivation of Maxwell's equations in vacuum, Comparison of displacement current with conduction current. Electromagnetic waves, Velocity of Electromagnetic waves in free space, Flow of energy and Poynting's vector (no derivation)

Module 5

Superconductivity & Photonics

Superconducting phenomena, Meissner effect and perfect diamagnetism, Types of superconductors-Type I and Type II, BCS Theory (Qualitative), High temperature superconductors-Applications of super conductivity

Introduction to photonics-Photonic devices-Light Emitting Diode, Photo detectors -Junction and PIN photodiodes, Solar cells-I-V Characteristics, Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications of optical fibre, Fibre optic sensors-Intensity Modulated and Phase modulated sensors.

Text Books

1. M.N.Avadhanulu, P.G.Kshirsagar,TVS Arun Murthy "A Text book of Engineering Physics", S.Chand &Co., Revised Edition 2019

2. H.K.Malik , A.K. Singh, "Engineering Physics" McGraw Hill Education, Second Edition 2017

Reference Books

1. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003
2. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015
3. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016
4. Aruldhas G., "Engineering Physics", PHI Pvt. Ltd., 2015
5. Ajoy Ghatak, "Optics", Mc Graw Hill Education, Sixth Edition, 2017
6. T. Pradeep, "Nano:The Essentials'', McGraw Hill India Ltd, 2007
7. Halliday, Resnick, Walker, "Fundamentals of Physics'', John Wiley & Sons.Inc, 2001
8. David J Griffiths, "Introduction to Electrodynamics'', Addison-Wesley publishing, 3rd Edition, 1999
9. Premlet B., "Advanced Engineering Physics", Phasor Books,10th edition,2017
10. I. Dominic and. A. Nahari, "A Text Book of Engineering physics", Owl Books Publishers, Revised edition, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Oscillations and Waves (9 hours)**	
1.1	Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression	2 hrs
1.2	Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators	3hrs
1.3	Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation)	2 hrs
1.4	Distinction between transverse and longitudinal waves. Transverse vibration in a stretched string, Statement of laws of vibration	2 hrs
2	**Wave Optics (9 hours)**	
2.1	Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference	2 hrs
2.2	Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings	4 hr
2.3	Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation	2 hrs
2.4	Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)	1 hr
3	**Quantum Mechanics &Nanotechnology (9hours)**	
3.1	Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism	2 hrs
3.2	Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)	4 hrs
3.3	Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots	2 hrs
3.4	Properties of nanomaterials-mechanical, electrical and optical Applications of nanotechnology (qualitative ideas)	1 hr
4	**Magnetism & Electro Magnetic Theory (9 hours)**	
4.1	Magnetic field and Magnetic flux density, Gauss's law for Magnetic flux	2 hrs

	density, Ampere's Circuital law, Faraday's law in terms of EMF produced by changing magnetic flux	
4.2	Explanation for Magnetic permeability and susceptibility Classification of magnetic materials- para, dia and ferromagnetic materials	1 hr
4.3	Fundamentals of vector calculus, concept of divergence, gradient and curl along with physical significance, Line, Surface and Volume integrals, Gauss divergence theorem & Stokes' theorem	2 hrs
4.4	Equation of continuity, Derivation of Maxwell's equations in vacuum, Comparison of displacement current with conduction current. Electromagnetic waves, Velocity of Electromagnetic waves in free space, Flow of energy and Poynting's vector (no derivation)	4 hrs
5	**Superconductivity &Photonics (9hours)**	
5.1	Super conducting Phenomena, Meissner effect and perfect diamagnetism, Types of superconductors-Type I and Type II	2 hrs
5.2	BCS Theory (Qualitative), High temperature superconductors, Applications of super conductivity	2 hrs
5.3	Introduction to photonics-Photonic devices-Light Emitting Diode, Photo detectors -Junction and PIN photodiodes, Solar cells-I-V Characteristics	2 hrs
5.4	Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications of optical fibre, Fibre optic sensors-Intensity Modulated and Phase modulated sensors	3 hrs

PHT 110	ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)	Category	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: The aim of the Engineering Physics program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes

Prerequisite: Higher secondary level Physics, Mathematical course on vector calculus, differential equations and linear algebra

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.
CO 2	Apply the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.
CO 3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices.
CO 4	Apply the knowledge of ultrasonics in non-destructive testing and use the principles of acoustics to explain the nature and characterization of acoustic design and to provide a safe and healthy environment
CO 5	Apply the comprehended knowledge about laser and fibre optic communication systems in various engineering applications

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2						1	2			1
CO 2	3	2						1	2			1
CO 3	3	2						1	2			1
CO 4	3							1	2			1
CO 5	3	2						1	2			1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	25	25	50

Apply	10	10	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE MARKS	ESE MARKS	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the effect of damping force on oscillators.
2. Distinguish between transverse and longitudinal waves.
3. (a) Derive an expression for the fundamental frequency of transverse vibration in a stretched string.
   (b) Calculate the fundamental frequency of a string of length 2 m weighing 6 g kept stretched by a load of 600 kg.

Course Outcome 2 (CO2):

1. Explain colours in thin films.
2. Distinguish between Fresnel and Fraunhofer diffraction.
3. (a) Explain the formation of Newton's rings and obtain the expression for radii of bright and dark rings in reflected system. Also explain how it is used to determine the wavelength of a monochromatic source of light.
   (b) A liquid of refractive index μ is introduced between the lens and glass plate. What happens to the fringe system? Justify your answer.

Course Outcome 3 (CO3):

1. Give the physical significance of wave function?

2. What are excitons ?
3. (a) Solve Schrodinger equation for a particle in a one dimensional box and obtain its energy eigen values and normalised wave functions.

   (b) Calculate the first three energy values of an electron in a one dimensional box of width 1 A^0 in electron volt.

Course Outcome 4 (CO4):

1. Explain reverberation and reverberation time.
2. How ultrasonic waves are used in non-destructive testing.
3. (a) With a neat diagram explain how ultrasonic waves are produced by a piezoelectric oscillator.

   (b) Calculate frequency of ultrasonic waves that can be produced by a nickel rod of length 4 cm. (Young's Modulus = 207 G Pa, Density = 8900 Kg /m^3)

Course Outcome 5 (CO 5):

1. Distinguish between spontaneous emission and stimulated emission.
2. Explain optical resonators.
3. (a) Explain the construction and working of Ruby Laser.

   (b) Calculate the numerical aperture and acceptance angle of a fibre with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fibre is inside water of refractive index 1.33.

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Model Question paper

QP CODE: PAGES:3

Reg No:_______________

Name :_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: PHT 110

Course Name: Engineering Physics B

Max.Marks: 100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Compare electrical and mechanical oscillators.

2. Distinguish between longitudinal and transverse waves.

3. Write a short note on antireflection coating.

4. Diffraction of light is not as evident in daily experience as that of sound waves. Give reason.

5. State and explain Heisenberg's Uncertainty principle. With the help of it explain natural line broadening.

6. Explain surface to volume ratio of nanomaterials.

7. Define sound intensity level. Give the values of threshold of hearing and threshold of pain.

8. Describe the method of non-destructive testing using ultra sonic waves

9. Explain the condition of population inversion

10. Distinguish between step index and graded index fibre. (10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. (a) Derive the differential equation of damped harmonic oscillator and deduce its solution. Discuss the cases of over damped, critically damped and under damped cases. (10)

(b) The frequency of a tuning fork is 500 Hz and its Q factor is 7×10^{4}. Find the relaxation time. Also calculate the time after which its energy becomes 1/10 of its initial undamped value. (4)

12. (a) Derive an expression for the velocity of propagation of a transverse wave in a stretched string. Deduce laws of transverse vibrations. (10)

(b) The equation of transverse vibration of a stretched string is given by y =0.00327 sin (72.1x-2.72t) m, in which the numerical constants are in S.I units. Evaluate (i) Amplitude (ii) Wavelength (iii) Frequency and (iv) Velocity of the wave. (4)

Module 2

13. (a) Explain the formation of Newton's rings and show that the radius of dark ring is proportional to the square root of natural numbers. How can we use Newton's rings experiment to determine the refractive index of a liquid? (10)

(b) Two pieces of plane glass are placed together with a piece of paper between two at one end. Find the angle of the wedge in seconds if the film is viewed with a monochromatic light of wavelength 4800Å. Given β = 0.0555 cm. (4)

14. (a) Explain the diffraction due to a plane transmission grating. Obtain the grating equation. (10)

(b) A grating has 6000 lines per cm. Find the angular separation of the two yellow lines of mercury of wavelengths 577 nm and 579 nm in the second order. (4)

Module 3

15. (a) Derive time dependent and independent Schrodinger equations. (10)

(b) An electron is confined to one dimensional potential box of length 2Å. Calculate the energies corresponding to the first and second quantum states in eV. (4)

16. (a) Classify nanomaterials based on dimensionality of quantum confinement and explain the following nanostructures. (i) nano sheets (ii) nano wires (iii) quantum dots. (10)

(b) Find the de Broglie wavelength of electron whose kinetic energy is 15 eV. (4)

Module 4

17. (a) Explain reverberation and reverberation time? What is the significance of Reverberation time. Explain the factors affecting the acoustics of a building and their corrective measures? (10)

(b) The volume of a hall is 3000 m^3. It has a total absorption of 100m^2 sabine. If the hall is filled with audience who add another 80 m^2sabine, then find the difference in reverberation time. (4)

18. (a) With a neat diagram explain how ultrasonic waves are produced by piezoelectric oscillator. Also discuss the piezoelectric method of detection of ultrasonic waves. (10)

(b) An ultrasonic source of 0.09 MHz sends down a pulse towards the sea bed which returns after 0.55 sec. The velocity of sound in sea water is 1800 m/s. Calculate the depth of the sea and the wavelength of the pulse. (4)

Module 5

19. (a) Outline the construction and working of Ruby laser. (8)

(b) What is the principle of holography? How is a hologram recorded? (6)

20. (a) Define numerical aperture of an optic fibre and derive an expression for the NA of a step index fibre with a neat diagram. (10)

(b) An optical fibre made with core of refractive index 1.5 and cladding with a fractional index difference of 0.0006. Find refractive index of cladding and numerical aperture. (4)

(14x5=70)

SYLLABUS

ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)

Module 1

Oscillations and Waves

Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression, Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators

Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation), Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration

Module 2

Wave Optics

Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference, Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings

Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation, Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)

Module 3

Quantum Mechanics & Nanotechnology

Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening Mechanism, Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)

Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots, Properties of nanomaterials-mechanical, electrical and optical, Applications of nanotechnology (qualitative ideas)

Module 4

Acoustics & Ultrasonics

Acoustics, Classification of sound-Musical sound-Noise, Characteristics of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation), Factors affecting architectural acoustics and their remedies

Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator –Working, Detection of ultrasonic waves - Thermal and Piezoelectric methods, Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid , Applications of ultrasonic waves -SONAR,NDT and Medical

Module 5

Laser and Fibre optics

Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein’s coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle, Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) ,Applications of laser, Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications

Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors

Text Books

1. M.N.Avadhanulu, P.G.Kshirsagar,TVS Arun Murthy “A Text book of Engineering Physics”, S.Chand &Co., Revised Edition, 2019.

2. H.K.Malik , A.K. Singh, “Engineering Physics” McGraw Hill Education, Second Edition, 2017.

Reference Books

1. Arthur Beiser, “Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003
2. D.K. Bhattacharya, Poonam Tandon, “Engineering Physics”, Oxford University Press, 2015
3. Md.N.Khan & S.Panigrahi “Principles of Engineering Physics 1&2”, Cambridge University Press, 2016
4. Aruldhas G., “Engineering Physics”, PHI Pvt. Ltd., 2015
5. Ajoy Ghatak, “Optics”, Mc Graw Hill Education, Sixth Edition, 2017
6. T. Pradeep, “Nano:The Essentials’’, McGraw Hill India Ltd, 2007
7. B. B. Laud, “Lasers and Non linear optics”, New age International Publishers, 2nd Edition ,2005
8. Premlet B., “Advanced Engineering Physics”, Phasor Books,10^{th} edition ,2017
9. I. Dominic and. A. Nahari, “A Text Book of Engineering physics”, Owl Books Publishers, Revised edition, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Oscillations and Waves (9 hours)**	
1.1	Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression	2 hrs
1.2	Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators	3hrs
1.3	Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation)	2 hrs
1.4	Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration	2 hrs
2	**Wave Optics (9 hours)**	
2.1	Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference	2 hrs
2.2	Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings	4 hrs
2.3	Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation	2 hrs
2.4	Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)	1 hr
3	**Quantum Mechanics &Nanotechnology (9hours)**	
3.1	Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism	2 hrs
3.2	Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)	4 hrs
3.3	Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots	2 hrs
3.4	Properties of nanomaterials-mechanical, electrical and optical Applications of nanotechnology (qualitative ideas)	1 hr
4	**Acoustics & Ultrasonics (9hrs)**	
4.1	Acoustics, Classification of sound-Musical sound-Noise, Characteristics	3 hrs

	of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation)	
4.2	Factors affecting architectural acoustics and their remedies	1 hr
4.3	Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator – Working, Detection of ultrasonic waves - Thermal and Piezoelectric methods	3hrs
4.4	Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid ,Applications of ultrasonic waves -SONAR,NDT and Medical.	2 hr
5	**Laser and Fibre optics (9hours)**	
5.1	Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein's coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle	2 hrs
5.2	Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) Applications of laser	3 hrs
5.3	Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications	1 hr
5.4	Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors	3 hrs

CYT 100	ENGINEERING CHEMISTRY	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	3	1	0	4	2019

Preamble: To enable the students to acquire knowledge in the concepts of chemistry for engineering applications and to familiarize the students with different application oriented topics like spectroscopy, electrochemistry, instrumental methods etc. Also familiarize the students with topics like mechanism of corrosion, corrosion prevention methods, SEM, stereochemistry, polymers, desalination etc., which enable them to develop abilities and skills that are relevant to the study and practice of chemistry.

Prerequisite: Concepts of chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Apply the basic concepts of electrochemistry and corrosion to explore its possible applications in various engineering fields.
CO 2	Understand various spectroscopic techniques like UV-Visible, IR, NMR and its applications.
CO 3	Apply the knowledge of analytical method for characterizing a chemical mixture or a compound. Understand the basic concept of SEM for surface characterisation of nanomaterials.
CO 4	Learn about the basics of stereochemistry and its application. Apply the knowledge of conducting polymers and advanced polymers in engineering.
CO 5	Study various types of water treatment methods to develop skills for treating wastewater.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2	1									
CO 2	1	1		1	2							
CO 3	1	1		1	2							
CO 4	2	1										
CO 5	1			1			3					

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			
Create			

End Semester Examination Pattern: There will be two parts- **Part A** and **Part B. Part A** contains **10** questions (**2** questions from each module), having **3** marks for each question. Students should answer **all** questions. **Part B** contains **2** questions from each module, of which student should answer any one. Each question can have maximum **2** subdivisions and carries **14** marks.

Course Level Assessment Questions

Course Outcome 1 (CO 1):

1. What is calomel electrode? Give the reduction reaction (3 Marks)

2. List three important advantages of potentiometric titration (3 Marks)

3. (a) Explain how electroless plating copper and nickel are carried out (10 Marks)

(b) Calculate the emf of the following cell at 30°C, Z n / Zn^{2+} (0.1M) // Ag^{+} (0.01M) // Ag.

Given E^0 Zn^{2+}/Zn = -0.76 V, E^0 Ag^{+}/Ag = 0.8 V. (4 Marks)

Course Outcome 2 (CO 2)

1. State Beer Lambert's law (3 Marks)

2. List the important applications of IR spectroscopy (3 Marks)

3. (a) What is Chemical shift? What are factors affecting Chemical shift? How ^{1}H NMR spectrum of CH_3COCH_2Cl interpreted using the concept of chemical shift. (10 Marks)

(b) Calculate the force constant of HF molecule, if it shows IR absorption at 4138 cm^{-1}. Given that atomic masses of hydrogen and fluorine are 1u and 19u respectively. (4 Marks)

Course Outcome 3 (CO 3):

1. Distinguish between TGA and DTA (3 Marks)

2. Give two differences between GSC and GLC (3 Marks)

3. (a) Explain the principle, instrumentation and procedure of HPLC (10 Marks)

(b) Interpret TGA of $CaC_2O_4 . H_2O$ (4 Marks)

Course Outcome 4 (CO 4):

1. Explain the geometrical isomerism in double bonds (3 Marks)

2. What are the rules of assigning R-S notation? (3 Marks)

3. (a) What are conducting polymers? How it is classified? Give the preparation of polyaniline (10 Marks)

(b) Draw the stereoisomers possible for CH_3-$(CHOH)_2$-COOH (4 Marks)

Course Outcome 5 (CO 5):

1. What is degree of hardness? (3 Marks)

2. Define BOD and COD (3 Marks)

3. (a) Explain the EDTA estimation of hardness (10 Marks)

(b) Standard hard water contains 20 g of CaCO3 per liter,50 mL of this required 30mL of EDTA solution, 50mL of sample water required 20mL of EDTA solution. 50mL sample water after boiling required 14 mL EDTA solution. Calculate the temporary hardness of the given sample of water, in terms of ppm. (4 Marks)

MODEL QUESTION PAPER

Total Pages:

Reg No.:________________ Name:____________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER B.TECH DEGREE EXAMINATION

Course Code: CYT100,

Course Name: ENGINEERING CHEMISTRY

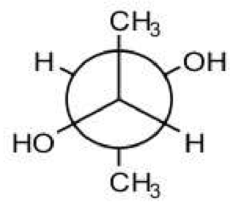
Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks Marks

1	What is potentiometric titration? How the end point is determined graphically?	(3)
2	What is Galvanic series? How is it different from electrochemical series?	(3)
3	Which of the following molecules can give IR absorption? Give reason? (a) O_2 (b) H_2O (c) N_2 (d) HCl	(3)
4	Which of the following molecules show UV-Visible absorption? Give reason. (a) Ethane (b) Butadiene (c) Benzene	(3)

5		What are the visualization techniques used in TLC?	(3)
6		Write the three important applications of nanomaterials.	(3)
7		Draw the Fischer projection formula and find R-S notation of	(3)



8		Write the structure of a) Polypyrroleb) Kevlar.	(3
9		What is break point chlorination?	(3)
10		What is reverse osmosis?	(3)

PART B

Answer any one full question from each module, each question carries 14 marks

Module 1

11	a)	Give the construction of Li-ion cell. Give the reactions that take place at the electrodes during charging and discharging. What happens to anodic material when the cell is 100% charged.	(10)
	b)	Calculate the standard electrode potential of Cu, if its electrode potential at 25 °C is 0.296 V and the concentration of Cu^{2+} is 0.015 M.	(4)

OR

12 a) Explain the mechanism of electrochemical corrosion of iron in oxygen rich and oxygen deficient acidic and basic environments. (10)

b) Given below are reduction potentials of some species (4)

$MnO_4^- + 8H^+ + 5e \rightarrow Mn^{2+} + 4H_2O$; $E^0 = +1.51$ V

$Cl_2 + 2e \rightarrow 2Cl^-$; $E^0 = +1.36$ V

$S_2O_8^{2-} + 2e \rightarrow 2SO_4^{2-}$; $E^0 = +1.98$ V

Use the above data to examine whether the acids, dil. HCl and dil. H_2SO_4 , can be used to provide acid medium in redox titrations involving $KMnO_4$.

Module 2

13	a)	What is spin-spin splitting? Draw the NMR spectrum of (i) CH_3 CH_2CH_2 Br (ii) $CH_3CH(Br)CH_3$ Explain how NMR spectrum can be used to identify the two isomers.	(10)
	b)	A dye solution of concentration 0.08M shows absorbance of 0.012 at 600 nm; while a test solution of same dye shows absorbance of 0.084 under same conditions. Find the concentration of the test solution.	(4)

OR

14	a)	Explain the basic principle of UV-Visible spectroscopy. What are the possible electronic transitions? Explain with examples.	(10)
	b)	Sketch the vibrational modes of CO_2 and H_2O. Which of them are IR active?	(4)

Module 3

15	a)	Explain the principle, instrumentation and procedure involved in gas chromatography.	(10)
	b)	Explain the DTA of $CaC_2O_4.H_2O$ with a neat sketch.	(4)
		OR	
16	a)	Explain the various chemical methods used for the synthesis of nanomaterial	(10)
	b)	How TGA is used to analyse the thermal stability of polymers?	(4)

Module 4

17	a)	What are conformers? Draw the*cis* and *trans*isomers of 1, 3-dimethylcylohexane. Which conformer (chair form) is more stable in each case?	(10)
	b)	What is ABS? Give properties and applications.	(4)
		OR	
18	a)	Explain the various structural isomers with suitable example.	(10)
	b)	What is OLED? Draw a labelled diagram.	(4)

Module 5

19	a)	What are ion exchange resins? Explain ion exchange process for removal of hardness of water? How exhausted resins are regenerated?	(10)
	b)	50 mL sewage water is diluted to 2000 mL with dilution water; the initial dissolved oxygen was 7.7 ppm. The dissolved oxygen level after 5 days of incubation was 2.4 ppm. Find the BOD of the sewage.	(4)
		OR	
20	a)	What are the different steps in sewage treatment? Give the flow diagram. Explain the working of trickling filter.	(10)
	b)	Calculate the temporary and permanent hardness of a water sample which contains $[Ca^{2+}]$ = 160 mg/L, $[Mg^{2+}]$ = 192 mg/L and $[HCO_3^-]$ = 122 mg/L.	(4)

Syllabus

Module 1

Electrochemistry and Corrosion

Introduction - Differences between electrolytic and electrochemical cells - Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes - SHE - Calomel electrode - Glass Electrode - Construction and Working. Single electrode potential - definition - Helmholtz electrical double layer -Determination of E^0 using calomel electrode.Determination of pH using glass electrode.Electrochemical series and its applications. Free energy and EMF - Nernst Equation - Derivation - single electrode and cell (Numericals) -Application - Variation of emf with temperature. Potentiometric titration - Introduction -Redox titration only.Lithiumion cell - construction and working.Conductivity- Measurement of conductivity of a solution (Numericals).

Corrosion-Electrochemicalcorrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.

Module 2

Spectroscopic Techniques and Applications

Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals). UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.IR-Spectroscopy – Principle - Number of vibrational modes - Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications. ^{1}H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).

Module 3

Instrumental Methods and Nanomaterials

Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $CaC_2O_4.H_2O$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $CaC_2O_4.H_2O$. Chromatographic methods - Basic principles and applications of column and TLC-Retention factor. GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.

Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).

Module 4

Stereochemistry and Polymer Chemistry

Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations). R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples.Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.

Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications.Kevlar-preparation, properties and applications.Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.

Module 5

Water Chemistry and Sewage Water Treatment

Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. Municipal water treatment (brief) - Disinfection methods - chlorination, ozone andUV irradiation.

Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD-definition, estimation (only brief procedure) and significance (Numericals). Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process.

Text Books

1. B. L. Tembe, Kamaluddin, M. S. Krishnan, "Engineering Chemistry (NPTEL Web-book)", 2018.

2. P. W. Atkins, "Physical Chemistry", Oxford University Press, 10th edn., 2014.

Reference Books

1. C. N. Banwell, "Fundamentals of Molecular Spectroscopy", McGraw-Hill, 4th edn., 1995.
2. Donald L. Pavia, "Introduction to Spectroscopy", Cengage Learning India Pvt. Ltd., 2015.
3. B. R. Puri, L. R. Sharma, M. S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., 47th Edition, 2017.
4. H. H. Willard, L. L. Merritt, "Instrumental Methods of Analysis", CBS Publishers, 7th Edition, 2005.
5. Ernest L. Eliel, Samuel H. Wilen, "Stereo-chemistry of Organic Compounds", WILEY, 2008.
6. Raymond B. Seymour, Charles E. Carraher, "Polymer Chemistry: An Introduction", Marcel Dekker Inc; 4th Revised Edition, 1996.
7. MuhammedArif, Annette Fernandez, Kavitha P. Nair "Engineering Chemistry", Owl Books, 2019.
8. Ahad J., "Engineering Chemistry", Jai Publication, 2019.
9. Roy K. Varghese, "Engineering Chemistry", Crownplus Publishers, 2019.
10. Soney C. George,RinoLaly Jose, "Text Book of Engineering Chemistry", S. Chand & Company Pvt Ltd, 2019.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures (hrs)
1	**Electrochemistry and Corrosion**	9
1.1	Introduction - Differences between electrolytic and electrochemical cells- Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes- SHE - Calomel electrode - Glass Electrode - Construction and Working.	2
1.2	Single electrode potential – definition - Helmholtz electrical double layer - Determination of E^0 using calomel electrode. Determination of pH using glass electrode. Electrochemical series and its applications. Free energy and EMF - Nernst Equation – Derivation - single electrode and cell (Numericals) -Application -Variation of emf with temperature.	3
1.3	Potentiometric titration - Introduction -Redox titration only. Lithiumion cell - construction and working. Conductivity- Measurement of conductivity of a solution (Numericals).	2
1.4	Corrosion-Electrochemicalcorrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.	2
2	**Spectroscopic Techniques and Applications**	9
2.1	Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals).	2
2.2	UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.	2
2.3	IR-Spectroscopy – Principle - Number of vibrational modes -Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications.	2
2.4	^{1}H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).	3
3	**Instrumental Methods and Nanomaterials**	9
3.1	Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $CaC_2O_4.H_2O$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $CaC_2O_4.H_2O$.	2

3.2	Chromatographic methods - Basic principles and applications of column and TLC-Retention factor.	**2**
3.3	GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.	**2**
3.4	Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).	**3**
4	**Stereochemistry and Polymer Chemistry**	**9**
4.1	Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations).	**2**
4.2	R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples.	**1**
4.3	Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.	**2**
4.4	Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications. Kevlar-preparation, properties and applications. Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.	**4**
5	**Water Chemistry and Sewage Water Treatment**	**9**
5.1	Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages.	**3**
5.2	Municipal water treatment (brief) - Disinfection methods - chlorination, ozone andUV irradiation.	**2**
5.3	Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD-definition, estimation (only brief procedure) and significance (Numericals).	**2**
5.4	Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram - Trickling filter and UASB process.	**2**

EST 100	ENGINEERING MECHANICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	1	0	3	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts of mechanics and enhance their problem-solving skills. It introduces students to the influence of applied force system and the geometrical properties of the rigid bodies while stationary or in motion. After this course students will be able to recognize similar problems in real-world situations and respond accordingly.

Prerequisite: Nil

Course Outcomes: After completion of the course the student will be able to:

CO 1	Recall principles and theorems related to rigid body mechanics
CO 2	Identify and describe the components of system of forces acting on the rigid body
CO 3	Apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	Choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	Solve problems involving rigid bodies, applying the properties of distributed areas and masses

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	-	-	-	-	-	-	-	-	-
CO 4	3	3	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	15
Understand	10	10	15
Apply	30	30	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

<u>End Semester Examination Pattern:</u> There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

<u>Course Level Assessment Questions:</u>

Part A

Course Outcome 1 (CO1): (One question from each module to meet the course objective 1: *To recall principles and theorems related to rigid body mechanics***)**

1. Explain D'Alembert's principle

2. Distinguish static and dynamic friction

3. State and explain perpendicular axis theorem

Course Outcome 2 (CO2) (One question from each module to meet the course objective 2: *To identify and describe the components of system of forces acting on the rigid body***)**

1. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.

2. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar

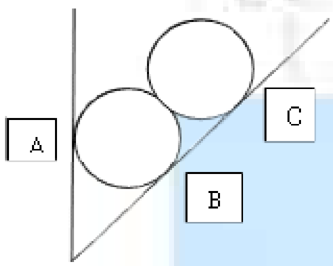
3. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

Part B

All the questions under this section shall assess the learning levels corresponding to the course outcomes listed below.

CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses

1. Two rollers each of weight 100 N are supported by an inclined plane and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth.

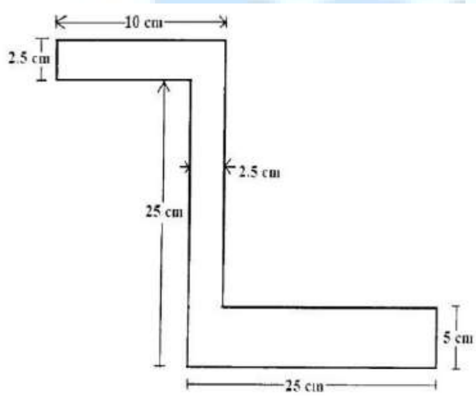


Course outcome identifier	**Description of course outcome**	**Learning level assessed**	**Marks allocated**
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent equilibrium state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

2. A cylindrical disc, 50 cm diameter and cm thickness, is in contact with a horizontal conveyor belts running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s. Also compute the moment acting about the axis of the disc in both cases.

Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

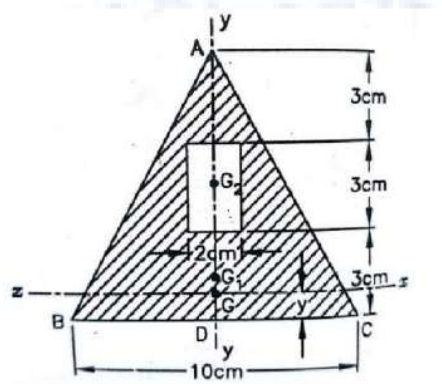
3. Determine the centroid of the given section



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of centroid for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed	Applying (Solve the problem based on the descriptions	6

	areas and masses	given in CO3 and CO4)	
Total			14

4. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC.



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of moment of inertia for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

Model Question Paper

QP CODE:

Reg No.:_______________

Name:___________________________ ___

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EST 100

ENGINEERING MECHANICS

Max. Marks: 100 Duration: 3 hours

Part A

(Answer all questions; each question carries 3 marks)

1. Explain D'Alembert's principle

2. Distinguish static and dynamic frictioni.

3. State and explain perpendicular axis theorem.

4. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.

5. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar

6. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

7. Compare damped and undamped free vibrations.

8. State the equation of motion of a rotating rigid body, rotating about its fixed axis.

9. Illustrate the significance of instantaneous centre in the analysis of rigid body undergoing rotational motion.

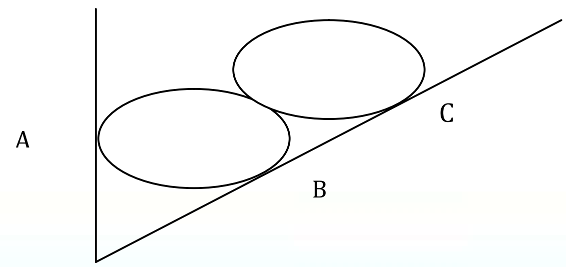
10. Highlight the principles of mechanics applied in the evaluation of elastic collusion of rigid bodies.

PART B

(Answer **one full** question from each module, each question carries **14** marks)

Module -I

11. Two identical rollers each of weight 100 N are supported by an inclined plane, making an angle of 30^{o} with the vertical, and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth. (14 marks)

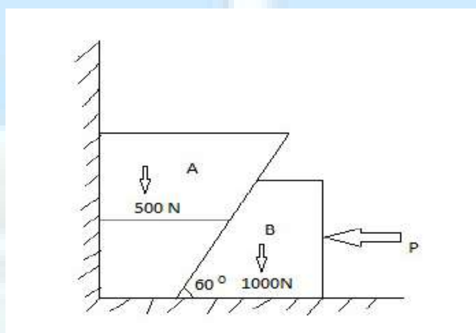


12. A string tied to a wall is made to pass over a pulley placed 2m away from it. A weight P is attached to the string such that the string stretches by 2m from the support on the wall to the location of attachment of weight. Determine the force P required to maintain 200 kg body in position for $\theta = 30^o$, The diameter of pulley B is negligible. (14 marks)

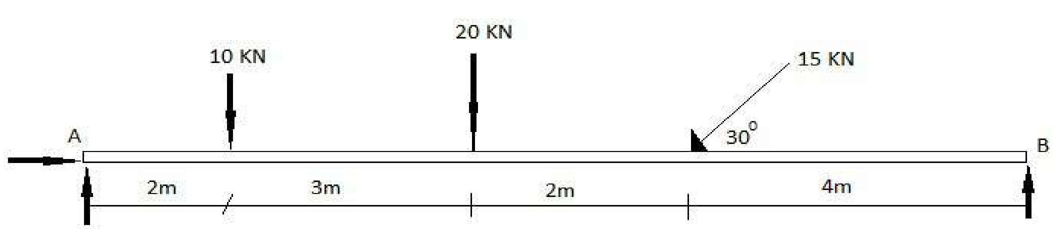
Module – 2

13. Two blocks A & B are resting against a wall and the floor as shown in figure below. Find the value of horizontal force P applied to the lower block that will hold the system in equilibrium. Coefficient of friction are : 0.25 at the floor, 0.3 at the wall and 0.2 between the blocks.

(14 marks)

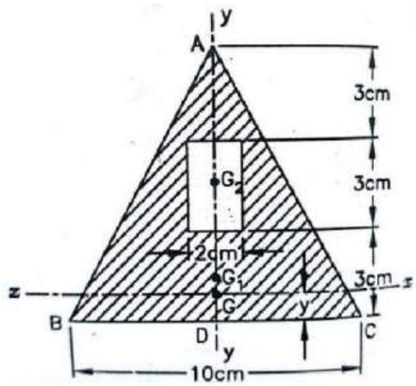


14. A beam is hinged at A and roller supported at B. It is acted upon by loads as shown below.
Find the reactions at A & B. (14 marks)

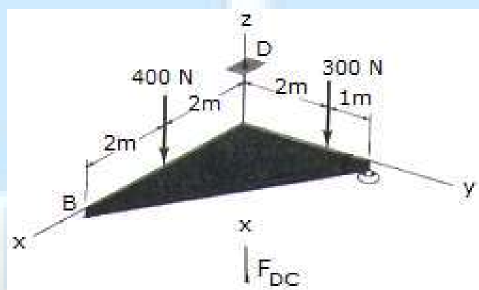


Module – 3

15. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC. (14 marks)



16. Support A has ball and socket connection. Roller support at B prevents motion in the —z direction. Corner *C* is tied to *D* by a rope. The triangle is weightless. Determine the unknown force components acting at *A*, *B*, and *C*. (14 marks)



Module - 4

17. A cricket ball is thrown by a fielder from a height of 2m at an angle of 30^0 to the horizontal with an initial velocity of 20 m/s , hits the wickets at a height of 0.5 m from the ground. How far was the fielder from the wicket? (14 marks)

18. An engine of weight 500 kN pull a train weighing 1500 kN up an incline of 1 in 100. The train starts from rest and moves with constant acceleration against a resistance of 5 N/kN. It attains a maximum speed of 36 kmph in 1 km distance. Determine the tension in the coupling between train and engine and the traction force developed by the engine. (14marks)

Module – 5

19. A cylindrical disc, 50 cm diameter and 10 cm thickness having mass of 10 kg, is in contact with a horizontal conveyor belt running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s in 10 seconds. Also compute the moment acting about the axis of the disc in both cases. (14 marks)

20. A wheel rotating about fixed axis at 20 rpm is uniformly accelerated for 70 seconds during which time it makes 50 revolutions. Find the (i) angular velocity at the end of this interval and (ii) time required for the velocity to reach 100 revolutions per minute. (14 marks)

SYLLABUS

Module 1

Introduction to Engineering Mechanics-statics-basic principles of statics-Parallelogram law, equilibrium law, principles of superposition and transmissibility, law of action and reaction(review) free body diagrams.

Concurrent coplanar forces-composition and resolution of forces-resultant and equilibrium equations – methods of projections – methods of moments – Varignon's Theorem of moments.

Module 2

Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –wedges, ladder-analysis of connected bodies .

Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads. General coplanar force system - resultant and equilibrium equations.

Module 3

Centroid of composite areas- – moment of inertia-parallel axis and perpendicular axis theorems. Polar moment of inertia,radius of gyration,mass moment of inertia-ring,cylinder and disc.

Theorem of Pappus Guldinus(demonstration only)

Forces in space - vectorial representation of forces, moments and couples –resultant and equilibrium equations – concurrent forces in space (simple problems only)

Module 4

Dynamics – rectilinear translation - equations of kinematics(review)

kinetics – equation of motion – D'Alembert's principle. – motion on horizontal and inclined surfaces, motion of connected bodies. Impulse momentum equation and work energy equation (concepts only).

Curvilinear translation - equations of kinematics –projectile motion(review), kinetics – equation of motion. Moment of momentum and work energy equation (concepts only).

Module 5

Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – rotation under a constant moment.

Plane motion of rigid body – instantaneous centre of rotation (concept only).

Simple harmonic motion – free vibration –degree of freedom- undamped free vibration of spring mass system-effect of damping(concept only)

Text Books

1. Timoshenko and Young, Engineering Mechanics, McGraw Hill Publishers
2. Shames, I. H., Engineering Mechanics - Statics and Dynamics, Prentice Hall of India.
3. R. C. Hibbeler and Ashok Gupta, Engineering Mechanics, Vol. I statics, Vol II Dynamics, Pearson Education.

References

1. Merriam J. L and Kraige L. G., Engineering Mechanics - Vols. 1 and 2, John Wiley.
2. Tayal A K, Engineering Mechanics – Statics and Dynamics, Umesh Publications
3. Bhavikkatti, S.S., Engineering Mechanics, New Age International Publishers
4. F.P.Beer abd E.R.Johnston (2011), Vector Mechanics for Engineers, Vol.I-Statics, Vol.II-Dynamics, 9th Ed, Tata McGraw Hill
5. Rajasekaran S and Sankarasubramanian G, Engineering Mechanics - Statics and Dynamics, Vikas Publishing House Pvt Ltd.

Course Contents and Lecture Schedule:

Module	Topic	Course outcomes addressed	No. of Hours
1	**Module 1**		**Total: 7**
1.1	Introduction to engineering mechanics – introduction on statics and dynamics - Basic principles of statics – Parellogram law, equilibrium law – Superposition and transmissibility, law of action and reaction (review the topics)	CO1 and CO2	1
1.2	Free body diagrams. Degree of freedom-types of supports and nature of reactions - exercises for free body diagram preparation – composition and resolution of forces, resultant and equilibrium equations (review the topics) - numerical exercises for illustration.	CO1 and CO2	1
1.3	Concurrent coplanar forces - analysis of concurrent forces -methods of projections – illustrative numerical exercise – teacher assisted problem solving.	CO1 and CO2	1
1.4	Analysis of concurrent forces -methods of moment-Varignon's Theorem of Moments - illustrative numerical exercise– teacher assisted problem solving.	CO1 and CO2	1
1.5	Analysis of concurrent force systems – extended problem solving - Session I.	CO3,CO4 and CO5	1
1.6	Analysis of concurrent force systems – extended problem solving - Session II – learning review quiz.	CO3,CO4 and CO5	1
1.7	Analysis of concurrent force systems – extended problem solving - Session III.	CO3,CO4 and CO5	1
2	**Module 2**		**Total: 7**
2.1	Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –illustrative examples on wedges and ladder-teacher	CO1 and CO2	1

	assisted problem solving tutorials using problems from wedges and ladder.		
2.2	Problems on friction - analysis of connected bodies. illustrative numerical exercise– teacher assisted problem solving.	CO3, CO4 and CO5	1
2.3	Problems on friction-extended problem solving	CO3,C04 and CO5	1
2.4	Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads.	CO1 and CO2	1
2.5	General coplanar force system - resultant and equilibrium equations - illustrative examples- teacher assisted problem solving.	CO1 and CO2	1
2.6	General coplanar force system-resultant and equilibrium equations - illustrative examples	CO3, CO4 and CO5	1
2.7	General coplanar force system - Extended problem solving - Quiz to evaluate learning level.	CO3, CO4 and CO5	1
3	**Module 3**		**Total: 7**
3.1	Centroid of simple and regular geometrical shapes – centroid of figures in combination - composite areas- examples for illustration – problems for practice to be done by self.	CO1 and CO2	1
3.2	Moment of inertia- parallel axis theorem –examples for illustration - problems for practice to be done by self.	CO1 and CO2	1
3.3	Moment of inertia - perpendicular axis theorem - example for illustration to be given as hand out and discussion on the solved example.	CO1 and CO2	1
3.4	Solutions to practice problems – problems related to centroid and moment of inertia - problems for practice to be done by self.	CO3, CO4 and CO5	1
3.5	Polar moment of inertia, Radius of gyration. Mass moment of inertia of ring, cylinder and uniform disc. Theorem of Pappus Guldinus - Demonstration	CO1 and CO2	1
3.6	Introduction to forces in space – vectorial representation of forces, moments and couples – simple problems to illustrate vector representations of forces, moments and couples to be done in class.	CO1,and CO2	1
3.7	Solution to practice problems - resultant and equilibrium equations for concurrent forces in space – concurrent forces in space - 2 simple problems to illustrate the application of resultant and equilibrium equations for concurrent forces in space.	CO3,CO4 and CO5	1
4	**Module 4**		**Total: 7**

4.1	Introduction to dynamics – review of rectilinear translation - equations of kinematics – problems to review the concepts – additional problems involving extended application as exercises .	CO1 and CO2	1
4.2	Solutions to exercises with necessary explanation given as hand out – introduction to kinetics – equation of motion – D'Alembert's principle – illustration of the concepts using one numerical exercise from motion on horizontal and inclined surfaces.	CO1 and CO2	1
4.3	Motion of connected bodies - example for illustration to be given as hand out and discussion on the solved example – problems for practice to be done by self.	CO3, CO4 and CO5	1
4.4	Motion of connected bodies-extended problem solving.	CO3, CO4 & CO5	1
4.5	Curvilinear translation - Review of kinematics –projectile motion – simple problems to review the concepts – introduction to kinetics – equation of motion – illustration of the concepts using numerical exercises.	CO3, CO4 & CO5	1
4.6	Extended problem solving – rectilinear and curvilinear translation.	CO3, CO4 & CO5	1
4.7	Concepts on Impulse momentum equation and work energy equation (rectilinear translation – discussions to bring out difference between elastic and inelastic collusions). Concepts on Moment of momentum and work energy equation (curvilinear translation).	CO1 and CO2	1
5	**Module 5**		**Total: 7**
5.1	Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – simple problems for illustration.	CO1 and CO2	1
5.2	Rotation under a constant moment – teacher assisted problem solving.	CO3,CO4 and CO5	1
5.3	Rotation under a constant moment - extended problem solving.	CO3, CO4 and CO5	1
5.4	Plane motion of rigid body- instantaneous centre of rotation (concept only).	CO1 and CO2	1
5.5	Introduction to harmonic oscillation –free vibrations - simple harmonic motion – differential equation and solution. Degree of freedom – examples of single degree of freedom (SDOF) systems – Idealisation of mechanical systems as spring-mass systems (concept only).	CO1 and CO2	1

5.6	SDOF spring mass system –equation of motion – undamped free vibration response - concept of natural frequency. Free vibration response due to initial conditions. Simple problems on determination of natural frequency and free vibration response to test the understanding level.	CO1 and CO2	1
5.7	Free vibration analysis of SDOF spring-mass systems – Problem solving Effect of damping on free vibration response (concept only).	CO1and CO2	1

EST 110	ENGINEERING GRAPHICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	0	2	3	2019

Preamble: To enable the student to effectively perform technical communication through graphical representation as per global standards.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Draw the projection of points and lines located in different quadrants
CO 2	Prepare multiview orthographic projections of objects by visualizing them in different positions
CO 3	Draw sectional views and develop surfaces of a given object
CO 4	Prepare pictorial drawings using the principles of isometric and perspective projections to visualize objects in three dimensions.
CO 5	Convert 3D views to orthographic views
CO 6	Obtain multiview projections and solid models of objects using CAD tools

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3											
CO 2	3											
CO 3	3	1										
CO 4	3									1		
CO 5	3									2		
CO 6	3				3					3		

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (100 Marks)
	Test 1 (15 Marks)	Test 2 (15 Marks)	
Remember			
Understand	5		20
Apply	10	10	80
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

CIA for section A carries 25 marks (15 marks for 1 test and Class work 10 marks)

CIA for section B carries 15 marks (10 marks for 1 test and Class work 5 marks)

End Semester Examination Pattern:

ESE will be of 3 hour duration on A4 size answer booklet and will be for 100 marks. The question paper shall contain two questions from each module of Section A only. Student has to answer any one question from each module. Each question carries 20 marks.

Course Level Assessment Questions

(Questions may be framed based on the outline given under each course outcome)

Course Outcome 1 (CO1):

1. Locate points in different quadrants as per given conditions.
2. Problems on lines inclined to both planes .
3. Find True length, Inclinations and Traces of lines.

Course Outcome 2 (CO2)

1. Draw orthographic views of solids and combination solids
2. Draw views of solids inclined to any one reference plane.
3. Draw views of solids inclined to both reference planes.

Course Outcome 3 (CO3):

1. Draw views of solids sectioned by a cutting plane
2. Find location and inclination of cutting plane given true shape of the section
3. Draw development of lateral surface of solids and also its sectioned views

Course Outcome 4 (CO4):

1. Draw Isometric views/projections of soilds
2. Draw Isometric views/projections of combination of soilds
3. Draw Perspective views of Soilds

Course Outcome 5 (CO5):

1. Draw Orthographic views of solids from given three dimensional view

Course Outcome 6 (CO6):

1. Draw the given figure including dimensions using 2D software
2. Create 3D model using modelling software from the given orthographic views or 3D figure or from real 3D objects

Model Question paper

QP CODE: PAGES:3

Reg No:_______________

Name :_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EST 110

ENGINEERING GRAPHICS

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

Instructions: Retain necessary Construction lines
Show necessary dimensions
Answer any ONE question from each module
Each question carries 20 marks

MODULE I

1. The end point A of a line is 20mm above HP and 10mm in front of VP. The other end of the line is 50mm above HP and 15mm behind VP. The distance between the end projectors is 70mm. Draw the projections of the line. Find the true length and true inclinations of the line with the principal planes. Also locate the traces of the line.

2. One end of a line is 20mm from both the principal planes of projection. The other end of the line is 50mm above HP and 40mm in front of VP. The true length of the line is 70mm. Draw the projections of the line. Find its apparent inclinations, elevation length and plan length. Also locate its traces.

MODULE II

3. A pentagonal pyramid of base side 25mm and height 40mm, is resting on the ground on one of its triangular faces. The base edge of that face is inclined 30^{o} to VP. Draw the projections of the solid.

4. A hexagonal prism has side 25mm and height 50mm has a corner of its base on the ground and the long edge containing that corner inclined at 30^{o} to HP and 45^{o} to VP. Draw the projections of the solid.

MODULE III

5. A triangular prism of base side 40mm and height 70mm is resting with its base on the ground and having an edge of the base perpendicular to VP. Section the solid such that the true shape of the section is a trapezium of parallel sides 30mm and 10mm. Draw the projections showing the true shape. Find the inclination of the cutting plane with the ground plane.

6. Draw the development of a pentagonal pyramid of base side 30mm and height 50mm. A string is wound from a corner of the base round the pyramid and back to the same point through the shortest distance. Show the position of the string in the elevation and plan.

MODULE IV

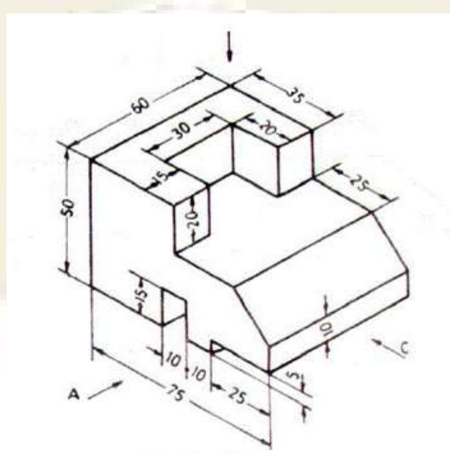
7. The frustum of a cone has base diameter 50mm and top diameter 40mm has a height of 60mm. It is paced centrally on top of a rectangular slab of size 80x60mm and of thickness 20mm. Draw the isometric view of the combination.

8. A hexagonal prism has base side 35mm and height 60mm. A sphere of diameter 40mm is placed centrally on top of it. Draw the isometric projection of the combination.

MODULE V

9. Draw the perspective view of a pentagonal prism, 20mm side and 45mm long lying on one of its rectangular faces on the ground and having its axis perpendicular to picture plane. One of its pentagonal faces touches the picture plane and the station point is 50mm in front of PP, 25mm above the ground plane and lies in a central plane, which is 70mm to the left of the center of the prism.

10. Draw three orthographic views with dimensions of the object shown in figure below.



(20X5=100)

Time : 3 hours **EST110 ENGINEERING GRAPHICS** **Max. Marks: 100**

SCHEME OF VALUATION

1. Locating the points and drawing the projections of the line – 4 marks
   Finding true length by any one method – 6 marks
   Finding true inclination with VP – 2 marks
   Finding true inclination with HP – 2 marks
   Locating horizontal trace – 2 marks
   Locating vertical trace – 2 marks
   Dimensioning and neatness – 2 marks
   Total = 20 marks
2. Locating the points and drawing true length of the line – 4 marks
   Finding projections by any method – 6 marks
   Finding length of elevation and plan – 2 marks
   Finding apparent inclinations – 2 marks
   Locating horizontal trace – 2 marks
   Locating vertical trace – 2 marks
   Dimensioning and neatness – 2 marks
   Total = 20 marks
3. Drawing initial position plan and elevation – 4 marks
   First inclination views – 4 marks
   Second inclination views -8 marks
   Marking invisible edges – 2 marks
   Dimensioning and neatness – 2 marks
   Total = 20 marks

   (Any one method or combination of methods for solving can be used.
   If initial position is wrong then maximum 50% marks may be allotted for the answer)

4. Drawing initial position plan and elevation – 4 marks
   First inclination views – 4 marks
   Second inclination views -8 marks
   Marking invisible edges – 2 marks
   Dimensioning and neatness – 2 marks
   Total = 20 marks

   (Any one method or combination of methods for solving can be used
   If initial position is wrong then maximum 50% marks may be allotted for the answer)

5. Drawing initial position plan and elevation – 4 marks
   Locating section plane as per given condition – 5 marks
   Drawing true shape -5 marks
   Finding inclination of cutting plane – 2 marks
   Dimensioning and neatness – 2 marks
   Total = 20 marks
6. Drawing initial position plan and elevation – 4 marks
   Development of the pyramid – 6 marks

Locating string in development -2 marks
Locating string in elevation – 3 marks
Locating string in plan – 3 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

7. Drawing initial positions – 4 marks
   Isometric View of Slab -6 marks
   Isometric View of Frustum – 10 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Initial position is optional, hence redistribute if needed.
   Reduce 4 marks if Isometric scale is taken)

8. Drawing initial positions – 4 marks
   Isometric scale – 4 marks
   Isometric projection of prism -5 marks
   Isometric projection of sphere – 5 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Initial position is optional, hence redistribute if needed.

9. Drawing the planes and locating the station point – 4 marks
   Locating elevation points – 2 marks
   Locating plan points – 2 marks
   Drawing the perspective view – 10 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

10. Drawing the elevation – 8marks
    Drawing the plan – 4 marks
    Drawing the side view – 4 marks
    Marking invisible edges – 2 marks
    Dimensioning and neatness – 2 marks

    Total = 20 marks

SYLLABUS

General Instructions:

- First angle projection to be followed
- Section A practice problems to be performed on A4 size sheets
- Section B classes to be conducted on CAD lab

SECTION A

Module 1

Introduction : Relevance of technical drawing in engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing.

Orthographic projection of Points and Lines: Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Trace of line. Inclination of lines with reference planes True length of line inclined to both the reference planes.

Module 2

Orthographic projection of Solids: Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone and Cylinder. Projection of solids in simple position including profile view. Projection of solids with axis inclined to one of the reference planes and with axis inclined to both reference planes.

Module 3

Sections of Solids: Sections of Prisms, Pyramids, Cone, Cylinder with axis in vertical position and cut by different section planes. True shape of the sections. Also locating the section plane when the true shape of the section is given.

Development of Surfaces: Development of surfaces of the above solids and solids cut by different section planes. Also finding the shortest distance between two points on the surface.

Module 4

Isometric Projection: Isometric View and Projections of Prisms, Pyramids, Cone , Cylinder, Frustum of Pyramid, Frustum of Cone, Sphere, Hemisphere and their combinations.

Module 5

Perspective Projection: Perspective projection of Prisms and Pyramids with axis perpendicular to the ground plane, axis perpendicular to picture plane.

Conversion of Pictorial Views: Conversion of pictorial views into orthographic views.

SECTION B

(To be conducted in CAD Lab)

Introduction to Computer Aided Drawing: Role of CAD in design and development of new products, Advantages of CAD. Creating two dimensional drawing with dimensions using suitable software. (Minimum 2 exercises mandatory)

Introduction to Solid Modelling: Creating 3D models of various components using suitable modelling software. (Minimum 2 exercises mandatory)

Text Books

1. Bhatt, N.D., Engineering Drawing, Charotar Publishing House Pvt. Ltd.
2. John, K.C. Engineering Graphics, Prentice Hall India Publishers.

Reference Books

1. Anilkumar, K.N., Engineering Graphics, Adhyuth narayan Publishers
2. Agrawal, B. And Agrawal, C.M., Engineering Darwing, Tata McGraw Hill Publishers.
3. Benjamin, J., Engineering Graphics, Pentex Publishers- 3rd Edition, 2017
4. Duff, J.M. and Ross, W.A., Engineering Design and Visualisation, Cengage Learning.
5. Kulkarni, D.M., Rastogi, A.P. and Sarkar, A.K., Engineering Graphics with AutoCAD, PHI.
6. Luzaddff, W.J. and Duff, J.M., Fundamentals of Engineering Drawing, PHI.
7. Varghese, P.I., Engineering Graphics, V I P Publishers
8. Venugopal, K., Engineering Drawing and Graphics, New Age International Publishers.

Course Contents and Lecture Schedule

No	**SECTION A**	No. of Hours
1	**MODULE I**	
1.1	Introduction to graphics, types of lines, Dimensioning	1
1.2	Concept of principle planes of projection, different quadrants, locating points on different quadrants	2
1.3	Projection of lines, inclined to one plane. Lines inclined to both planes, trapezoid method of solving problems on lines.	2
1.4	Problems on lines using trapezoid method	2
1.5	Line rotation method of solving, problems on line rotation method	2
2	**MODULE II**	
2.1	Introduction of different solids, Simple position plan and elevation of solids	2
2.2	Problems on views of solids inclined to one plane	2
2.3	Problems on views of solids inclined to both planes	2
2.4	Practice problems on solids inclined to both planes	2

3	**MODULE III**	
3.1	Introduction to section planes. AIP and AVP. Principle of locating cutting points and finding true shape	2
3.2	Problems on sections of different solids	2
3.3	Problems when the true shape is given	2
3.4	Principle of development of solids, sectioned solids	2
4	**MODULE IV**	
4.1	Principle of Isometric View and Projection, Isometric Scale. Problems on simple solids	2
4.2	Isometric problems on Frustum of solids, Sphere and Hemisphere	2
4.3	Problems on combination of different solids	2
5	**MODULE V**	
5.1	Introduction to perspective projection, different planes, station point etc. Perspective problems on pyramids	2
5.2	Perspective problems on prisms	2
5.3	Practice on conversion of pictorial views into orthographic views	2
	SECTION B *(To be conducted in CAD lab)*	
1	Introduction to CAD and software. Familiarising features of 2D software. Practice on making 2D drawings	2
2	Practice session on 2D drafting	2
3	Introduction to solid modelling and software	2
4	Practice session on 3D modelling	2

EST 120	BASICS OF CIVIL & MECHANICAL ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:

Objective of this course is to provide an insight and inculcate the essentials of Civil Engineering discipline to the students of all branches of Engineering and to provide the students an illustration of the significance of the Civil Engineering Profession in satisfying the societal needs.

To introduce the students to the basic principles of mechanical engineering

Prerequisite: NIL

Course Outcomes: After completion of the course, the student will be able to

CO 1	Recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.
CO 2	Explain different types of buildings, building components, building materials and building construction
CO 3	Describe the importance, objectives and principles of surveying.
CO 4	Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps
CO 5	Discuss the Materials, energy systems, water management and environment for green buildings.
CO 6	Analyse thermodynamic cycles and calculate its efficiency
CO 7	Illustrate the working and features of IC Engines
CO 8	Explain the basic principles of Refrigeration and Air Conditioning
CO 9	Describe the working of hydraulic machines
CO 10	Explain the working of power transmission elements
CO 11	Describe the basic manufacturing, metal joining and machining processes

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	3	2	2	-	-	-	-
CO2	3	2	-	1	3	-	-	3	-	-	-	-
CO3	3	2	-	-	3	-	-	-	2	-	-	-

CO4	3	2	-	-	3	-	-	-	2	-	-	-
CO5	3	2	-	-	3	2	3	-	2	-	-	-
CO6	3	2										
CO7	3	1										
CO8	3	1										
CO9	3	2										
CO10	3	1										
CO11	3											

Assessment Pattern

	Basic Civil Engineering			**Basic Mechanical Engineering**		
Bloom's Category	**Continuous Assessment**		**End Semester Examination (marks)**	**Continuous Assessment**		**End Semester Examination (marks)**
	Test 1 marks	**Test 2 marks**		**Test 1 marks**	**Test 2 marks**	
Remember	5	5	10	7.5	7.5	15
Understand	20	20	40	12.5	12.5	25
Apply				5	5	10
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	**CIE (Marks)**	**ESE (Marks)**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern:

There will be two parts; Part I – Basic Civil Engineering and Part II – Basic Mechanical Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts -

Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions:

Course Outcome CO1: *To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.*

1.Explain relevance of Civil engineering in the overall infrastructural development of the country.
Course outcome 2 (CO2) (One question from each module and not more than two)

Explain different types of buildings, building components, building materials and building construction
1. Discuss the difference between plinth area and carpet area.

Course outcome 3 (CO3) (One question from each module and not more than two)

Describe the importance, objectives and principles of surveying.

1. Explain the importance of surveying in Civil Engineering

Course outcome 4 (CO4) (One question from each module and not more than two)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps

1. Explain the civil engineering aspects of elevators, escalators and ramps in buildings

Course outcome 5 (CO5) (One question from each module and not more than two)

Discuss the Materials, energy systems, water management and environment for green buildings.

1. Discuss the relevance of Green building in society

Section II *Answer any 1 full question from each module. Each full question carries 10 marks*

Course Outcome 1 (CO1) (Two full question from each module and each question can have maximum 2 sub-divisions)

To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering
CO Questions

1. a List out the types of building as per occupancy. Explain any two, each in about five sentences.
b. Discuss the components of a building with a neat figure.
2. a. What are the major disciplines of civil engineering and explain their role in the infrastructural framework.

b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country.

Course Outcome 2 (CO2) & Course Outcome 3 (CO3) (Two full question from each module and each question can have maximum 2 sub-divisions)

Explain different types of buildings, building components, building materials and building construction & Describe the importance, objectives and principles of surveying.

CO Questions

1. **a.** What are the different kinds of cement available and what is their use.
   b. List the properties of good building bricks. Explain any five.
2. a. List and explain any five modern construction materials used for construction.
   b. Explain the objectives and principles of surveying

Course outcome 4 (CO4) & Course outcome 5 (CO5) (Two full question from each module and each question can have maximum 2 sub-divisions)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps & Discuss the Materials, energy systems, water management and environment for green buildings.

CO Questions

1. **a**. Draw the elevation and plan of one brick thick wall with English bond
   b. Explain the energy systems and water management in Green buildings

2. **a.** Draw neat sketch of the following foundations: (i) Isolated stepped footing; (ii) Cantilever footing; and (iii) Continuous footing.

   b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building

Course Outcome 6 (CO6):

1. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35^{o}C, 0.1 MPa. The maximum temperature of the cycle is 1100^{o}C. Find
   i) Heat supplied per kg of air,
   ii) Work done per kg of air,
   iii) Cycle efficiency
   Take Cp = 1.005 kJ/kgK and Cv=0.718 kJ/kgK
2. A Carnot cycle works with adiabatic compression ratio of 5 and isothermal expansion ratio of 2. The volume of air at the beginning of isothermal expansion is 0.3 m^3. If the maximum temperature and pressure is limited to 550K and 21 bar, determine the minimum temperature in the cycle and efficiency of the cycle.
3. In an ideal diesel cycle, the temperature at the beginning and end of compression is 65^{o}C and 620^{o}C respectively. The temperature at the beginning and end of the expansion is 1850^{o}C and 850 ^{o}C. Determine the ideal efficiency of the cycle.

4. Explain the concepts of CRDI and MPFI in IC Engines.

Course Outcome 7 (CO7)

1. With the help of a neat sketch explain the working of a 4 stroke SI engine
2. Compare the working of 2 stroke and 4 stroke IC engines
3. Explain the classification of IC Engines.

Course Outcome 8(CO8):

1. Explain the working of vapour compression refrigeration system.
2. With the help of suitable sketch explain the working of a split air conditioner.
3. Define: COP, specific humidity, relative humidity and dew point temperature.

Course Outcome 9 (CO9):

1. Explain the working of a single stage centrifugal pump with sketches.
2. With the help of a neat sketch, explain the working of a reciprocating pump.
3. A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 m^3/s. If the overall efficiency of the turbine is 90%. Determine the power developed by the turbine.

Course Outcome 10 (CO10):

1. Explain the working of belt drive and gear drive with the help of neat sketches
2. Explain a single plate clutch.
3. Sketch different types of gear trains and explain.

Course Outcome 11 (CO11):

1. Describe the operations which can be performed using drilling machine.
2. Explain the functions of runners and risers used in casting.
3. With a neat sketch, explain the working and parts of a lathe.

Model Question Paper

QP CODE: **EST120** page:3

Reg No:___________________

Name:_____________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EST 120

Course Name: BASICS OF CIVIL AND MECHANICAL ENGINEERING

Max. Marks: 100 Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

PART I: BASIC CIVIL ENGINEERING

PART A

(Answer all questions. Each question carries 4 marks)

1. Explain relevance of Civil engineering in the overall infrastructural development of the country.
2. Discuss the difference between plinth area and carpet area.
3. Explain different types of steel with their properties.
4. What are the different kinds of cement available and what is their use?
5. Define bearing capacity of soil.

(5 x 4 = 20)

Part B

Answer one full question from each module.

MODULE I

6a. List out the types of building as per occupancy. Explain any two, each in about five sentences. (5)
b. Discuss the components of a building with a neat figure. (5)

OR

7a. What are the major disciplines of civil engineering and explain their role in the infrastructural framework. (5)
b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country. (5)

MODULE II

8a. What are the different kinds of cement available and what is their use. (5)
b. List the properties of good building bricks. Explain any five. (5)

OR

9a. List and explain any five modern construction materials used for construction. (5)
b. Explain the objectives and principles of surveying (5)

MODULE III

10a. Draw the elevation and plan of one brick thick wall with English bond (5)
b. Explain the energy systems and water management in Green buildings (5)

OR

11a. Draw neat sketch of the following foundations: (i) Isolated stepped footing; (ii) Cantilever footing; and (iii) Continuous footing. (5)
b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building (5)

[10 x 3 = 30]

PART II: BASIC MECHANICAL ENGINEERING

PART A

Answer all questions. Each question carries 4 marks

1. Sketch the P-v and T-s diagram of a Carnot cycle and List the processes.
2. Illustrate the working of an epicyclic gear train.
3. Explain cooling and dehumidification processes.
4. Differentiate between soldering and brazing.
5. Explain the principle of Additive manufacturing.

4 x 5 = 20 marks

Part B

Answer one full question from each module.

MODULE I

6. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35°C, 0.1MPa. The maximum temperature of the cycle is 1100°C. Find
   i) Heat supplied per kg of air,
   ii) Work done per kg of air,
   iii) Cycle efficiency
   Take C_p = 1.005 kJ/kgK and C_v=0.718 kJ/kgK — 10 marks

OR

7. a) Explain the working of a 4 stroke SI engine with neat sketches. — 7 marks
   b) Explain the fuel system of a petrol engine. — 3 marks

MODULE II

8. a) Explain the working of a vapour compression system with help of a block diagram. — 7 marks
   b) Define: Specific humidity, relative humidity and dew point temperature. — 3 marks

OR

9. With the help of a neat sketch, explain the working of a centrifugal pump. — 10 marks

MODULE III

10. Explain the two high, three high, four high and cluster rolling mills with neat sketches. — 10 marks

OR

11. a) Describe the arc welding process with a neat sketch. — 6 marks
    b) Differentiate between up-milling and down-milling operations. — 4 marks

SYLLABUS

Module 1

General Introduction to Civil Engineering: Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment. Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.

Introduction to buildings: Types of buildings, selection of site for buildings, components of a residential building and their functions.

Building rules and regulations: Relevance of NBC, KBR & CRZ norms (brief discussion only).

Building area: Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.

Module 2

Surveying: Importance, objectives and principles.

Construction materials, Conventional construction materials**:** types, properties and uses of building materials: bricks, stones, cement, sand and timber

Cement concrete: Constituent materials, properties and types.

Steel: Steel sections and steel reinforcements, types and uses.

Modern construction materials:- Architectural glass, ceramics, Plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials. Modern uses of gypsum, pre-fabricated building components (brief discussion only).

Module 3

Building Construction: Foundations: Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Load bearing and framed structures (concept only).

Brick masonry: - Header and stretcher bond, English bond & Flemish bond random rubble masonry.

Roofs and floors: - Functions, types; flooring materials (brief discussion only).

Basic infrastructure services: MEP, HVAC, elevators, escalators and ramps (Civil Engineering aspects only), fire safety for buildings.

Green buildings:- Materials, energy systems, water management and environment for green buildings. (brief discussion only).

Module 4

Analysis of thermodynamic cycles: Carnot, Otto, Diesel cycles, Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency. IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines. Efficiencies of IC Engines(Definitions only), Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines.

Module 5

Refrigeration: Unit of refrigeration, reversed Carnot cycle,COP, vapour compression cycle (only description and no problems); Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.

Description about working with sketches of: Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)

Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches.

Module 6

Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.

Metal Joining Processes: List types of welding, Description with sketches of Arc Welding, Soldering and Brazing and their applications

Basic Machining operations: Turning, Drilling, Milling and Grinding.

Description about working with block diagram of: Lathe, Drilling machine, Milling machine, CNC Machine. Principle of CAD/CAM, Rapid and Additive manufacturing.

Text Books:

1. Rangwala, S. C., Essentials of Civil Engineering, Charotar Publishing House
2. Mckay, W.B. and Mckay, J. K., Building Construction, Volumes 1 to 4, Pearson India Education Services

References Books:

1. Chen W.F and Liew J Y R (Eds), The Civil Engineering Handbook. II Edition CRC Press (Taylor and Francis)
2. Chudley, R and Greeno R, Building construction handbook, Addison Wesley, Longman group, England
3. Chudley, R, Construction Technology, Vol. I to IV, Longman group, England Course Plan
4. Kandya A A, Elements of Civil Engineering, Charotar Publishing house
5. Mamlouk, M. S., and Zaniewski, J. P., Materials for Civil and Construction Engineering, Pearson Publishers
6. Rangwala S.C and Dalal K B Building Construction Charotar Publishing house
7. Clifford, M., Simmons, K. and Shipway, P., An Introduction to Mechanical Engineering Part I - CRC Press
8. Roy and Choudhary, Elements of Mechanical Engineering, Media Promoters &Publishers Pvt. Ltd., Mumbai.
9. Sawhney, G. S., Fundamentals of Mechanical Engineering, PHI
10. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018
11. Benjamin,J.,Basic Mechanical Engineering,Pentex Books,9th Edition,2018
12. Balachandran, P.Basic Mechanical Engineering,Owl Books

Course Contents and Lecture Schedule:

No	Topic	Course outcomes addressed	No. of Lectures
1	**Module I**		**Total: 7**
1.1	*General Introduction to Civil Engineering*: Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment.	CO1	1
1.2	Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.	CO1	2
1.3	*Introduction to buildings:* Types of buildings, selection of site for buildings, components of a residential building and their functions.	CO2	2
1.4	*Building rules and regulations:* Relevance of NBC, KBR & CRZ norms (brief discussion only)	CO2	1
1.5	*Building area:* Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.	CO2	1
2	**Module 2**		**Total: 7**
2.1	*Surveying:* Importance, objectives and principles.	CO3	1
2.2	Bricks: - Classification, properties of good bricks, and tests on bricks	CO2	1
2.3	Stones: - *Qualities* of good stones, types of stones and their uses. Cement: - Good qualities of cement, types of cement and their uses.	CO2	1
2.4	Sand: - Classification, qualities of good sand and sieve analysis (basics only). Timber: - Characteristics, properties and uses.	CO2	1
2.5	Cement concrete: - Constituent materials, properties and types, Steel: - Steel sections and steel reinforcements, types and uses.	CO2	1

2.6	Modern construction materials: - Architectural glass, ceramics, plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials, modern uses of gypsum, pre-fabricated building components (brief discussion only)	CO2	2
3	**Module 3**		**Total: 7**
3.1	Foundations: - Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Brick masonry: - Header and stretcher bond, English bond & Flemish bond– elevation and plan (one & one and a half brick wall only). Random rubble masonry.	CO2	2
3.2	Roofs: Functions, types; roofing materials (brief discussion only) Floors: Functions, types; flooring materials (brief discussion only)	CO2	2
3.3	*Basic infrastructure services:* MEP, HVAC, Elevators, escalators and ramps (Civil Engineering aspects only) fire safety for buildings	CO4	2
3.4	*Green buildings:*- Materials, energy systems, water management and environment for green buildings. (brief discussion only)	CO5	1
4	**MODULE 4**		
4.1	Analysis of thermodynamic cycles: Carnot, Otto, and Diesel cycle-Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency	4	
4.2	IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines, efficiencies of IC Engines(Description only)	2	
4.3	Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines	2	
5	**MODULE 5**		
5.1	Refrigeration: Unit of refrigeration, reversed Carnot cycle, COP, vapour compression cycle (only description and no problems)	1	
5.2	Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.	1	

5.3	Description about working with sketches : Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)	4
5.4	Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches	3
6	**MODULE 6**	
6.1	Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.	2
6.2	Metal Joining Processes :List types of welding, Description with sketches of Arc Welding, Soldering and Brazing, and their applications	1
6.3	Basic Machining operations: Turning, Drilling, Milling and Grinding Description about working with block diagrams of: Lathe, Drilling machine, Milling machine, CNC Machine	3
6.4	Principle of CAD/CAM, Rapid and Additive manufacturing	1

EST 130	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:
This course aims to (1) equip the students with an understanding of the fundamental principles of electrical engineering(2) provide an overview of evolution of electronics, and introduce the working principle and examples of fundamental electronic devices and circuits (3) provide an overview of evolution of communication systems, and introduce the basic concepts in radio communication.

Prerequisite: Physics and Mathematics (Pre-university level)

Course Outcomes: After the completion of the course the student will be able to

CO 1	Apply fundamental concepts and circuit laws to solve simple DC electric circuits
CO 2	Develop and solve models of magnetic circuits
CO 3	Apply the fundamental laws of electrical engineering to solve simple ac circuits in steady state
CO 4	Describe working of a voltage amplifier
CO 5	Outline the principle of an electronic instrumentation system
CO 6	Explain the principle of radio and cellular communication

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	-	-	-	-	-	-	-	-	-	2
CO 2	3	1	-	-	-	-	-	-	-	-	-	2
CO 3	3	1	-	-	-	-	-	-	-	-	-	2
CO 4	2	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	2
CO 6	2	-	-	-	-	-	-	-	-	-	-	2

Assessment Pattern

	Basic Electrical Engineering			**Basic Electronics Engineering**		
Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (Marks)**	**Continuous Assessment Tests**		**End Semester Examination (Marks)**
	Test 1 (Marks)	**Test 2 (Marks)**		**Test 1 (Marks)**	**Test 2 (Marks)**	
Remember	0	0	10	10	10	20
Understand	12.5	12.5	20	15	15	30
Apply	12.5	12.5	20			
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part I – Basic Electrical Engineering and Part II – Basic Electronics Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts - Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Solve problems based on current division rule.

2. Solve problems with Mesh/node analysis.

3. Solve problems on Wye-Delta Transformation.

Course Outcome 2 (CO2):

1. Problems on series magnetic circuits

2. Problems on parallel magnetic circuits

3. Problems on composite magnetic ciruits

4. **Course Outcome 3 (CO3):**

1. problems on self inductance, mutual inductance and coefficient of coupling

2. problems on rms and average values of periodic waveforms

3. problems on series ac circuits

4. Compare star and Delta connected 3 phase AC systems.

Course Outcome 4 (CO4): Describe working of a voltage amplifier

1.What is the need of voltage divider biasing in an RC coupled amplifier?

2. Define operating point in the context of a BJT amplifier.

3. Why is it required to have a voltage amplifier in a public address system?

Course Outcome 5 (CO5): Outline the principle of an electronic instrumentation system

1. Draw the block diagram of an electronic instrumentation system.

2. What is a transducer?

3. Explain the working principle of operation of digital multimeter.

Course Outcome 6 (CO6): Explain the principle of radio and cellular communication

1. What is the working principle of an antenna when used in a radio transmitter?

2. What is the need of two separate sections RF section and IF section in a super heterodyne receiver?

3. What is meant by a cell in a cellular communication?

Model Question Paper

QP CODE: Pages: 3

Reg No.:________________

Name:__________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EST 130

Course Name: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Max. Marks: 100 Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

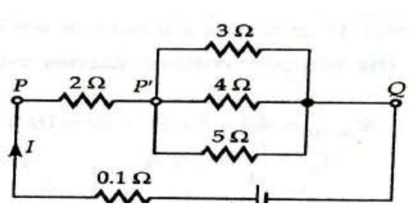
PART I

BASIC ELECTRICAL ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Calculate the current through the $4\,\Omega$ resistor in the circuit shown, applying current division rule:



2. Calculate the RMS and average values of a purely sinusoidal current having peak value 15A.

3. An alternating voltage of (80+j60)V is applied to an RX circuit and the current flowing through the circuit is (-4+j10)A. Calculate the impedance of the circuit in rectangular and polar forms. Also determine if X is inductive or capacitive.

4. Derive the relation between line and phase values of voltage in a three phase star connected system.

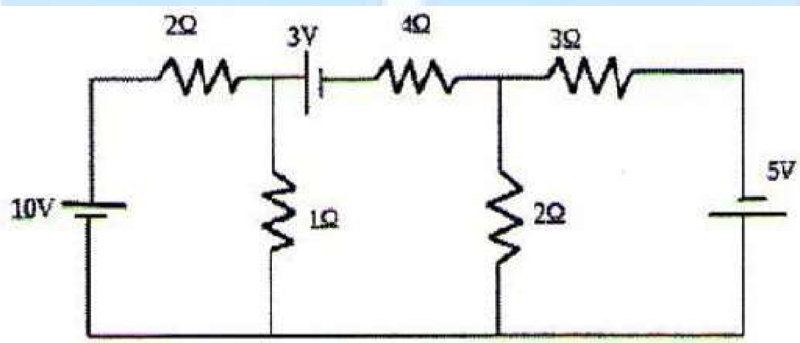
5. Compare electric and magnetic circuits. *(5x4=20)*

PART B

Answer one question from each module; each question carries 10 marks.

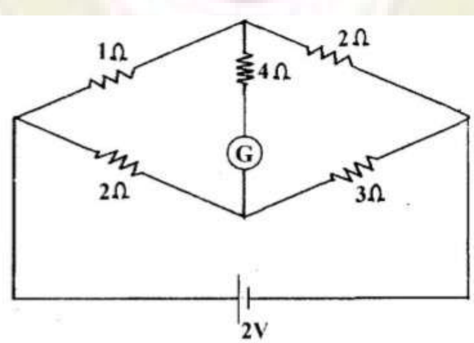
Module 1

6. . Calculate the node voltages in the circuit shown, applying node analysis:



7. (a) State and explain Kirchhoff's laws. (4 marks)

(b) Calculate the current through the galvanometer (G) in the circuit shown:



(6 marks)

Module 2

8. (a) State and explain Faraday's laws of electromagnetic induction with examples. (4 marks)

(b) Differentiate between statically and dynamically induced emf. A conductor of length 0.5m moves in a uniform magnetic field of flux density 1.1T at a velocity of 30m/s. Calculate the emf induced in the conductor if the direction of motion of the conductor is inclined at 60^0 to the direction of field. (6 marks)

9. (a) Derive the amplitude factor and form factor of a purely sinusoidal waveform. (5 marks)

(b) A current wave is made up of two components-a 5A dc component and a 50Hz ac component, which is a sinusoidal wave with a peak value of 5A. Sketch the resultant waveform and determine its RMS and average values. (5 marks)

Module 3

10. Draw the power triangle and define active, reactive and apparent powers in ac circuits. Two coils A and B are connected in series across a 240V, 50Hz supply. The resistance of A is 5Ω and the inductance of B is 0.015H. If the input from the supply is 3kW and 2kVAR, find the inductance of A and the resistance of B. Also calculate the voltage across each coil.

11. A balanced three phase load consists of three coils each having resistance of 4Ω and inductance 0.02H. It is connected to a 415V, 50Hz, 3-phase ac supply. Determine the phase voltage, phase current, power factor and active power when the loads are connected in (i) star (ii) delta.

(3x10=30)

PART II

BASIC ELECTRONICS ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Give the specifications of a resistor. The colour bands marked on a resistor are Blue, Grey, Yellow and Gold. What are the minimum and maximum resistance values expected from that resistance?
2. What is meant by avalanche breakdown?
3. Explain the working of a full-wave bridge rectifier.
4. Discuss the role of coupling and bypass capacitors in a single stage RC coupled amplifier.
5. Differentiate AM and FM communication systems.

(5x4=20)

PART B

Answer one question from each module; each question carries 10 marks.

Module 4

6. a) Explain with diagram the principle of operation of an NPN transistor. (5)

   b) Sketch and explain the typical input-output characteristics of a BJT when connected in common emitter configuration. (5)

OR

7. a) Explain the formation of a potential barrier in a P-N junction diode. (5)

   b) What do you understand by Avalanche breakdown? Draw and explain the V-I characteristics of a P-N junction and Zener diode. (5)

Module 5

8. a) With a neat circuit diagram, explain the working of an RC coupled amplifier. (6)

   b) Draw the frequency response characteristics of an RC coupled amplifier and state the reasons for the reduction of gain at lower and higher frequencies. (4)

OR

9. a) With the help of block diagram, explain how an electronic instrumentation system. (6)

   b) Explain the principle of an antenna. (4)

Module 6

10. a) With the help of a block diagram, explain the working of Super hetrodyne receiver. (6)

    b) Explain the importance of antenna in a communication system. (4)

OR

11. a) With neat sketches explain a cellular communication system. (5)

    b) Explain GSM communication with the help of a block diagram. (5)

(3x10=30)

SYLLABUS

MODULE 1: Elementary Concepts of Electric Circuits

Elementary concepts of DC electric circuits: Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)-problems.

Analysis of DC electric circuits: Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.

MODULE 2: Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals

Magnetic Circuits: Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.

Electromagnetic Induction: Faraday's laws, problems, Lenz's law- statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling

Alternating Current fundamentals: Generation of alternating voltages-Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.

MODULE 3: AC Circuits

AC Circuits: Phasor representation of sinusoidal quantities. Trignometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.

Three phase AC systems: Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems

MODULE 4

Introduction to Semiconductor devices: Evolution of electronics – Vacuum tubes to nano electronics. Resistors, Capacitors and Inductors (constructional features not required): types, specifications. Standard values, color coding. PN Junction diode: Principle of operation, V-I characteristics, principle of avalanche breakdown. Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration.

MODULE 5

Basic electronic circuits and instrumentation: Rectifiers and power supplies: Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

MODULE 6

Introduction to Communication Systems: Evolution of communication systems – Telegraphy to 5G. Radio communication: principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge. Mobile communication: basic principles of cellular communications, principle and block diagram of GSM.

Text Books

1. D P Kothari and I J Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. D C Kulshreshtha, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
3. ChinmoySaha, Arindham Halder and Debarati Ganguly, Basic Electronics - Principles and Applications, Cambridge University Press, 2018.
4. M.S.Sukhija and T.K.Nagsarkar, Basic Electrical and Electronics Engineering, Oxford University Press, 2012.
5. Wayne Tomasi and Neil Storey, A Textbook On Basic Communication and Information Engineering, Pearson, 2010.

Reference Books

1. Del Toro V, “Electrical Engineering Fundamentals”, Pearson Education.
2. T. K. Nagsarkar, M. S. Sukhija, “Basic Electrical Engineering”, Oxford Higher Education.
3. Hayt W H, Kemmerly J E, and Durbin S M, “Engineering Circuit Analysis”, Tata McGraw-Hill
4. Hughes, “Electrical and Electronic Technology”, Pearson Education.
5. V. N. Mittle and Arvind Mittal, “Basic Electrical Engineering,” Second Edition, McGraw Hill.
6. Parker and Smith, “Problems in Electrical Engineering”, CBS Publishers and Distributors.
7. S. B. Lal Seksena and Kaustuv Dasgupta, “Fundamentals of Electrical Engineering”, Cambridge University Press.
8. Anant Agarwal, Jeffrey Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann Publishers, 2005.
9. Bernard Grob, Ba sic Electronics, McGraw Hill.
10. A. Bruce Carlson, Paul B. Crilly, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, Tata McGraw Hill, 5th Edition.

COURSE CONTENTS AND LECTURE SCHEDULE

No	**Topic**	**No. of Lectures**
1	***Elementary Concepts of Electric Circuits***	
1.1	**Elementary concepts of DC electric circuits:** Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)-problems.	1 2 1
1.2	**Analysis of DC electric circuits:** Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.	1 1 2
2	**Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals**	
2.1	**Magnetic Circuits:** Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.	1 2
2.2	**Electromagnetic Induction:** Faraday's laws, problems, Lenz's law-statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling	1 2
2.3	**Alternating Current fundamentals:** Generation of alternating voltages-Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.	2
3	**AC Circuits**	

3.1	**AC Circuits:** Phasor representation of sinusoidal quantities. Trigonometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power, Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.	1 2 1 2
3.2	**Three phase AC systems:** Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems.	2
4	**Introduction to Semiconductor devices**	
4.1	Evolution of electronics – Vacuum tubes to nano electronics (In evolutional perspective only)	1
4.2	Resistors, Capacitors and Inductors: types, specifications. Standard values, color coding (No constructional features)	2
4.3	**PN Junction diode**: Principle of operation, V-I characteristics, principle of avalanche breakdown	2
4.4	**Bipolar Junction Transistors:** PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration	3
5	**Basic electronic circuits and instrumentation**	
5.1	**Rectifiers and power supplies:** Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator	3
5.2	**Amplifiers:** Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing	4
5.3	**Electronic Instrumentation:** Block diagram of an electronic instrumentation system	2
6	**Introduction to Communication Systems**	
6.1	Evolution of communication systems – Telegraphy to 5G	1

6.2	**Radio communication:** principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge	4
6.3	**Mobile communication:** basic principles of cellular communications, principle and block diagram of GSM.	2

Suggested Simulation Assignments for Basic Electronics Engineering

1. Plot V-I characteristics of Si and Ge diodes on a simulator
2. Plot Input and Output characteristics of BJT on a simulator
3. Implementation of half wave and full wave rectifiers
4. Simulation of RC coupled amplifier with the design supplied
5. Generation of AM signal

Note: The simulations can be done on open tools such as QUCS, KiCad, GNURadio or similar software to augment the understanding.

HUN 102	PROFESSIONAL COMMUNICATION	CATEGORY	L	T	P	CREDIT
		MNC	2	0	2	--

Preamble: Clear, precise, and effective communication has become a *sine qua non* in today's information-driven world given its interdependencies and seamless connectivity. Any aspiring professional cannot but master the key elements of such communication. The objective of this course is to equip students with the necessary skills to listen, read, write, and speak so as to comprehend and successfully convey any idea, technical or otherwise, as well as give them the necessary polish to become persuasive communicators.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to

CO 1	Develop vocabulary and language skills relevant to engineering as a profession
CO 2	Analyze, interpret and effectively summarize a variety of textual content
CO 3	Create effective technical presentations
CO 4	Discuss a given technical/non-technical topic in a group setting and arrive at generalizations/consensus
CO 5	Identify drawbacks in listening patterns and apply listening techniques for specific needs
CO 6	Create professional and technical documents that are clear and adhering to all the necessary conventions

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1										3		2
CO 2										1		3
CO 3						1			1	3		
CO 4										3		1
CO 5		1							2	3		
CO 6	1					1			1	3		

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation

Total Marks: 50

Attendance	: 10 marks
Regular assessment	: 25 marks
Series test (one test only, should include verbal aptitude for placement and higher studies, this test will be conducted for 50 marks and reduced to 15)	: 15 marks

Regular assessment

Project report presentation and Technical presentation through PPT	: 7.5 marks
Listening Test	: 5 marks
Group discussion/mock job interview	: 7.5 marks
Resume submission	: 5 marks

End Semester Examination

Total Marks: 50, Time: 2 hrs.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. List down the ways in which gestures affect verbal communication.
2. Match the words and meanings

Ambiguous	promotion
Bona fide	referring to whole
Holistic	not clear
Exaltation	genuine

3. Expand the following Compound Nouns - a. Water supply. b. Object recognition. c. Steam turbine

Course Outcome 2 (CO2)

1. Read the passage below and prepare notes:

Mathematics, rightly viewed, possesses not only truth, but supreme beauty—a beauty cold and austere, like that of sculpture, without appeal to any part of our weaker nature, without the gorgeous trappings of painting or music, yet sublimely pure, and capable of a stern perfection such as only the greatest art can show. The true spirit of delight, the exaltation, the sense of being more than man, which is the touchstone of the highest excellence, is to be found in mathematics as surely as in poetry. What is best in mathematics deserves not merely to be learnt as a task, but to be assimilated as a part of daily thought, and brought again and again before the mind with ever-renewed encouragement. Real life is, to most men, a long second-best, a perpetual compromise between the ideal and the possible; but the world of pure reason knows no compromise, no practical limitations, no barrier to the creative activity embodying in splendid edifices the passionate aspiration after the perfect from which all great work springs. Remote from human passions, remote even from the pitiful facts of nature, the generations have gradually created an ordered cosmos, where pure thought can dwell as in its natural home, and where one, at least, of our nobler impulses can escape from the dreary exile of the actual world.

So little, however, have mathematicians aimed at beauty, that hardly anything in their work has had this conscious purpose. Much, owing to irrepressible instincts, which were better than avowed *beliefs, has been moulded by an unconscious taste; but much also has been spoilt by false notions of what was fitting. The characteristic excellence of mathematics is only to be found where the reasoning is rigidly logical: the rules of logic are to mathematics what those of structure are to architecture. In the most beautiful work, a chain of argument is presented in which every link is important on its own account, in which there is an air of ease and lucidity throughout, and the premises achieve more than would have been thought possible, by means which appear natural and inevitable. Literature embodies what is general in particular circumstances whose universal significance shines through their individual dress; but mathematics endeavours to present whatever is most general in its purity, without any irrelevant trappings.*

How should the teaching of mathematics be conducted so as to communicate to the learner as much as possible of this high ideal? Here experience must, in a great measure, be our guide; but some maxims may result from our consideration of the ultimate purpose to be achieved.

- From "On the teaching of mathematics" – Bertrand Russell

2. Enumerate the advantages and disadvantages of speed reading. Discuss how it can impact comprehension.

Course Outcome 3(CO3):

1. What are the key elements of a successful presentation?
2. Elucidate the importance of non-verbal communication in making a presentation
3. List out the key components in a technical presentation.

Course Outcome 4 (CO4):

1. Discuss: 'In today's world, being a good listener is more important than being a good Speaker.'
2. Listen to a video/live group discussion on a particular topic, and prepare a brief summary of the proceedings.
3. List the do's and don'ts in a group discussion.

Course Outcome 5 (CO5):

1. Watch a movie clip and write the subtitles for the dialogue.
2. What do you mean by barriers to effective listening? List ways to overcome each of these.
3. What are the different types of interviews? How are listening skills particularly important in Skype/telephonic interviews?

Course Outcome 6 (CO6):

1. Explain the basic structure of a technical report.
2. You have been offered an internship in a much sought-after aerospace company and are very excited about it. However, the dates clash with your series tests. Write a letter to the Manager – University Relations of the company asking them if they can change the dates to coincide with your vacation.
3. You work in a well-reputed aerospace company as Manager – University Relations. You are in charge of offering internships. A student has sent you a letter requesting you to change the dates allotted to him since he has series exams at that time. But there are no vacancies available during the period he has requested for. Compose an e-mail informing him of this and suggest that he try to arrange the matter with his college.

Syllabus

Module 1

Use of language in communication: Significance of technical communication Vocabulary Development: technical vocabulary, vocabulary used in formal letters/emails and reports, sequence words, misspelled words, compound words, finding suitable synonyms, paraphrasing, verbal analogies. Language Development: subject-verb agreement, personal passive voice, numerical adjectives, embedded sentences, clauses, conditionals, reported speech, active/passive voice.

Technology-based communication: Effective email messages, slide presentations, editing skills using software. Modern day research and study skills: search engines, repositories, forums such as Git Hub, Stack Exchange, OSS communities (MOOC, SWAYAM, NPTEL), and Quora; Plagiarism

Module 2

Reading, Comprehension, and Summarizing: Reading styles, speed, valuation, critical reading, reading and comprehending shorter and longer technical articles from journals, newspapers, identifying the various transitions in a text, SQ3R method, PQRST method, speed reading. Comprehension: techniques, understanding textbooks, marking and underlining, Note-taking: recognizing non-verbal cues.

Module 3

Oral Presentation: Voice modulation, tone, describing a process, Presentation Skills: Oral presentation and public speaking skills, business presentations, Preparation: organizing the material, self-Introduction, introducing the topic, answering questions, individual presentation practice, presenting visuals effectively.

Debate and Group Discussions: introduction to Group Discussion (GD), differences between GD and debate; participating GD, understanding GD, brainstorming the topic, questioning and clarifying, GD strategies, activities to improve GD skills

Module 4

Listening and Interview Skills Listening: Active and Passive listening, listening: for general content, to fill up information, intensive listening, for specific information, to answer, and to understand. Developing effective listening skills, barriers to effective listening, listening to longer technical talks, listening to classroom lectures, talks on engineering /technology, listening to documentaries and making notes, TED talks.

Interview Skills: types of interviews, successful interviews, interview etiquette, dress code, body language, telephone/online (skype) interviews, one-to-one interview & panel interview, FAQs related to job interviews

Module 5

Formal writing: Technical Writing: differences between technical and literary style. Letter Writing (formal, informal and semi formal), Job applications, Minute preparation, CV preparation (differences between Bio-Data, CV and Resume), and Reports. Elements of style, Common Errors in Writing: describing a process, use of sequence words, Statements of Purpose, Instructions, Checklists.

Analytical and issue-based Essays and Report Writing: basics of report writing; Referencing Style (IEEE Format), structure of a report; types of reports, references, bibliography.

Lab Activities

Written: Letter writing, CV writing, Attending a meeting and Minute Preparation, Vocabulary Building
Spoken: Phonetics, MMFS (Multimedia Feedback System), Mirroring, Elevator Pitch, telephone etiquette, qualities of a good presentation with emphasis on body language and use of visual aids.
Listening: Exercises based on audio materials like radio and podcasts. Listening to Song. practice and exercises.
Reading: Speed Reading, Reading with the help of Audio Visual Aids, Reading Comprehension Skills
Mock interview and Debate/Group Discussion: concepts, types, Do's and don'ts- intensive practice

Reference Books

1. English for Engineers and Technologists (Combined edition, Vol. 1 and 2), Orient Blackswan 2010.
2. Meenakshi Raman and Sangeetha Sharma,"Technical Communication: Principles and Practice", 2nd Edition, Oxford University Press, 2011
3. Stephen E. Lucas, "The Art of Public Speaking", 10th Edition; McGraw Hill Education, 2012.
4. Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw Hill Education, 2017.
5. William Strunk Jr. & E.B. White, "The Elements of Style", 4th Edition, Pearson, 1999.
6. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004.
7. Goodheart-Willcox, "Professional Communication", First Edition , 2017.
8. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6 edition, 2015.
9. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013.
10. Anand Ganguly, "Success in Interview", RPH, 5th Edition, 2016.
11. Raman Sharma, "Technical Communications", Oxford Publication, London, 2004.

<table>
<tr><td rowspan="2">EST
102</td><td rowspan="2">PROGRAMING IN C</td><td>CATEGORY</td><td>L</td><td>T</td><td>P</td><td>CREDIT</td><td>YEAR OF INTRODUCTION</td></tr>
<tr><td>ESC</td><td>2</td><td>1</td><td>2</td><td>4</td><td>2019</td></tr>
</table>

Preamble: The syllabus is prepared with the view of preparing the Engineering Graduates capable of writing readable C programs to solve computational problems that they may have to solve in their professional life. The course content is decided to cover the essential programming fundamentals which can be taught within the given slots in the curriculum. This course has got 2 Hours per week for practicing programming in C. A list showing 24 mandatory programming problems are given at the end. The instructor is supposed to give homework/assignments to write the listed programs in the rough record as and when the required theory part is covered in the class. The students are expected to come prepared with the required program written in the rough record for the lab classes.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Analyze a computational problem and develop an algorithm/flowchart to find its solution
CO 2	Develop readable* C programs with branching and looping statements, which uses Arithmetic, Logical, Relational or Bitwise operators.
CO 3	Write readable C programs with arrays, structure or union for storing the data to be processed
CO 4	Divide a given computational problem into a number of modules and develop a readable multi-function C program by using recursion if required, to find the solution to the computational problem
CO 5	Write readable C programs which use pointers for array processing and parameter passing
CO 6	Develop readable C programs with files for reading input and storing output

readable* - readability of a program means the following:

1. Logic used is easy to follow
2. Standards to be followed for indentation and formatting
3. Meaningful names are given to variables
4. Concise comments are provided wherever needed

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔	✔		✔				✔	✔	✔
CO2	✔	✔	✔	✔	✔					✔		✔
CO3	✔	✔	✔	✔	✔					✔		✔
CO4	✔	✔	✔	✔	✔					✔	✔	✔
CO5	✔	✔			✔					✔		✔
CO6	✔	✔			✔					✔		✔

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks**
	Test 1 (Marks)	**Test 2 (Marks)**	
Remember	15	10	25
Understand	10	15	25
Apply	20	20	40
Analyse	5	5	10
Evaluate			
Create			

Mark distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test 1 (for theory, for 2 hrs) : 20 marks

Continuous Assessment Test 2 (for lab, internal examination, for 2 hrs) : 20 marks

Internal Examination Pattern: There will be two parts; Part A and Part B. Part A contains 5 questions with 2 questions from each module (2.5 modules x 2 = 5), having 3 marks for each question. Students should answer all questions. Part B also contains 5 questions with 2 questions from each module (2.5 modules x 2 = 5), of which a student should answer any one. The questions should not have sub-divisions and each one carries 7 marks.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1): Write an algorithm to check whether largest of 3 natural numbers is prime or not. Also, draw a flowchart for solving the same problem.

Course Outcome 2 (CO2): Write an easy to read C program to process a set of n natural numbers and to find the largest even number and smallest odd number from the given set of numbers. The program should not use division and modulus operators.

Course Outcome 3(CO3): Write an easy to read C program to process the marks obtained by n students of a class and prepare their rank list based on the sum of the marks obtained. There are 3 subjects for which examinations are conducted and the third subject is an elective where a student is allowed to take any one of the two courses offered.

Course Outcome 4 (CO4): Write an easy to read C program to find the value of a mathematical function f which is defined as follows. f(n) = n! / (sum of factors of n), if n is not prime and f(n) = n! / (sum of digits of n), if n is prime.

Course Outcome 5 (CO5): Write an easy to read C program to sort a set of n integers and to find the number of unique numbers and the number of repeated numbers in the given set of numbers. Use a function which takes an integer array of n elements, sorts the array using the Bubble Sorting Technique and returns the number of unique numbers and the number of repeated numbers in the given array.

Course Outcome 6 (CO6): Write an easy to read C program to process a text file and to print the Palindrome words into an output file.

Model Question paper

QP CODE: PAGES:3

Reg No:______________

Name :______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

***Course Code:* EST 102**

Course Name: Programming in C (Common to all programs)

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Write short note on processor and memory in a computer.
2. What are the differences between compiled and interpreted languages? Give example for each.
3. Write a C program to read a Natural Number through keyboard and to display the reverse of the given number. For example, if "3214567" is given as input, the output to be shown is "7654123".
4. Is it advisable to use *goto* statements in a C program? Justify your answer.
5. Explain the different ways in which you can *declare & initialize* a single dimensional array.
6. Write a C program to read a sentence through keyboard and to display the count of white spaces in the given sentence.
7. What are the advantages of using functions in a program?
8. With a simple example program, explain *scope* and *life time* of variables in C.
9. Write a function in C which takes the address of a single dimensional array (containing a finite sequence of numbers) and the number of numbers stored in the array as arguments and stores the numbers in the same array in reverse order. Use pointers to access the elements of the array.
10. With an example, explain the different modes of opening a file. (10x3=30)

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. (a) Draw a flow chart to find the position of an element in a given sequence, using linear searching technique. With an example explain how the flowchart finds the position of a given element. **(10)**

    (b) Write a pseudo code representing the flowchart for linear searching. **(4)**

OR

12. (a) With the help of a flow chart, explain the bubble sort operation. Illustrate with an example. **(10)**
    (b) Write an algorithm representing the flowchart for bubble sort. **(4)**

13. (a) Write a C program to read an English Alphabet through keyboard and display whether the given Alphabet is in upper case or lower case. **(6)**
    (b) Explain how one can use the builtin function in C, *scanf*to read values of different data types. Also explain using examples how one can use the builtin function in C, *printf*for text formatting. **(8)**

OR

14. (a) With suitable examples, explain various operators in C. (10)
    (b) Explain how characters are stored and processed in C. **(4)**

15. (a) Write a function in C which takes a 2-Dimensional array storing a matrix of numbers and the order of the matrix (number of rows and columns) as arguments and displays the sum of the elements stored in each row. **(6)**
    (b) Write a C program to check whether a given matrix is a diagonal matrix. **(8)**

OR

16. (a) Without using any builtin string processing function like *strlen*, *strcat* etc., write a program to concatenate two strings. **(8)**
    (b) Write a C program to perform bubble sort. **(6)**

17. (a) Write a function namely *myFact* in C to find the factorial of a given number. Also, write another function in C namely*nCr* which accepts two positive integer parameters *n* and *r* and returns the value of the mathematical function*C(n,r)*(n! / (r! x (n - r)!)). The function *nCr* is expected to make use of the factorial function *myFact.* *(10)*
    (b) What is recursion? Give an example. **(4)**

OR

18. (a) With a suitable example, explain the differences between a structure and a union in C. **(6)**
    (b) Declare a structure namely *Student* to store the details (*roll number, name, mark_for_C*) of a student. Then, write a program in C to find the average mark obtained by the students in a class for the subject *Programming in C* (using the field *mark_for_C*). Use array of structures to store the required data **(8)**

19. (a) With a suitable example, explain the concept of pass by reference. **(6)**
    (b) With a suitable example, explain how pointers can help in changing the content of a single dimensionally array passed as an argument to a function in C. **(8)**

OR

20. (a) Differentiate between sequential files and random access files? **(4)**

(b) Using the prototypes explain the functionality provided by the following functions. (10)

rewind()

i. *fseek()*

ii. *ftell()*

iii. *fread()*

iv. *fwrite()* ***(14X5=70)***

SYLLABUS

Programming in C (Common to all disciplines)

Module 1

Basics of Computer Hardware and Software

Basics of Computer Architecture: processor, Memory, Input& Output devices

Application Software & System software: Compilers, interpreters, High level and low level languages

Introduction to structured approach to programming, Flow chart Algorithms, Pseudo code (*bubble sort, linear search - algorithms and pseudocode*)

Module 2

Program Basics

Basic structure of C program: Character set, Tokens, Identifiers in C, Variables and Data Types , Constants, Console IO Operations, printf and scanf

Operators and Expressions: Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, size of operator, Assignment operators and Bitwise Operators. Operators Precedence

Control Flow Statements: If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements.(Simple programs covering control flow)

Module 3

Arrays and strings

Arrays Declaration and Initialization, 1-Dimensional Array, 2-Dimensional Array

String processing: In built String handling functions (strlen, strcpy, strcat and strcmp, puts, gets) Linear search program, bubble sort program, simple programs covering arrays and strings

Module 4

Working with functions

Introduction to modular programming, writing functions, formal parameters, actual parameters Pass by Value, Recursion, Arrays as Function Parameters structure, union, Storage Classes, Scope and life time of variables, *simple programs using functions*

Module 5

Pointers and Files

Basics of Pointer: declaring pointers, accessing data though pointers, NULL pointer,array access using pointers, pass by reference effect

File Operations: open, close, read, write, append

Sequential access and random access to files: In built file handlingfunctions (*rewind() ,fseek(), ftell(), feof(), fread(), fwrite()*), *simple programs covering pointers and files.*

Text Books

1. Schaum Series, Gottfried B.S.,Tata McGraw Hill,Programming with C
2. E. Balagurusamy, Mcgraw Hill,Programming in ANSI C
3. Asok N Kamthane, Pearson,Programming in C
4. Anita Goel, Pearson, Computer Fundamentals

Reference Books

1. Anita Goel and Ajay Mittal, Pearson, Computer fundamentals and Programming in C
2. Brian W. Kernighan and Dennis M. Ritchie, Pearson, C Programming Language
3. Rajaraman V, PHI, Computer Basics and Programming in C
4. Yashavant P, Kanetkar, BPB Publications, Let us C

Course Contents and Lecture Schedule

	Module 1: Basics of Computer Hardware and Software	**(7 hours)**
1.1	**Basics of Computer Architecture:** Processor, Memory, Input& Output devices	**2 hours**
1.2	**Application Software & System software:** Compilers, interpreters, High level and low level languages	**2 hours**
1.3	Introduction to structured approach to programming, Flow chart	**1 hours**
1.4	Algorithms, Pseudo code (*bubble sort, linear search - algorithms and pseudocode*)	**2 hours**
Module 2: Program Basics		**(8 hours)**
2.1	**Basic structure of C program:** Character set, Tokens, Identifiers in C, Variables and Data Types , Constants, Console IO Operations, printf and scanf	**2 hours**
2.2	**Operators and Expressions:** Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, sizeof operator, Assignment operators and Bitwise Operators. Operators Precedence	**2 hours**

2.3	**Control Flow Statements:** If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements.*(Simple programs covering control flow)*	**4 hours**
Module 3: Arrays and strings:		**(6 hours)**
3.1	Arrays Declaration and Initialization, 1-Dimensional Array, 2-Dimensional Array	**2 hours**
3.2	**String processing:** In built String handling functions(*strlen, strcpy, strcat and strcmp, puts, gets*)	**2 hours**
3.3	Linear search program, bubble sort program, *simple programs covering arrays and strings*	**3 hours**
Module 4: Working with functions		**(7 hours)**
4.1	Introduction to modular programming, writing functions, formal parameters, actual parameters	**2 hours**
4.2	Pass by Value, Recursion, Arrays as Function Parameters	**2 hours**
4.3	structure, union, Storage Classes,Scope and life time of variables, *simple programs using functions*	**3 hours**
Module 5: Pointers and Files		**(7 hours)**
5.1	**Basics of Pointer**: declaring pointers, accessing data though pointers, NULL pointer,array access using pointers, pass by reference effect	**3 hours**
5.2	**File Operations**: open, close, read, write, append	1 **hours**
5.3	**Sequential access and random access to files:** In built file handlingfunctions (*rewind() ,fseek(), ftell(), feof(), fread(), fwrite()*)**,** *simple programs covering pointers and files.*	**2 hours**

C PROGRAMMING LAB (Practical part of EST 102, Programming in C)

Assessment Method: The Academic Assessment for the Programming lab should be done internally by the College. The assessment shall be made on 50 marks and the mark is divided as follows: Practical Records/Outputs - 20 marks (internal by the College), Regular Lab Viva - 5 marks (internal by the College), Final Practical Exam – 25 marks (internal by the College).

The mark obtained out of 50 will be converted into equivalent proportion out of 20 for CIE computation.

LIST OF LAB EXPERIMENTS

1. Familiarization of Hardware Components of a Computer

2. Familiarization of Linux environment – How to do Programming in C with Linux

3. Familiarization of console I/O and operators in C

i) Display "Hello World"

ii) Read two numbers, add them and display theirsum

iii) Read the radius of a circle, calculate its area and display it

iv)Evaluate the arithmetic expression ((a -b / c * d + e) * (f +g)) and display its solution.Read the values of the variables from the user through console.

4. Read 3 integer values and find the largest amoung them.

5. Read a Natural Number and check whether the number is prime or not

6. Read a Natural Number and check whether the number is Armstrong or not

7. Read n integers, store them in an array and find their sum and average

8. Read n integers, store them in an array and search for an element in the array using an algorithm for Linear Search

9. Read n integers, store them in an array and sort the elements in the array using Bubble Sort algorithm

10**.** Read a string (word), store it in an array and check whether it is a palindrome word or not.

11. Read two strings (each one ending with a $ symbol), store them in arrays and concatenate them without using library functions.

12. Read a string (ending with a $ symbol), store it in an array and count the number of vowels, consonants and spaces in it.

13. Read two input each representing the distances between two points in the Euclidean space, store these in structure variables and add the two distance values.

14. Using structure, read and print data of n employees (*Name, Employee Id and Salary*)

15. Declare a union containing 5 string variables (*Name, House Name, City Name, State and Pin code*) each with a length of C_SIZE (user defined constant). Then, read and display the address of a person using a variable of the union.

16. Find the factorial of a given Natural Number n usingrecursive and non recursive functions

17. Read a string (word), store it in an array and obtain its reverse by using a user defined function.

18. Write a menu driven program for performing matrix addition, multiplication and finding the transpose. Use functions to (i) read a matrix, (ii) find the sum of two matrices, (iii) find the product of two matrices, (i) find the transpose of a matrix and (v) display a matrix.

19. Do the following using pointers

i) add two numbers

ii) swap two numbers using a user defined function

20. Input and Print the elements of an array using pointers

21. Compute sum of the elements stored in an array using pointers and user defined function.

22. Create a file and perform the following

iii) Write data to the file

iv) Read the data in a given file & display the file content on console

v) append new data and display on console

23. Open a text input file and count number of characters, words and lines in it; and store the results in an output file.

PHL 120	ENGINEERING PHYSICS LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	0	0	2	1	2019

Preamble: The aim of this course is to make the students gain practical knowledge to co-relate with the theoretical studies and to develop practical applications of engineering materials and use the principle in the right way to implement the modern technology.

Prerequisite: Higher secondary level Physics

Course Outcomes: After the completion of the course the student will be able to

CO 1	Develop analytical/experimental skills and impart prerequisite hands on experience for engineering laboratories
CO 2	Understand the need for precise measurement practices for data recording
CO 3	Understand the principle, concept, working and applications of relevant technologies and comparison of results with theoretical calculations
CO 4	Analyze the techniques and skills associated with modern scientific tools such as lasers and fiber optics
CO 5	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				3			1	2			1
CO 2	3				3			1	2			1
CO 3	3				3			1	2			1
CO 4	3				3			1	2			1
CO 5	3				3			1	2			1

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

LIST OF EXPERIMENTS

(Minimum 8 experiments should be completed)

1. CRO-Measurement of frequency and amplitude of wave forms
2. Measurement of strain using strain gauge and wheatstone bridge
3. LCR Circuit – Forced and damped harmonic oscillations
4. Melde's string apparatus- Measurement of frequency in the transverse and longitudinal mode
5. Wave length measurement of a monochromatic source of light using Newton's Rings method.
6. Determination of diameter of a thin wire or thickness of a thin strip of paper using air wedge method.
7. To measure the wavelength using a millimeter scale as a grating.
8. Measurement of wavelength of a source of light using grating.
9. Determination of dispersive power and resolving power of a plane transmission grating
10. Determination of the particle size of lycopodium powder
11. Determination of the wavelength of He-Ne laser or any standard laser using diffraction grating
12. Calculate the numerical aperture and study the losses that occur in optical fiber cable.
13. I-V characteristics of solar cell.
14. LED Characteristics.
15. Ultrasonic Diffractometer- Wavelength and velocity measurement of ultrasonic waves in a liquid
16. Deflection magnetometer-Moment of a magnet- Tan A position.

Reference books

1. S.L.Gupta and Dr.V.Kumar, "Practical physics with viva voice", Pragati PrakashanPublishers, Revised Edition, 2009
2. M.N.Avadhanulu, A.A.Dani and Pokely P.M, "Experiments in Engineering Physics", S.Chand&Co,2008
3. S. K. Gupta, "Engineering physics practicals", Krishna Prakashan Pvt. Ltd., 2014
4. P. R. Sasikumar "Practical Physics", PHI Ltd., 2011.

CYL 120	ENGINEERING CHEMISTRY LAB	CATEGORY	L	T	P	CREDIT
		BSC	0	0	2	1

Preamble: To impart scientific approach and to familiarize with the experiments in chemistry relevant for research projects in higher semesters

Prerequisite: Experiments in chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Understand and practice different techniques of quantitative chemical analysis to generate experimental skills and apply these skills to various analyses
CO 2	Develop skills relevant to synthesize organic polymers and acquire the practical skill to use TLC for the identification of drugs
CO 3	Develop the ability to understand and explain the use of modern spectroscopic techniques for analysing and interpreting the IR spectra and NMR spectra of some organic compounds
CO 4	Acquire the ability to understand, explain and use instrumental techniques for chemical analysis
CO 5	Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments
CO 6	Function as a member of a team, communicate effectively and engage in further learning. Also understand how chemistry addresses social, economical and environmental problems and why it is an integral part of curriculum

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				2							3
CO 2	3				3							3
CO 3	3				3							3
CO 4	3				3							3
CO 5	3				1							3
CO 6	3				1							3

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

LIST OF EXPERIMENTS (MINIMUM 8 MANDATORY)

1. Estimation of total hardness of water-EDTA method
2. Potentiometric titration
3. Determination of cell constant and conductance of solutions.
4. Calibration of pH meter and determination of pH of a solution
5. Estimation of chloride in water
6. Identification of drugs using TLC
7. Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution
8. Determination of molar absorptivity of a compound ($KMnO_4$ or any water soluble food colorant)
9. Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
10. Estimation of iron in iron ore
11. Estimation of copper in brass
12. Estimation of dissolved oxygen by Winkler's method
13. (a) Analysis of IR spectra (minimum 3 spectra) (b) Analysis of ^{1}H NMR spectra (minimum 3 spectra)
14. Flame photometric estimation of Na^{+} to find out the salinity in sand
15. Determination of acid value of a vegetable oil
16. Determination of saponification of a vegetable oil

Reference Books

1. G. Svehla, B. Sivasankar, "Vogel's Qualitative Inorganic Analysis", Pearson, 2012.
2. R. K. Mohapatra, "Engineering Chemistry with Laboratory Experiments", PHI Learning, 2017.
3. Muhammed Arif, "Engineering Chemistry Lab Manual", Owl publishers, 2019.
4. Ahad J., "Engineering Chemistry Lab manual", Jai Publications, 2019.
5. Roy K Varghese, "Engineering Chemistry Laboratory Manual", Crownplus Publishers, 2019.
6. Soney C George, Rino Laly Jose, "Lab Manual of Engineering Chemistry", S. Chand & Company Pvt Ltd, New Delhi, 2019.

ESL 120	CIVIL & MECHANICAL WORKSHOP	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
			0	0	2	1	2019

Preamble: The course is designed to train the students to identify and manage the tools, materials and methods required to execute an engineering project. Students will be introduced to a team working environment where they develop the necessary skills for planning, preparing and executing an engineering project.

To enable the student to familiarize various tools, measuring devices, practices and different methods of manufacturing processes employed in industry for fabricating components.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to:

Course Outcome	Course Outcome Description
CO 1	Name different devices and tools used for civil engineering measurements
CO 2	Explain the use of various tools and devices for various field measurements
CO 3	Demonstrate the steps involved in basic civil engineering activities like plot measurement, setting out operation, evaluating the natural profile of land, plumbing and undertaking simple construction work.
CO 4	Choose materials and methods required for basic civil engineering activities like field measurements, masonry work and plumbing.
CO 5	Compare different techniques and devices used in civil engineering measurements
CO 6	Identify Basic Mechanical workshop operations in accordance with the material and objects
CO 7	Apply appropriate Tools and Instruments with respect to the mechanical workshop trades
CO 8	Apply appropriate safety measures with respect to the mechanical workshop trades

Mapping of course outcomes with program outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	-	-	-	1	1	-	-	2	2	-	-
CO 2	1	-	-	-	1	1	-	-	2	2	-	-
CO 3	1	-	-	-	1	1	-	2	2	2	1	-
CO 4	1	-	-	-	1	1	-	2	2	2	1	1
CO 5	1	-	-	-	1	1	-	-	2	2		1
CO 6	2											

CO 7	2											
CO 8	2											

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	70	30	1 hour

Assessment Procedure: Total marks allotted for the course is 100 marks. CIE shall be conducted for 70 marks and ESE for 30 marks. CIE should be done for the work done by the student and also viva voce based on the work done on each practical session. ESE shall be evaluated by written examination of one hour duration conducted internally by the institute.

Continuous Internal Evaluation Pattern:

Attendance : 20 marks
Class work/ Assessment /Viva-voce : 50 marks
End semester examination (Internally by college) : 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

PART 1

CIVIL WORKSHOP

Exercise 1. Calculate the area of a built-up space and a small parcel of land- Use standard measuring tape and digital distance measuring devices

Exercise 2. (a) Use screw gauge and vernier calliper to measure the diameter of a steel rod and thickness of a flat bar

(b) Transfer the level from one point to another using a water level

(c) Set out a one room building with a given plan and measuring tape

Exercise 3. Find the level difference between any two points using dumpy level

Exercise 4. (a) Construct a $1\frac{1}{2}$ thick brick wall of 50 cm height and 60 cm length using English bond. Use spirit level to assess the tilt of walls.

(b) Estimate the number of different types of building blocks to construct this wall.

Exercise 5. (a) Introduce the students to plumbing tools, different types of pipes, type of connections, traps, valves ,fixtures and sanitary fittings.

(b) Install a small rainwater harvesting installation in the campus

Reference Books:

1. Khanna P.N, “Indian Practical Civil Engineering Handbook”, Engineers Publishers.
2. Bhavikatti. S, "Surveying and Levelling (Volume 1)", I.K. International Publishing House
3. Arora S.P and Bindra S.P, " Building Construction", Dhanpat Rai Publications
4. S. C. Rangwala, “Engineering Materials,” Charotar Publishing House.

PART II

MECHANICAL WORKSHOP

LIST OF EXERCISES

(Minimum EIGHT units mandatory and FIVE models from Units 2 to 8 mandatory)

UNIT 1:- General : Introduction to workshop practice, Safety precautions, Shop floor ethics, Basic First Aid knowledge.

Study of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc.

UNIT 2:- Carpentry : Understanding of carpentry tools

Minimum any one model

1. T –Lap joint 2. Cross lap joint 3. Dovetail joint 4. Mortise joints

UNIT 3:- Foundry : Understanding of foundry tools

Minimum any one model

1.Bench Molding 2. Floor Molding 3. Core making 4. Pattern making

UNIT 4: - Sheet Metal : Understanding of sheet metal working tools

Minimum any one model

1. Cylindrical shape
2. Conical shape
3. Prismatic shaped job from sheet metal

UNIT 5: - Fitting : Understanding of tools used for fitting

Minimum any one model

1. Square Joint
2. V- Joint
3. Male and female fitting

UNIT 6: - Plumbing : Understanding of plumbing tools, pipe joints

Any one exercise on joining of pipes making use of minimum three types of pipe joints

UNIT 7: - Smithy: Understanding of tools used for smithy.

Demonstrating the forge-ability of different materials (MS, Al, alloy steel and cast steels) in cold and hot states.

Observing the qualitative difference in the hardness of these materials

Minimum any one exercise on smithy

1. Square prism
2. Hexagonal headed bolt
3. Hexagonal prism
4. Octagonal prism

UNIT 8: -Welding: Understanding of welding equipments

Minimum any one welding practice

Making Joints using electric arc welding. bead formation in horizontal, vertical and over head positions

UNIT 9: - Assembly: Demonstration only

Dissembling and assembling of

1. Cylinder and piston assembly
2. Tail stock assembly
3. Bicycle
4. Pump or any other machine

UNIT 10: - Machines: Demonstration and applications of the following machines

Shaping and slotting machine; Milling machine; Grinding Machine; Lathe; Drilling Machine.

UNIT 11: - Modern manufacturing methods: Power tools, CNC machine tools, 3D printing, Glass cutting.

Course Contents and Lecture Schedule:

No	Topic	No of Sessions
1	**INTRODUCTION**	
1.1	Workshop practice, shop floor precautions, ethics and First Aid knowledge. Studies of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc	1
2	**CARPENTRY**	
2.1	Understanding of carpentry tools and making minimum one model	2

3	**FOUNDRY**	
3.1	Understanding of foundry tools and making minimum one model	2
4	**SHEET METAL**	
4.1	Understanding of sheet metal working tools and making minimum one model	2
5	**FITTING**	
5.1	Understanding of fitting tools and making minimum one model	2
6	**PLUMBING**	
6.1	Understanding of pipe joints and plumbing tools and making minimum one model	2
7	**SMITHY**	
7.1	Understanding of smithy tools and making minimum one model	2
8	**WELDING**	
8.1	Understanding of welding equipments and making minimum one model	2
9	**ASSEMBLY**	
9.1	Demonstration of assembly and dissembling of multiple parts components	1
10	**MACHINES**	
10.1	Demonstration of various machines	1
11	**MODERN MANUFACTURING METHODS**	
11.1	Demonstrations of: power tools, CNC Machine tools, 3D printing, Glass cutting	1

ESL 130	ELECTRICAL & ELECTRONICS WORKSHOP	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	0	0	2	1	2019

Preamble: Electrical Workshop is intended to impart skills to plan and carry out simple electrical wiring. It is essential for the practicing engineers to identify the basic practices and safety measures in electrical wiring.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Demonstrate safety measures against electric shocks.
CO 2	Identify the tools used for electrical wiring, electrical accessories, wires, cables, batteries and standard symbols
CO 3	Develop the connection diagram, identify the suitable accessories and materials necessary for wiring simple lighting circuits for domestic buildings
CO 4	Identify and test various electronic components
CO 5	Draw circuit schematics with EDA tools
CO 6	Assemble and test electronic circuits on boards
CO 7	Work in a team with good interpersonal skills

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	3	-	-	-	-	-	1
CO 2	2	-	-	-	-	-	-	-	-	1	-	-
CO 3	2	-	-	1	-	1	-	1	2	2	-	2
CO 4	3	-	-	-	-	-	-	-	-	-	-	2
CO 5	3	-	-	-	2	-	-	-	-	-	-	2
CO 6	3	-	-	-	2	-	-	-	-	-	-	1
CO 7	-	-	-	-	-	-	-	-	3	2	-	2

Mark distribution

Total Marks	CIE	ESE	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

Syllabus

PART 1

ELECTRICAL

List of Exercises / Experiments

1. a) Demonstrate the precautionary steps adopted in case of Electrical shocks.

   b)Identify different types of cables, wires, switches, fuses, fuse carriers, MCB, ELCB and MCCB with ratings.
2. Wiring of simple light circuit for controlling light/ fan point (PVC conduit wiring)
3. Wiring of light/fan circuit using Two way switches . (Staircase wiring)
4. Wiring of Fluorescent lamps and light sockets (6A) with a power circuit for controlling power device. (16A socket)
5. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and Energy meter.
6. a)Identify different types of batteries with their specifications.

   b)Demonstrate the Pipe and Plate Earthing Schemes using Charts/Site Visit.

PART II

ELECTRONICS

List of Exercises / Experiments (Minimum of 7 mandatory)

1. Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.)

2. Drawing of electronic circuit diagrams using BIS/IEEE symbols and introduction to EDA tools (such as Dia or XCircuit), Interpret data sheets of discrete components and IC's, Estimation and costing.

3. Familiarization/Application of testing instruments and commonly used tools. [Multimeter, Function generator, Power supply, DSO etc.] [Soldering iron, De-soldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de- soldering station etc.]

4. Testing of electronic components [Resistor, Capacitor, Diode, Transistor and JFET using multimeter.]

5. Inter-connection methods and soldering practice. [Bread board, Wrapping, Crimping, Soldering - types - selection of materials and safety precautions, soldering practice in connectors and general purpose PCB, Crimping.]

6. Printed circuit boards (PCB) [Types, Single sided, Double sided, PTH, Processing methods, Design and fabrication of a single sided PCB for a simple circuit with manual etching (Ferric chloride) and drilling.]
7. Assembling of electronic circuits using SMT (Surface Mount Technology) stations.
8. Assembling of electronic circuit/system on general purpose PCB, test and show the functioning (**Any Two circuits).**

    1. Fixed voltage power supply with transformer, rectifier diode, capacitor filter, zener/IC regulator.
    2. Square wave generation using IC 555 timer in IC base.
    3. Sine wave generation using IC 741 OP-AMP in IC base.
    4. RC coupled amplifier with transistor BC107.

SEMESTER III

MAT 203	DISCRETE MATHEMATICAL STRUCTURES	CATEGORY	L	T	P	CREDITS
		BSC	3	1	0	4

Preamble:

The purpose of this course is to create awareness in students about the basic terminologies used in advanced courses in Computer Science and develop rigorous logical thinking for solving different kinds of problems in Computer Science. This course helps the learner to apply the theory and applications of elementary Counting Principles, Propositional Logic, Predicate Logic, Lattices, Generating Functions, Recurrence Relations and Algebraic Structures eventually in practical applications.

Prerequisite: A sound background in higher secondary school Mathematics

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Check the validity of predicates in Propositional and Quantified Propositional Logic using truth tables, deductive reasoning and inference theory on Propositional Logic **(Cognitive Knowledge Level: Apply)**
CO2	Solve counting problems by applying the elementary counting techniques - Rule of Sum, Rule of Product, Permutation, Combination, Binomial Theorem, Pigeonhole Principle and Principle of Inclusion and Exclusion **(Cognitive Knowledge Level: Apply)**
CO3	Classify binary relations into various types and illustrate an application for each type of binary relation, in Computer Science (**Cognitive Knowledge Level: Understand)**
CO4	Illustrate an application for Partially Ordered Sets and Complete Lattices, in Computer Science **(Cognitive Knowledge Level: Apply)**
CO5	Explain Generating Functions and solve First Order and Second Order Linear Recurrence Relations with Constant Coefficients **(Cognitive Knowledge Level: Apply)**
CO6	Illustrate the abstract algebraic systems - Semigroups, Monoids, Groups, Homomorphism and Isomorphism of Monoids and Groups **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓		✓						✓
CO4	✓	✓	✓	✓		✓						✓
CO5	✓	✓	✓	✓								✓
CO6	✓	✓	✓	✓								✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests (Average of Series Tests 1 & 2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Fundamentals of Logic)

Mathematical logic - Basic connectives and truth table, Statements, Logical Connectives, Tautology, Contradiction. Logical Equivalence - The Laws of Logic, The Principle of duality, Substitution Rules . The implication - The Contrapositive, The Converse,The Inverse.

Logical Implication - Rules of Inference. The use of Quantifiers - Open Statement, Quantifier. Logically Equivalent – Contrapositive, Converse , Inverse , Logical equivalences and implications for quantified statement, Implications , Negation .

Module - 2 (Fundamentals of Counting Theory)

The Rule of Sum – Extension of Sum Rule . The Rule of Product - Extension of Product Rule . Permutations. Combinations. The Binomial Theorem (without proof). Combination with Repetition. The Pigeon hole Principle. The Principle of Inclusion and Exclusion Theorem (Without Proof) - Generalization of the Principle. Derangements.

Module - 3 (Relations and Functions)

Cartesian Product - Binary Relation. Function – domain , range-one to one function, Image-restriction. Properties of Relations- Reachability Relations, Reflexive Relations, Symmetric Relations, Transitive relations, Anti-symmetric Relations, Partial Order relations, Equivalence Relations, Irreflexive relations.

Partially ordered Set – Hasse Diagram, Maximal-Minimal Element, Least upper bound (lub), Greatest Lower bound(glb) (Topological sorting Algorithm- excluded). Equivalence Relations and Partitions - Equivalence Class.

Lattice - Dual Lattice , Sub lattice , Properties of glb and lub , Properties of Lattice , Special Lattice , Complete Lattice, Bounded Lattice, Completed Lattice , Distributive Lattice.

Module - 4 (Generating Functions and Recurrence Relations)

Generating Function - Definition and Examples , Calculation techniques, Exponential generating function. First order linear recurrence relations with constant coefficients – homogeneous, non-homogeneous Solution. Second order linear recurrence relations with constant coefficients, homogeneous, non-homogeneous Solution.

Module - 5 (Algebraic Structures)

Algebraic system-properties- Homomorphism and Isomorphism. Semi group and monoid – cyclic monoid , sub semi group and sub monoid, Homomorphism and Isomorphism of Semi group and monoids. Group- Elementary properties, subgroup, symmetric group on three symbols ,The direct product of two groups, Group Homomorphism, Isomorphism of groups, Cyclicgroup. Rightcosets - Leftcosets. Lagrange's Theorem

Text Book

1. Discrete and Combinatorial Mathematics (An Applied Introduction), Ralph P Grimaldi, B V Ramana , 5th Edition, Pearson

Reference Books

1) Kenneth H. Rosen, Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, MGH, 2011
2) Trembly J.P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata Mc Graw Hill Pub. Co. Ltd., New Delhi, 2003.
3) Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, "Discrete Mathematical Structures", Pearson Education Pvt Ltd., New Delhi, 2003
4) Kenneth H .Rosen, "Discrete Mathematics and its Applications", 5/e, Tata Mc Graw Hill Pub. Co. Ltd, New Delhi 2003
5) Richard Johnsonbaugh, "Discrete Mathematics", 5/e, Pearson Education Asia, NewDelhi, 2002.
6) Joe L Mott, Abraham Kandel, Theodore P Baker,"Discrete Mathematics for Computer Scientists and Mathematicians", 2/e, Prentice-Hall India, 2009.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Show that $R \vee M$, $\urcorner R \vee S$, $\urcorner M$, $\urcorner S$ cannot exist simultaneously (without using truth table)
2. Represent the following statement in symbolic form "Not every city in Canada is clean".

Course Outcome 2 (CO2):

1. How many possible arrangements are there for the letters in MASSASAUGA in which 4 A' s are together?
2. Find the number of integers between 1 and 1000 inclusive, which are not divisible by 5, 6 or 8

Course Outcome 3 (CO3):

1. If A = {1, 2, 3, 4}, give an example of a relation R that is reflexive and symmetric but not transitive.
2. Let Z be the set of integers. R is a relation called "Congruence Modulo 3 " defined by R = { (x,y) /x ε Z,y ε Z, x - y is divisible by 3 } . Show that R is an equivalence relation.

Course Outcome 4 (CO4):

1. Assume A ={ a, b, c}. Let P(A) be its power set and '≤ ' be the subset relation on the power set. Draw the Hasse diagram of (P(A), ≤).
2. What is meant by Bounded Lattice ? Give an example.

Course Outcome 5 (CO5):

1. Solve $a_r - 3a_{r-1} - 4a_{r-2} = 3^r$ using Generating function method; Given $a_0 = 1$, $a_1 = 2$.
2. Find the generating function for the sequence 1, 3, 3^2, 3^3 …….

Course Outcome 6 (CO6):

1. Prove that the group { 1,-1, i, -i } is cyclic with generators i and –i.
2. State and prove Lagrange's Theorem.

Model Question Paper

QP CODE:

Reg No:______________

Name :______________ **PAGES : 3**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MAT 203

Course Name: Discrete Mathematical Structures

Max.Marks :100 **Duration: 3 Hrs**

PART A

Answer all Questions. Each question carries 3 Marks

1. Show the following implication without constructing the truth table: $(P \wedge Q) \Rightarrow P \rightarrow Q$
2. Write the negation of the following statement. " If I drive, then I will not walk"
3. What is pigeon hole principle? Explain. If you select any five numbers from 1 to 8 then prove that at least two of them will add up to 9 .
4. In how many ways can the letters of the word ALLAHABAD be arranged ?
5. Show that the divisibility relation ' / ' is a partial ordering on the set Z^+.
6. Consider the functions given by $f(x) = 2x+3$ and $g(x) = x^2$. Find (g o f) and (f o g).
7. What is meant by exponential generating function? Explain.
8. Provide one example of linear homogeneous recurrence relation. Mention the degree also.
9. What is a monoid ? Explain.
10. Let (A, .) be a group. Show that $(ab)^{-1} = b^{-1}a^{-1}$

(10 x 3 = 30 Marks)

PART B

(Answer any one Question from each Module. Each question carries 14 Marks)

11.

(a) Show that $S \vee R$ is tautologically implied by $(P \vee Q) \wedge (P \rightarrow R) \wedge (Q \rightarrow S)$

(6 marks)

(b) Show that from

(ii) $(\exists x)(F(x) \land S(x)) \rightarrow (y)(M(y) \rightarrow W(y))$.

(iii) $(\exists y)(M(y) \land \urcorner W(y))$ the conclusion $(x)(F(x) \rightarrow \urcorner S(x))$ follows.

(8 marks)

OR

12.

(a) Show that $(x)(P(x) \lor Q(x)) \Rightarrow ((x)P(x) \lor (\exists x)Q(x))$ using indirect method of proof .

(6 marks)

(b) Discuss indirect method of proof . Show that the following premises are inconsistent

(i) If Jack misses many classes through illness, then he fails high school.
(ii) If Jack fails high school, then he is uneducated.
(iii) If Jack reads a lot of books, then he is not uneducated.
(iv) Jack misses many classes through illness and reads a lot of books.

(8 marks)

13.

(a) Explain binomial theorem. Determine the coefficient of x^9y^3 in the expansion of $(x+y)^{12}$, $(x+2y)^{12}$ and $(2x-3y)^{12}$ using binomial theorem.

(6 marks)

(b) How many 5 digit numbers can be formed from the digits 1,2,3,4,5 using the digits without repetition ?

(i) How many of them are even?
(ii) How many are even and greater than 30,000?

(8 marks)

OR

14.

(a) There are 8 guests in a party. Each guest brings a gift and receives another gift in return. No one is allowed to receive the gift they bought. How many ways are there to distribute the gifts?

(6 marks)

(b) Six papers are set in an examination of which two are mathematical. Only one examination will be conducted in a day. In how many different orders ,can the papers be arranged so that

(i) Two mathematical papers are consecutive?
(ii) Two mathematical papers are not consecutive?

(8 marks)

15.

(a) Let A = { 1,2,3,4,...11,12} and let R be the equivalence relation on A x A defined by (a,b) R (c,d) iff a+d = b+c. Prove that R is an equivalence relation and find the equivalence class of (2 ,5)

(8 marks)

(b) What is a chain lattice ? Explain. Also show that every chain is a distributive lattice.

(6 marks)

OR

16.

(a) Suppose f(x) = x+2 , g(x) = x-2, and h(x) = 3x for $x \in R$, where R is the set of real numbers. Find (g o f) , (f o g) , (f o f) and (g o g)

(8 marks)

(b) Let R and S be two relations on a set A . If R and S are symmetric, Prove that (R∩S) is also symmetric.

(6 marks)

17.

(a) Solve the recurrence relation $a_r - 7a_{r-1} + 10a_{r-2} = 0$ for $r \geq 2$; Given $a_0 = 0$; $a_1 = 41$ using generating functions

(8 marks)

(b) Solve the recurrence relation $a_r - 4a_{r-1} + 4a_{r-2} = (r+1)^2$ using generating function.

(6 marks)

OR

18.

(a) Solve $a_n - 3a_{n-1} + 2$; $a_0 = 1$ $n \geq 1$, using generating functions.

(8 marks)

(b) Use generating function to solve the following recurrence relation $a_n = 2a_{n-1} + 2^n$; with $a_0 = 2$.

(6 marks)

19.

(a) Prove that the set 'Q' of rational numbers other than 1 forms an abelian group with respect to the operation ' * ' defined by a * b = a+b -ab.

(8 Marks)

(b) Show that the direct product of two group is a group.

(6 Marks)

OR

20.

(a) Show that the subgroup of a cyclic group is cyclic.

(8 Marks)

(b) Let (A,*) be a group. Show that (A,*) is an abelian group if and only if $a^2 * b^2 = (a*b)^2$ for all 'a' and 'b' in A

(6 Marks)

TEACHING PLAN

No	Contents	No of Lecture Hrs
Module – 1 (Fundamentals of Logic) (9 hrs)		
1.1	Mathematical logic, Basic Connectives and Truth Table	1
1.2	Statements, Logical Connectives, Tautology, Contradiction	1
1.3	Logical Equivalence, The Laws of Logic	1
1.4	The Principle of duality, Substitution Rules	1
1.5	The implication, The Contrapositive, the Converse , the Inverse	1
1.6	Logical Implication,Rules of Inference, Logical Implication	1
1.7	The use of Quantifiers, Open Statement, Quantifier, Negation	1
1.8	Logically Equivalent, Contrapositive, The Converse, The Inverse	1
1.9	Logical Implications	1
Module - 2 (Fundamentals of Counting Theory) (9 hrs)		
2.1	The Pigeon-hole Principle	1
2.2	The Rule of Sum	1
2.3	Extension of Sum Rule	1
2.4	The Rule of Product	1
2.5	Extension of Product Rule , Permutations	1
2.6	Combinations, Combination with repetition	1
2.7	The Binomial Theorem	1
2.8	The Principle of Inclusion and Exclusion Theorem (Without Proof) Generalization of the Principle	1
2.9	Derangements	1
Module - 3 (Relations and Functions) (9 hrs)		
3.1	Cartesian Product, Binary Relation, Function, Domain, Range , One to One Function Image - Restriction	1
3.2	Properties, Reachability Relations, Reflexive Relations,Symmetric Relations,Transitive relations, Antisymmetric Relations.	1

3.3	Partial Order relations	1
3.4	Equivalence Relation, Irreflexive Relations.	1
3.5	Partially ordered Set, Hasse Diagram.	1
3.6	Maximal-Minimal Element, Least Upper bound, Greatest Lower Bound	1
3.7	Equivalence Relations and Partitions ,Equivalence Class	1
3.8	Lattice- Dual Lattice,sub lattice , Properties of glb and lub	1
3.9	Properties of Lattice , Special Lattice , Complete Lattice, Bounded Lattice, Completed Lattice, Distributive Lattice	1
Module - 4 (Generating Functions and Recurrence Relations) (9 hrs)		
4.1	Generating Function , Definition and Examples	1
4.2	Exponential Generating Function.	1
4.3	First Order Linear Recurrence Relations with Constant Coefficients (Lecture I)	1
4.4	First Order Linear Recurrence Relations with Constant Coefficients (Lecture II)	1
4.5	Homogeneous Solution	1
4.6	Non homogeneous Solution	1
4.7	Second order linear recurrence relations with constant coefficients	1
4.8	Homogeneous Solution	1
4.9	Non homogeneous Solution	1
Module - 5 (Algebraic Structures)(9 hrs)		
5.1	Algebraic System-Properties, Homomorphism and Isomorphism	1
5.2	Semi group , Monoid, Cyclic monoid	1

5.3	Sub semigroup and sub monoid	1
5.4	Homomorphism and Isomorphism of Semigroup, Monoids and Groups	1
5.5	Elementary Properties, Subgroup, Symmetric group on three symbols	1
5.6	The direct Product of two Groups	1
5.7	Group Homomorphism, Isomorphism, Cyclic group	1
5.8	Right coset, Left coset	1
5.9	Lagrange’s Theorem	1

<table>
<tr><td rowspan="2">CST201</td><td rowspan="2">DATA STRUCTURES</td><td>CATEGORY</td><td>L</td><td>T</td><td>P</td><td>CREDIT</td><td>YEAR OF INTRODUCTION</td></tr>
<tr><td>PCC</td><td>3</td><td>1</td><td>0</td><td>4</td><td>2019</td></tr>
</table>

Preamble: This course aims at moulding the learner to understand the various data structures, their organization and operations. The course helps the learners to assess the applicability of different data structures and associated algorithms for solving real world problem which requires to compare and select appropriate data structures to solve the problem efficiently. This course introduces abstract concepts for data organization and manipulation using data structures such as stacks, queues, linked lists, binary trees, heaps and graphs for designing their own data structures to solve practical application problems in various fields of Computer Science.

Prerequisite: Topics covered under the course Programming in C (EST 102)

CO1	Design an algorithm for a computational task and calculate the time/space complexities of that algorithm **(Cognitive Knowledge Level: Apply)**
CO2	Identify the suitable data structure (array or linked list) to represent a data item required to be processed to solve a given computational problem and write an algorithm to find the solution of the computational problem **(Cognitive Knowledge Level: Apply)**
CO3	Write an algorithm to find the solution of a computational problem by selecting an appropriate data structure (binary tree/graph) to represent a data item to be processed **(Cognitive Knowledge Level: Apply)**
CO4	Store a given dataset using an appropriate Hash Function to enable efficient access of data in the given set **(Cognitive Knowledge Level: Apply)**
CO5	Select appropriate sorting algorithms to be used in specific circumstances (Cognitive Knowledge Level: **Analyze**)
CO6	Design and implement Data Structures for solving real world problems efficiently **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓		✓						✓
CO2	✓	✓	✓	✓		✓						✓
CO3	✓	✓	✓	✓		✓						✓
CO4	✓	✓	✓	✓		✓						✓
CO5	✓	✓	✓	✓		✓						✓
CO6	✓	✓	✓	✓		✓						✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (Percentage)	Test2 (Percentage)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40

Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

Module 1

Basic Concepts of Data Structures

System Life Cycle, Algorithms, Performance Analysis, Space Complexity, Time Complexity, Asymptotic Notation, Complexity Calculation of Simple Algorithms

Module 2

Arrays and Searching

Polynomial representation using Arrays, Sparse matrix, Stacks, Queues-Circular Queues, Priority Queues, Double Ended Queues, Evaluation of Expressions

Linear Search and Binary Search

Module 3

Linked List and Memory Management

Self Referential Structures, Dynamic Memory Allocation, Singly Linked List-Operations on Linked List. Doubly Linked List, Circular Linked List, Stacks and Queues using Linked List, Polynomial representation using Linked List

Memory allocation and de-allocation-First-fit, Best-fit and Worst-fit allocation schemes

Module 4

Trees and Graphs

Trees, Binary Trees-Tree Operations, Binary Tree Representation, Tree Traversals, Binary Search Trees- Binary Search Tree Operations

Graphs, Representation of Graphs, Depth First Search and Breadth First Search on Graphs, Applications of Graphs

Module 5

Sorting and Hashing

Sorting Techniques – Selection Sort, Insertion Sort, Quick Sort, Merge Sort and Heap Sort

Hashing- Hashing Techniques, Collision Resolution, Overflow handling, Hashing functions – Mid square, Division, Folding, Digit Analysis

Text Book

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Universities Press, Fundamentals of Data Structures in C

Reference Books

1. Samanta D., Classic Data Structures, Prentice Hall India.
2. Richard F. Gilberg, Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, 2/e, Cengage Learning.
3. Aho A. V., J. E. Hopcroft and J. D. Ullman, Data Structures and Algorithms, Pearson Publication.
4. Tremblay J. P. and P. G. Sorenson, Introduction to Data Structures with Applications, Tata McGraw Hill.
5. Peter Brass, Advanced Data Structures, Cambridge University Press.
6. Lipschuts S., Theory and Problems of Data Structures, Schaum's Series.
7. Wirth N., Algorithms + Data Structures = Programs, Prentice Hall.
8. Hugges J. K. and J. I. Michtm, A Structured Approach to Programming, PHI.
9. Martin Barrett, Clifford Wagner, C And Unix: Tools For Software Design, John Wiley.

Sample Course Level Assessment Questions

Course Outcome1(CO1): Write an algorithm for matrix multiplication and calculate its time complexity.

Course Outcome 2(CO2): How a linked list can be used to represent the polynomial $5x^4y^6+24x^3y^4-17x^2y^3+15xy^2+45$.Write an algorithm to add two Bivariate polynomials represented using linked list.

Course Outcome 3(CO3): Create a Binary search Tree with node representing the following sequence 14, 15, 4, 18, 9, 16, 20, 17, 3, 7, 5, 2 and perform inorder, preorder and postorder traversals on the above tree and print the output.

Course Outcome 4(CO4): The size of a hash table is 7. The index of the hash table varies from 0 to 6. Consider the keys 89, 18, 49, 58, 25 in the order. Show how the keys are stored in the hash table using Linear probing.

Course Outcome 5(CO5): In what circumstances does Quick Sort perform over Merge sort.

Course Outcome 6(CO6): Design a reservation system for railways that include waiting list. If the reservation is full "Display reservation full" and put the passenger in in waiting list and give a waiting list number. If a passenger cancels the ticket, then the seat should be automatically allocated to the first passenger in the waiting list.

Model Question Paper

QP CODE: PAGES:3

Reg No:_______________

Name:_________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 201

Course Name: DATA STRUCTURES

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Calculate the frequency count of the statement x = x+1; in the following code segment

   for (i = 0; i< n; i++)

   for (j = 0; j< n; j*=2)

   x = x + 1;

2. What is the relevance of verification in System Life Cycle?

3. Write an algorithm to insert a new element in a particular position of an array.

4. Convert the expression ((A/(B-D+E))*(F-G)*H) to postfix form. Show each step in the conversion including the stack contents

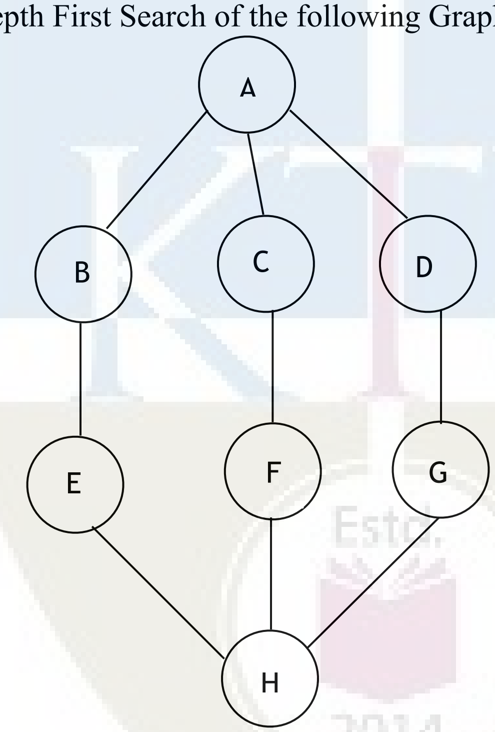
5. Write an algorithm to count the number of occurrences of a character in a linked list (each node contains only one character)

6. Write an algorithm for best-fit method of memory allocation

7. Draw the binary tree whose sequential representation is given below

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	B	C	-	D	E	-	-	-	-	F	G	-	-	-

8. Find the Depth First Search of the following Graph



9. Write an algorithm to arrange n numbers in nonincreasing order.

10. Let the size of a hash table is 10. The index of the hash table varies from 0 to 9. Assume the keys 73, 54, 15, 48, 89, 66, 37, 18, 41, 22, 62 are mapped using modulo operator. Show how the keys are distributed using chaining method.

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. a) Explain the System Life Cycle in detail (10)

    b) How the performance of an algorithm is evaluated? (4)

OR

12. a) Write algorithms for Linear Search and Binary Search and Compare their time complexities (10)

    b) Between O(nlogn) and O(logn) which one is better and why? (4)

13. a) Write algorithms to insert and delete elements from a double ended queue. Demonstrate with examples (10)

    b) Compare and contrast Circular Queue with a Normal Queue (4)

OR

14. a) Write an algorithm to insert and delete elements from a Priority Queue (8)

    b) Discuss an algorithm to convert an infix expression to a prefix expression (6)

15. a) Write an algorithm to multiply two polynomials represented using linked list (10)

    b) How doubly linked list can be used to find palindromes ? (4)

OR

16. a) How is memory compaction (de-allocation) done in memory management ? (8)

    b) Discuss the advantages and disadvantages of First-fit, Best-fit and Worst-fit allocation schemes (6)

17. a) List the properties of Binary Search Tree. Write an algorithm to search an element from a Binary Search Tree (10)

b) Write an iterative algorithm for in-order traversal of a Binary Tree (4)

OR

18. a) Give algorithms for DFS and BFS of a graph and explain with examples (8)

b) How graphs can be represented in a Computer? (6)

19. a) Write algorithms for Merge sort and Quick Sort. (10)

b) Illustrate the working of Quick sort on the following input 38, 8, 0, 28, 45, -12, 89, 66, 42 (4)

OR

20. a) With examples discuss the different hash functions used for hashing (10)

b) Apply the hash function h(x) = x mod 7 for linear probing on the data 2341, 4234, 2839, 430, 22, 397, 3920 and show the resulting hash table (4)

Teaching Plan		
	Module 1 :Basic Concepts of Data Structures	(5 hours)
1.1	System Life Cycle,	1 hour
1.2	Algorithms , Performance Analysis	1 hour
1.3	Space Complexity, Time Complexity	1 hour
1.4	Asymptotic Notation (Big O Notation)	1 hour
1.5	Complexity Calculation of Simple Algorithms	1hour
	Module 2 :**Arrays and Searching**	(10 hours)
2.1	Polynomial representation using Arrays	1 hour
2.2	Sparse matrix (Lecture 1)	1 hour
2.3	Sparse matrix (Lecture 2)	1 hour

2.4	Stacks	1 hour
2.5	Queues, Circular Queues	1 hour
2.6	Priority Queues,	1 hour
2.7	Double Ended Queues,	1 hour
2.8	Conversion and Evaluation of Expressions (Lecture 1)	1 hour
2.9	Conversion and Evaluation of Expressions (Lecture 2)	1 hour
2.10	Linear Search and Binary Search	1 hour
Module 3 : **Linked List and Memory Management**		(12 hours)
3.1	Self Referential Structures	1 hour
3.2	Dynamic Memory Allocation	1 hour
3.3	Singly Linked List-Operations on Linked List,	1 hour
3.4	Doubly Linked List	1 hour
3.5	Circular Linked List	1 hour
3.6	Stacks using Linked List	1 hour
3.7	Queues using Linked List	1 hour
3.8	Polynomial representation using Linked List (Lecture 1)	1 hour
3.9	Polynomial representation using Linked List (Lecture2)	1 hour
3.10	Memory de-allocation	1 hour
3.11	Memory allocation-First-fit	1 hour
3.12	Best-fit and Worst-fit allocation schemes	1hour
Module 4 :**Trees and Graphs**		(8 hours)
4.1	Trees, Binary Trees	1hour
4.2	Tree Operations, Binary Tree Representation,	1hour
4.3	Tree Traversals	1hour
4.4	Binary Search Trees	1hour
4.5	Binary Search Tree Operations	1hour
4.6	Graphs, Representation of Graphs	1hour

4.7	Depth First Search and Breadth First Search on Graphs	1hour
4.8	Applications of Graphs	1hour
Module 5 : **Sorting and Hashing**		(10 hours)
5.1	Sorting Techniques – Selection Sort	1hour
5.2	Insertion Sort	1hour
5.3	Quick Sort	1hour
5.4	Merge Sort	1hour
5.5	Heap Sort	1hour
5.6	Hashing- Hashing Techniques	1hour
5.7	Collision Resolution	1hour
5.8	Overflow handling	1hour
5.9	Hashing functions – Mid square and Division methods	1hour
5.10	Folding and Digit Analysis methods	1hour

CST 203	LOGIC SYSTEM DESIGN	Category	L	T	P	Credit	Year of Introduction
		PCC	3	1	0	4	2019

Preamble: The objective of the course is to familiarize learners with the basic concepts of Boolean algebra and digital systems. This course covers the design of simple combinational and sequential logic circuits, representation and arithmetic algorithms for Binary, BCD (Binary Coded Decimal) and Floating point numbers which in turn are helpful in understanding organization & design of a computer system and understanding how patterns of ones and zeros can be used to store information on computers, including multimedia data.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Illustrate decimal, binary, octal, hexadecimal and BCD number systems, perform conversions among them and do the operations - complementation, addition, subtraction, multiplication and division on binary numbers (**Cognitive Knowledge level: Understand**)
CO2	Simplify a given Boolean Function and design a combinational circuit to implement the simplified function using Digital Logic Gates (**Cognitive Knowledge level: Apply**)
CO3	Design combinational circuits - Adders, Code Convertors, Decoders, Magnitude Comparators, Parity Generator/Checker and design the Programmable Logic Devices - ROM and PLA. **(Cognitive Knowledge level: Apply)**
CO4	Design sequential circuits - Registers, Counters and Shift Registers. **(Cognitive Knowledge level: Apply)**
CO5	Use algorithms to perform addition and subtraction on binary, BCD and floating point numbers **(Cognitive Knowledge level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓	✓	✓		✓						✓
CO3	✓	✓	✓	✓		✓						✓
CO4	✓	✓	✓	✓		✓						✓
CO5	✓	✓	✓									✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern:

Bloom's Category	Test 1 (%)	Test 2 (%)	End Semester Examination Marks (%)
Remember	20	20	20
Understand	35	35	35
Apply	45	45	45
Analyse			
Evaluate			
Create			

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test : 25 marks
Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

Module I

Number systems, Operations & Codes

Decimal, Binary, Octal and Hexadecimal Number Systems- Number Base Conversions. Addition, Subtraction, Multiplication and Division of binary numbers. Representation of negative numbers- Complements, Subtraction with complements. Addition and subtraction of BCD, Octal and Hexadecimal numbers. Binary codes- Decimal codes, Error detection codes, Reflected code, Character coding schemes – ASCII, EBCDIC.

Module II

Boolean Algebra

Postulates of Boolean Algebra. Basic theorems and Properties of Boolean Algebra. Boolean Functions - Canonical and Standard forms. Simplification of Boolean Functions- Using Karnaugh- Map Method (upto five variables), Don't care conditions, Product of sums simplification, Tabulation Method. Digital Logic Gates- Implementation of Boolean functions using basic and universal gates.

Module III

Combinational Logic Circuits

Design Procedure & Implementation of combinational logic circuits- Binary adders and subtractors, Binary Parallel adder, Carry look ahead adder, BCD adder, Code converter, Magnitude comparator, Decoder, Demultiplexer, Encoder, Multiplexer, Parity generator/ Checker.

Module IV

Sequential logic circuits:

Flip-flops- SR, JK, T and D. Triggering of flip-flops- Master slave flip- flops, Edge- triggered flip- flops. Excitation table and characteristic equation. Registers- register with parallel load. Counter design: Asynchronous counters- Binary and BCD counters, timing sequences and state diagrams. Synchronous counters- Binary Up- down counter, BCD counter.

Module V

Shift registers

Shift registers – Serial In Serial Out, Serial In Parallel Out, Bidirectional Shift Register with Parallel load. Ring counter. Johnson counter- timing sequences and state diagrams.

Arithmetic algorithms

Algorithms for addition and subtraction of binary numbers in signed magnitude and 2's complement representations. Algorithm for addition and subtraction of BCD numbers. Representation of floating point numbers, Algorithm for addition and subtraction of floating point numbers.

Programmable Logic devices

ROM. Programmable Logic Array(PLA)- Implementation of simple circuits using PLA.

Text Books:

1. M. Morris Mano, Digital Logic & Computer Design, 4/e, Pearson Education, 2013
2. Thomas L Floyd, Digital Fundamentals, 10/e, Pearson Education, 2009.
3. M. Morris Mano, Computer System Architecture, 3/e, Pearson Education, 2007.

Reference Books:

1. M. Morris Mano, Michael D Ciletti , Digital Design With An Introduction to the Verilog HDL, 5/e, Pearson Education, 2013.
2. Donald D Givone, Digital Principles and Design, Tata McGraw Hill, 2003

Sample Course Level Assessment Questions

Course Outcome1(CO1): Perform the following number base conversions:

a) $(250.55)_{10}$ to Hexadecimal b) $(357)_8$ to Decimal

Course Outcome 2(CO2): Given a Boolean function F and don't care conditions D, using Karnaugh map obtain the simplified expression in (i) SOP and (ii) POS:

$$F(A,B,C,D) = A'B'D' + A'CD + A'BC$$
$$D(A,B,C,D) = A'BC'D + ACD + AB'D$$

Course Outcome 3(CO3): Design a BCD to Excess-3 Code Convertor.

Course Outcome 4(CO4): Design a 4- bit binary ripple counter.

Course Outcome 5(CO5): Demonstrate floating-point addition algorithm.

Model Question Paper

QP CODE: PAGES: 2

Reg No:_______________

Name:_________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 203

Course name : LOGIC SYSTEM DESIGN

Max Marks: 100 **Duration: 3 Hours**

PART-A

(Answer All Questions. Each question carries 3 marks)

1. Represent the decimal numbers $(459)_{10}$ and $(859)_{10}$ in hexadecimal and perform addition of these hexadecimal numbers.
2. Subtract $(1101)_2$ from $(11010)_2$ using: i) $2's$ complement and ii) $1's$ complement arithmetic.
3. Find the dual and complement of the boolean function $F = AB' + B(A + B')$.
4. Using K-map, reduce the expression: $AB + ABC + ABC + BC$.
5. Design a half subtractor with NAND gates only.
6. Design a combinational circuit that multiplies an input decimal digit by 5 represented in BCD. The output is also in BCD. Show that the outputs can be obtained from the input lines without using any logic gates.
7. Differentiate between ripple counter and synchronous counter.
8. Construct D flip- flop using NAND gates. Also give its truth table.
9. Explain how a shift register is used for serial data transfer?
10. Write short notes on ROM.

PART-B

(Answer any one full question from each module) **(14X5=70)**

11. (a) Perform the following operations using 2's complement arithmetic: (8)

(i) $88_{10} + (-37)_{10}$ (ii) $(-20)_{10} + (-12)_{10}$

(b) Perform the following base conversions: (i) $(101011.11)_2$ to octal (6)
(ii) $(3F9B)_{16}$ to binary (iii) $(121)_{10}$ to binary (iv) $(3077)_8$ to binary

OR

12. (a) Find the 12 bit $2's$ complement representation of the following decimal numbers. (6)
(i) – 97 (ii) – 224 (iii) - 197.5

(b) Perform the following operations (8)
(i) $(520)_8 + (488)_8$ (ii) $(520)_{16} - (488)_{16}$

13. (a) Prove that (i) $AB + A(B + C) + B(B + C) = B + AC$ (4)
(ii) $AB + A(B + C) + B(B + D) = A$

(b) Using K-map, simplify the Boolean function F in sum of products form, using the don't care conditions d: (10
$$F(w, x, y, z) = w'(x'y + x'y' + xyz) + x'z'(y + w)$$
$$d(w, x, y, z) = w'x(y'z + yz') + wyz$$

OR

14. (a) Simplify the following expressions using Karnaugh- map method. (8)
(i) $F = \Sigma(0,2,4,6,9,11,13,15,17,21,25,27,29,31)$
(ii) $F = \Pi(0,2,5,7)$

(b) Convert the following to the other canonical form: (6)

(i) $F(x, y, z, a) = \sum (1,3,7)$

(ii) $F(x, y, z) = \Pi(0,3,6,7)$

(iii) $F(A, B, C, D) = \Pi(0,1,2,3,4,6,12)$

15. (a) Implement Full adder circuit using NAND gate only. (4)

(b) Design a code converter for converting BCD to Excess 3 code (10)

OR

16. (a) With a neat diagram explain 4-bit carry look-ahead adder. (6)

(b) Design a Gray to binary code converter using a 4x1 MUX. Draw the circuit diagram and explain. (8)

17. (a) Design a counter that count the states 0,3,5,6,0… using T flip- flops. (10)

(b) Write the characteristics equation, excitation table of JK, T and D flipflop. (4)

OR

18. (a) Explain race around condition and how it can be avoided. (6)

(b) Design a synchronous Binary Up-Down Counter. (8)

19. (a) With a neat diagram explain universal shift register. (8)

(b) Explain Johnson Counter with timing diagram. (6)

OR

20. (a) Write algorithm for floating point addition and subtraction. (8)

(b) Implement the functions $Y_1 = AB'C' + AB'C + ABC$ and $Y_2 = BC + AC$ using minimum gates Programmable Logic Array. (6)

Teaching Plan

Module 1: Number systems, Operations & Codes (No algorithms)		**(7 hours)**
1.1	**Number Systems**: Decimal, Binary, Octal and Hexadecimal number systems, Number Base Conversions.	**1 hour**
1.2	**Binary Arithmetic:** Addition, Subtraction, Multiplication & Division of Binary Numbers. (Lecture 1)	**1 hour**
1.3	Addition, Subtraction, Multiplication & Division of Binary Numbers. (Lecture 2)	**1 hour**
1.4	Representation of Negative Numbers- Complements, subtraction with complements.	**1 hour**
1.5	**BCD Arithmetic:** Addition and Subtraction of BCD Numbers	**1 hour**
1.6	**Octal and Hexadecimal Arithmetic**: Addition & Subtraction of Octal and Hexadecimal Numbers.	**1 hour**

1.7	**Binary Codes:** Decimal Codes, Error detection codes, Reflected code, Character Coding Schemes-ASCII, EBCDIC	**1 hour**
Module 2: Boolean Algebra		**(9 hours)**
2.1	**Introduction to Boolean Algebra:** Postulates of Boolean Algebra	**1 hour**
2.2	Basic theorems and Properties of Boolean Algebra	**1 hour**
2.3	**Boolean Functions:** Canonical and Standard Forms	**1 hour**
2.4	**Simplification of Boolean Functions**: Karnaugh -Map Method (upto five variables), Don't care conditions (Lecture 1)	**1 hour**
2.5	**Simplification of Boolean Functions**: Karnaugh -Map Method (upto five variables), Don't care conditions (Lecture 2)	**1 hour**
2.6	**Product of sums simplification**	**1 hour**
2.7	**Tabulation method**	**1 hour**
2.8	**Digital Logic Gates:** AND, OR, NOT, NAND, NOR, XOR, XNOR, Implementation of Boolean functions using basic and universal gates. (Lecture 1)	**1 hour**
2.9	**Digital Logic Gates:** AND, OR, NOT, NAND, NOR, XOR, XNOR, Implementation of Boolean functions using basic and universal gates. (Lecture 2)	**1 hour**
Module 3: Combinational Logic Circuits		**(9 hours)**
3.1	Design Procedure & Implementation of Combinational Circuits	**1 hour**
3.2	**Binary Adders:** Implementation of Half Adder, Full Adder	**1 hour**
3.3	**Binary Subtractors:** Implementation of Half Subtractor, Full Subtractor	**1 hour**
3.4	Implementation of Binary Parallel Adder ,Carry look ahead Adder, BCD Adder (Lecture 1)	**1 hour**
3.5	Implementation of Binary Parallel Adder ,Carry look ahead Adder, BCD Adder (Lecture 2)	**1 hour**

3.6	**Implementation of Various Combinational Circuits:** Code Converters, Magnitude Comparator	**1 hour**
3.7	Implementation of Decoder, Demultiplexer	**1 hour**
3.8	Implementation of Encoder, Multiplexer	**1 hour**
3.9	Implementation of Parity Generator/Checker	**1 hour**
Module 4: Sequential logic circuits:		**(9 hours)**
4.1	**Flip flops:** SR, JK, T and D flip- flops (Lecture 1)	**1 hour**
4.2	SR, JK, T and D flip- flops (Lecture 2)	**1 hour**
4.3	Triggering of flip-flops- Master slave flip- flop, Edge- triggered flip-flops (Lecture 1)	**1 hour**
4.4	Triggering of flip-flops- Master slave flip- flop, Edge- triggered flip-flops (Lecture 2)	**1 hour**
4.5	Excitation table and characteristic equations of flip- flops	**1 hour**
4.6	**Registers-** Register with parallel load	**1 hour**
4.7	**Counter Design:** Asynchronous counters- Binary and BCD counters- timing sequences and state diagrams. (Lecture 1)	**1 hour**
4.8	Asynchronous counters- Binary and BCD counters- timing sequences and state diagrams. (Lecture 2)	**1 hour**
4.9	Synchronous counters- Binary Up- down counter, BCD counter	**1 hour**
Module 5: Shift registers, Arithmetic algorithms & PLD's		**(11 hours)**
5.1	**Shift Registers** - Serial In Serial Out, Serial In Parallel Out.	**1 hour**
5.2	Bidirectional Shift Register with Parallel load	**1 hour**

5.3	**Shift register counters** - Ring Counter, Johnson Counter- timing sequences and state diagrams	**1 hour**
5.4	**Arithmetic Algorithms:** Algorithm for addition and subtraction of binary numbers in Signed magnitude and 2's complement representations (Lecture 1)	**1 hour**
5.5	Algorithm for addition and subtraction of binary numbers in Signed magnitude and 2's complement representations (Lecture 2)	**1 hour**
5.6	Algorithm for addition and subtraction of BCD numbers	**1 hour**
5.7	Representation of floating point numbers (IEEE Standard representations).	**1 hour**
5.8	Algorithms for floating point addition and subtraction	**1 hour**
5.9	**Programmable Logic devices** - ROM	**1 hour**
5.10	PLA, Implementation of simple circuits using PLA(Lecture 1)	**1 hour**
5.11	PLA, Implementation of simple circuits using PLA(Lecture 2)	**1 hour**

<table>
<tr><td rowspan="2">CST 205</td><td rowspan="2">OBJECT ORIENTED PROGRAMMING USING JAVA</td><td>CATEGORY</td><td>L</td><td>T</td><td>P</td><td>CREDIT</td><td>YEAR OF INTRODUCTION</td></tr>
<tr><td>PCC</td><td>3</td><td>1</td><td>0</td><td>4</td><td>2019</td></tr>
</table>

Preamble: The purpose of this course is to enable learners to solve problems by breaking it down to object level while designing software and to implement it using Java. This course covers Object Oriented Principles, Object Oriented Programming in Java, Inheritance, Exception handling, Event handling, multithreaded programming and working with window-based graphics. This course helps the learners to develop Desktop GUI Applications, Mobile applications, Enterprise Applications, Scientific Applications and Web based Applications.

Prerequisite: Topics covered under the course PROGRAMMING IN C (EST 102)

Course Outcomes: After the completion of the course the student will be able to

CO1	Write Java programs using the object oriented concepts - classes, objects, constructors, data hiding, inheritance and polymorphism (Cognitive Knowledge Level: **Apply**)
CO2	Utilise datatypes, operators, control statements, built in packages & interfaces, Input/ Output Streams and Files in Java to develop programs (Cognitive Knowledge Level: **Apply**)
CO3	Illustrate how robust programs can be written in Java using exception handling mechanism (Cognitive Knowledge Level: **Understand**)
CO4	Write application programs in Java using multithreading and database connectivity (Cognitive Knowledge Level: **Apply**)
CO5	Write Graphical User Interface based application programs by utilising event handling features and Swing in Java (Cognitive Knowledge Level: **Apply**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔	✔								✔
CO2	✔	✔	✔	✔								✔
CO3	✔	✔	✔	✔						✔		✔
CO4	✔	✔	✔	✔								✔
CO5	✔	✔	✔	✔								✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test1 (Marks %)	Test2 (Marks %)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

SYLLABUS

Object Oriented Programming Using Java

Module 1

Introduction:

Approaches to Software Design - Functional Oriented Design, Object Oriented Design, Case Study of Automated Fire Alarm System.

Object Modeling Using Unified Modeling Language (UML) – Basic Object Oriented concepts, UML diagrams, Use case model, Class diagram, Interaction diagram, Activity diagram, State chart diagram.

Introduction to Java **-** Java programming Environment and Runtime Environment, Development Platforms -Standard, Enterprise. Java Virtual Machine (JVM), Java compiler, Bytecode, Java applet, Java Buzzwords, Java program structure, Comments, Garbage Collection, Lexical Issues.

Module 2

Core Java Fundamentals:

Primitive Data types - Integers, Floating Point Types, Characters, Boolean. Literals, Type Conversion and Casting, Variables, Arrays, Strings, Vector class.

Operators **-** Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence.

Control Statements - Selection Statements, Iteration Statements and Jump Statements.

Object Oriented Programming in Java - Class Fundamentals, Declaring Objects, Object Reference, Introduction to Methods, Constructors, ***this*** Keyword, Method Overloading, Using Objects as Parameters, Returning Objects, Recursion, Access Control, Static Members, Final Variables, Inner Classes, Command Line Arguments, Variable Length Arguments.

Inheritance - Super Class, Sub Class, The Keyword ***super***, protected Members, Calling Order of Constructors, Method Overriding, the Object class, Abstract Classes and Methods, using ***final*** with Inheritance.

Module 3

More features of Java:

Packages and Interfaces - Defining Package, CLASSPATH, Access Protection, Importing Packages, Interfaces.

Exception Handling **-** Checked Exceptions, Unchecked Exceptions, ***try*** Block and ***catch*** Clause, Multiple ***catch*** Clauses, Nested ***try*** Statements, ***throw***, ***throws*** and ***finally***.

Input/Output - I/O Basics, Reading Console Input, Writing Console Output, PrintWriter Class, Object Streams and Serialization, Working with Files.

Module 4

Advanced features of Java:

Java Library - String Handling – String Constructors, String Length, Special String Operations - Character Extraction, String Comparison, Searching Strings, Modifying Strings, using valueOf(), Comparison of StringBuffer and String.

Collections framework **-** Collections overview, Collections Interfaces- Collection Interface, List Interface.

Collections Class – ArrayList class. Accessing a Collection via an Iterator.

Event handling **-** Event Handling Mechanisms, Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Using the Delegation Model.

Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread, Creating Multiple Threads, Synchronization, Suspending, Resuming and Stopping Threads.

Module 5

Graphical User Interface and Database support of Java:

Swings fundamentals - Swing Key Features, Model View Controller (MVC), Swing Controls, Components and Containers, Swing Packages, Event Handling in Swings, Swing Layout Managers, Exploring Swings –JFrame, JLabel, The Swing Buttons, JTextField.

Java DataBase Connectivity (JDBC) **-** JDBC overview, Creating and Executing Queries – create table, delete, insert, select.

Text Books:

1. Herbert Schildt, Java: The Complete Reference, 8/e, Tata McGraw Hill, 2011.
2. Rajib Mall, Fundamentals of Software Engineering, 4th edition, PHI, 2014.
3. Paul Deitel, Harvey Deitel, Java How to Program, Early Objects 11th Edition, Pearson, 2018.

Reference Books:

1. Y. Daniel Liang, Introduction to Java Programming, 7/e, Pearson, 2013.
2. Nageswararao R., Core Java: An Integrated Approach, Dreamtech Press, 2008.
3. Flanagan D., Java in A Nutshell, 5/e, O'Reilly, 2005.
4. Barclay K., J. Savage, Object Oriented Design with UML and Java, Elsevier, 2004.
5. Sierra K., Head First Java, 2/e, O'Reilly, 2005.
6. Balagurusamy E., Programming JAVA a Primer, 5/e, McGraw Hill, 2014.

Sample Course Level Assessment Questions

Course Outcome1(CO1): For the following passage develop UML diagrams and then implement it as a Java program in accordance with your UML design.

Passage: College Office collects semester fee and college bus fee for each student. A clerk at the college office collects the fees from each student. The bus fee is calculated depending on the distance of the corresponding bus stop from the college. The semester fee varies depending upon the semester as well as branch of each student. Students are supposed to pay the fees in full. Economically backward students are eligible for 50% discount in semester fee. The consolidated fees receipt is issued to each student by the clerk, which contains the student name, admission number, semester and branch of student along with details of fees collected. Students can log in and view the details of fees remitted and dues if any. The system allows students and clerk level login to the system. Clerk is able to view reports of each class showing status of fees payment of each student.

Course Outcome 2(CO2): Write a Java program to evaluate a post fix expression containing two operands and a single operator using stack. Stack should be implemented as a separate entity so as to reflect OOP concepts.

Course Outcome 3(CO3): Write a program to demonstrate the start, run, sleep and join methods in Thread class.

Course Outcome 4(CO4): Write a GUI based program with separate buttons to add, delete and display student details i.e. name, student ID, current semester and branch of study based on student ID.

Course Outcome 5(CO5): Using Swing create a JFrame with a JLabel and two JButtons. Set the texts of JButtons as “Yes” and “No” respectively. Set the JLabel’s text to the text of the button currently being pressed. Initially the JLabel’s text is blank.

Model Question Paper

QP CODE: PAGES:3

Reg No:_______________

Name:_________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 205

Course Name: Object Oriented Programming using Java

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Briefly explain the portable, secure and robust features of Java.
2. Describe the concepts of object and class with a suitable Java program.
3. Explain the concept of method overriding with an example.
4. What is the use of the keyword ***final*** in Java?
5. Explain the concept of streams.
6. Explain any two applications of Serialization.
7. Distinguish the usage of "==" and ***equals()*** method when comparing String type?
8. What are Collections in Java? Explain any one Collection interface in Java.
9. Explain any two properties of Swing components in Java.
10. Explain JLabel component. With suitable examples explain any two of its constructors.

Part B

Answer any one question completely from each module

11.

(a) Describe in detail any three Object Oriented Programming principles. Illustrate with suitable examples.

(9)

(b) What is Java Runtime Environment? What is the role of Java Virtual Machine in it? (5)

OR

12.

(a) Compare and contrast Java standard edition and Java enterprise edition. (5)

(b) Why is Java considered to be platform independent? What is the role of Bytecode in making Java platform independent? (9)

13.

(a) Explain in detail the primitive data types in Java. (8)

(b) Explain automatic type conversion in Java with an example. What are the two conditions required for it? (6)

OR

14.

(a) Using a suitable Java program explain the difference between ***private*** and ***public*** members in the context of inheritance. (8)

(b) Is it possible to use the keyword ***super*** within a static method? Give justification for your answer. (6)

15.

(a) Explain in detail about byte streams and character streams with suitable code samples. (6)

(b) Describe in detail about exception handling, ***try*** block and ***catch*** clause with the help of a suitable Java program. (8)

OR

16.

(a) Explain object streams in Java. Explain the role of Serializable interface with a suitable code sample. (8)

(b) Explain ***throw***, ***throws*** and ***finally*** constructs with the help of a Java program. (6)

17.

(a) Describe in detail the creation of a thread using the Runnable interface and the Thread class with suitable examples. (10)

(b) Explain List Interface. Mention any two exceptions thrown by its methods. (4)

OR

18.

(a) Explain in detail the Delegation Event model for event handling in Java. (7)

(b) Write a simple program by extending appropriate class to demonstrate the working of threads in java. (7)

19.

(a) Write a Java program to demonstrate the use of JLabel and JButton by adding them to JFrame. (7)

(b) Explain step-by-step procedure of using Java DataBase Connectivity in Java programs. (7)

OR

20.

(a) Explain the class hierarchy of Java Swing components. (7)

(b) Write a Java Program to create a student table and to add student details to it using JDBC. (7)

Teaching Plan		
Module 1 : Introduction		(8 hours)
1.1	Approaches to Software Design- Functional Oriented Design, Object-Oriented Design, Case Study of Automated Fire Alarm System.	1 hour
1.2	Object Modeling Using UML – Basic object oriented concepts	1 hour
1.3	Basic object oriented concepts	1 hour
1.4	UML diagrams, Use case model	1hour
1.5	Class diagram, Interaction diagram	1hour
1.6	Activity diagram, State chart diagram	1hour
1.7	Java programming Environment and Runtime Environment, Development Platforms -Standard, Enterprise. JVM, Java compiler, Bytecode	1hour
1.8	Java applet, Java Buzzwords, Java program structure, Comments, Garbage Collection, Lexical Issues	1hour
Module 2: Core Java Fundamentals		(11 hours)
2.1	Core Java Fundamentals**:** Primitive Data types, Integers, Floating Point Types, Characters, Boolean	1 hour
2.2	Literals, Type Conversion and Casting, Variables, Arrays, Strings, Vector class.	1 hour
2.3	Operators: Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence.	1 hour
2.4	Control Statements: Selection Statements, Iteration Statements and Jump Statements.	1 hour
2.5	Object Oriented Programming in Java**:** Class Fundamentals, Declaring Objects, Object Reference, Introduction to Methods	1 hour
2.6	Constructors, ***this*** Keyword, Method Overloading, Using Objects as Parameters	1 hour
2.7	Returning Objects, Recursion, Access Control, static Members	1 hour

2.8	Final Variables, Inner Classes, Command-Line Arguments, Variable Length Arguments	1 hour
2.9	Inheritance : Super class, Sub class, the keywords ***super***, ***protected*** Members,	1 hour
2.10	Calling Order of Constructors, Method Overriding, the Object class,	1 hour
2.11	Abstract Classes and Methods, Using ***final*** with Inheritance	1 hour
Module 3: More features of Java		(8 hours)
3.1	Packages and Interfaces: Defining Package, CLASSPATH, Access Protection, Importing Packages	1 hour
3.2	Interfaces	1 hour
3.3	Input / Output: I/O Basics, Reading Console Input, Writing Console Output, PrintWriter Class	1 hour
3.4	Object Streams and Serialization	1 hour
3.5	Working with Files	1 hour
3.6	Exception Handling**:** Checked Exceptions, Unchecked Exceptions, ***try*** Block and ***catch*** Clause	1 hour
3.7	Multiple ***catch*** Clauses, Nested ***try*** Statements	1 hour
3.8	***throw***, ***throws*** and ***finally***	1 hour
Module 4:Advanced features of Java		(10 hours)
4.1	Java Library: String Handling – String Constructors, String Length, Special String Operations	1hour
4.2	Character Extraction, String Comparison, Searching Strings, Modifying Strings Using valueOf( ), Comparison of String Buffer and String.	1hour
4.3	Collections framework – Collections overview, Collections Interfaces- Collection Interface	1hour
4.4	List Interface, Collections Class – ArrayList Class	1hour
4.5	Accessing Collections via an Iterator.	1hour
4.6	Event handling**:** Event Handling Mechanisms, Delegation Event Model	1hour
4.7	Delegation Event Model, Event Classes	1hour

4.8	Sources of Events, Event Listener Interfaces, Using the Delegation Model	1hour
4.9	Multithreaded Programming: The Java Thread Model, The Main Thread, Creating Thread	1hour
4.10	Creating Multiple Threads, Synchronization, Suspending, Resuming and Stopping Threads.	1hour
Module 5: Graphical User Interface and Database support of Java		(8 hours)
5.1	Swings fundamentals, Swing Key Features	1hour
5.2	MVC, Swing Controls, Components and Containers	1hour
5.3	Swing Packages, Event Handling in Swings.	1 hour
5.4	Swing Layout Managers	1hour
5.5	Exploring Swings –JFrame, JLabel, The Swing Buttons, JTextField.	1 hour
5.6	JDBC overview, Creating and Executing Queries – create table, delete, insert, select (Basics only, DBMS course is not a prerequisite).	1hour
5.7	Creating and Executing Queries – create table, delete, insert, select.	1 hour
5.8	Creating and Executing Queries – create table, delete, insert, select.	1 hour

<table>
<tr><td rowspan="2">CSL201</td><td rowspan="2">DATA STRUCTURES LAB</td><td>CATEGORY</td><td>L</td><td>T</td><td>P</td><td>CREDIT</td><td>YEAR OF INTRODUCTION</td></tr>
<tr><td>PCC</td><td>0</td><td>0</td><td>3</td><td>2</td><td>2019</td></tr>
</table>

Preamble: The aim of the Course is to give hands-on experience for Learners on creating and using different Data Structures. Data Structures are used to process data and arrange data in different formats for many applications. The most commonly performed operations on data structures are traversing, searching, inserting, deleting and few special operations like merging and sorting.

Prerequisite: Topics covered under the course Programming in C (EST 102)

CO1	Write a time/space efficient program using arrays/linked lists/trees/graphs to provide necessary functionalities meeting a given set of user requirements **(Cognitive Knowledge Level: Analyse)**
CO2	Write a time/space efficient program to sort a list of records based on a given key in the record (**Cognitive Knowledge Level: Apply**)
CO3	Examine a given Data Structure to determine its space complexity and time complexities of operations on it (**Cognitive Knowledge Level: Apply**)
CO4	Design and implement an efficient data structure to represent given data (**Cognitive Knowledge Level: Apply**)
CO5	Write a time/space efficient program to convert an arithmetic expression from one notation to another (**Cognitive Knowledge Level: Apply**)
CO6	Write a program using linked lists to simulate Memory Allocation and Garbage Collection (**Cognitive Knowledge Level: Apply**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓		✓		✓		✓		✓
CO2	✓	✓	✓	✓				✓		✓		✓
CO3	✓	✓	✓	✓				✓		✓		✓
CO4	✓	✓	✓	✓				✓		✓		✓
CO5	✓	✓	✓					✓		✓		✓
CO6	✓	✓	✓					✓		✓		✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Test (Internal Exam)*Percentage*	End Semester Examination *Percentage*
Remember	20	20
Understand	20	20
Apply	60	60
Analyse		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**75**	**75**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Evaluation in Lab : 30 marks

Continuous Assessment Test : 15 marks

Viva-voce : 15 marks

Internal Examination Pattern: The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

End Semester Examination Pattern: The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks will be converted out of 75 for End Semester Examination.

Operating System to Use in Lab **:** Linux

Compiler/Software to Use in Lab **:** gcc

Programming Language to Use in Lab **:** Ansi C

Fair Lab Record:

All Students attending the Data Structures Lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record the right hand page should contain Experiment Heading, Experiment Number, Date of Experiment, Aim of Experiment, Data Structure used and the operations performed on them, Details of Experiment including algorithm and Result of Experiment. The left hand page should contain a print out of the code used for the experiment and sample output obtained for a set of input.

SYLLABUS

1. Implementation of Polynomials and Sparse matrices using arrays**
2. Implementation of Stack , Queues, Priority Queues, DEQUEUE and Circular Queues using arrays**
3. Application problems using stacks: Conversion of expression from one notation to another notation . **
4. Implementation of various linked list operations. **
5. Implementation of stack, queue and their applications using linked list.pression
6. Implementation of trees using linked list
7. Representation of polynomials using linked list, addition and multiplication of polynomials. **
8. Implementation of binary trees using linked lists and arrays- creations, insertion, deletion and traversal. **
9. Implementation of binary search trees – creation, insertion, deletion, search
10. Any application programs using trees
11. Implementation of sorting algorithms – bubble, insertion, selection, quick, merge sort

and heap sort.**

12. Implementation of searching algorithms – linear search, binary search.**

13. Representation of graphs and computing various parameters (in degree, out degree etc.) - adjacency list, adjacency matrix.

14. Implementation of BFS and DFS for each graph representations.**

15. Implementation of hash table using your own mapping functions and observe collisions and overflow resolving schemes.**

16. Simulation of first-fit, best-fit and worst-fit allocations.

17. Simulation of a basic memory allocator and garbage collector using doubly linked list.
** mandatory.

DATA STRUCTURES LAB - PRACTICE QUESTIONS

1. Write a program to read two polynomials and store them in an array. Calculate the sum of the two polynomials and display the first polynomial, second polynomial and the resultant polynomial.

2. C Write a program to enter two matrices in normal form . Write a function to convert two matrices to tuple form and display it. Also find the transpose of the two matrices represented in tuple form and display it. Find the sum of the two matrices in tuple form and display the sum in tuple form.

3. Write a program to enter two matrices in normal form . Write a function to convert two matrices to tuple form and display it. Also find the transpose of the two matrices represented in tuple form and display it. Find the sum of the two matrices in tuple form and display the sum in tuple form.

4. Implement a circular queue using arrays with the operations:
   4.1. Insert an element to the queue.
   4.2. Delete an elements from the queue.
   4.3. Display the contents of the queue after each operation.

5. Implement a Queue using arrays with the operations:

5.1. Insert elements to the Queue.
5.2. Delete elements from the Queue.
5.3. Display the contents of the Queue after each operation.

6. Implement a Stack using arrays with the operations:
   6.1. Pushing elements to the Stack.
   6.2. Popping elements from the Stack
   6.3. Display the contents of the Stack after each operation.

7. Implement a Priority Queue using arrays with the operations:
   7.1. Insert elements to the Priority Queue.
   7.2. Delete elements from the Priority Queue.
   7.3. Display the contents of the Priority Queue after each operation.

8. Implement a Double-Ended Queue (DEQUEUE) with the operations:
   8.1. Insert elements to the Front of the queue.
   8.2. Insert elements to the Rear of the queue
   8.3. Delete elements from the Front of the queue.
   8.4. Delete elements from the Rear of the queue.
   8.5. Display the queue after each operation.

9. Using stack convert an infix expression to a postfix expression and evaluate the postfix expression.

10. Write a program to convert an infix expression to a prefix expression using stacks.

11. Convert an infix expression to a postfix expression without using a stack

12. Write a menu driven program for performing the following operations on a Linked List:
    12.1. Display
    12.2. Insert at Beginning
    12.3. Insert at End
    12.4. Insert at a specified Position
    12.5. Delete from Beginning
    12.6. Delete from End
    12.7. Delete from a specified Position

13. Implement a stack using linked list with the operations:
    13.1. Push elements to the queue.
    13.2. Pop elements from the queue.
    13.3. Display the queue after each operation.

14. Implement a Queue using linked list with the operations:

14.1. Insert an elements to the queue.
14.2. Delete an elements from the queue.
14.3. Display the queue after each operation.

15. Write a program to reverse the content of queue using stack

16. Write a program to read two polynomials and store them using linked list. Calculate the sum of the two polynomials and display the first polynomial, second polynomial and the resultant polynomial.

17. Write a program to read two polynomials and store them using linked list. Find the product of two polynomials and store the result using linked list. Display the resultant polynomial.

18. Write a program for addition of polynomials containing two variables using linked list.

19. The details of students(number, name, total-mark) are to be stored in a linked list. Write functions for the following operations:
    19.1. Insert
    19.2. Delete
    19.3. Search
    19.4. Sort on the basis of number
    19.5. Display the resultant list after every operation

20. Create a Doubly Linked List from a string taking each character from the string. Check if the given string is palindrome in an efficient method.

21. Create a binary tree with the following operations
    21.1. Insert a new node
    21.2. Inorder traversal.
    21.3. Preorder traversal.
    21.4. Postorder traversal.
    21.5. Delete a node.

22. Write a program to create a binary search tree and find the number of leaf nodes

23. Create a binary search tree with the following operations:
    23.1. Insert a new node .
    23.2. Inorder traversal.
    23.3. Preorder traversal.
    23.4. Postorder traversal.
    23.5. Delete a node.

24. Write a program to sort a set of numbers using a binary tree.

25. Represent any given graph and
    25.1. Perform a depth first search .
    25.2. Perform a breadth first search

26. Create a text file containing the name, height, weight of the students in a class. Perform Quick sort and Merge sort on this data and store the resultant data in two separate files. Also write the time taken by the two sorting methods into the respective files.

Eg.	Sony Mathew	5.5	60
	Arun Sajeev	5.7	58
	Rajesh Kumar	6.1	70

27. Write a program to sort a set of numbers using Heap sort and find a particular number from the sorted set using Binary Search.

28. Implement a Hash table using Chaining method. Let the size of hash table be 10 so that the index varies from 0 to 9.

29. Implement a Hash table that uses Linear Probing for collision resolution

CSL 203	OBJECT ORIENTED PROGRAMMING LAB (IN JAVA)	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3	2	2019

Preamble: The aim of the course is to provide hands-on experience to the learners on various object oriented concepts in Java Programming. This course helps the learners to enhance the capability to design and implement various Java applications for real world problems.

Prerequisite: Topics covered under the course Programming in C (EST 102)

Course Outcomes:

At the end of the course, the student should be able to

CO1	Implement the Object Oriented concepts - constructors, inheritance, method overloading & overriding and polymorphism in Java (Cognitive Knowledge Level: **Apply**)
CO2	Implement programs in Java which use datatypes, operators, control statements, built in packages & interfaces, Input/Output streams and Files (Cognitive Knowledge Level: **Apply**)
CO3	Implement robust application programs in Java using exception handling (Cognitive Knowledge Level: **Apply**)
CO4	Implement application programs in Java using multithreading and database connectivity (Cognitive Knowledge Level: **Apply**)
CO5	Implement Graphical User Interface based application programs by utilizing event handling features and Swing in Java (Cognitive Knowledge Level: **Apply**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓			✓		✓		✓
CO2	✓	✓	✓	✓	✓			✓		✓		✓
CO3	✓	✓	✓	✓	✓			✓		✓		✓
CO4	✓	✓	✓	✓	✓			✓		✓		✓
CO5	✓	✓	✓	✓	✓			✓		✓		✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Test - Internal Exam (Percentage)	End Semester Examination (Percentage)
Remember	20	20
Understand	20	20
Apply	60	60
Analyse		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	75	75	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 15 marks
Continuous Evaluation in Lab	: 30 marks
Continuous Assessment Test	: 15 marks
Viva-voce	: 15 marks

Internal Examination Pattern: The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

End Semester Examination Pattern: The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks will be converted out of 75 for End Semester Examination.

Operating System to Use in Lab	**:** Linux
Compiler/Software to Use in Lab	**:** gcc, javac, jdk, jre, Eclipse, NetBeans, MySQL / PostgreSQL.
Programming Language to Use in Lab	**:** Java

Fair Lab Record:
All Students attending the Object Oriented Programming Lab (in Java) should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record the right hand page should contain Experiment Heading, Experiment Number, Date of Experiment, Aim of Experiment, Operations Performed, Details of Experiment including algorithm and Result of Experiment. The left hand page should contain a print out of the code used for the experiment and sample output obtained for a set of input.

SYLLABUS

The syllabus contains six sessions (A, B, C, D, E, F). Each session consists of three concrete Java exercises, out of which at least two questions are mandatory.

(A) Basic programs using datatypes, operators, and control statements in Java.

1) Write a Java program that checks whether a given string is a palindrome or not.
   Ex: MALAYALAM is palindrome.
2) Write a Java Program to find the frequency of a given character in a string. **
3) Write a Java program to multiply two given matrices. **

(B) Object Oriented Programming Concepts: Problem on the use of constructors, inheritance, method overloading & overriding, polymorphism and garbage collection:

4) Write a Java program which creates a class named 'Employee' having the following members: Name, Age, Phone number, Address, Salary. It also has a method named 'print-Salary( )' which prints the salary of the Employee. Two classes 'Officer' and 'Manager' inherits the 'Employee' class. The 'Officer' and 'Manager' classes have data members 'spe-cialization' and 'department' respectively. Now, assign name, age, phone number, address and salary to an officer and a manager by making an object of both of these classes and print the same. (Exercise to understand inheritance). **
5) Write a java program to create an abstract class named Shape that contains an empty method named numberOfSides( ). Provide three classes named Rectangle, Triangle and Hexagon such that each one of the classes extends the class Shape. Each one of the classes contains only the method numberOfSides( ) that shows the number of sides in the given geometrical structures. (Exercise to understand polymorphism). **
6) Write a Java program to demonstrate the use of garbage collector.

(C) Handling different types of files as well as input and output management methods:

7) Write a file handling program in Java with reader/writer.
8) Write a Java program that read from a file and write to file by handling all file related exceptions. **
9) Write a Java program that reads a line of integers, and then displays each integer, and the sum of all the integers (Use String Tokenizer class of java.util). **

(D) Exception handling and multi-threading applications:

10) Write a Java program that shows the usage of try, catch, throws and finally. **
11) Write a Java program that implements a multi-threaded program which has three threads. First thread generates a random integer every 1 second. If the value is even, second thread computes the square of the number and prints. If the value is odd the third thread will print the value of cube of the number.
12) Write a Java program that shows thread synchronization. **

(E) Graphics Programming:

13) Write a Java program that works as a simple calculator. Arrange Buttons for digits and the + - * % operations properly. Add a text field to display the result. Handle any possible exceptions like divide by zero. Use Java Swing. **
14) Write a Java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green. When a radio button is selected, the light is turned on, and only one light can be on at a time. No light is on when the program starts. **
15) Write a Java program to display all records from a table using Java Database Connectivity (JDBC).

(F) Standard Searching and Sorting Algorithms using data structures and algorithms learned from course Data Structures (**CST 201**):

16) Write a Java program for the following: **
    1) Create a doubly linked list of elements.
    2) Delete a given element from the above list.
    3) Display the contents of the list after deletion.
17) Write a Java program that implements Quick sort algorithm for sorting a list of names in ascending order. **
18) Write a Java program that implements the binary search algorithm.

** Mandatory

PRACTICE QUESTIONS

1) Write a Java program to reverse an given string.
2) Write a Java program to display the transpose of a given matrix.
3) Write a Java program to find the second smallest element in an array.
4) Write a Java program to check whether a given number is prime or not.
5) Write a Java program to calculate the area of different shapes namely circle, rectangle, and triangle using the concept of method overloading.
6) Write two Java classes Employee and Engineer. Engineer should inherit from Employee class. Employee class to have two methods display() and calcSalary(). Write a program to display the engineer salary and to display from Employee class using a single object instantiation (i.e., only one object creation is allowed).
   - display() only prints the name of the class and does not return any value. Ex. " Name of class is Employee."
   - calcSalary() in Employee displays "Salary of employee is 10000" and calcSalary() in Engineer displays "Salary of employee is 20000."
7) Write a Java program to illustrate Interface inheritance.
8) Write a Java program that shows how to create a user-defined exception.
9) Write a Java program to create two threads: One for displaying all odd number between 1 and 100 and second thread for displaying all even numbers between 1 and 100.
10) Write a Java program that shows thread priorities.
11) Write a Java program that reads a file and displays the file on the screen, with a line number before each line.
12) Write a Java program that displays the number of characters, lines and words in a text file.
13) Write a Java program for handling mouse events.
14) Write a Java program for handling key events using Adapter classes (general).
15) Write a Java program that allows the user to draw lines, rectangles and ovals.
16) Write a Java Swing program to print a wave form on the output screen.
17) Write a program to accept rollno, name, CGPA of "n" students and store the data to a database using JDBC connectivity. Display the list of students having CGPA greater than 7. (Use MySQL /PostgreSQL).
18) Write a Java program to implement Heap sort algorithm using array.

SEMESTER IV

MAT256	PROBABILITY AND STATISTICAL MODELLING	Category	L	T	P	Credit	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: Study of this course provides the learners a clear understanding of fundamental concepts in probability and statistics. This course covers the modern theory of probability and statistics, important models of sampling, techniques of hypothesis testing and correlation & regression. The course helps the learners to find varied applications in engineering and science like disease modelling, climate prediction and computer networks.

Prerequisite: A sound knowledge in Calculus.

Mapping of course outcomes with program outcomes

CO1	Explain the concept, properties and important models of discrete random variables and use them to analyze suitable random phenomena**(Cognitive Knowledge Level: Apply)**
CO2	Summarize the properties and relevant models of continuous random variables and use them to analyze suitable random phenomena**(Cognitive Knowledge Level: Apply)**
CO3	Make use of concepts of sampling and theory of estimation to solve application level problems **(Cognitive Knowledge Level: Apply)**
CO4	Organize the basic concepts in hypothesis testing and develop decision procedures for the most frequently encountered testing problems**(Cognitive Knowledge Level: Apply)**
CO5	Build statistical methods like correlation and regression analysis to interpret experimental data **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔	✔								✔
CO2	✔	✔	✔	✔								✔
CO3	✔	✔	✔	✔								✔
CO4	✔	✔	✔	✔								✔
CO5	✔	✔	✔	✔								✔
CO6	✔	✔	✔	✔								✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	**30**	**30**	**30**
Understand	**30**	**30**	**30**
Apply	**40**	**40**	**40**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3**

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests(Average of Internal Tests1&2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1 (Discrete probability distributions)

Discrete random variables and their probability distributions, Expectation, mean and variance, Binomial distribution, Poisson distribution, Poisson approximation to the binomial distribution, Discrete bivariate distributions, marginal distributions, Independent random variables, Expectation ,multiple random variables.

Module - 2(Continuous probability distributions)

Continuous random variables and their probability distributions, Expectation, mean and variance, Uniform, exponential and normal distributions, Continuous bivariate distributions, marginal distributions, Independent random variables. Expectation-multiple random variables, independent and identically distributed (i.i.d) random variables and Central limit theorem (Proof not required).

Module - 3(Sampling Techniques)

Need for Sampling, Some Fundamental Definitions, Important Sampling Distributions, Sampling Theory, Sandler's A-test, Concept of Standard Error, Estimation, Estimating the Population Mean(μ), Estimating Population Proportion, Sample Size and its Determination, Determination of

Sample Size through the Approach Based on Precision Rate and Confidence Level, Determination of Sample Size through the Approach Based on Bayesian Statistics

Module– 4**(Testing of Hypothesis)**

Hypothesis and Test Procedures, Tests about a population mean, Tests concerning a population proportion, p-values, Single factor ANOVA, F-test, Multiple comparisons in ANOVA, Two factor ANOVA

Module - 5 (Correlation and Regression Analysis)

Simple Linear Regression Model, Estimating model parameters, Correlation, Non-Linear and multiple regression, Assessing Model Adequacy, Regression with transformed values, Polynomial Regression, Multiple Regression Analysis

Text Books

1. Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 8th edition, Cengage, 2012
2. Research Methodology: Methods and Techniques: C.R. Kothari, New Age International Publishers

Reference Books

1. HosseinPishro-Nik, Introduction to Probability, Statistics and Random Processes, Kappa Research, 2014 (Also available online at www.probabilitycourse.com)
2. Sheldon M. Ross, Introduction to probability and statistics for engineers and scientists, 4th edition, Elsevier, 2009.
3. T. VeeraRajan, Probability, Statistics and Random processes, Tata McGraw-Hill,2008
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36 Edition, 2010
5. Levin R.I. and Rubin D.S., Statistics for Management, 7th edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2001.
6. Srivastava TN, Shailaja Rego, Statistics for Management, Tata McGraw Hill, 2008.
7. Anand Sharma, Statistics for Management, Himalaya Publishing House, Second Revised edition, 2008.
8. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edition. The World Press, Kolkata.
9. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edition.), Pearson Education, Asia.
10. Sampling of Populations: Methods and Applications (2008): Paul S. Levy , Stanley Lemeshow (Fourth Edition), John Wiley &Sons

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Organizers of a concert are limiting tickets sales to a maximum of 4 tickets per customer. Let T be the number of tickets purchased by a random customer. Here is the probability distribution of T:

T=#of tickets	1	2	3	4
P(T)	0.1	0.3	0.2	0.4

Calculate the expected value of T.

2. X is a binomial random variable B (n, p) with n = 100 and p= 0.1. How would you approximate it by a Poisson random variable?
3. Three balls are drawn at random without replacement from a box containing 2 white,3 red and 4 black balls. If X denotes the number of white balls drawn and Y denotes the number of red balls drawn, find the joint probability distribution of (X, Y).

Course Outcome 2(CO2):

1. What can you say about P(X = a) for any real number a when X is a (i) discrete random variable? (ii) continuous random variable?
2. Let X be a random variable with PDF given by

$$f_X(x) = \begin{cases} \mathbf{cx^2} & \mathbf{|x| \le 1} \\ \mathbf{0} & \text{Otherwise} \end{cases}$$

   a. Find the constant c.
   b. Find E(X) and Var(X).
   c. Find P(X≥1/2).

3. A string, 1 meter long, is cut into two pieces at a random point between its ends. What is the probability that the length of one piece is at least twice the length of the other?

Course Outcome 3(CO3):

1. In a random selection of 64 of the 2400 intersections in a small city, the mean number of scooter accidents per year was 3.2 and the sample standard deviation was 0.8.
   (a) Make an estimate of the standard deviation of the population from the sample standard deviation.
   (b) Work out the standard error of mean for this finite population.
   (c) If the desired confidence level is 0.90, what will be the upper and lower limits of the confidence interval for the mean number of accidents per intersection per year?

2. Suppose a certain hotel management is interested in determining the percentage of the hotel's guests who stay for more than 3 days. The reservation manager wants to be 95 per cent confident that the percentage has been estimated to be within ± 3% of the true value. What is the most conservative sample size needed for this problem?
3. 500 articles were selected at random out of a batch containing 10000 articles and 30 were found defective. How many defective articles would you reasonably expect to find in the whole batch?

Course Outcome 4(CO4):

1. A manufacturer of sprinkler systems used for fire protection in office buildings claims that the true average system-activation temperature is 130°F. A sample of n=9 systems, when tested, yields a sample average activation temperature of 131.08°F. If the distribution of activation times is normal with standard deviation 1.5°F, does the data contradict the manufacturer's claim at significance level α=0.01?
2. Let m denote the true average radioactivity level (picocuries per liter). The value 5 pCi/L is considered the dividing line between safe and unsafe water. Would you recommend testing H_0: μ =5 versus H_a: μ >5 or H_0: μ =5 versus H_a: μ <5 ? Explain your reasoning.
3. Pairs of P-values and significance levels, a, are given. For each pair, state whether the observed *P*-value would lead to rejection of H_0 at the given significance level.
   a. P-value=0.084, α=0.05
   b. P-value=0.003, α=0.001

Course Outcome 5 (CO5):

1.Calculate and interpret the correlation coefficient of the two variables below.

Person	Hand	Height
A	17	150
B	15	154
C	19	169
D	17	172
E	21	175

2. You are told that a 95% CI for expected lead content when traffic flow is 15, based on a sample of n=10 observations is (462.1, 597.7). Calculate a CI with confidence level 99% for expected lead content when traffic flow is 15.
3. A trucking company considered a multiple regression model for relating the dependent variable y=total daily travel time for one of its drivers (hours) to the predictors x_1=distance travelled (miles) and x_2=the number of deliveries made. Suppose that the model equation is $Y = \mathbf{-0.800 + 0.060\, x_1 + 0.900 x_2 + \varepsilon}$. What is the mean value of travel time when distance traveled is 50 miles and three deliveries are made?

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MAT256

Course Name: Probability and Statistical Modelling

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Let X denote the number that shows up when an unfair die is tossed. Faces 1 to 5 of the die are equally likely, while face 6 is twice as likely as any other. Find the probability distribution, mean and variance of X.

2. An equipment consists of 5 components each of which may fail independently with probability 0.15. If the equipment is able to function properly when at least 3 of the components are operational, what is the probability that it functions properly?

3. A random variable has a normal distribution with standard deviation 10. If the probability that it will take on a value less than 82.5 is 0.82, what is the probability that it will take on a value more than 58.3?

4. X and Y are independent random variables with X following an exponential distribution with parameter μ and Y following and exponential distribution with parameterλ. Find $P(X+Y \leqslant 1)$.

5. Discuss the difference between F-distribution and Chi-square distribution.

6. From a random sample of 36 New Delhi civil service personnel, the mean age and the sample standard deviation were found to be 40 years and 4.5 years

respectively. Construct a 95 per cent confidence interval for the mean age of civil servants in New Delhi.

7. A sample of 50 lenses used in eyeglasses yields a sample mean thickness of 3.05 mm and a sample standard deviation of .34 mm. The desired true average thickness of such lenses is 3.20 mm. Does the data strongly suggest that the true average thickness of such lenses is something other than what is desired? Test using α=0.05.

8. A random sample of 110 lightning flashes in a certain region resulted in a sample average radar echo duration of 0.81 sec and a sample standard deviation of 0.34 sec. Calculate a 99% (two-sided) confidence interval for the true average echo duration m, and interpret the resulting interval.

9. Let the test statistic T have a t distribution when H_0 is true. Give the significance level for the following situation H_a: $\mu > \mu_0$, df=15, rejection region $t \geq 3.733$.

10. Calculate the regression coefficient and obtain the lines of regression for the following data

X	1	2	3	4	5	6	7
Y	9	8	10	12	11	13	14

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) The probability mass function of a discrete random variable is P(x) = kx ; x = 1,2,3 where k is positive constant. Find (i) the value of k (ii) P(X ≤2) (iii) E[X] (iv) var(1-X). **(7)**

(b) Find the mean and variance of a binomial random variable **(7)**

OR

12. (a) Accidents occur at an intersection at a Poisson rate of 2 per day. What is the probability that there would be no accidents on a given day? What is the probability that in January there are at least 3 days (not necessarily consecutive) without any accidents? **(7)**

(b) One fair die is rolled. Let X denote the number on the die and Y = 0 or 1, according as the die shows an even number or odd number. Find (i) the joint probability distribution of X and Y, (ii) the marginal distributions. (iii) Are X and Y independent? **(7)**

13. (a) The IQ of an individual randomly selected from a population is a normal distribution with mean 100 and standard deviation 15. Find the probability that an individual has IQ (i) above 140 (ii) between 120 and 130. **(7)**

(b) A continuous random variable X is uniformly distributed with mean 1 and variance 4/3. Find $P(X < 0)$? **(7)**

OR

14. (a) The joint density function of random variables X and Y is given by **(7)**

$$f(x, y) = \begin{cases} e^{-(x+y)}, & x>0,\ y>0 \\ 0 & \text{otherwise} \end{cases}$$

Find $P(X + Y \leq 1)$. Are X and Y independent? Justify

(b) The lifetime of a certain type of electric bulb may be considered as an exponential random variable with mean 50 hours. Using central limit theorem, find the approximate probability that 100 of these electric bulbs will provide a total of more than 6000 hours of burning time. **(7)**

15. (a) A market research survey in which 64 consumers were contacted and states that 64 percent of all consumers of a certain product were motivated by the product's advertising. Find the confidence limits for the proportion of consumers motivated by advertising in the population, given a confidence level equal to 0.95. **(7)**

(b) Determine the size of the sample for estimating the true weight of the cereal containers for the universe with N = 5000 on the basis of the following information: **(7)**
(i) the variance of weight = 4 ounces on the basis of past records.
(ii) estimate should be within 0.8 ounces of the true average weight with 99% probability.

OR

16. (a) The foreman of *ABC* mining company has estimated the average quantity of iron ore extracted to be 36.8 tons per shift and the sample standard deviation to be 2.8 tons per shift, based upon a random selection of 4 shifts. Construct a 90 percent confidence interval around this estimate. **(7)**

(b) What should be the size of the sample if a simple random sample from a population of 4000 items is to be drawn to estimate the percent defective within 2 per cent of the true value with 95.5 per cent probability? What would be the size of the sample if the population is assumed to be infinite in the given case? **(7)**

17. The calibration of a scale is to be checked by weighing a10-kg test specimen 25 times. Suppose that the results of different weighings are independent of one another and that the weight on each trial is normally distributed with $\sigma = 0.200$kg. Let μ denote the true average weight reading on the scale.

(a)What hypotheses should be tested? **(7)**

(b)Suppose the scale is to be recalibrated if either $\bar{x} \geq 10.1032$ or $\bar{x} \leq 0.8968$. What is the probability that recalibration is carried out when it is actually unnecessary? **(7)**

OR

18. (a) Lightbulbs of a certain type are advertised as having an average lifetime of 750 hours. The price of these bulbs is very favorable, so a potential customer has decided to go ahead with a purchase arrangement unless it can be conclusively demonstrated that the true average lifetime is smaller than what is advertised. A random sample of 50 bulbs was selected, the lifetime of each bulb determined, and the appropriate hypotheses were tested using Minitab, resulting in the accompanying output.

Variable	N	Mean	StDev	SEMean	Z	P-Value
lifetime	50	738.44	38.20	5.40	-2.14	0

What conclusion would be appropriate for a significance level of 0.05? A significance level of 0.01? What significance level and conclusion would you recommend**?** **(7)**

(b) The recommended daily dietary allowance for zinc among males older than age 50 years is 15 mg/day. The article "Nutrient Intakes and Dietary Patterns of Older Americans: A National Study" reports the following summary data on intake for a sample of males age 65–74 years: $n=115$, $\bar{x} = 11.3$, and $s=6.43$. Does this data indicate that average daily zinc intake in the population of all males ages 65–74 falls below the recommended allowance? **(7)**

19. The flow rate y (m^3/min) in a device used for air-quality measurement depends on the pressure drop x (inches of water) across the device's filter. Suppose that for x values between 5 and 20, the two variables are related according to the simple linear regression model with true regression line $y = -0.12 + 0.095x$

(a)What is the expected change in flow rate associated with a 1 inch increase in pressure drop? Explain. **(7)**

(b)What change in flow rate can be expected when pressure drop decreases by 5 inches? **(7)**

OR

20. Suppose that in a certain chemical process the reaction time y (hr) is related to the temperature (°F) in the chamber in which the reaction takes place according to the simple linear regression model with equation $y = 5.00 - 0.01x$ and $\sigma = 0.075$

(a)What is the expected change in reaction time for a 1°F increase and 10°F increase in temperature? **(7)**

(b)What is the expected reaction time when temperature is 200°F and 250°F? **(7)**

Teaching Plan

No	Contents	No. of Lecture Hours (45 hrs)
Module 1- (Discrete Probability distributions) (9 hours)		
1.1	Discrete random variables	1 hour
1.2	Probability Distributions	1 hour
1.3	Expectation, mean and variance	1 hour
1.4	Binomial distribution	1 hour
1.5	Poisson distribution	1 hour
1.6	Poisson approximation to binomial Distribution	1 hour
1.7	Discrete bivariate distributions	1 hour
1.8	Marginal distributions, Independent Random variables	1 hour
1.9	Expectation-multiple random variables	1 hour
Module-2 Continuous Probability distributions(9 hours)		
2.1	Continuous random variables and probability distributions	1 hour

2.2	Expectation, mean and variance	1 hour
2.3	Uniform distributions	1 hour
2.4	Exponential Distribution	1 hour
2.5	Normal distribution	1 hour
2.6	Continuous Bivariate distributions	1 hour
2.7	Marginal distributions, Independent random variables	1 hour
2.8	Expectation-multiple random variables, i.i.d random variables	1 hour
2.9	Central limit theorem.	1 hour
Module-3 (Sampling Techniques) (9 hours)		
3.1	Need for Sampling	1 hour
3.2	Some fundamental Definitions, Important Sampling Distributions	1 hour
3.3	Sampling Theory, Sandler's A-test	1 hour
3.4	Concept of Standard Error, Estimation , Estimating the Population Mean(μ)	1 hour
3.5	Estimating Population Proportion	1 hour
3.6	Sample Size and its Determination	1 hour
3.7	Determination of Sample Size through the Approach Based on Precision Rate and Confidence Level	1 hour
3.8	Determination of Sample Size through the Approach Based on Bayesian Statistics	1 hour
3.9	Determination of Sample Size through the Approach Based on Bayesian Statistics(continued)	1 hour
Module-4 (Testing of Hypothesis) (9 hours)		
4.1	Null and alternate Hypothesis	1 hour
4.2	Test Procedures	1 hour
4.3	Test Tests about a population mean	1 hour
4.4	Tests concerning a population proportion	1 hour
4.5	p-values	1 hour

4.6	Single factor ANOVA	1 hour
4.7	F-Test	1 hour
4.8	Multiple comparisons in ANOVA	1 hour
4.9	Two factor ANOVA	1 hour
Module-5 (Correlation and Regression Analysis) (9 hours)		
5.1	Simple Linear Regression Model(Lecture 1)	1 hour
5.2	Simple Linear Regression Model(Lecture 2)	1 hour
5.3	Estimating model parameters	1 hour
5.4	Correlation	1 hour
5.5	Non-Linear and multiple regression	1 hour
5.6	Assessing Model Adequacy	1 hour
5.7	Regression with transformed values	1 hour
5.8	Polynomial Regression	1 hour
5.9	Multiple Regression Analysis	1 hour

CST 202	COMPUTER ORGANISATION AND ARCHITECTURE	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	3	1	0	4	2019

Preamble:

The course is prepared with the view of enabling the learners capable of understanding the fundamental architecture of a digital computer. Study of Computer Organization and Architecture is essential to understand the hardware behind the code and its execution at physical level by interacting with existing memory and I/O structure. It helps the learners to understand the fundamentals about computer system design so that they can extend the features of computer organization to detect and solve problems occurring in computer architecture.

Prerequisite : Topics covered under the course Logic System Design (CST 203)

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Recognize and express the relevance of basic components, I/O organization and pipelining schemes in a digital computer **(Cognitive knowledge: Understand)**
CO2	Explain the types of memory systems and mapping functions used in memory systems **(Cognitive Knowledge Level: Understand)**
CO3	Demonstrate the control signals required for the execution of a given instruction **(Cognitive Knowledge Level: Apply)**)
CO4	Illustrate the design of Arithmetic Logic Unit and explain the usage of registers in it (**Cognitive Knowledge Level: Apply**)
CO5	Explain the implementation aspects of arithmetic algorithms in a digital computer **(Cognitive Knowledge Level:Apply)**
CO6	Develop the control logic for a given arithmetic problem (**Cognitive Knowledge Level: Apply**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								✓
CO2	✓	✓	✓	✓						✓		✓
CO3	✓	✓	✓	✓						✓		✓
CO4	✓	✓	✓	✓						✓		✓
CO5	✓	✓	✓							✓		✓
CO6	✓	✓	✓	✓								✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks (%)**
	Test1 (%)	**Test2 (%)**	
Remember	20	20	30
Understand	40	40	30
Apply	40	40	40
Analyze			

Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module 1

Basic Structure of computers – functional units - basic operational concepts - bus structures. Memory locations and addresses - memory operations,Instructions and instruction sequencing , addressing modes.

Basic processing unit – fundamental concepts – instruction cycle – execution of a complete instruction - single bus and multiple bus organization

Module 2

Register transfer logic: inter register transfer – arithmetic, logic and shift micro operations.

Processor logic design: - processor organization – Arithmetic logic unit - design of arithmetic circuit - design of logic circuit - Design of arithmetic logic unit - status register – design of shifter - processor unit – design of accumulator.

Module 3

Arithmetic algorithms: Algorithms for multiplication and division (restoring method) of binary numbers. Array multiplier , Booth's multiplication algorithm.
Pipelining: Basic principles, classification of pipeline processors, instruction and arithmetic pipelines (Design examples not required), hazard detection and resolution.

Module 4

Control Logic Design: Control organization – Hard_wired control-microprogram control – control of processor unit - Microprogram sequencer,micro programmed CPU organization - horizontal and vertical micro instructions.

Module 5

I/O organization: accessing of I/O devices – interrupts, interrupt hardware -Direct memory access.

Memory system: basic concepts – semiconductor RAMs. memory system considerations – ROMs, Content addressable memory, cache memories - mapping functions.

Text Books

1. Hamacher C., Z. Vranesic and S. Zaky, Computer Organization ,5/e, McGraw Hill, 2011
2. Mano M. M., Digital Logic & Computer Design, PHI, 2004
3. KaiHwang, Faye Alye Briggs, Computer architecture and parallel processing McGraw-Hill, 1984

Reference Books

1. Mano M. M., Digital Logic & Computer Design, 3/e, Pearson Education, 2013.
2. Patterson D.A. and J. L. Hennessy, Computer Organization and Design, 5/e, Morgan Kaufmann Publishers, 2013.
3. William Stallings, Computer Organization and Architecture: Designing for Performance, Pearson, 9/e, 2013.
4. Chaudhuri P., Computer Organization and Design, 2/e, Prentice Hall, 2008.
5. Rajaraman V. and T. Radhakrishnan, Computer Organization and Architecture, Prentice Hall, 2011

Sample Course Level Assessment Questions

Course Outcome1(CO1): Which are the registers involved in a memory access operation and how are they involved in it?

Course Outcome 2(CO2): Explain the steps taken by the system to handle a write miss condition inside the cache memory.

Course Outcome 3(CO3): Generate the sequence of control signals required for the execution of the instruction MOV [R1],R2 in a threebus organization.

Course Outcome 4(CO4): Design a 4-bit combinational logic shifter with 2 control signals H0 and H1 that perform the following operations :

H1	H0	Operation
0	0	Transfer 1's to all output line
0	1	No shift operation
1	0	Shift left
1	1	Shift right

Course Outcome 5(CO5): Explain the restoring algorithm for binary division. Also trace the algorithm to divide $(1001)_2$ by $(11)_2$

Course Outcome 6(CO6): Design a software control logic based on microprogramed control to perform the addition of 2 signed numbers represented in sign magnitude form.

Model Question Paper

QP CODE: PAGES:2

Reg No:_______________

Name:_________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 202

Course Name: Computer organisation and architecture

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Give the significance of instruction cycle.
2. Distinguish between big endian and little endian notations. Also give the significance of these notations.
3. Compare I/O mapped I/O and memory mapped I/O.
4. Give the importance of interrupts in I/O interconnection.
5. Justify the significance of status register.
6. How does the arithmetic circuitry perform logical operations in an ALU.
7. Illustrate divide overflow with an example.
8. Write notes on arithmetic pipeline.
9. Briefly explain the role of micro program sequence.
10. Differentiate between horizontal and vertical micro instructions.

Part B

Answer any one Question from each module. Each question carries 14 Marks

11.

11.(a) What is the significance of addressing modes in computer architecture.

(4)

11.(b) Write the control sequence for the instruction DIV R1,[R2] in a three bus structure.

(10)

OR

12. Explain the concept of a single bus organization with help of a diagram. Write the control sequence for the instruction ADD [R1],[R2].

(14)

13. Explain various register transfer logics.

(14)

OR

14.

14.(a) Design a 4 bit combinational logic shifter with 2 control signals H1 and H2 that perform the following operations (bit values given in parenthesis are the values of control variable H1 and H2 respectively.) : Transfer of 0's to S (00), shift right (01), shift left (10), no shift (11).

(5)

14.(b) Design an ALU unit which will perform arithmetic and logic operation with a given binary adder.

(9)

15.

15.(a) Give the logic used behind Booth's multiplication algorithm.

(4)

15.(b) Identify the appropriate algorithm available inside the system to perform the multiplication between -14 and -9. Also trace the algorithm for the above input.

(10)

OR

16.

16.(a) List and explain the different pipeline hazards and their possible solutions

(10)

16.(b) Design a combinational circuit for 3x2 multiplication.

(4)

17. Design a hardwared control unit used to perform addition/subtraction of 2 numbers represented in sign magnitude form.

(14)

OR

18. Give the structure of the micro program sequencer and its role in sequencing the micro instructions.

(14)

19.

19.(a) Explain the different ways in which interrupt priority schemes can be implemented

(10)

19.(b) Give the structure of SRAM cell.

(4)

OR

20.

20.(a) Explain the various mapping functions available in cache memory.

(9)

20.(b) Briefly explain content addressable memory.

(5)

TEACHING PLAN		
No	**Contents**	**No of Lecture Hrs**
	Module 1 : (Basic Structure of computers) (9 hours)	
1.1	Functional units,basic operational concepts,bus structures (introduction)	1
1.2	Memory locations and addresses , memory operations	1
1.3	Instructions and instruction sequencing	1
1.4	Addressing modes	1
1.5	Fundamental concepts of instruction execution, instruction cycle	1
1.6	Execution of a complete instruction - single bus organization (Lecture 1)	1
1.7	Execution of a complete instruction - single bus organization (Lecture 2)	1
1.8	Execution of a complete instruction - multiple bus organization (Lecture 1)	1
1.9	Execution of a complete instruction - multiple bus organization (Lecture 2)	1
	Module 2 :(Register transfer logic and Processor logic design) (10 hours)	
2.1	Inter register transfer – arithmetic micro operations	1
2.2	Inter register transfer – logic and shift micro operations	1
2.3	Processor organization	1
2.4	Design of arithmetic circuit	1
2.5	Design of logic circuit	1
2.6	Design of arithmetic logic unit	1
2.7	Design of status register	1
2.8	Design of shifter - processor unit	1

2.9	Design of accumulator (Lecture 1)	1
2.10	Design of accumulator (Lecture 2)	1
Module 3 : (Arithmetic algorithms and Pipelining) (9 hours)		
3.1	Algorithm for multiplication of binary numbers	1
3.2	Algorithm for division (restoring method) of binary numbers	1
3.3	Array multiplier	1
3.4	Booth's multiplication algorithm	1
3.5	Pipelining: Basic principles	1
3.6	Classification of pipeline processors (Lecture 1)	1
3.7	Classification of pipeline processors (Lecture 2)	1
3.8	Instruction and arithmetic pipelines (Design examples not required)	1
3.9	Hazard detection and resolution	1
Module 4 :(Control Logic Design) (9 hours)		
4.1	Control organization –design of hardwired control logic (Lecture 1)	1
4.2	Control organization –design of hardwired control logic (Lecture 2)	1
4.3	Control organization –design of hardwired control logic (Lecture 3)	1
4.4	Design of microprogram control logic–control of processor unit (Lecture1)	1
4.5	Design of microprogram control logic–control of processor unit (Lecture2)	1
4.6	Design of microprogram control logic–control of processor unit (Lecture3)	1
4.7	Microprogram sequencer	1
4.8	Micro programmed CPU organization	1
4.9	Microinstructions –horizontal and vertical micro instructions	1
Module 5 : (Basic processing units, I/O and memory) (8 hours)		
5.1	Accessing of I/O devices –interrupts	1
5.2	Interrupt hardware	1

5.3	Direct memory access	1
5.4	Memory system: basic concepts –semiconductor RAMs	1
5.5	Memory system considerations – ROMs	1
5.6	Content addressable memory	1
5.7	Cache memories -mapping functions (Lecture 1)	1
5.8	Cache memories -mapping functions (Lecture 2)	1

<table>
<tr><td rowspan="2">CST 204</td><td rowspan="2">DATABASE MANAGEMENT SYSTEMS</td><td>CATEGORY</td><td>L</td><td>T</td><td>P</td><td>CREDIT</td><td>YEAR OF INTRODUCTION</td></tr>
<tr><td>PCC</td><td>3</td><td>1</td><td>0</td><td>4</td><td>2019</td></tr>
</table>

Preamble: This course provides a clear understanding of fundamental principles of Database Management Systems (DBMS) with special focus on relational databases to the learners. The topics covered in this course are basic concepts of DBMS, Entity Relationship (ER) model, Relational Database principles, Relational Algebra, Structured Query Language (SQL), Physical Data Organization, Normalization and Transaction Processing Concepts. The course also gives a glimpse of the alternative data management model, NoSQL. This course helps the learners to manage data efficiently by identifying suitable structures to maintain data assets of organizations and to develop applications that utilize database technologies.

Prerequisite: Topics covered under the course Data Structures (CST 201), Exposure to a High Level Language like C/python.

Course Outcomes: After the completion of the course the student will be able to

CO1	Summarize and exemplify fundamental nature and characteristics of database systems (**Cognitive Knowledge Level: Understand)**
CO2	Model real word scenarios given as informal descriptions, using Entity Relationship diagrams. **(Cognitive Knowledge Level: Apply**)
CO3	Model and design solutions for efficiently representing and querying data using relational model (**Cognitive Knowledge Level: Analyze**)
CO4	Demonstrate the features of indexing and hashing in database applications **(Cognitive Knowledge Level: Apply**)
CO5	Discuss and compare the aspects of Concurrency Control and Recovery in Database systems **(Cognitive Knowledge Level: Apply**)
CO6	Explain various types of NoSQL databases (**Cognitive Knowledge Level: Understand**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔									✔
CO2	✔	✔	✔	✔								✔
CO3	✔	✔	✔	✔								✔
CO4	✔	✔	✔							✔		✔
CO5	✔	✔	✔							✔		✔
CO6	✔	✔	✔		✔					✔		✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test1 (%)	Test2 (%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30

Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module 1: Introduction & Entity Relationship (ER) Model

Concept & Overview of Database Management Systems (DBMS) - Characteristics of Database system, Database Users, structured, semi-structured and unstructured data. Data Models and Schema - Three Schema architecture. Database Languages, Database architectures and classification.

ER model **-** Basic concepts, entity set & attributes, notations, Relationships and constraints, cardinality, participation, notations, weak entities, relationships of degree 3.

Module 2: Relational Model

Structure of Relational Databases - Integrity Constraints, Synthesizing ER diagram to relational schema

Introduction to Relational Algebra - select, project, cartesian product operations, join - Equi-join, natural join. query examples, introduction to Structured Query Language (SQL), Data Definition Language (DDL), Table definitions and operations – CREATE, DROP, ALTER, INSERT, DELETE, UPDATE.

Module 3: SQL DML (Data Manipulation Language), Physical Data Organization

SQL DML (Data Manipulation Language) - SQL queries on single and multiple tables, Nested queries (correlated and non-correlated), Aggregation and grouping, Views, assertions, Triggers, SQL data types.

Physical Data Organization - Review of terms: physical and logical records, blocking factor, pinned and unpinned organization. Heap files, Indexing, Singe level indices, numerical examples, Multi-level-indices, numerical examples, B-Trees & B+-Trees (structure only, algorithms not required), Extendible Hashing, Indexing on multiple keys – grid files.

Module 4: Normalization

Different anomalies in designing a database, The idea of normalization, Functional dependency, Armstrong's Axioms (proofs not required), Closures and their computation, Equivalence of Functional Dependencies (FD), Minimal Cover (proofs not required). First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF), Boyce Codd Normal Form (BCNF), Lossless join and dependency preserving decomposition, Algorithms for checking Lossless Join (LJ) and Dependency Preserving (DP) properties.

Module 5: Transactions, Concurrency and Recovery, Recent Topics

Transaction Processing Concepts - overview of concurrency control, Transaction Model, Significance of concurrency Control & Recovery, Transaction States, System Log, Desirable Properties of transactions.

Serial schedules, Concurrent and Serializable Schedules, Conflict equivalence and conflict serializability, Recoverable and cascade-less schedules, Locking, Two-phase locking and its variations. Log-based recovery, Deferred database modification, check-pointing.

Introduction to NoSQL Databases, Main characteristics of Key-value DB (examples from: Redis), Document DB (examples from: MongoDB)

Main characteristics of Column - Family DB (examples from: Cassandra) and Graph DB (examples from : ArangoDB)

Text Books

1. Elmasri R. and S. Navathe, Database Systems: Models, Languages, Design and Application Programming, Pearson Education, 2013.
2. Sliberschatz A., H. F. Korth and S. Sudarshan, Database System Concepts, 6/e, McGraw Hill, 2011.

Reference Books:

1. Adam Fowler, NoSQL for Dummies, John Wiley & Sons, 2015
2. NoSQL Data Models: Trends and Challenges (Computer Engineering: Databases and Big Data), Wiley, 2018
3. Web Resource: https://www.w3resource.com/redis/
4. web Resource: https://www.w3schools.in/category/mongodb/
5. Web Resource: https://www.tutorialspoint.com/cassandra/cassandra_introduction.htm
6. Web Resource : https://www.tutorialspoint.com/arangodb/index.htm

Sample Course Level Assessment Questions

Course Outcome1 (CO1):

1. List out any three salient features of database systems, which distinguish it from a file system.
2. Give one example each for logical and physical data independence.

Course Outcome 2(CO2):

1. What facts about the relationships between entities EMPLOYEE and PROJECT are conveyed by the following ER diagram?

1. Design an ER diagram for the following scenario:
   There is a set of teams, each team has an ID (unique identifier), name, main stadium, and to which city this team belongs. Each team has many players, and each player belongs to one team. Each player has a number (unique identifier), name, DoB, start year, and shirt number that he uses. Teams play matches, in each match there is a host team and a guest team.

Course Outcome 3(CO3):

1. For the SQL query, SELECT *A, B FROM R WHERE B='apple' AND C = 'orange'* on the table R(A, B, C, D), where A is a key, write any three equivalent relational algebra expressions.
2. Given the FDs P→Q, P→R, QR→S, Q→T, QR→U, PR→U, write the sequence of *Armstrong's Axioms* needed to arrive at the following FDs: (a) P → T (b) PR → S (c) QR → SU
3. Consider a relation PLAYER (PLAYER-NO, PLAYER-NAME, PLAYER-POSN, TEAM, TEAM-COLOR, COACH-NO, COACH-NAME, TEAM-CAPTAIN). Assume that PLAYER-NO is the *only* key of the relation and that the following dependencies hold:

   TEAM→{TEAM-COLOR, COACH-NO, TEAM-CAPTAIN}
   COACH-NO→COACH-NAME.

   i. Is the relation in 2NF? If not, decompose to 2NF.
   ii. Is the relation in 3NF? If not, decompose to 3NF.

4. In the following tables foreign keys have the same name as primary keys except DIRECTED-BY, which refers to the primary key ARTIST-ID. Consider only *single-director* movies.
   MOVIES(<u>MOVIE-ID</u>, MNAME, GENRE, LENGTH, DIRECTED-BY)
   ARTIST(<u>ARTIST-ID</u>, ANAME)
   ACTING(<u>ARTIST-ID, MOVIE-ID</u>)
   Write SQL expressions for the following queries:
   (a) *Name(s) and director name(s) of movie(s) acted by 'Jenny'.*
   (b) *Names of actors who have <u>never</u> acted with 'Rony'*
   (c) *Count of movies genre-wise.*
   (d) *Name(s) of movies with maximum length.*

Course Outcome 4(CO4):

1. Consider an EMPLOYEE file with 10000 records where each record is of size 80 bytes. The file is sorted on employee number (15 bytes long), which is the primary key. Assuming un-spanned organization, block size of 512 bytes and block pointer size of 5 bytes. Compute the number of block accesses needed for retrieving an employee record based on employee number if (i) No index is used (ii) Multi-level primary index is used.

Course Outcome 5(CO5):

1. Determine if the following schedule is *recoverable*. Is the schedule *cascade-less*? Justify your answer. *r1(X), r2(Z), r1(Z), r3(X), r3(Y), w1(X), c1, w3(Y), c3, r2(Y), w2(Z), w2(Y), c2*. (*Note: ri(X)/wi(X)* means transaction *Ti* issues read/write on item X; *ci* means transaction *Ti* commits.)
2. Two-phase locking protocol ensures serializability. Justify.

Course Outcome 6(CO6):

1. List out any three salient features of NoSQL databases. Give example of a document in MongoDB.

Model Question paper

QPCODE

Reg No:__________________

Name:____________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 204

Course Name: **Database Management Systems**

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1 List out any three salient features of a database systems.

2 When is multi-valued composite attribute used in ER modelling?

3 For the SQL query, SELECT *A, B FROM R WHERE B='apple' AND C = 'orange'* on the table R(A, B, C, D), where A is a key, write any two equivalent relational algebra expressions.

4 Outline the concept of *theta*-join.

5 How is the purpose of *where* clause is different from that of having clause?

6 What is the use of a trigger?

7 When do you say that a relation is not in 1NF?

8 Given the FDs $P \rightarrow Q$, $P \rightarrow R$, $QR \rightarrow S$, $Q \rightarrow T$, $QR \rightarrow U$, $PR \rightarrow U$, write the sequence of Armstrong's Axioms needed to arrive at a. $P \rightarrow T$ b. $PR \rightarrow S$

9 What is meant by the lost update problem?

10 What is meant by check pointing?

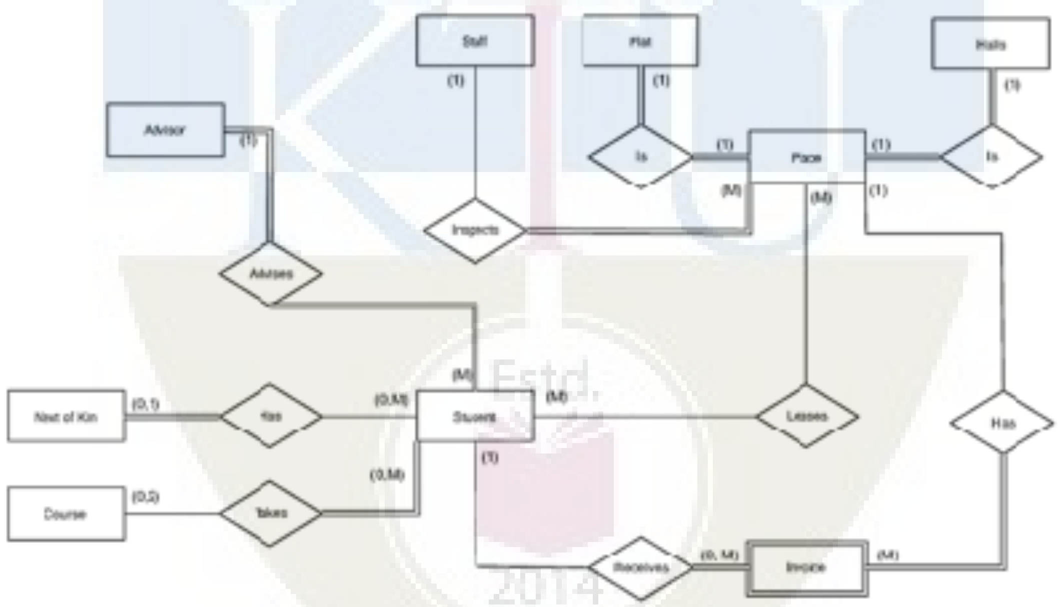
PART B

Answer any one Question from each module. Each question carries 14 Marks

11 a. Design an ER diagram for the following scenario: There is a set of teams, each team has an ID (unique identifier), name, main stadium, and to which city this team belongs. Each team has many players, and each player belongs to one team. Each player has a number (unique identifier), name, DoB, start year, and shirt number that he uses. Teams play matches, in each match there is a host team and a guest team. The match takes place in the stadium of the host team. For each match we need to keep track of the following: The date on which the game is played The final result of the match. The players participated in the match. For each player, how many goals he scored, whether or not he took yellow card, and whether or not he took red card. During the match, one player may substitute another player. We want to capture this substitution and the time at which it took place. Each match has exactly three referees. For each referee we have an ID (unique identifier), name, DoB, years of experience. One referee is the main referee and the other two are assistant referee. (14)

OR

12 a. Interpret the the following ER diagram. (8)



b. Distinguish between physical data independence and logical data independence with suitable examples. (6)

13 **EMPLOYEE(ENO, NAME, ADDRESS, DOB, AGE, GENDER, SALARY, DNUM, SUPERENO)** (14)
DEPARTMENT(DNO, DNAME, DLOCATION, DPHONE, MGRENO)
PROJECT(PNO, PNAME, PLOCATION, PCOST, CDNO)

DNUM is a foreign key that identifies the department to which an employee belongs. MGRENO is a foreign key identifying the employee who manages the department. CDNO is a foreign key identifying the department that controls the project. SUPERENO is a foreign key identifying the supervisor of each employee.

Write relational algebra expressions for the following queries:-

(a) Names of female employees whose salary is more than 20000.
(b) Salaries of employee from ‘Accounts’ department
(c) Names of employees along with his/her superviser’s name
(d) For each employee return name of the employee along with his department name and the names of projects in which he/she works
(e) Names of employees working in all the departments

OR

14 a. Write SQL DDL statements for the the following (Assume suitable domain types): (10)

i. Create the tables STUDENT(ROLLNO, NAME, CLASS, SEM, ADVISER), FACULTY(FID, NAME, SALARY, DEPT). Assume that ADVISER is a foreign key referring FACUTY table.

ii. Delete department with name ‘CS’ and all employees of the department.

iii. Increment salary of every faculty by 10%.

b. Illustrate foreign key constraint with a typical example. (4)

15 For the relation schema below, give an expression in SQL for each of the queries that follows: (14)

employee(<u>employee-name</u>, street, city)
works(<u>employee-name, company-name</u>, salary)
company(<u>company-name</u>, city)
manages(<u>employee-name, manager-name</u>)

a) Find the names, street address, and cities of residence for all employees who work for the Company 'RIL Inc.' and earn more than $10,000.
b) Find the names of all employees who live in the same cities as the companies for which they work.
c) Find the names of all employees who do not work for 'KYS Inc.'. Assume that all people work for exactly one company.
d) Find the names of all employees who earn more than every employee of 'SB Corporation'. Assume that all people work for at most one company.
e) List out number of employees company-wise in the decreasing order of number of employees.

OR

16 a. Consider an EMPLOYEE file with 10000 records where each record is of size 80 bytes. The file is sorted on employee number (15 bytes long), which is the primary key. Assuming un-spanned organization and block size of 512 bytes compute the number of block accesses needed for selecting records based on employee number if, (9)

i. No index is used
ii. Single level primary index is used
iii. Multi-level primary index is used

Assume a block pointer size of 6 bytes.

b. Illustrate correlated and non-correlated nested queries with real examples. (5)

17 a. Illstrate3NF and BCNF with suitable real examples. (6)

b. Given a relation R(A1,A2,A3,A4,A5) with functional dependencies A1→A2A4 and A4→A5, check if the decomposition R1(A1,A2,A3), R2(A1,A4), R3(A2,A4,A5) is lossless. (8)

OR

18 a. Consider the un-normalized relation R(A, B, C, D, E, F, G) with the FDs A→B , AC→G, AD→EF, EF→G, CDE→AB. Trace the normalization process to reach 3NF relations. (7)

	b.	Illustrate Lossless Join Decomposition and Dependency Preserving Decomposition with typical examples.	(7)
19	a.	Discuss the four ACID properties and their importance.	(7)
	b.	Determine if the following schedule is conflict serializable. Is the schedule recoverable? Is the schedule cascade-less? Justify your answers. r1(X), r2(Z), r1(Z), r3(X), r3(Y), w1(X), c1, w3(Y), c3, r2(Y), w2(Z), w2(Y), c2 (Note: ri(X)/wi(X) means transaction Ti issues read/write on item X; ci means transaction Ti commits.)	(7)

OR

20	a.	Discuss the main characteristics of Key-value DB and Graph DB.	(7)
	b.	Illustrate two-phase locking with a schedule containing three transactions. Argue that 2PL ensures serializability. Also argue that 2Pl can lead to deadlock.	(7)

Teaching Plan

	Course Name	Hours (48)
	Module 1: Introduction & ER Model	**8**
1.1	Concept & Overview of DBMS, Characteristics of DB system, Database Users.	1
1.2	Structured, semi-structured and unstructured data. Data Models and Schema	1
1.3	Three-Schema-architecture. Database Languages	1
1.4	Database architectures and classification	1
1.5	ER model: basic concepts, entity set & attributes, notations	1
1.6	Relationships and constraints – cardinality, participation, notations	1
1.7	Weak entities, relationships of degree 3	1
1.8	ER diagram – exercises	1
	Module 2: Relational Model	**7**
2.1	Structure of relational Databases, Integrity Constraints	1
2.2	Synthesizing ER diagram to relational schema, Introduction to relational algebra.	1
2.3	Relational algebra: select, project, Cartesian product operations	1
2.4	Relational Algebra: join - Equi-join, Natural join	1
2.5	Query examples	1
2.6	Introduction to SQL, important data types	1
2.7	DDL, Table definitions and operations – CREATE, DROP, ALTER, INSERT, DELETE, UPDATE	1
	Module 3: SQL DML, Physical Data Organization	**11**
3.1	SQL DML, SQL queries on single and multiple tables	1
3.2	Nested queries (correlated and non-correlated)	1
3.3	Aggregation and grouping	1

	Course Name	Hours (48)
3.4	Views, assertions (with examples)	1
3.5	Triggers (with examples), SQL data types	1
3.6	Review of terms: physical and logical records, blocking factor, pinned and unpinned organization. Heap files, Indexing	1
3.7	Singe level indices, numerical examples	1
3.8	Multi-level-indices, numerical examples	1
3.9	B-Trees and B+Trees (structure only, algorithms not required)	1
3.10	Extendible Hashing	1
3.11	Indexing on multiple keys – grid files	1
	Module 4: Normalization	**8**
4.1	Different anomalies in designing a database, The idea of normalization	1
4.2	Functional dependency, Armstrong's Axioms (proofs not required)	1
4.3	Closures and their computation, Equivalence of FDs, minimal Cover (proofs not required).	1
4.4	1NF, 2NF	1
4.5	3NF, BCNF	1
4.6	Lossless join and dependency preserving decomposition	1
4.7	Algorithms for checking Lossless Join and Dependency preserving properties (Lecture 1)	1
4.8	Algorithms for checking Lossless Join and Dependency preserving properties (Lecture 2)	1
	Module 5: Transactions, Concurrency and Recovery, Recent Topics	**14**
5.1	Transaction Processing Concepts: Transaction Model	1
5.2	Overview of concurrency control, Significance of concurrency Control & Recovery	1
5.3	Transaction States, System Log	1

	Course Name	Hours (48)
5.4	Desirable Properties of transactions, Serial schedules	1
5.5	Concurrent and Serializable Schedules	1
5.6	Conflict equivalence and conflict serializability	1
5.7	Recoverable and cascade-less schedules	1
5.8	Locking, Two-phase locking, strict 2PL.	1
5.9	Log-based recovery	1
5.10	Deferred database modification (serial schedule), example	1
5.11	Deferred database modification (concurrent schedule) example, check-pointing	1
5.12	Introduction to NoSQL Databases	1
5.13	Main characteristics of Key-value DB (examples from: Redis), Document DB (examples from: MongoDB) [detailed study not expected]	1
5.14	Main characteristics of Column-Family DB (examples from: Cassandra) and Graph DB (examples from : ArangoDB) [detailed study not expected]	1

<table>
<tr><td rowspan="2">CST 206</td><td rowspan="2">OPERATING SYSTEMS</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td><td>Year of Introduction</td></tr>
<tr><td>PCC</td><td>3</td><td>1</td><td>0</td><td>4</td><td>2019</td></tr>
</table>

Preamble: Study of operating system is an essential to understand the overall working of computer system, tradeoffs between performance and functionality and the division of jobs between hardware and software. This course introduces the concepts of memory management, device management, process management, file management and security & protection mechanisms available in an operating system. The course helps the learner to understand the fundamentals about any operating system design so that they can extend the features of operating system to detect and solve many problems occurring in operating system and to manage the computer resources appropriately.

Prerequisite: Topics covered in the courses are **Data Structures (CST 201)** and **Programming in C (EST 102)**

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the relevance, structure and functions of Operating Systems in computing devices. (**Cognitive knowledge: Understand**)
CO2	Illustrate the concepts of process management and process scheduling mechanisms employed in Operating Systems. (**Cognitive knowledge: Understand**)
CO3	Explain process synchronization in Operating Systems and illustrate process synchronization mechanisms using Mutex Locks, Semaphores and Monitors (**Cognitive knowledge: Understand**)
CO4	Explain any one method for detection, prevention, avoidance and recovery for managing deadlocks in Operating Systems. (**Cognitive knowledge: Understand**)
CO5	Explain the memory management algorithms in Operating Systems. (**Cognitive knowledge: Understand**)
CO6	Explain the security aspects and algorithms for file and storage management in Operating Systems. **(Cognitive knowledge: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔							✔		✔
CO2	✔	✔	✔	✔						✔		✔
CO3	✔	✔	✔	✔						✔		✔
CO4	✔	✔	✔	✔						✔		✔
CO5	✔	✔	✔	✔						✔		✔
CO6	✔	✔	✔	✔						✔		✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	PO#	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Test 1 (Marks in percentage)	Test 2 (Marks in percentage)	End Semester Examination (Marks in percentage)
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:
Attendance : 10 marks
Continuous Assessment Test : 25 marks
Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:
There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module I

Introduction: Operating system overview – Operations, Functions, Service – System calls, Types – Operating System structure - Simple structure, Layered approach, Microkernel, Modules – System boot process.

Module II

Processes - Process states, Process control block, threads, scheduling, Operations on processes - process creation and termination – Inter-process communication - shared memory systems, Message passing systems.

Process Scheduling – Basic concepts- Scheduling criteria -scheduling algorithms- First come First Served, Shortest Job Firs, Priority scheduling, Round robin scheduling

Module III

Process synchronization- Race conditions – Critical section problem – Peterson's solution, Synchronization hardware, Mutex Locks, Semaphores, Monitors – Synchronization problems - Producer Consumer, Dining Philosophers and Readers-Writers.

Deadlocks: Necessary conditions, Resource allocation graphs, Deadlock prevention, Deadlock avoidance – Banker's algorithms, Deadlock detection, Recovery from deadlock.

Module IV

Memory Management: Concept of address spaces, Swapping, Contiguous memory allocation, fixed and variable partitions, Segmentation, Paging. Virtual memory, Demand paging, Page replacement algorithms.

Module V

File System: File concept - Attributes, Operations, types, structure – Access methods, Protection. File-system implementation, Directory implementation. Allocation methods.
Storage Management: Magnetic disks, Solid-state disks, Disk Structure, Disk scheduling, Disk formatting.

Text Book

Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, ' Operating System Concepts' 9th Edition, Wiley India 2015.

Reference Books:

1. Andrew S Tanenbaum, "Modern Operating Systems" , 4th Edition, Prentice Hall, 2015.
2. William Stallings, "Operating systems", 6th Edition, Pearson, Global Edition, 2015.
3. Garry Nutt, Nabendu Chaki, Sarmistha Neogy, "Operating Systems", 3rd Edition, Pearson Education.
4. D.M.Dhamdhere, "Operating Systems", 2nd Edition, Tata McGraw Hill, 2011.
5. Sibsankar Haldar, Alex A Aravind, "Operating Systems", Pearson Education.

Sample Course Level Assessment Questions

Course Outcome1 (CO1): What is the main advantage of the micro kernel approach to system design? How do user program and system program interact in a microkernel architecture?

Course Outcome 2 (CO2): Define process. With the help of a neat diagram explain different states of process.

Course Outcome 3 (CO3): What do you mean by binary semaphore and counting semaphore? With C, explain implementation of wait () and signal().

Course Outcome 4 (CO4): Describe resource allocation graph for the following. a) with a deadlock b) with a cycle but no deadlock.

Course Outcome 5 (CO5): Consider the following page reference string 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6. Find out the number of page faults if there are 4 page frames, using the following page replacement algorithms. i) LRU ii) FIFO iii) Optimal

Course Outcome 6 (CO6): Explain the different file allocation methods with advantages and disadvantages.

Model Question Paper

QP CODE: PAGES: ___

Reg No:________________
Name:__________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 206

Course name : OPERATING SYSTEMS

Max Marks: 100 **Duration: 3 Hours**

PART-A

(Answer All Questions. Each question carries 3 marks)

1. How does hardware find the Operating System kernel after system switch-on?
2. What is the purpose of system call in operating system?
3. Why is context switching considered as an overhead to the system?

4. How is inter process communication implement using shared memory?

5. Describe resource allocation graph for the following.

   a) with a deadlock   b)with a cycle but no deadlock.

6. What is critical section? What requirement should be satisfied by a solution to the critical section problem?

7. Consider the reference string 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6. How many page faults occur while using FCFS for the following cases.

   a) frame=2   b)frame=3

8. Differentiate between internal and external fragmentations.

9. Compare sequential access and direct access methods of storage devices.

10. Define the terms (i) Disk bandwidth (ii) Seek time.

PART-B(Answer any one question from each module)

11. a) Explain the following structures of operating system (i) Monolithic systems (ii) Layered Systems (iii) Micro Kernel (iv) Modular approach. **(12)**

    b) Under what circumstances would a user be better of using a time sharing system than a PC or a single user workstation? **(2)**

OR

12. a) What is the main advantage of the micro kernel approach to system design? How do user program and system program interact in a microkernel architecture? **(8)**

    b) Describe the differences between symmetric and asymmetric multiprocessing? What are the advantages and disadvantages of multiprocessor systems? **(6)**

13. a) Define process. With the help of a neat diagram explain different states of process. **(8)**

    b) Explain how a new process can be created in Unix using fork system call. **(6)**

OR

14 a) Find the average waiting time and average turnaround time for the processes given in the table below using:- i) SRT scheduling algorithm ii) Priority scheduling algorithm **(9)**

Process	Arrival Time (ms)	CPU Burst Time (ms)	Priority
P1	0	5	3
P2	2	4	1
P3	3	1	2
P4	5	2	4

b) What is a Process Control Block? Explain the fields used in a Process Control Block. **(5)**

15. Consider a system with five processes P_0 through P_4 and three resources of type A, B, C. Resource type A has 10 instances, B has 5 instances and C has 7 instances. Suppose at time t_0 following snapshot of the system has been taken:

Process	Allocation			Max			Available		
	A	B	C	A	B	C	A	B	C
P_0	0	1	0	7	5	3	3	3	2
P_1	2	0	0	3	2	2			
P_2	3	0	2	9	0	2			
P_3	2	1	1	2	2	2			
P_4	0	0	2	4	3	3			

i) What will be the content of the Need matrix? Is the system in a safe state? If Yes, then what is the safe sequence? **(8)**

iii)What will happen if process P_1 requests one additional instance of resource type A and two instances of resource type C? **(6)**

OR

16. a) State dining philosopher's problem and give a solution using semaphores. **(7)**

b) What do you mean by binary semaphore and counting semaphore? With C struct, explain implementation of wait () and signal() **(7)**

17. a) Consider the following page reference string 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6. Find out the number of page faults if there are 4 page frames, using the following page replacement algorithms i) LRU ii) FIFO iii) Optimal **(9)**

b) Explain the steps involved in handling a page fault. **(5)**

OR

18. a) With a diagram, explain how paging is done with TLB. **(5)**

b) Memory partitions of sizes 100 kb, 500 kb, 200 kb, 300 kb, 600 kb are available, how would best ,worst and first fit algorithms place processes of size 212 kb, 417 kb, 112 kb, 426 kb in order. Rank the algorithms in terms of how efficiently they uses memory. **(9)**

19. a) Suppose that a disk drive has 5000 cylinders, numbered 0 to 4999. the drive currently services a request at cylinder 143, and the previous request was at cylinder 125. the queue of pending request in FIFO order is 86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130. Starting from the current position, what is the total distance (in cylinders) that the disk arm moves to satisfy all pending requests for each of the following algorithms

i) FCFS ii) SSFT iii) SCAN iv) LOOK v) C-SCAN **(10)**

b) What is the use of access matrix in protection mechanism? **(4)**

OR

20. a) Explain the different file allocation operations with advantages and disadvantages. **(8)**

b) Explain the following i) file types ii) file operation iii) file attributes **(6)**

Teaching Plan

	Module 1 - Introduction	**5 Hours**
1.1	Introduction to Operating System	1
1.2	Operating System operations, functions, service	1
1.3	System calls, Types	1
1.4	Operating System Structure: Simple, Layered, Microkernel, Modules	1
1.5	System Boot Process	1
	Module 2 – Processes and Process Scheduling	**9 Hours**
2.1	Processes, Process states	1
2.2	Process Control Block, Threads	1

2.3	Scheduling	1
2.4	Operations on processes: process creation and termination	1
2.5	Inter-process communication: Shared memory systems, Message Passing	1
2.6	Process Scheduling – Basic concepts, Scheduling Criteria	1
2.7	Scheduling algorithms - Basics	1
2.8	First come First Served, Shortest Job First	1
2.9	Priority scheduling, Round Robin Scheduling	1
	Module 3 - Process synchronization and Dead locks	**13 Hours**
3.1	Process synchronization, Race conditions	1
3.2	Critical Section problem, Peterson's solution	1
3.3	Synchronization hardware, Mutex Locks	1
3.4	Semaphores	1
3.5	Monitors	1
3.6	Synchronization problem examples (Lecture 1)	1
3.7	Synchronization problem examples (Lecture 2)	1
3.8	Deadlocks: Necessary conditions, Resource Allocation Graphs	1
3.9	Deadlock prevention	1
3.10	Deadlock avoidance	1
3.11	Banker's algorithm	1
3.12	Deadlock detection	1
3.13	Deadlock recovery	1
	Module 4 - Memory Management	**9 Hours**
4.1	Memory Management: Concept of Address spaces	1
4.2	Swapping	1
4.3	Contiguous memory allocation, fixed and variable partitions	1
4.4	Segmentation.	1
4.5	Paging (Lecture 1)	1
4.6	Paging (Lecture 2)	1
4.7	Virtual memory, Demand Paging	1

4.8	Page replacement algorithms (Lecture 1)	1
4.9	Page replacement algorithms (Lecture 2)	1
	Module 5 - File and Disk management	**9 Hours**
5.1	File concept, Attributes, Operations, types, structure	1
5.2	Access methods	1
5.3	Protection	1
5.4	File-System implementation	1
5.5	Directory implementation	1
5.6	Allocation methods	1
5.7	Magnetic disks, Solid-state disks, Disk structure	1
5.8	Disk scheduling	1
5.9	Disk formatting	1

ADL202	PYTHON AND STATISTICAL MODELLING LAB	Category	L	T	P	Credits	Year of introduction
		PCC	0	0	3	2	2019

Preamble: The Python and Statistical modelling course is intended to impart the elementary concepts of Python and apply various statistical techniques to a variety of data. This course provides the learners with hands-on experience in Python and statistical processes like measures of central tendency, measures of dispersion, probability distributions, graphical analysis, correlation analysis and use of statistical analysis software. The course enables the students to get an exposure to Python programming and use proper methods to analyze and interpret data effectively.

Prerequisite: A basic knowledge of Probability and Statistical Modelling.

Course Outcomes: After the completion of the course the student will be able to

CO#	Course Outcomes
CO 1	Experiment with concepts of iteration, function, string and list **(Cognitive Knowledge Level: Apply)**
CO 2	Identify the importance of tuples, dictionary traversal, dictionary methods, files and operations **(Cognitive Knowledge Level: Apply)**
CO 3	Model graphical representation of data, measures of central tendency and measures of dispersion **(Cognitive Knowledge Level: Apply)**
CO 4	Solve problems based on Binomial distribution, Poisson distribution, sampling and regression analysis **(Cognitive Knowledge Level: Apply)**
CO 5	Make use of various correlation tests and utilize statistical analysis software **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔					✔				✔
CO2	✔	✔	✔	✔				✔				✔
CO3	✔	✔	✔	✔				✔				✔
CO4	✔	✔	✔	✔				✔				✔
CO5	✔	✔	✔	✔	✔			✔				✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests	End Semester Examination (Percentage)
Remember	20	20
Understand	20	20
Apply	60	60
Analyze		
Evaluate		
Create		

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	75	75	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks
Continuous Evaluation in Lab : 30 marks
Continuous Assessment Test : 15 marks
Viva Voce : 15 marks

Internal Examination Pattern:

The marks will be distributed as Design/Algorithm 30 marks, Implementation/Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

End Semester Examination Pattern:

The marks will be distributed as Design/Algorithm 30 marks, Implementation/Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks will be converted out of 75 for End Semester Examination.

Fair Lab Record:

All Students attending the Statistical Modelling Using Python Lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record, the right-hand page should contain Experiment Heading, Experiment Number, Date of experiment, Aim of the Experiment and the operations performed on them, Details of experiment including algorithm and result of Experiment. The left-hand page should contain a print out of the code used for experiment and sample output obtained for a set of input.

SYLLABUS

PYTHON AND STATISTICAL MODELLING LAB

1. Familiarization of expressions, conditional and iteration statements.
2. Problems on function and function calls. **
3. String traversal and other important string methods. **
4. List traversal and list operations. **
5. Tuples, dictionary traversal and dictionary methods. **
6. Problems based on files and operations. **
7. Problems on graphical representation of data. **
8. Problems based on measures of central tendency and measures of dispersion using raw data and grouped data. **
9. Application problems based on Binomial and Poisson distribution. **
10. Implement Chi-square test for goodness of fit. **
11. Perform t-test for difference of means. **
12. Implement Correlation tests. (Karl Pearson correlation coefficient and Spearman rank correlation coefficient).
13. Estimation of gain in precision due to stratification. **
14. Analysis of a one way/ two-way ANOVA.
15. Problems on Lines of regression, regression coefficients, angle between regression lines.
16. Familiarization with statistical analysis software. (SPSS or similar) **

**mandatory

PYTHON AND STATISTICAL MODELLING LAB – Practice Questions

1. Write a program to find the largest of three numbers.
2. Write a program to print the multiplication table of a number n.
3. Write a program to find Surface area and volume of a cylinder using function.
4. Write a program to replace a word by another word in a sentence.
5. Write a program to confirm the validity of an email id by verifying its format.
6. Write a program to remove every occurrence of a number from a list.
7. Write a program to add two matrices.
8. Write a program to read a tuple of numbers and print even tuple and odd tuple.
9. Create a dictionary with a set of book title and corresponding stock. Write a program to update the stock and to add or delete books.
10. A set of numbers are stored in a file. Write a program to print the prime numbers among them.
11. Write a program to count the number of words, sentences, upper case letters, lowercase letters and special symbols in a text stored in file.
12. Plot a graph y = f(x).
13. The areas of the various continents of the world (in millions of square miles) are as follows:11.7 for Africa; 10.4 for Asia; 1.9 for Europe; 9.4 for North America; 3.3 Oceania; 6.9 South America; 7.9 Soviet Union. Draw a bar chart representing the given data.
14. Draw the histogram of the following data:

Height of student(m)	135 - 140	140 - 145	145 - 150	150 - 155
No. of students	4	12	16	8

15. Table contains population and murder rates (in units of murders per 100,000 people per year) for different states. Compute the mean, median and variance for the population.

State	**Population**	**Murder**
Alabama	4,779,736	5.7
Alaska	710,231	5.6
Arizona	6,392,017	4.7
Arkansas	2,915,918	5.6
California	37,253,956	4.4
Colorado	5,029,196	2.8
Connecticut	3,574,097	2.4
Delaware	897,934	5.8

16. Calculate the S.D. and coefficient of variation (C.V.) for the following table:

Class:	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Frequency:	5	10	20	40	30	20	10	5

17. If X is binomially distributed with 6 trials and a probability of success equal to 0.25 at each attempt, what is the probability of:
    a) exactly 4 successes b) at least one success
18. If the random variable X follows a Poisson distribution with mean 3.4, find P(X=6).
19. A random sample of 395 people were surveyed and each person was asked to report the highest education level they obtained. The data that resulted from the survey is summarized in the following table. Are gender and education level dependent at 5% level of significance?

	High School	Bachelors	Masters	Ph.D.	Total
Female	60	54	46	41	201
Male	40	44	53	57	194
Total	100	98	99	98	395

20. Calculate the correlation coefficient of the two variables shown in the table below.

Person	Hand	Height
A	17	150
B	15	154
C	19	169
D	17	172
E	21	175

21. Suppose a sample of 16 light trucks is randomly selected off the assembly line. The trucks are driven 1000 miles and the fuel mileage (MPG) of each truck is recorded. It is found that the mean MPG is 22 with a SD equal to 3. The previous model of the light truck got 20 MPG. Conduct a t- test of the null hypothesis at p = 0.05

22. The mean productivity rating for all employees at a company was 3.8 on a five-point scale last year. This year you get ratings from a representative sample of fifteen employees from the Human Research Management. Do the data from this sample provide evidence that employee productivity in the department of Human Resource Management is significantly higher than in the company as a whole? Write the null and alternative hypotheses for this problem. Use statistical analysis software to test the null hypothesis stated above.

23. Obtain the regression equation for predicting systolic blood pressure from job satisfaction with reference to the given data using statistical analysis software. If one knows that a subject in the future has a score on job satisfaction of 15, what is their systolic blood pressure predicted to be? What is the standard error of estimate?

Job Satisfaction	Systolic BP
34	124
23	128
19	157
43	133
56	116
47	125
32	147
16	167
55	110
25	156

<table>
<tr><td rowspan="2">CSL204</td><td rowspan="2">OPERATING SYSTEMS LAB</td><td>CATEGORY</td><td>L</td><td>T</td><td>P</td><td>CREDIT</td><td>YEAR OF INTRODUCTION</td></tr>
<tr><td>PCC</td><td>0</td><td>0</td><td>3</td><td>2</td><td>2019</td></tr>
</table>

Preamble: The course aims to offer students a hands-on experience on Operating System concepts using a constructivist approach and problem-oriented learning. Operating systems are the fundamental part of every computing device to run any type of software.

Prerequisite: Topics covered in the courses are **Data Structures (CST 201)** and **Programming in C (EST 102)**

Course Outcomes:

At the end of the course, the student should be able to

CO1	Illustrate the use of systems calls in Operating Systems. **(Cognitive knowledge: Understand)**
CO2	Implement Process Creation and Inter Process Communication in Operating Systems. **(Cognitive knowledge: Apply)**
CO3	Implement Fist Come First Served, Shortest Job First, Round Robin and Priority-based CPU Scheduling Algorithms. **(Cognitive knowledge: Apply)**
CO4	Illustrate the performance of First In First Out, Least Recently Used and Least Frequently Used Page Replacement Algorithms. **(Cognitive knowledge: Apply)**
CO5	Implement modules for Deadlock Detection and Deadlock Avoidance in Operating Systems. **(Cognitive knowledge: Apply)**
CO6	Implement modules for Storage Management and Disk Scheduling in Operating Systems. **(Cognitive knowledge: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓					✓		✓		✓
CO2	✓	✓	✓					✓		✓		✓
CO3	✓	✓	✓	✓				✓		✓		✓
CO4	✓	✓	✓	✓				✓		✓		✓
CO5	✓	✓	✓	✓				✓		✓		✓
CO6	✓	✓	✓	✓				✓		✓		✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern:

Bloom's Category	**Continuous Assessment Test (Internal Exam) Marks in percentage**	**End Semester Examination Marks in percentage**
Remember	20	20
Understand	20	20
Apply	60	60
Analyse		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**75**	**75**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Evaluation in Lab : 30 marks

Continuous Assessment Test : 15 marks

Viva Voce : 15 marks

Internal Examination Pattern: The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

End Semester Examination Pattern: The percentage of marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 75 marks.

Operating System to Use in Lab : Linux

Compiler/Software to Use in Lab : gcc

Progamming Language to Use in Lab : Ansi C

Fair Lab Record:

All Students attending the Operating System Lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record, the right hand page should contain Experiment Heading, Experiment Number, Date of experiment, Aim of the Experiment and the operations performed on them, Details of experiment including algorithm and result of Experiment. The left hand page should contain a print out of the code used for experiment and sample output obtained for a set of input.

SYLLABUS

OPERATING SYSTEMS LAB

* mandatory

1. Basic Linux commands
2. Shell programming
   - -Command syntax
   - -Write simple functions with basic tests, loops, patterns
3. System calls of Linux operating system:*
   fork, exec, getpid, exit, wait, close, stat, opendir, readdir
4. Write programs using the I/O system calls of Linux operating system (open, read, write)
5. Implement programs for Inter Process Communication using Shared Memory *
6. Implement Semaphores*
7. Implementation of CPU scheduling algorithms. a) Round Robin b) SJF c) FCFS d) Priority *
8. Implementation of the Memory Allocation Methods for fixed partition*
   a) First Fit b) Worst Fit c) Best Fit
9. Implement l page replacement algorithms a) FIFO b) LRU c) LFU*
10. Implement the banker's algorithm for deadlock avoidance. *
11. Implementation of Deadlock detection algorithm
12. Simulate file allocation strategies.
    b) Sequential b) Indexed c) Linked
13. Simulate disk scheduling algorithms. *
    c) FCFS b)SCAN c) C-SCAN

OPERATING SYSTEMS LAB - PRACTICE QUESTIONS

1. Write a program to create a process in linux.
2. Write programs using the following system calls of Linux operating system:
   fork, exec, getpid, exit, wait, close, stat, opendir, readdir
3. Write programs using the I/O system calls of Linux operating system (open, read, write)

4. Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for FCFS and SJF. For each of the scheduling policies, compute and print the average waiting time and average turnaround time
5. Write a C program to simulate following non-preemptive CPU scheduling algorithms to find turnaround time and waiting time.

   a)FCFS b) SJF c) Round Robin (pre-emptive) d) Priority
6. Write a C program to simulate following contiguous memory allocation techniques

   a) Worst-fit b) Best-fit c) First-fit
7. Write a C program to simulate paging technique of memory management.
8. Write a C program to simulate Bankers algorithm for the purpose of deadlock avoidance.
9. Write a C program to simulate disk scheduling algorithms a) FCFS b) SCAN c) C-SCAN
10. Write a C program to simulate page replacement algorithms a) FIFO b) LRU c) LFU
11. Write a C program to simulate producer-consumer problem using semaphores.
12. Write a program for file manipulation for display a file and directory in memory.
13. Write a program to simulate algorithm for deadlock prevention.
14. Write a C program to simulate following file allocation strategies.

    a)Sequential b) Indexed c) Linked

SEMESTER IV

HONOURS

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT	Year of Introduction
CST292	NUMBER THEORY	VAC	4	0	0	4	2019

Preamble: This is the foundational course for awarding B. Tech. Honours in Computer Science and Engineering with specialization in ***Security in Computing***. The purpose of this course is to create awareness among learners about the important areas of number theory used in computer science. This course covers Divisibility & Modular Arithmetic, Primes & Congruences, Euler's Function, Quadratic Residues and Arithmetic Functions, Sum of Squares and Continued fractions. Concepts in Number Theory help the learner to apply them eventually in practical applications in Computer organization & Security, Coding & Cryptography, Random number generation, Hash functions and Graphics.

Prerequisite: A sound background in Higher Secondary School Mathematics

Course Outcomes: After the completion of the course the student will be able to

CO1	Illustrate modular arithmetic operations, methods and techniques **(Cognitive Knowledge Level:Understand)**
CO2	Use the methods - Induction, Contraposition or Contradiction to verify the correctness of mathematical assertions **(Cognitive Knowledge Level: Apply)**
CO3	Utilize theorems and results about prime numbers, congruences, quadratic residues and integer factorization for ensuring security in computing systems **(Cognitive Knowledge Level: Analyse)**
CO4	Illustrate uses of Chinese Remainder Theorem & Euclidean algorithm in Cryptography and Security **(Cognitive Knowledge Level: Apply)**
CO5	Explain applications of arithmetic functions in Computer Science **(Cognitive Knowledge Level:Understand)**
CO6	Implement Number Theoretic Algorithms using a programming language **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓						✓		✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓		✓						✓
CO4	✓	✓	✓	✓		✓						✓
CO5	✓	✓	✓	✓						✓		✓
CO6	✓	✓	✓	✓	✓			✓				✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (Percentage)
	Test1 (Percentage)	Test2 (Percentage)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

Module 1

Divisibility and Modular Arithmetic:

Finite Fields – Groups, Rings and Fields.

Divisibility - Divisibility and Division Algorithms, Well ordering Principle,Bezout's Identity.

Modular Arithmetic- Properties, Euclid's algorithm for the greatest common divisor, Extended Euclid's Algorithm, Least Common multiple, Solving Linear Diophantine Equations, Modular Division.

Module 2

Primes and Congruences:

Prime Numbers-Prime Numbers andprime-powerfactorization, Fermat and Mersenne primes., Primality testing and factorization.

Congruences-Linear congruences, Simultaneous linear congruences, Chinese Remainder Theorem, Fermat's little theorem, Wilson's theorem.

Module 3

Congruences with a Prime-Power Modulus&Euler's Function:

Congruences with a Prime-Power Modulus-Arithmetic modulo p, Pseudoprimes and Carmichael numbers, Solving congruences modulo prime powers.

Euler's Function-Euler's Totient function, Applications of Euler's Totient function, Traditional Cryptosystem, Limitations.

The Group of units- The group U_n,Primitive roots, Existence of primitive roots, Applications of primitive roots.

Module 4

Quadratic Residues & Arithmetic Functions :

Quadratic Residues- Quadratic Congruences, The group of Quadratic residues, Legendre symbol, Jacobi Symbol, Quadratic reciprocity.

Arithmetic Functions- Definition and examples, Perfect numbers, Mobius function and its properties, Mobius inversion formula, The Dirichlet Products.

Module 5

Sum of Squares and Continued Fractions:

Sum of Squares- Sum of two squares, The Gaussian Integers, Sum of three squares, Sum of four squares.

Continued Fractions -Finite continued fractions, Infinite continued fractions, Pell's Equation, Solution of Pell's equation by continued fractions.

Text Books

1. G.A. Jones & J.M. Jones, Elementary Number Theory, Springer UTM, 2007.

2. Joseph Silverman, A Friendly introduction to Number Theory, Pearson Ed. 2009.

Reference Books

1. William Stallings, Cryptography and Network Security Principles and Practice, Pearson Ed.

2. Tom M.Apostol, 'Introduction to Analytic Number Theory', Narosa Publishing House Pvt. Ltd, New Delhi, (1996).

3. Neal Koblitz, A course in Number Theory and Cryptography, 2nd Edition, Springer ,2004.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1): Describe the properties of modular arithmetic and modulo operator.

Course Outcome 2 (CO2): Prove that the equation $y^2 = x^3 - 2$ has only the integer solution $(3, \pm 5)$.

Course Outcome 3 (CO3): State the law of reciprocity for Jacobi symbols and use it to determine whether 888 is a quadratic residue or non residue of the prime 1999.

Course Outcome 4 (CO4): Using Chinese remainder theorem, solve the system of congruence $x \equiv 2 \pmod 3$, $x \equiv 3 \pmod 5$, $x \equiv 2 \pmod 7$

Course Outcome 5(CO5): State and prove Dirichlet product.

Course Outcome 6 (CO6): Use extended Euclid's algorithm to solve Diophantine equations efficiently. Given three numbers $a>0$, $b>0$, and c, the algorithm should return some x and y such that $a x + b y = c$.

Model Question Paper

QP CODE: PAGES: 03

RegNo : …............................... Name :………..……………

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER BTECH (HONOURS) DEGREE EXAMINATION, MONTH &YEAR

Course Code:CST 292 Course
Name: Number Theory

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks (10x3=30)

1. State and prove well ordering principle.
2. Find gcd d of x=525 and y=231 and express d as ax + by where a and b are integers.
3. Solve the congruence equation 103 x≡ 57 (mod 211).
4. Use Fermat's Little theorem to show that 91 is not a prime.
5. If m is relatively prime to n , show that $\Phi(mn) = \Phi(m)\ \Phi(n)$.
6. Explain how public key cryptography can be used for digital signatures.
7. Define Mobius function and prove Mobius function is a multiplicative.
8. State and prove Dirichlet product.
9. Show that every prime of the form 4k+1 canbe represented uniquely as the sum of two squares.
10. Find the continued fraction representation of the rational number 55/89.

Part B

Answer any one Question from each module.
Each question carries 14 Marks

11. (a) State the Euclidean algorithm and its extension with an example. (7)

    (b) Find all the solutions of 24x + 34 y = 6. (7)

OR

12. (a) Describe the properties of modular arithmetic and modulo operator. (7)

    (b) Explain Extended Euclidean algorithm. Using the algorithm find the multiplicative inverse of 135 mod 61 (7)

13. (a) State and prove Wilson's theorem . (7)

(b) Explain Fermat's factorization method and use it to factor 809009 (7)

OR

14. (a) Using Chinese remainder theorem, solve the system of congruences, $x \equiv 2 (\text{mod } 3)$, $x \equiv 3 (\text{mod } 5)$, $x \equiv 2 (\text{mod } 7)$ (7)

(b) Define Fermat primes. Show that any two distinct Fermat numbers are Relatively prime. (7)

15. (a) Distinguish between public key and private key encryption techniques. Also point out the merits and demerits of both. (7)

(b) Define Carmichael number and show that a Carmichael number must be the product of at least three distinct primes. (7)

OR

16. (a)Define a pseudo prime to a base and find all non trivial bases for which 15 is a pseudo prime. (6)

(b) Find an element of

i) order 5 modulo 11 ii) order 4 modulo 13

iii) order 8 modulo 17 iv) order 6 modulo 19 (8)

17. (a) Determine the quadratic residues and non residues modulo 17. Also determine whether 219 is a quadratic residue or non residue of the prime 383. (8)

(b) State the law of quadratic reciprocity. Determine those odd primes p for which 3 is a quadratic residue and those for which it is a non residue. (6)

OR

18. (a) State and prove properties of Legendre's symbol. (7)

(b) State the law of reciprocity for Jacobi symbols and using it determine whether 888 is a quadratic residue or non residue of the prime 1999. (7)

19. (a) Prove that the equation $y^2 = x^3 - 2$ has only the integer solution $(3, \pm 5)$. (7)

(b) Define a Gaussian integer. Factorize the Gaussian integer 440 − 55i. (7)

OR

20. (a) If *m*, and *n* can be expressed as sum of four squares, then show that *mn* can also be expressed the sum of four squares. (7)

(b) Find all the solutions of the Diophantine equation $x^2 - 6y^2 = 1$. (7)

Teaching Plan

Module 1: Divisibility and Euclidean Algorithm		**9 hours**
1.1	Finite Fields – Groups and Rings.	1 hour
1.2	Finite Fields – Fields.	1 hour
1.3	Divisibility and Division Algorithms, Well ordering Principle.	1 hour
1.4	Decimal Expansion of a positive Integer, Greatest Common Divisor, Bezout's Theorem.	1 hour
1.5	Modular Arithmetic- Properties of congruences, Modular Arithmetic Operations, Properties of Modular Arithmetic.	1 hour
1.6	Euclid's algorithm for the greatest common divisor, Extended Euclid's Algorithm.	1 hour
1.7	Solving Linear Diophantine Equations.	1 hour
1.8	Least Common multiple and Modular Division.	1 hour
1.9	Implementation of Euclid's algorithm, Extended Euclid's Algorithm and solution of Linear Diophantine Equations.	1 hour
Module 2: Primes and Congruences		**9 hours**
2.1	Prime Numbersand prime-powerFactorization.	1 hour
2.2	Fermat and Mersenne primes.	1 hour
2.3	Primality testing and factorization, Miller -Rabin Test for Primality.	1 hour
2.4	Pollard's Rho Method for Factorization, Fermat's Factorization.	1 hour

2.5	Linear congruences, Simultaneous linear congruences.	1 hour
2.6	Chinese Remainder Theorem.	1 hour
2.7	Implementation of Chinese Remainder Theorem.	1 hour
2.8	Fermat's little theorem.	1 hour
2.9	Wilson's theorem.	1 hour
Module 3: Congruences with a Prime-Power Modulus &Euler's Function		**9 hours**
3.1	Congruences with a Prime-Power Modulus, Arithmetic modulo p.	1 hour
3.2	Pseudo-primes and Carmichael numbers.	1 hour
3.3	Solving congruences modulo prime powers.	1 hour
3.4	Definition of Euler Totient function, Examples and properties.	1 hour
3.5	Multiplicativity of Euler's Totient function.	1 hour
3.6	Applications of Euler’s function, Euler’s Theorem.	1 hour
3.7	Traditional Cryptosystem, Limitations, Public Key Cryptography.	1 hour
3.8	The Group of Units, Primitive Roots.	1 hour
3.9	Existence of primitive roots for Primes, Applications of primitive roots.	1 hour
Module 4: Quadratic Residues and Arithmetic Functions		**9 hours**
4.1	Quadratic congruences, The group of Quadratic Residues.	1 hour
4.2	Legendre symbol, Jacobi Symbol.	1 hour
4.3	Quadratic reciprocity.	1 hour
4.4	Quadratic residues for prime-power moduli.	1 hour
4.5	Arithmetic Functions: Definition and examples.	1 hour

4.6	Perfect numbers, Definition and proposition.	1 hour
4.7	Mobius inversion formula., application of the Mobius inversion formula.	1 hour
4.8	Mobius function and its properties.	1 hour
4.9	The Dirichlet Product, Definition and proof.	1 hour
Module 5: Sum of Squares and Continued Fractions		**9 hours**
5.1	Sum of Squares, Sum of two squares.	1 hour
5.2	The Gaussian Integers.	1 hour
5.3	Sum of three squares.	1 hour
5.4	Sum of four squares.	1 hour
5.5	Continued Fractions, Finite continued fractions.	1 hour
5.6	Continued Fractions, Finite continued fractions.	1 hour
5.7	Infinite continued fractions.	1 hour
5.8	Pell's Equation, Definition.	1 hour
5.9	Solution of Pell's equation by continued fractions.	1 hour

ADT294	COMPUTATIONAL FUNDAMENTALS FOR BIOINFORMATICS	Category	L	T	P	Credit	Year of Introduction
		VAC	3	1	0	4	2020

Preamble: Bioinformatics is an interdisciplinary area that combines Computer Science, Molecular Biology, and Mathematics and allied areas of Science. This course covers computational fundamentals of Bioinformatics and Computational Biology such as DNA, genes and proteins, transcription, translation, sequence alignment, representation and basic Python programming required for handling bioinformatics data. The learners will be able to solve basic bioinformatics problems using python programming.

Prerequisite: Basic understanding of programming languages.

Mapping of course outcomes with program outcomes

CO 1	Describe the basic concepts of Bioinformatics with an emphasis on biological macromolecules-DNA, RNA and Protein and synthesis of biomolecules (**Cognitive knowledge level : Understand**)
CO 2	Identify biological data formats and databases, retrieve bio-sequences, and align bio-sequences to identify similarity, dynamic programming (**Cognitive knowledge level : Apply)**
CO 3	Illustrate nucleotide attributes and transcription using programming tools (**Cognitive knowledge level : Apply)**
CO 4	Demonstrate the concepts of Parsing FASTA and Sequences Analysis (**Cognitive knowledge level : Apply)**
CO 5	Compute k-mers, translation of DNA subsequences and Open reading frame. (**Cognitive knowledge level : Apply**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√									√
CO2	√	√	√	√	√	√						√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√								√

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	Test1 (%)	Test2 (%)	
Remember	**10**	**10**	**10**
Understand	**30**	**30**	**70**
Apply	**10**	**10**	**20**
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance 10 marks

Continuous Assessment Tests (Average of Internal Tests 1 & 2) 25 marks

Continuous Assessment Assignment 15 marks

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

Module-1 (Introduction to bioinformatics)
Introduction to bioinformatics, Nature & Scope of Bioinformatics, animal vs plants, Eukaryote vs prokaryote,Nucleus. Chromosome, gene DNA, RNA, amino acids, and Protein, The Central Dogma, Messenger RNA, tRNA, rRNA, Genetic code, Gene Structure, Transcription, translation.

Module-2 (Introduction to bio sequences and analysis)
Introduction to Biological Databases and data storage, NCBI, Genbank, Bio sequence formats-Database Similarity Searching, BLAST, Sequence alignment, Scoring Matrices, Multiple-Sequence Alignment, Dynamic programming

Module 3: (Introduction to Processing Nucleotides)
Tetranucleotide Frequency, Counting the Nucleotides, Writing and Verifying a Solution, Transcribing DNA into mRNA: Mutating Strings, Reading and Writing Files, Reverse Complement of DNA, String Manipulation, Iterating Over a Reversed String.

Module 4: (Processing Nucleotides GC Content and Hamming Distance)
Creating the Fibonacci Sequence, Writing, Testing, and Benchmarking Algorithms, retrieving FASTA Using Biopython, Iterating the Sequences Using a for Loop, Parsing FASTA and Analyzing Sequences, Computing GC Content, Finding the Hamming Distance, Counting Point Mutations

Module 5 (Translation of DNA and subsequence)

K-mers and Codons, Translating Codons, Translating mRNA into Protein, Finding Subsequences of DNA, Find a Motif in DNA, Finding Overlapping Patterns Using Regular Expressions, Sequence Similarity, Finding the Shortest Sequence in a FASTA File, Extracting K-mers from a Sequence, Counting Frequencies of K-mers, Finding Open Reading Frames

Text Books

1. Mount, D. W.. Bioinformatics: Sequence and Genome Analysis. India, CBS Publishers & Distributors, 2005.
2. Youens-Clark, Ken. *Mastering Python for Bioinformatics*. United States: O'Reilly Media, 2021.

References

1. Kelley, S.T. and Didulo, D, *Computational Biology: A Hypertextbook*. John Wiley & Sons, 2020
2. Baxevanis, Andreas D., Gary D. Bader, and David S. Wishart, eds. *Bioinformatics*. John Wiley & Sons, 2020.
3. Shaik, Noor Ahmad, et al. *Essentials of Bioinformatics, Volume I.* Springer, 2019
4. Selzer, Paul M., Richard J. Marhöfer, and Andreas Rohwer, *Applied bioinformatics*. *An introduction–Springer, Verlag,*, 2008.
5. S C Rastogi, N Mendiratta and P Rastogi, *Bioinformatics: Methods and Applications,* PHI Learning Private Limited, New Delhi, 2015.
6. D E Krane and M L Raymer, *Fundamental Concepts of Bioinformatics*, Pearson Education, 2006.
7. Bassi, Sebastian. *Python for Bioinformatics*. United Kingdom: CRC Press, 2017.
8. Model, Mitchell L. Bioinformatics Programming Using Python. United States: O'Reilly Media, 2010.
9. Antao, Tiago. *Bioinformatics with Python Cookbook*. United Kingdom: Packt Publishing, 2015.Antao, Tiago. Bioinformatics with Python Cookbook: Learn how to Use Modern Python Bioinformatics Libraries and Applications to Do Cutting-edge Research in Computational Biology, 2nd Edition. United Kingdom: Packt Publishing, 2018.

Course Level Assessment Questions

Course Outcome 1 (CO1)

1. Compare and contrast the DNA and RNA on the basis of structure and functions.
2. Demonstrate with the help of a flow diagram the generation of protein using the transcription and translation process.

Course Outcome 2 (CO2):

1. Identify the following qualifiers for GenBank and give their definitions: [ACCN], [ALL], [AUTH], [ECNO], [FKEY], [GENE], [JOUR], [KYWD]

2. Find the sequence alignment between the following two sequences, locally and Globally
   Sequence1: GATTCTATCTAACTA, Sequence2: GTTCTATTCTAAC
3. Retrieve sequence of Severe acute respiratory syndrome coronavirus 2 and use BLAST to find the similar sequences

Course Outcome 3 (CO3):

1. Write a Python program pseudocode to read the below given sequence as command line argument and print the counts for each of the bases A, C, G, and T.
   Sequence: ACTGCAACGGGCAATATGTCTC
2. Write a python pseudocode to transcribe the following DNA sequence to its mRNA sequence.
   Sequence: TGCAACGGGCAATATGTCTC

Course Outcome 4 (CO4)

1. Solve the problem of generating the Fibonacci sequence using Python**.**
2. Use a simple python program using a list to find the DNA string having the highest GC content, provided any 5 random DNA strings.

Course Outcome 5 (CO5)

1. Illustrate with the help of an example how an RNA string is getting converted to a protein string.
2. Write a python code to print the position and the number of times a subsequence is present in a given DNA string.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE (HONOURS) EXAMINATION, MONTH & YEAR

Course Code: ADT294

Course Name: COMPUTATIONAL FUNDAMENTALS FOR BIOINFORMATICS

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Differentiate DNA, Gene, genome and chromosome.
2. What do you mean by Gene expression?
3. Specify the functions of mRNA, tRNA and rRNA?
4. Differentiate between local and global alignment.
5. Find the reverse complement of the following DNA given in 5’-3’order? AAAACCCGGT
6. List any 3 string manipulation construct used in processing nucleotides.
7. Illustrate how recursion is implemented using a Python pseudocode.
8. What is GC content? Give the GC content of the DNA string: “AGCTATAG”.
9. Discuss the role of K-mers and codons in protein synthesis.
10. Define motif in DNA. Mention its importance in finding a conserved sequence.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Discuss the central dogma of molecular biology. **(7)**

(b) How is the primary transcript produced by a prokaryote different from that produced by a eukaryotic cell? **(7)**

OR

12. (a) Differentiate between Prokaryote and Eukaryote Cell **(7)**

(b) Describe with the help of a neat diagram, the structure of DNA. **(7)**

13. (a) What is sequence alignment? Explain any five applications of sequence alignment in Bioinformatics? **(7)**

(b) Discuss variants of BLAST with its input and output **(7)**

OR

14. (a) Explain the working principles of the Nucleotide BLAST with an example **(7)**

(b) Differentiate primary and secondary databases in Bioinformatics. **(7)**

15. (a) How do you find the reverse complement of a DNA sequence? Write at least 2 different Python pseudocodes using different constructs to print the reverse complement of a given the 5'-3' end of a DNA sequence. **(10)**

(b) Write a Python pseudocode to convert DNA sequence to RNA sequence by using the re.sub() regular expression construct. **(4)**

OR

16. (a) What is the need for 'argparse' module in Python? How can we use this module in different ways to do a tetra nucleotide frequency count? **(7)**

(b) Write a Python program pseudocode to read the below given sequence as command line argument and print the counts for each of the bases A, C, G, and T. **(7)**

17. (a) Generate a random DNA sequence using python and find the transcribed (7)

DNA sequence of its reverse complement

(b) Write a python code using regular expressions to find the DNA sequence having the highest GC content in a DNA sequence. **(7)**

OR

18. (a) Define Hamming distance. Using hamming distance, find the percentage of similarity between the sequence AAACCCGGGTTT and AACCCGGGTTTA with one sequence in line with other. **(7)**

(b) Write a Python code using zip() function to find the hamming distance between 2 sequence. Give comments on each construct used in the code. **(7)**

19. (a) Write a Python program using function and a list comprehension to translate RNA into protein. Illustrate working of the program with an example RNA string. **(10)**

(b) Illustrate with python pseudocode to show how the str.find( ) function can be used to find a substring and its position in an input sequence. **(4)**

OR

20. (a) Illustrate with the help of an example how an RNA string is getting converted to a protein string.. **(6)**

(b) Write notes on ORF. Write a python code to find the ORF using the str.find( ) and str.partition( ) functions. **(8)**

TEACHING PLAN

No	Contents	No of Lecture Hrs
Module-1 (Introduction to bioinformatics)(10 hrs)		
1.1	Introduction to bioinformatics	1
1.2	Nature & Scope of Bioinformatics	1
1.3	Animal vs plants, Eukaryote vs prokaryote	1
1.4	Nucleus. Chromosome, gene	1
1.5	DNA, RNA, and Protein	1
1.6	The Central Dogma introduction	1
1.7	Messenger RNA, tRNA, rRNA,	1
1.8	Genetic code	1
1.9	Gene Structure and Control	1
1.10	Transcription, Translation	1
Module-2 (Introduction to bio sequences and analysis) (10 hrs)		
2.1	Introduction to Biological Databases and data storage	1
2.2	NCBI, Genbank	1
2.3	NCBI, Genbank Sequence retrieval	1
2.4	Bio sequence formats	1
2.5	Database Similarity Searching, BLAST	1
2.6	BLAST Exercises	1
2.7	Sequence alignment	1
2.8	Scoring Matrices	1
2.9	Multiple-Sequence Alignment	1
2.10	Introduction to Dynamic programming in MSA	1
Module-3 (Introduction to Processing Nucleotides) (8 hrs)		
3.1	Counting the Nucleotides, Writing and Verifying a Solution	1

3.2	Transcribing DNA into mRNA	1
3.3	Iterating the Input Files	1
3.4	Mutating Strings	1
3.5	Writing and Reading Output Sequences	1
3.6	Reverse Complement of DNA	1
3.7	String Manipulation	1
3.8	Iterating Over a Reversed String	1

Module-4 (Processing Nucleotides GC Content and Hamming Distance) (8 hrs)		
4.1	Creating the Fibonacci Sequence	1
4.2	Writing, Testing, and Benchmarking Algorithms	1
4.3	Retrieving FASTA Using Biopython	1
4.4	Parsing FASTA and Analysing Sequences	1
4.5	Computing GC Content	1
4.6	Finding the Hamming Distance	1
4.7	Iterating the Characters of Two Strings	1
4.8	Counting Point Mutations	1
Module-5 (Translation of DNA and subsequence) (9 hrs)		
5.1	K-mers and Codons	1
5.2	Translating mRNA into Protein	1
5.3	Finding Subsequence of DNA	1
5.4	Find a Motif in DNA	1
5.5	Finding Overlapping Patterns Using Regular Expressions	1
5.6	Sequence Similarity	1
5.7	Finding the Shortest Sequence in a FASTA File , Extracting K-mers from a Sequence	1
5.8	Counting Frequencies of K-mers	1
5.9	Finding Open Reading Frames	1

ADT296	**ADVANCED TOPICS IN COMPUTER GRAPHICS**	**CATEGORY**	**L**	**T**	**P**	**CREDITS**
		VAC	**3**	**1**	**0**	**4**

Preamble: This course helps the learners to make awareness about strong theoretical concept in computer graphics. It covers the three-dimensional environment representation in a computer, transformation of 2D/3D objects, basic mathematical techniques and algorithms used to build useful applications. This course enables the learners to develop the ability to create image processing frameworks for different domains and develops algorithms for emerging display technologies.

Prerequisite: A sound knowledge of Mathematics and concepts of any programming language.

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Describe the working principles of graphics devices**(Cognitive Knowledge level: Understand)**
CO2	Illustrate line drawing, circle drawing and polygon filling algorithms**(Cognitive Knowledge level: Apply)**
CO3	Demonstrate geometric representations and transformations on 2D & 3D objects. **(Cognitive Knowledge level: Apply)**
CO4	Demonstrate the working of various clipping algorithms and projection algorithms. **(Cognitive Knowledge level: Apply)**
CO5	Summarize visible surface detection methods**(Cognitive Knowledge level: Understand)**
CO6	Explain the concept of realism in a scene and its performance preservation**(Cognitive Knowledge level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											✓
CO2	✓	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓											✓
CO6	✓	✓										✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests (Average of SeriesTests1& 2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one full question. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

Module – 1(Line and Circle drawing algorithms) S

Basics of Computer Graphics and its applications. Video Display devices - Refresh Cathode Ray Tubes, Random Scan Displays and systems, Raster scan displays and systems, Color CRT displays, Flat panel display and its categories. Line drawing algorithms - DDA, Bresenham's algorithm. Circle drawing algorithms - Midpoint Circle generation algorithm, Bresenham's algorithm.

Module - 2(Filled Area Primitives and Two dimensional transformations)

Filled Area Primitives- Scan line polygon filling, Boundary filling and flood filling. Two dimensional transformations-Translation, Rotation, Scaling, Reflection and Shearing, Composite transformations, Matrix representations and homogeneous coordinates.

Module - 3 (Clipping and 3D transformations)

Window to viewport transformation. Cohen Sutherland and Midpoint subdivision line clipping algorithms, Sutherland Hodgeman and Weiler Atherton Polygon clipping algorithms. Three dimensional viewing pipeline. Basic 3D transformations.

Module - 4 (Projections and Visible Surface detection)

Projections- Parallel and Perspective projections. Visible surface detection algorithms- Back face detection, Depth buffer algorithm, Scan line algorithm, A buffer algorithm

Module - 5 (Realism and performance)

Realism - Illumination Shading, Shadows, Texture mapping, Bump mapping, Environment mapping, Transparency, Accumulation Buffer, Back face Culling, Visibility Culling.

Text Books

1. Donald Hearn and M. Pauline Baker, Computer Graphics, PHI, 2e, 1996
2. Aditi Majumder and M.Gopi , Introduction to VISUAL COMPUTING Core Concepts in Computer Vision, Graphics, and Image Processing, 2018

References

1) William M. Newman and Robert F. Sproull, Principles of Interactive Computer Graphics. McGraw Hill, 2001
2) Zhigang Xiang and Roy Plastock, Computer Graphics (Schaum's outline Series), McGraw Hill, 2019.
3) David F. Rogers , Procedural Elements for Computer Graphics, Tata McGraw Hill,2001.
4) Donald Hearn, M. Pauline Baker and Warren Carithers, Computer Graphics with OpenGL, PHI, 4e, 2013

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Compare the working principle of raster scan systems and random scan systems.
2. How much time is spent scanning across each row of pixels during screen refresh on a raster system with resolution of 1280*1024 and a refresh rate of 60 frames per second?

Course Outcome 2 (CO2):

1. Rasterize the line with end points accepted from the user(2,3) and (5,8) using Bresenham's line drawing algorithm and implement it using any appropriate programming language. (Assignment)
2. Illustrate how the 4-connected area filling approach differs from 8- connected area filling in boundary filling algorithm and implement it using any appropriate programming language.(Assignment)

Course Outcome 3 (CO3):

1. Rotate a triangle ABC 45 degree counter clockwise about the pivot point (10,3) , where the position vector of the coordinate ABC is given as A(4,1), B(5,2) and C(4,3).
2. Implement the above transformation using any appropriate programming language with user inputs. (Assignment)

Course Outcome 4 (CO4):

1. Given a clipping window A(20,20), B(60,20), C(60,40) and D(20,40). Using Cohen Sutherland algorithm, find the visible portion of the line segment joining the points P(40,80) and Q(120,30).
2. Implement Cohen Sutherland clipping algorithm using any appropriate programming language with user inputs. (Assignment)

Course Outcome 5 (CO5):

1. Explain scan line algorithm for detecting visible surfaces in an object.

Course Outcome 6 (CO6):

1. You are rendering a black and white checkered tiled floor using a single texture mapped polygon. The view is simulating a person standing on the floor and looking at a point far away from him on the floor. (1)Artifacts at the distant end of the floor can be seen. How would you remove these artifacts? (2) How can you explain why this method works using the sampling theorem?
2. You are seeing an object which is either texture mapped, bump mapped or displacement mapped but you don't know which one. However, you have the liberty to move the light and the viewpoint of an object and see it from different angles and for different positions of the light. How will you figure out which technique was used?

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE (HONOURS) EXAMINATION, MONTH & YEAR

Course Code:ADT296

Course Name: Advanced Topics in Computer Graphics

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Consider a raster system with a resolution of 1024*1024. Compute the size of the raster needed to store 4 bits per pixel? How much storage is needed if 8 bits per pixel are to be stored?

2. How 8-way symmetry of circle can be used for writing circle drawing algorithms? Write the symmetric points if (x, y) is a point on the circle with centre at origin.

3. Show that two successive reflections about either of the coordinate axes is equivalent to a single rotation about the coordinate origin.

4. Determine a sequence of basic transformations that are equivalent to the x-direction shearing matrix.

5. Find the window to viewport normalization transformation with window lower left corner at (1,1) and upper right corner at (2,6).

6. How does Cohen Sutherland algorithm determine whether a line is visible, invisible or a candidate for clipping based on the region codes assigned to the end points of the line?

7. Define the terms (i) Centre of projection (ii) Principal vanishing point

8. Differentiate between the object space and image space method for the hidden surface removal of an image.

9. Describe the steps used to convert the normal map to bump mapping.

10. One artifact of Gouraud shading is that it can miss specular highlights in the interior of the triangles. How can this be explained as an aliasing artifact?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11.	(a)	Derive the initial decision parameter of Bresenham's line drawing algorithm and rasterize a line with endpoints (2,2) and (10,10).	**(8)**
	(b)	Draw the architecture of raster scan display systems and explain its working principle	**(6)**

OR

12.	(a)	Explain the working principle of a Refresh CRT monitor with suitable diagrams.	**(7)**
	(b)	Write Midpoint circle drawing algorithm and plot a circle with radius=20 and center (50,30) using the algorithm.	**(7)**
13.	(a)	Differentiate between boundary fill and flood fill algorithms.	**(5)**
	(b)	Reflect a triangle ABC about the line 3x-4y+8=0, where the position vector of the coordinate ABC is given as A(4,1), B(5,2) and C(4,3).	**(9)**

OR

14.	(a)	A diamond shaped polygon is located at P(-1,0), Q(0,-2), R(1,0) and S(0,2). Find the transformation matrix which would rotate the triangle by 90 degree counter clockwise about the point Q. Using the transformation matrix, find the coordinates of the rotated polygon.	**(7)**

(b) Illustrate the working principle of scan line polygon filling algorithm **(7)**

15. (a) Illustrate Weiler – Atherton polygon clipping algorithm. **(6)**

(b) Explain Cohen-Sutherland line clipping algorithm. Use the algorithm to clip line P1 (70, 20) and P2(100,10) against a window lower left hand corner (50,10) and upper right hand corner (80,40). **(8)**

OR

16. (a) Describe the steps required for a general 3D rotation if the rotation axis is not parallel to any one of the principal axis. The rotation axis is defined by the points P1(x1,y1,z1) and P2(x2,y2,z2). Give its composite matrix representation **(6)**

(b) Describe Sutherland Hodgeman polygon clipping algorithm and list out its limitations **(8)**

17. (a) Explain how visible surfaces can be detected using depth buffer algorithm. **(7)**

(b) Define parallel projection. Describe orthographic and oblique parallel projection. **(7)**

OR

18. (a) Illustrate the scan line method used in visible surface detection. **(7)**

(b) Explain the steps involved in performing perspective projections **(7)**

19. (a) Specify any three shading algorithms used in interactive graphics. **(6)**

(b) Explain the procedure of texture to object space mapping. **(8)**

OR

20. (a) Explain the mapping scheme in which the effects of small bumps on the surface of an object can be simulate without changing the number of primitives **(8)**

(b) Describe about object to screen space mapping. **(6)**

TEACHING PLAN

No	Contents	No of Lecture Hrs
	Module – 1 (Line and Circle drawing algorithms) (10 hrs)	
1.1	Basics of Computer Graphics and applications	1
1.2	Refresh Cathode Ray Tubes	1
1.3	Random and Raster Scan Displays and systems,	1
1.4	Color CRT displays	1
1.5	Flat panel display and its categories.	1
1.6	DDA Line drawing Algorithm	1
1.7	Bresenham's line drawing algorithm	1
1.8	Midpoint Circle generation algorithm	1
1.9	Bresenham's Circle generation algorithm	1
1.10	Illustration of line and circle drawing algorithms	1
	Module - 2 (Filled Area Primitives and Two dimensional transformations) (9 hrs)	
2.1	Scan line polygon filling	1
2.2	Boundary filling and flood filling	1
2.3	Basic 2D transformations-Translation	1
2.4	Basic 2D transformations- Rotation	1
2.5	Basic 2D transformations- Scaling	1
2.6	Reflection and Shearing	1
2.7	Illustration of Basic 2D Transformations	1
2.8	Composite transformations	1
2.9	Matrix representations and homogeneous coordinates	1
	Module - 3 (Clipping and 3D transformations) (8 hrs)	
3.1	Window to viewport transformation	1
3.2	Cohen Sutherland Line clipping algorithm	1
3.3	Midpoint subdivision Line clipping algorithm	1
3.4	Sutherland Hodgeman Polygon clipping algorithm	1
3.5	Weiler Atherton Polygon clipping algorithm	1
3.6	Three dimensional viewing pipeline	1

3.7	Basic 3D transformation-Translation and scaling	1
3.8	Basic 3D transformation-Rotation	1
Module - 4 (Projections and Visible Surface detection) (7 hrs)		
4.1	Projections-Parallel projections	1
4.2	Projections- Perspective projections	1
4.3	Illustration of projection methods	1
4.4	Visible surface detection algorithms- Back face detection	1
4.5	Depth buffer algorithm	1
4.6	Scan line visible surface detection algorithm	1
4.7	*A buffer* algorithm	1
Module - 5 (Realism and performance)(10 hrs)		
5.1	Illumination	1
5.2	Shading and Shadows	1
5.3	Texture mapping-Texture to object space mapping	1
5.4	Texture mapping-Object to screen space mapping and Mip Mapping	1
5.5	Bump mapping	1
5.6	Bump mapping-Illustration	1
5.7	Environment mapping and Transparency	1
5.8	Accumulation Buffer and Back face Culling	1
5.9	Visibility Culling	1
5.10	Visibility Culling	1

COMMON COURSES S3 & S4

SEMESTER -3

CODE MCN201	SUSTAINABLE ENGINEERING	CATEGORY	L	T	P	CREDIT
			2	0	0	NIL

Preamble: Objective of this course is to inculcate in students an awareness of environmental issues and the global initiatives towards attaining sustainability. The student should realize the potential of technology in bringing in sustainable practices.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the relevance and the concept of sustainability and the global initiatives in this direction
CO 2	Explain the different types of environmental pollution problems and their sustainable solutions
CO 3	Discuss the environmental regulations and standards
CO 4	Outline the concepts related to conventional and non-conventional energy
CO 5	Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2	3					2
CO 2						2	3					2
CO 3						2	3					2
CO 4						2	3					2
CO 5						2	3					2

Assessment Pattern

Mark distribution

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	**2**	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Course Level Assessment Questions

Course Outcome 1 (CO1): Understand the relevance and the concept of sustainability and the global initiatives in this direction

1. Explain with an example a technology that has contributed positively to sustainable development.
2. Write a note on Millennium Development Goals.

Course Outcome 2 (CO2): Explain the different types of environmental pollution problems and their sustainable solutions

1. Explain the 3R concept in solid waste management?
2. Write a note on any one environmental pollution problem and suggest a sustainable solution.
3. In the absence of green house effect the surface temperature of earth would not have been suitable for survival of life on earth. Comment on this statement.

Course Outcome 3(CO3): Discuss the environmental regulations and standards

1. Illustrate Life Cycle Analysis with an example of your choice.
2. "Nature is the most successful designer and the most brilliant engineer that has ever evolved". Discuss.

Course Outcome 4 (CO4): Outline the concepts related to conventional and non-conventional energy

1. Suggest a sustainable system to generate hot water in a residential building in tropical climate.
2. Enumerate the impacts of biomass energy on the environment.

Course Outcome 5 (CO5): Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

1. Suggest suitable measures to make the conveyance facilities used by your institution sustainable.

Model Question paper

Part A

(Answer all questions. Each question carries 3 marks each)

1. Define sustainable development.
2. Write a short note on Millennium Development Goals.
3. Describe carbon credit.
4. Give an account of climate change and its effect on environment.
5. Describe biomimicry? Give two examples.
6. Explain the basic concept of Life Cycle Assessment.
7. Name three renewable energy sources.

8. Mention some of the disadvantages of wind energy.

9. Enlist some of the features of sustainable habitat.

10. Explain green engineering.

Part B

(Answer one question from each module. Each question carries 14 marks)

11. Discuss the evolution of the concept of sustainability. Comment on its relevance in the modern world.

OR

12. Explain Clean Development Mechanism.

13. Explain the common sources of water pollution and its harmful effects.

OR

14. Give an account of solid waste management in cities.

15. Explain the different steps involved in the conduct of Environmental Impact Assessment.

OR

16. Suggest some methods to create public awareness on environmental issues.

17. Comment on the statement, “Almost all energy that man uses comes from the Sun”.

OR

18. Write notes on:

    a. Land degradation due to water logging.

    b. Over exploitation of water.

19. Discuss the elements related to sustainable urbanisation.

OR

20. Discuss any three methods by which you can increase energy efficiency in buildings.

Syllabus

Sustainability- need and concept, technology and sustainable development-Natural resources and their pollution, Carbon credits, Zero waste concept. Life Cycle Analysis, Environmental Impact Assessment studies, Sustainable habitat, Green buildings, green materials, Energy, Conventional and renewable sources, Sustainable urbanization, Industrial Ecology.

Module 1

Sustainability: Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

Module 2

Environmental Pollution: Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon foot print, legal provisions for environmental protection.

Module 3

Environmental management standards: ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.

Module 4

Resources and its utilisation: Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans and Geothermal energy.

Module 5

Sustainability practices: Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanisation, Sustainable cities, Sustainable transport.

Reference Books

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
3. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
4. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
5. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
6. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
7. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
8. Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios Publication

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Sustainability	
1.1	Introduction, concept, evolution of the concept	1
1.2	Social, environmental and economic sustainability concepts	1
1.3	Sustainable development, Nexus between Technology and Sustainable development	1
1.4	Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs)	1
1.5	Clean Development Mechanism (CDM)	1
2	Environmental Pollution	
2.1	Air Pollution and its effects	1
2.2	Water pollution and its sources	1
2.3	Zero waste concept and 3 R concepts in solid waste management	1
2.4	Greenhouse effect, Global warming, Climate change, Ozone layer depletion	1
2.5	Carbon credits, carbon trading and carbon foot print.	1
2.6	Legal provisions for environmental protection.	1
3	Environmental management standards	
3.1	Environmental management standards	1
3.2	ISO 14001:2015 frame work and benefits	1
3.3	Scope and Goal of Life Cycle Analysis (LCA)	1
3.4	Circular economy, Bio-mimicking	1
3.5	Environment Impact Assessment (EIA)	1
3.6	Industrial Ecology, Industrial Symbiosis	1
4	Resources and its utilisation	
4.1	Basic concepts of Conventional and non-conventional energy	1
4.2	General idea about solar energy, Fuel cells	1
4.3	Wind energy, Small hydro plants, bio-fuels	1
4.4	Energy derived from oceans and Geothermal energy	1
5	Sustainability Practices	
5.1	Basic concept of sustainable habitat	1
5.2	Methods for increasing energy efficiency of buildings	1
5.3	Green Engineering	1
5.4	Sustainable Urbanisation, Sustainable cities, Sustainable transport	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
			2	0	0	2
EST 200	DESIGN AND ENGINEERING					

Preamble:

The purpose of this course is to

i) introduce the undergraduate engineering studentsthe fundamental principles of design engineering,

ii) make them understand the steps involved in the design process and

iii) familiarize them with the basic tools used and approaches in design.

Students are expected to apply design thinking in learning as well as while practicing engineering, which is very important and relevant for today. Case studies from various practical situations will help the students realize that design is not only concerned about the function but also many other factors like customer requirements, economics, reliability, etc. along with a variety of life cycle issues.

The course will help students to consider aesthetics, ergonomics and sustainability factors in designs and also to practice professional ethics while designing.

Prerequisite:

Nil. The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines.

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Explain the different concepts and principles involved in design engineering.
CO 2	Apply design thinking while learning and practicing engineering.
CO 3	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1					1			1		
CO 2		2				1		1				2
CO 3			2			1	1		2	2		1

Assessment Pattern

Continuous Internal Evaluation (CIE) Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination (ESE) Pattern: There will be two parts; Part A and Part B.
Part A : 30 marks
part B : 70 marks
Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.
Part B contains 2 case study questions from each module of which student should answer any one. Each question carry 14 marks and can have maximum 2 sub questions.

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	10
Understand	10	10	20
Apply	35	35	70
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course Level Assessment Questions

Course Outcome 1 (CO1): Appreciate the different concepts and principles involved in design engineering.

1. State how engineering design is different from other kinds of design

2. List the different stages in a design process.

3. Describedesign thinking.

4. State the function of prototyping and proofing in engineering design.

5. Write notes on the following concepts in connection with design engineering 1) Modular Design, 2) Life Cycle Design , 3) Value Engineering, 4) Concurrent Engineering, and 5) Reverse Engineering

6. State design rights.

Course Outcome 2 (CO2) Apply design thinking while learning and practicing engineering.

1. Construct the iterative process for design thinking in developing simple products like a pen, umbrella, bag, etc.

2. Show with an example how divergent-convergent thinking helps in generating alternative designs and then how to narrow down to the best design.

3. Describe how a problem-based learning helps in creating better design engineering solutions.

4. Discuss as an engineer, how ethics play a decisive role in your designs

Course Outcome 3(CO3): Develop innovative, reliable, sustainable and economically viable designs incorporating different segments of knowledge in engineering.

1. Illustratethe development of any simple product by passing through the different stages of design process

2. Show thegraphical design communication with the help of detailed 2D or 3D drawings for any simple product.

3. Describe how to develop new designs for simple products through bio-mimicry.

Model Question paper

Reg No.:_______________Name:___________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: EST 200

Course Name: DESIGN AND ENGINEERING

Max. Marks: 100Duration: 3 Hours

PART A

Answer all questions, each question carries 3 marks
Use only hand sketches

(1) Write aboutthe basic design process.

(2) Describe how to finalize the design objectives.

(3) State the role of divergent-convergent questioning in design thinking.

(4) Discuss how to perform design thinking in a team managing the conflicts.

(5) Show how engineering sketches and drawings convey designs.

(6) Explain the role of mathematics and physics in design engineering process.

(7) Distinguish between project-based learning and problem-based learning in design engineering.

(8) Describe how concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?

(9) Show how designs are varied based on the aspects of production methods, life span, reliability and environment?

(10) Explain how economics influence the engineering designs?

(10x3 marks =30 marks)

Part B

Answer any ONE question from each module. Each question carry 14 marks

Module 1

(11) Show the designing of a wrist watch going through the various stages of the design process. Use hand sketches to illustrate the processes.

or

(12) Find the customer requirements for designing a new car showroom. Show how the design objectives were finalized considering the design constraints?

Module 2

(13) Illustrate the design thinking approach for designing a bag for college students within a limited budget. Describe each stage of the process and the iterative procedure involved. Use hand sketches to support your arguments.

or

(14) Construct a number of possible designs and then refine them to narrow down to the best design for a drug trolley used in hospitals. Show how the divergent-convergent thinking helps in the process. Provide your rationale for each step by using hand sketches only.

Module 3

(15) Graphically communicate the design of a thermo flask used to keep hot coffee. Draw the detailed 2D drawings of the same with design detailing, material selection, scale drawings, dimensions, tolerances, etc. Use only hand sketches.

or

(16) Describe the role of mathematical modelling in design engineering. Show how mathematics and physics play a role in designing a lifting mechanism to raise 100 kg of weight to a floor at a height of 10 meters in a construction site.

Module 4

(17) Show the development of a nature inspired design for a solar poweredbus waiting shed beside a highway. Relate between natural and man-made designs. Use hand sketches to support your arguments.

or

(18) Show the design of a simple sofa and then depict how the design changes when considering 1) aesthetics and 2) ergonomics into consideration. Give hand sketches and explanations to justify the changes in designs.

Module 5

(19) Examine the changes in the design of a foot wear with constraints of 1) production methods, 2) life span requirement, 3) reliability issues and 4) environmental factors. Use hand sketches and give proper rationalization for the changes in design.

or

(20) Describe the how to estimate the cost of a particular design using ANY of the following: i) a website, ii) the layout of a plant, iii) the elevation of a building, iv) anelectrical or electronic system or device and v) a car.

Show how economics will influence the engineering designs. Use hand sketches to support your arguments.

(5x14 marks =70 marks)

Syllabus

Module 1

Design Process:- Introduction to Design and Engineering Design, Defining a Design Process-:Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.

Module 2

Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment.

Module 3

Design Communication (Languages of Engineering Design):-Communicating Designs Graphically, Communicating Designs Orally and in Writing. Mathematical Modeling In Design, Prototyping and Proofing the Design.

Module 4

Design Engineering Concepts:-Project-based Learning and Problem-based Learning in Design.Modular Design and Life Cycle Design Approaches. Application of Bio-mimicry,Aesthetics and Ergonomics in Design. Value Engineering, Concurrent Engineering, and Reverse Engineering in Design.

Module 5

Expediency, Economics and Environment in Design Engineering:-Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design

Text Books

1) YousefHaik, SangarappillaiSivaloganathan, Tamer M. Shahin, Engineering Design Process, Cengage Learning 2003, Third Edition, ISBN-10: 9781305253285,

2) Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051

Reference Books

1.Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition, ISBN: 9780128012420.

2. Clive L. Dym, Engineering Design: A Project-Based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5

3. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361

4. Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN 978-1-84628-319-2

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1: Design Process**	
1.1	Introduction to Design and Engineering Design. *What does it mean to design something? How Is engineering design different from other kinds of design? Where and when do engineers design? What are the basic vocabularyin engineering design? How to learn and do engineering design.*	1
1.2	*Defining a Design Process*-: Detailing Customer Requirements. *How to do engineering design? Illustrate the process with an example. How to identify the customer requirements of design?*	1
1.3	*Defining a Design Process*-: Setting Design Objectives, Identifying Constraints, Establishing Functions. *How to finalize the design objectives? How to identify the design constraints? How to express the functions a design in engineering terms?*	1
1.4	*Defining a Design Process*-: Generating Design Alternatives and Choosing a Design. *How to generate or create feasible design alternatives? How to identify the "best possible design"?*	1
1.5	Case Studies:- Stages of Design Process. *Conduct exercises for designing simple products going through the different stages of design process.*	1
2	**Module 2: Design Thinking Approach**	
2.1	Introduction to Design Thinking *How does the design thinking approach help engineers in creating innovative and efficient designs?*	1
2.2	Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. *How can the engineers arrive at better designs utilizing the iterative design thinking process (in which knowledge acquired in the later stages can be applied back to the earlier stages)?*	1
2.3	Design Thinking as Divergent-Convergent Questioning. *Describe how to create a number of possible designs and then how to refine and narrow down to the 'best design'.*	1
2.4	Design Thinking in a Team Environment. *How to perform design thinking as a team managing the conflicts ?*	1
2.5	Case Studies: Design Thinking Approach. *Conduct exercises using the design thinking approach for*	1

	designing any simple products within a limited time and budget	
3	**Module 3: Design Communication (Languages of Engineering Design)**	
3.1	Communicating Designs Graphically. *How do engineering sketches and drawings convey designs?*	1
3.2	Communicating Designs Orally and in Writing. *How can a design be communicated through oral presentation or technical reports efficiently?*	1
	First Series Examination	
3.3	Mathematical Modelling in Design. *How do mathematics and physics become a part of the design process?*	1
3.4	Prototyping and Proofing the Design. *How to predict whether the design will function well or not?*	1
3.5	Case Studies: Communicating Designs Graphically. *Conduct exercises for design communication through detailed 2D or 3D drawings of simple products with design detailing, material selection, scale drawings, dimensions, tolerances, etc.*	1
4	**Module 4: Design Engineering Concepts**	
4.1	Project-based Learning and Problem-based Learning in Design. *How engineering students can learn design engineering through projects?* *How students can take up problems to learn design engineering?*	1
4.2	Modular Design and Life Cycle Design Approaches. *What is modular approach in design engineering? How it helps?* *How the life cycle design approach influences design decisions?*	1
4.3	Application of Bio-mimicry, Aesthetics and Ergonomics in Design. *How do aesthetics and ergonomics change engineering designs?* *How do the intelligence in nature inspire engineering designs? What are the common examples of bio-mimicry in engineering?*	1
4.4	Value Engineering, Concurrent Engineering, and Reverse Engineering in Design. *How do concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?*	1
4.5	Case Studies: Bio-mimicry based Designs. *Conduct exercises to develop new designs for simple*	1

	products using bio-mimicry and train students to bring out new nature inspired designs.	
5	**Module 5: Expediency, Economics and Environment in Design Engineering**	
5.1	Design for Production, Use, and Sustainability. *How designs are finalized based on the aspects of production methods, life span, reliability and environment?*	1
5.2	Engineering Economics in Design. *How to estimate the cost of a particular design and how will economics influence the engineering designs?*	1
5.3	Design Rights. *What are design rights and how can an engineer put it into practice?*	1
5.4	Ethics in Design. *How do ethics play a decisive role in engineering design?*	1
5.5	Case Studies: Design for Production, Use, and Sustainability. *Conduct exercises using simple products to show how designs change with constraints of production methods, life span requirement, reliability issues and environmental factors.*	1
Second Series Examination		

Code.	Course Name	L	T	P	Hrs	Credit
HUT 200	**Professional Ethics**	2	0	0	2	2

Preamble: To enable students to create awareness on ethics and human values.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the core values that shape the ethical behaviour of a professional.
CO 2	Adopt a good character and follow an ethical life.
CO 3	Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.
CO 4	Solve moral and ethical problems through exploration and assessment by established experiments.
CO 5	Apply the knowledge of human values and social values to contemporary ethical values and global issues.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1								2			2	
CO 2								2			2	
CO 3								3			2	
CO 4								3			2	
CO 5								3			2	

Assessment Pattern

Bloom's category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	15	15	30
Understood	20	20	40
Apply	15	15	30

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Tests (2 Nos)	:	25 marks
Assignments/Quiz	:	15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):
1. Define integrity and point out ethical values.
2. Describe the qualities required to live a peaceful life.
3. Explain the role of engineers in modern society.

Course Outcome 2 (CO2)
1. Derive the codes of ethics.
2. Differentiate consensus and controversy.
3. Discuss in detail about character and confidence.

Course Outcome 3(CO3):
1. Explain the role of professional's ethics in technological development.
2. Distinguish between self interest and conflicts of interest.
3. Review on industrial standards and legal ethics.

Course Outcome 4 (CO4):
1. Illustrate the role of engineers as experimenters.
2. Interpret the terms safety and risk.
3. Show how the occupational crimes are resolved by keeping the rights of employees.

Course Outcome 5 (CO5):
1. Exemplify the engineers as managers.
2. Investigate the causes and effects of acid rain with a case study.
3. Explorate the need of environmental ethics in technological development.

Model Question paper

QP CODE: **Reg No:______________**

PAGES:3 **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: HUT 200
Course Name: PROFESSIONAL ETHICS

Max. Marks: 100 **Duration: 3 Hours**

(2019-Scheme)

PART A

(Answer all questions, each question carries 3 marks)

1. Define empathy and honesty.

2. Briefly explain about morals, values and ethics.

3. Interpret the two forms of self-respect.

4. List out the models of professional roles.

5. Indicate the advantages of using standards.

6. Point out the conditions required to define a valid consent?

7. Identify the conflicts of interests with an example?

8. Recall confidentiality.

9. Conclude the features of biometric ethics.

10. Name any three professional societies and their role relevant to engineers.

(10x3 = 30 marks)

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Classify the relationship between ethical values and law?

b) Compare between caring and sharing. (10+4 = 14 marks)

Or

12. a) Exemplify a comprehensive review about integrity and respect for others.

b) Discuss about co-operation and commitment. (8+6 = 14 marks)

MODULE II

13.a) Explain the three main levels of moral developments, deviced by Kohlberg.

b) Differentiate moral codes and optimal codes. (10+4 = 14 marks)

Or

14. a) Extrapolate the duty ethics and right ethics.

b) Discuss in detail the three types of inquiries in engineering ethics (8+6 = 14 marks)

MODULE III

Summarize the following features of morally responsible engineers.

(i) Moral autonomy **(ii)** Accountability

b)Explain the rights of employees (8+6 = 14 marks)

Or

16. a) Explain the reasons for Chernobyl mishap ?

b) Describe the methods to improve collegiality and loyalty. (8+6 = 14 marks)

MODULE IV

17.a) Execute collegiality with respect to commitment, respect and connectedness.

b) Identify conflicts of interests with an example. (8+6 = 14 marks)

Or

18. a) Explain in detail about professional rights and employee rights.

b) Exemplify engineers as managers.

MODULE V

19.a) Evaluate the technology transfer and appropriate technology.

b) Explain about computer and internet ethics. (8+6 = 14 marks)

Or

20. a) Investigate the causes and effects of acid rain with a case study.

b) Conclude the features of ecocentric and biocentric ethics. (8+6 = 14 marks)

Syllabus

Module 1 – Human Values.

Morals, values and Ethics – Integrity- Academic integrity-Work Ethics- Service Learning- Civic Virtue-Respect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitment-Empathy-Self Confidence -Social Expectations.

Module 2 - Engineering Ethics & Professionalism.

Senses of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy – Kohlberg's theory- Gilligan's theory- Consensus and Controversy-Profession and Professionalism- Models of professional roles-Theories about right action –Self interest-Customs and Religion- Uses of Ethical Theories.

Module 3- Engineering as social Experimentation.

Engineering as Experimentation – Engineers as responsible Experimenters- Codes of Ethics- Plagiarism-A balanced outlook on law - Challenges case study- Bhopal gas tragedy.

Module 4- Responsibilities and Rights.

Collegiality and loyalty – Managing conflict- Respect for authority- Collective bargaining- Confidentiality-Role of confidentiality in moral integrity-Conflicts of interest- Occupational crime- Professional rights-Employee right- IPR Discrimination.

Module 5- Global Ethical Issues.

Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics -Role in Technological Development-Engineers as Managers- Consulting Engineers- Engineers as Expert witnesses and advisors-Moral leadership.

Text Book

1. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.
2. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited ,New Delhi,2006.

Reference Books

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi,2014.
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics- Concepts and cases, Wadsworth Thompson Learning, United states,2005.
4. http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics.

Course Contents and Lecture Schedule

SL.No	Topic	No. of Lectures 25
1	**Module 1 – Human Values.**	
1.1	Morals, values and Ethics, Integrity, Academic Integrity,Work Ethics	1
1.2	Service Learning, Civic Virtue, Respect for others, Living peacefully	1
1.3	Caring and Sharing, Honesty, Courage, Co-operation commitment	2
1.4	Empathy, Self Confidence, Social Expectations	1
2	**Module 2- Engineering Ethics & Professionalism.**	
2.1	Senses of Engineering Ethics, Variety of moral issues, Types of inquiry	1
2.2	Moral dilemmas, Moral Autonomy, Kohlberg's theory	1
2.3	Gilligan's theory, Consensus and Controversy,Profession& Professionalism, Models of professional roles, Theories about right action	2
2.4	Self interest-Customs and Religion, Uses of Ethical Theories	1
3	**Module 3- Engineering as social Experimentation.**	
3.1	Engineering as Experimentation, Engineers as responsible Experimenters	1
3.2	Codes of Ethics,Plagiarism, A balanced outlook on law	2
3.3	Challenger case study, Bhopal gas tragedy	2
4	**Module 4- Responsibilities and Rights.**	
4.1	Collegiality and loyalty, Managing conflict, Respect for authority	1
4.2	Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest	2
4.3	Occupational crime, Professional rights, Employee right, IPR Discrimination	2
5	**Module 5- Global Ethical Issues.**	
5.1	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics	2
5.2	Role in Technological Development, Moral leadership	1
5.3	Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors	2

SEMESTER -4

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MCN202	CONSTITUTION OF INDIA		2	0	0	NIL

Preamble:

The study of their own country constitution and studying the importance environment as well as understanding their own human rights help the students to concentrate on their day to day discipline. It also gives the knowledge and strength to face the society and people.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Explain the background of the present constitution of India and features.
CO 2	Utilize the fundamental rights and duties.
CO 3	Understand the working of the union executive, parliament and judiciary.
CO 4	Understand the working of the state executive, legislature and judiciary.
CO 5	Utilize the special provisions and statutory institutions.
CO 6	Show national and patriotic spirit as responsible citizens of the country

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2	2	2		2		
CO 2						3	3	3		3		
CO 3						3	2	3		3		
CO 4						3	2	3		3		
CO 5						3	2	3		3		
CO 6						3	3	3		2		

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			

Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1 Discuss the historical background of the Indian constitution.

2 Explain the salient features of the Indian constitution.

3 Discuss the importance of preamble in the implementation of constitution.

Course Outcome 2 (CO2)

1 What are fundamental rights ? Examine each of them.

2 Examine the scope of freedom of speech and expression underlying the constitution.

3 The thumb impression of an accused is taken by the police against his will. He contends that this is a violation of his rights under Art 20(3) of the constitution. Decide.

Course Outcome 3(CO3):

1 Explain the powers of the President to suspend the fundamental rights during emergency.

2 Explain the salient features of appeal by special leave.

3. List the constitutional powers of President.

Course Outcome 4 (CO4):

1 Discuss the constitutional powers of Governor.

2 Examine the writ jurisdiction of High court.

3 Discuss the qualification and disqualification of membership of state legislature.

Course Outcome 5 (CO5):

1 Discuss the duties and powers of comptroller of auditor general.

2 Discuss the proclamation of emergency.

3 A state levies tax on motor vehicles used in the state, for the purpose of maintaining roads in the state. X challenges the levy of the tax on the ground that it violates the freedom of interstate commerce guaranteed under Art 301. Decide.

Course Outcome 6 (CO6):

1 Explain the advantages of citizenship.

2 List the important principles contained in the directive principles of state policy.

3 Discuss the various aspects contained in the preamble of the constitution

Model Question paper

PART A

(Answer all questions. Each question carries 3 marks)

1 Define and explain the term constitution.

2 Explain the need and importance of Preamble.

3 What is directive principle of state policy?

4 Define the State.

5 List the functions of Attorney general of India.

6 Explain the review power of Supreme court.

7 List the qualifications of Governor.

8 Explain the term and removal of Judges in High court.

9 Explain the powers of public service commission.

10 List three types of emergency under Indian constitution.

(10X3=30marks)

PART B

(Answer on question from each module. Each question carries 14 marks)

Module 1

11 Discuss the various methods of acquiring Indian citizenship.

12 Examine the salient features of the Indian constitution.

Module 2

13 A high court passes a judgement against X. X desires to file a writ petition in the supreme court under Art32, on the ground that the judgement violates his fundamental rights. Advise him whether he can do so.

14 What is meant by directive principles of State policy? List the directives.

Module3

15 Describe the procedure of election and removal of the President of India.

16 Supreme court may in its discretion grant special leave to appeal. Examine the situation.

Module 4

17 Discuss the powers of Governor.

18 X filed a writ petition under Art 226 which was dismissed. Subsequently, he filed a writ petition under Art 32 of the constitution, seeking the same remedy. The Government argued that the writ petition should be dismissed, on the ground of res judicata. Decide.

Module 5

19 Examine the scope of the financial relations between the union and the states.

20 Discuss the effects of proclamation of emergency.

(14X5=70marks)

Syllabus

Module 1 Definition, historical back ground, features, preamble, territory, citizenship.

Module 2 State, fundamental rights, directive principles, duties.

Module 3 The machinery of the union government.

Module 4 Government machinery in the states

Module 5 The federal system, Statutory Institutions, miscellaneous provisions.

Text Books

1 D D Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi, 24e, 2019

2 PM Bhakshi, The constitution of India, Universal Law, 14e, 2017

Reference Books

1 Ministry of law and justice, The constitution of India, Govt of India, New Delhi, 2019.

2 JN Pandey, The constitutional law of India, Central Law agency, Allahabad, 51e, 2019

3 MV Pylee, India's Constitution, S Chand and company, New Delhi, 16e, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1**	
1.1	Definition of constitution, historical back ground, salient features of the constitution.	1
1.2	Preamble of the constitution, union and its territory.	1
1.3	Meaning of citizenship, types, termination of citizenship.	2
2	**Module 2**	
2.1	Definition of state, fundamental rights, general nature, classification, right to equality ,right to freedom , right against exploitation	2

2.2	Right to freedom of religion, cultural and educational rights, right to constitutional remedies. Protection in respect of conviction for offences.	2
2.3	Directive principles of state policy, classification of directives, fundamental duties.	2
3	**Module 3**	
3.1	The Union executive, the President, the vice President, the council of ministers, the Prime minister, Attorney-General, functions.	2
3.2	The parliament, composition, Rajya sabha, Lok sabha, qualification and disqualification of membership, functions of parliament.	2
3.3	Union judiciary, the supreme court, jurisdiction, appeal by special leave.	1
4	**Module 4**	
4.1	The State executive, the Governor, the council of ministers, the Chief minister, advocate general, union Territories.	2
4.2	The State Legislature, composition, qualification and disqualification of membership, functions.	2
4.3	The state judiciary, the high court, jurisdiction, writs jurisdiction.	1
5	**Module 5**	
5.1	Relations between the Union and the States, legislative relation, administrative relation, financial Relations, Inter State council, finance commission.	1
5.2	Emergency provision, freedom of trade commerce and inter course, comptroller and auditor general of India, public Services, public service commission, administrative Tribunals.	2
5.3	Official language, elections, special provisions relating to certain classes, amendment of the Constitution.	2

HUMANITIES

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
EST 200	DESIGN AND ENGINEERING		2	0	0	2

Preamble:

The purpose of this course is to

i) introduce the undergraduate engineering studentsthe fundamental principles of design engineering,

ii) make them understand the steps involved in the design process and

iii) familiarize them with the basic tools used and approaches in design.

Students are expected to apply design thinking in learning as well as while practicing engineering, which is very important and relevant for today. Case studies from various practical situations will help the students realize that design is not only concerned about the function but also many other factors like customer requirements, economics, reliability, etc. along with a variety of life cycle issues.

The course will help students to consider aesthetics, ergonomics and sustainability factors in designs and also to practice professional ethics while designing.

Prerequisite:

Nil. The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines.

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Explain the different concepts and principles involved in design engineering.
CO 2	Apply design thinking while learning and practicing engineering.
CO 3	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1					1			1		
CO 2		2				1		1				2
CO 3			2			1	1		2	2		1

Assessment Pattern

Continuous Internal Evaluation (CIE) Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination (ESE) Pattern: There will be two parts; Part A and Part B.

Part A	: 30 marks
part B	: 70 marks

Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.

Part B contains 2 case study questions from each module of which student should answer any one. Each question carry 14 marks and can have maximum 2 sub questions.

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	5	5	10
Understand	10	10	20
Apply	35	35	70
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course Level Assessment Questions

Course Outcome 1 (CO1): Appreciate the different concepts and principles involved in design engineering.

1. State how engineering design is different from other kinds of design

2. List the different stages in a design process.

3. Describedesign thinking.

4. State the function of prototyping and proofing in engineering design.

5. Write notes on the following concepts in connection with design engineering 1) Modular Design, 2) Life Cycle Design , 3) Value Engineering, 4) Concurrent Engineering, and 5) Reverse Engineering

6. State design rights.

Course Outcome 2 (CO2) Apply design thinking while learning and practicing engineering.

1. Construct the iterative process for design thinking in developing simple products like a pen, umbrella, bag, etc.

2. Show with an example how divergent-convergent thinking helps in generating alternative designs and then how to narrow down to the best design.

3. Describe how a problem-based learning helps in creating better design engineering solutions.

4. Discuss as an engineer, how ethics play a decisive role in your designs

Course Outcome 3(CO3): Develop innovative, reliable, sustainable and economically viable designs incorporating different segments of knowledge in engineering.

1. Illustratethe development of any simple product by passing through the different stages of design process

2. Show thegraphical design communication with the help of detailed 2D or 3D drawings for any simple product.

3. Describe how to develop new designs for simple products through bio-mimicry.

Model Question paper

Reg No.:_______________Name:___________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: EST 200

Course Name: DESIGN AND ENGINEERING

Max. Marks: 100Duration: 3 Hours

PART A

Answer all questions, each question carries 3 marks

Use only hand sketches

(1) Write aboutthe basic design process.

(2) Describe how to finalize the design objectives.

(3) State the role of divergent-convergent questioning in design thinking.

(4) Discuss how to perform design thinking in a team managing the conflicts.

(5) Show how engineering sketches and drawings convey designs.

(6) Explain the role of mathematics and physics in design engineering process.

(7) Distinguish between project-based learning and problem-based learning in design engineering.

(8) Describe how concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?

(9) Show how designs are varied based on the aspects of production methods, life span, reliability and environment?

(10) Explain how economics influence the engineering designs?

(10x3 marks =30 marks)

Part B

Answer any ONE question from each module. Each question carry 14 marks

Module 1

(11) Show the designing of a wrist watch going through the various stages of the design process. Use hand sketches to illustrate the processes.

or

(12) Find the customer requirements for designing a new car showroom. Show how the design objectives were finalized considering the design constraints?

Module 2

(13) Illustrate the design thinking approach for designing a bag for college students within a limited budget. Describe each stage of the process and the iterative procedure involved. Use hand sketches to support your arguments.

or

(14) Construct a number of possible designs and then refine them to narrow down to the best design for a drug trolley used in hospitals. Show how the divergent-convergent thinking helps in the process. Provide your rationale for each step by using hand sketches only.

Module 3

(15) Graphically communicate the design of a thermo flask used to keep hot coffee. Draw the detailed 2D drawings of the same with design detailing, material selection, scale drawings, dimensions, tolerances, etc. Use only hand sketches.

or

(16) Describe the role of mathematical modelling in design engineering. Show how mathematics and physics play a role in designing a lifting mechanism to raise 100 kg of weight to a floor at a height of 10 meters in a construction site.

Module 4

(17) Show the development of a nature inspired design for a solar poweredbus waiting shed beside a highway. Relate between natural and man-made designs. Use hand sketches to support your arguments.

or

(18) Show the design of a simple sofa and then depict how the design changes when considering 1) aesthetics and 2) ergonomics into consideration. Give hand sketches and explanations to justify the changes in designs.

Module 5

(19) Examine the changes in the design of a foot wear with constraints of 1) production methods, 2) life span requirement, 3) reliability issues and 4) environmental factors. Use hand sketches and give proper rationalization for the changes in design.

or

(20) Describe the how to estimate the cost of a particular design using ANY of the following: i) a website, ii) the layout of a plant, iii) the elevation of a building, iv) anelectrical or electronic system or device and v) a car.

Show how economics will influence the engineering designs. Use hand sketches to support your arguments.

(5x14 marks =70 marks)

Syllabus

Module 1

Design Process:- Introduction to Design and Engineering Design, Defining a Design Process-:Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.

Module 2

Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment.

Module 3

Design Communication (Languages of Engineering Design):-Communicating Designs Graphically, Communicating Designs Orally and in Writing. Mathematical Modeling In Design, Prototyping and Proofing the Design.

Module 4

Design Engineering Concepts:-Project-based Learning and Problem-based Learning in Design.Modular Design and Life Cycle Design Approaches. Application of Bio-mimicry,Aesthetics and Ergonomics in Design. Value Engineering, Concurrent Engineering, and Reverse Engineering in Design.

Module 5

Expediency, Economics and Environment in Design Engineering:-Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design

Text Books

1) YousefHaik, SangarappillaiSivaloganathan, Tamer M. Shahin, Engineering Design Process, Cengage Learning 2003, Third Edition, ISBN-10: 9781305253285,

2) Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051

Reference Books

1.Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition, ISBN: 9780128012420.
2. Clive L. Dym, Engineering Design: A Project-Based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5
3. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361
4. Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN 978-1-84628-319-2

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1: Design Process**	
1.1	Introduction to Design and Engineering Design. *What does it mean to design something? How Is engineering design different from other kinds of design? Where and when do engineers design? What are the basic vocabularyin engineering design? How to learn and do engineering design.*	1
1.2	*Defining a Design Process-*: Detailing Customer Requirements. *How to do engineering design? Illustrate the process with an example. How to identify the customer requirements of design?*	1
1.3	*Defining a Design Process-*: Setting Design Objectives, Identifying Constraints, Establishing Functions. *How to finalize the design objectives? How to identify the design constraints? How to express the functions a design in engineering terms?*	1
1.4	*Defining a Design Process-*: Generating Design Alternatives and Choosing a Design. *How to generate or create feasible design alternatives? How to identify the "best possible design"?*	1
1.5	Case Studies:- Stages of Design Process. *Conduct exercises for designing simple products going through the different stages of design process.*	1
2	**Module 2: Design Thinking Approach**	
2.1	Introduction to Design Thinking *How does the design thinking approach help engineers in creating innovative and efficient designs?*	1
2.2	Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. *How can the engineers arrive at better designs utilizing the iterative design thinking process (in which knowledge acquired in the later stages can be applied back to the earlier stages)?*	1
2.3	Design Thinking as Divergent-Convergent Questioning. *Describe how to create a number of possible designs and then how to refine and narrow down to the 'best design'.*	1
2.4	Design Thinking in a Team Environment. *How to perform design thinking as a team managing the conflicts ?*	1
2.5	Case Studies: Design Thinking Approach. *Conduct exercises using the design thinking approach for*	1

	designing any simple products within a limited time and budget	
3	**Module 3: Design Communication (Languages of Engineering Design)**	
3.1	Communicating Designs Graphically. *How do engineering sketches and drawings convey designs?*	1
3.2	Communicating Designs Orally and in Writing. *How can a design be communicated through oral presentation or technical reports efficiently?*	1
	First Series Examination	
3.3	Mathematical Modelling in Design. *How do mathematics and physics become a part of the design process?*	1
3.4	Prototyping and Proofing the Design. *How to predict whether the design will function well or not?*	1
3.5	Case Studies: Communicating Designs Graphically. *Conduct exercises for design communication through detailed 2D or 3D drawings of simple products with design detailing, material selection, scale drawings, dimensions, tolerances, etc.*	1
4	**Module 4: Design Engineering Concepts**	
4.1	Project-based Learning and Problem-based Learning in Design. *How engineering students can learn design engineering through projects?* *How students can take up problems to learn design engineering?*	1
4.2	Modular Design and Life Cycle Design Approaches. *What is modular approach in design engineering? How it helps?* *How the life cycle design approach influences design decisions?*	1
4.3	Application of Bio-mimicry, Aesthetics and Ergonomics in Design. *How do aesthetics and ergonomics change engineering designs?* *How do the intelligence in nature inspire engineering designs? What are the common examples of bio-mimicry in engineering?*	1
4.4	Value Engineering, Concurrent Engineering, and Reverse Engineering in Design. *How do concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?*	1
4.5	Case Studies: Bio-mimicry based Designs. *Conduct exercises to develop new designs for simple*	1

	products using bio-mimicry and train students to bring out new nature inspired designs.	
5	**Module 5: Expediency, Economics and Environment in Design Engineering**	
5.1	Design for Production, Use, and Sustainability. *How designs are finalized based on the aspects of production methods, life span, reliability and environment?*	1
5.2	Engineering Economics in Design. *How to estimate the cost of a particular design and how will economics influence the engineering designs?*	1
5.3	Design Rights. *What are design rights and how can an engineer put it into practice?*	1
5.4	Ethics in Design. *How do ethics play a decisive role in engineering design?*	1
5.5	Case Studies: Design for Production, Use, and Sustainability. *Conduct exercises using simple products to show how designs change with constraints of production methods, life span requirement, reliability issues and environmental factors.*	1
	Second Series Examination	

Code.	Course Name	L	T	P	Hrs	Credit
HUT 200	**Professional Ethics**	2	0	0	2	2

Preamble: To enable students to create awareness on ethics and human values.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the core values that shape the ethical behaviour of a professional.
CO 2	Adopt a good character and follow an ethical life.
CO 3	Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.
CO 4	Solve moral and ethical problems through exploration and assessment by established experiments.
CO 5	Apply the knowledge of human values and social values to contemporary ethical values and global issues.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1								2			2	
CO 2								2			2	
CO 3								3			2	
CO 4								3			2	
CO 5								3			2	

Assessment Pattern

Bloom's category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	15	15	30
Understood	20	20	40
Apply	15	15	30

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Tests (2 Nos)	:	25 marks
Assignments/Quiz	:	15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):
1. Define integrity and point out ethical values.
2. Describe the qualities required to live a peaceful life.
3. Explain the role of engineers in modern society.

Course Outcome 2 (CO2)
1. Derive the codes of ethics.
2. Differentiate consensus and controversy.
3. Discuss in detail about character and confidence.

Course Outcome 3(CO3):
1. Explain the role of professional's ethics in technological development.
2. Distinguish between self interest and conflicts of interest.
3. Review on industrial standards and legal ethics.

Course Outcome 4 (CO4):
1. Illustrate the role of engineers as experimenters.
2. Interpret the terms safety and risk.
3. Show how the occupational crimes are resolved by keeping the rights of employees.

Course Outcome 5 (CO5):
1. Exemplify the engineers as managers.
2. Investigate the causes and effects of acid rain with a case study.
3. Explorate the need of environmental ethics in technological development.

Model Question paper

QP CODE: **Reg No:______________**

PAGES:3 **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: HUT 200

Course Name: PROFESSIONAL ETHICS

Max. Marks: 100 **Duration: 3 Hours**

(2019-Scheme)

PART A

(Answer all questions, each question carries 3 marks)

1. Define empathy and honesty.

2. Briefly explain about morals, values and ethics.

3. Interpret the two forms of self-respect.

4. List out the models of professional roles.

5. Indicate the advantages of using standards.

6. Point out the conditions required to define a valid consent?

7. Identify the conflicts of interests with an example?

8. Recall confidentiality.

9. Conclude the features of biometric ethics.

10. Name any three professional societies and their role relevant to engineers.

(10x3 = 30 marks)

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Classify the relationship between ethical values and law?

b) Compare between caring and sharing. (10+4 = 14 marks)

Or

12. a) Exemplify a comprehensive review about integrity and respect for others.

b) Discuss about co-operation and commitment. (8+6 = 14 marks)

MODULE II

13.a) Explain the three main levels of moral developments, deviced by Kohlberg.

b) Differentiate moral codes and optimal codes. (10+4 = 14 marks)

Or

14. a) Extrapolate the duty ethics and right ethics.

b) Discuss in detail the three types of inquiries in engineering ethics (8+6 = 14 marks)

MODULE III

Summarize the following features of morally responsible engineers.

(i) Moral autonomy **(ii)** Accountability

b)Explain the rights of employees (8+6 = 14 marks)

Or

16. a) Explain the reasons for Chernobyl mishap ?

b) Describe the methods to improve collegiality and loyalty. (8+6 = 14 marks)

MODULE IV

17.a) Execute collegiality with respect to commitment, respect and connectedness.

b) Identify conflicts of interests with an example. (8+6 = 14 marks)

Or

18. a) Explain in detail about professional rights and employee rights.

b) Exemplify engineers as managers.

MODULE V

19.a) Evaluate the technology transfer and appropriate technology.

b) Explain about computer and internet ethics. (8+6 = 14 marks)

Or

20. a) Investigate the causes and effects of acid rain with a case study.

b) Conclude the features of ecocentric and biocentric ethics. (8+6 = 14 marks)

Syllabus

Module 1 – Human Values.

Morals, values and Ethics – Integrity- Academic integrity-Work Ethics- Service Learning- Civic Virtue-Respect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitment-Empathy-Self Confidence -Social Expectations.

Module 2 - Engineering Ethics & Professionalism.

Senses of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy –Kohlberg's theory- Gilligan's theory- Consensus and Controversy-Profession and Professionalism- Models of professional roles-Theories about right action –Self interest-Customs and Religion- Uses of Ethical Theories.

Module 3- Engineering as social Experimentation.

Engineering as Experimentation – Engineers as responsible Experimenters- Codes of Ethics- Plagiarism-A balanced outlook on law - Challenges case study- Bhopal gas tragedy.

Module 4- Responsibilities and Rights.

Collegiality and loyalty – Managing conflict- Respect for authority- Collective bargaining- Confidentiality-Role of confidentiality in moral integrity-Conflicts of interest- Occupational crime- Professional rights-Employee right- IPR Discrimination.

Module 5- Global Ethical Issues.

Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics -Role in Technological Development-Engineers as Managers- Consulting Engineers- Engineers as Expert witnesses and advisors-Moral leadership.

Text Book

1. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.
2. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited ,New Delhi,2006.

Reference Books

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi,2014.
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics- Concepts and cases, Wadsworth Thompson Learning, United states,2005.
4. http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics.

Course Contents and Lecture Schedule

SL.No	Topic	No. of Lectures 25
1	**Module 1 – Human Values.**	
1.1	Morals, values and Ethics, Integrity, Academic Integrity,Work Ethics	1
1.2	Service Learning, Civic Virtue, Respect for others, Living peacefully	1
1.3	Caring and Sharing, Honesty, Courage, Co-operation commitment	2
1.4	Empathy, Self Confidence, Social Expectations	1
2	**Module 2- Engineering Ethics & Professionalism.**	
2.1	Senses of Engineering Ethics, Variety of moral issues, Types of inquiry	1
2.2	Moral dilemmas, Moral Autonomy, Kohlberg's theory	1
2.3	Gilligan's theory, Consensus and Controversy,Profession& Professionalism, Models of professional roles, Theories about right action	2
2.4	Self interest-Customs and Religion, Uses of Ethical Theories	1
3	**Module 3- Engineering as social Experimentation.**	
3.1	Engineering as Experimentation, Engineers as responsible Experimenters	1
3.2	Codes of Ethics,Plagiarism, A balanced outlook on law	2
3.3	Challenger case study, Bhopal gas tragedy	2
4	**Module 4- Responsibilities and Rights.**	
4.1	Collegiality and loyalty, Managing conflict, Respect for authority	1
4.2	Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest	2
4.3	Occupational crime, Professional rights, Employee right, IPR Discrimination	2
5	**Module 5- Global Ethical Issues.**	
5.1	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics	2
5.2	Role in Technological Development, Moral leadership	1
5.3	Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors	2

SEMESTER V

CST 301	FORMAL LANGUAGES AND AUTOMATA THEORY	Category	L	T	P	Credit	Year of Introduction
		PCC	3	1	0	4	2019

Preamble: This is a core course in theoretical computer science. It covers automata and grammar representations for languages in Chomsky Hierarchy. For regular languages, it also covers representations using regular expression and Myhill-Nerode Relation. The topics covered in this course have applications in various domains including compiler design, decidability and complexity theory, software testing, formal modelling and verification of hardware and software.

Prerequisite: Basic knowledge about the following topic is assumed: sets, relations - equivalence relations, functions, proof by Principle of Mathematical Induction.

Course Outcomes: After the completion of the course the student will be able to

CO1	Classify a given formal language into Regular, Context-Free, Context Sensitive, Recursive or Recursively Enumerable. **[Cognitive knowledge level: Understand]**
CO2	Explain a formal representation of a given regular language as a finite state automaton, regular grammar, regular expression and Myhill-Nerode relation. [**Cognitive knowledge level: Understand**]
CO3	Design a Pushdown Automaton and a Context-Free Grammar for a given context-free language. [**Cognitive knowledge level** : **Apply**]
CO4	Design Turing machines as language acceptors or transducers. [**Cognitive knowledge level: Apply]**
CO5	Explain the notion of decidability. [**Cognitive knowledge level: Understand]**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔									✔

CO2	✔	✔	✔	✔								✔
CO3	✔	✔	✔	✔								✔
CO4	✔	✔	✔	✔								✔
CO5	✔	✔	✔	✔								✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks**
	Test 1 (Marks)	**Test 2 (Marks)**	
Remember	**30**	**30**	**30**
Understand	**30**	**30**	**30**
Apply	**40**	**40**	**40**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**
Continuous Assessment - Test : **25 marks**
Continuous Assessment - Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

CST 301 Formal Languages and Automata Theory

Module - 1 (Introduction to Formal Language Theory and Regular Languages)

Introduction to formal language theory– Alphabets, Strings, Concatenation of strings, Languages.

Regular Languages - Deterministic Finite State Automata (DFA) (Proof of correctness of construction not required), Nondeterministic Finite State Automata (NFA), Equivalence of DFA and NFA**,** Regular Grammar (RG), Equivalence of RGs and DFA.

Module - 2 (More on Regular Languages)

Regular Expression (RE), Equivalence of REs and DFA, Homomorphisms, Necessary conditions for regular languages, Closure Properties of Regular Languages, DFA state minimization (No proof required).

Module - 3 (Myhill-Nerode Relations and Context Free Grammars)

Myhill-Nerode Relations (MNR)- MNR for regular languages, Myhill-Nerode Theorem (MNT) (No proof required), Applications of MNT.

Context Free Grammar (CFG)- CFG representation of Context Free Languages (proof of correctness is required), derivation trees and ambiguity, Normal forms for CFGs.

Module - 4 (More on Context-Free Languages)

Nondeterministic Pushdown Automata (PDA), Deterministic Pushdown Automata (DPDA), Equivalence of PDAs and CFGs (Proof not required), Pumping Lemma for Context-Free Languages (Proof not required), Closure Properties of Context Free Languages.

Module - 5 (Context Sensitive Languages, Turing Machines)

Context Sensitive Languages **-** Context Sensitive Grammar (CSG), Linear Bounded Automata.

Turing Machines - Standard Turing Machine, Robustness of Turing Machine, Universal Turing Machine, Halting Problem, Recursive and Recursively Enumerable Languages.

Chomsky classification of formal languages.

Text Book

1. Dexter C. Kozen, Automata and Computability, Springer (1999)

Reference Materials

1. John E Hopcroft, Rajeev Motwani and Jeffrey D Ullman, Introduction to Automata Theory, Languages, and Computation, 3/e, Pearson Education, 2007
2. Michael Sipser, Introduction To Theory of Computation, Cengage Publishers, 2013.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1): Identify the class of the following languages in Chomsky Hierarchy:

- $L_1 = \{a^p | p is\ a\ prime\ number\}$
- $L_2 =$
$\{x\{0,1\}^* | x is\ the\ binary\ representation\ of\ a\ decimal\ number\ which\ is\ a\ multiple\ of 5\}$
- $L_3 = \{a^n b^n c^n | n \geq 0\}$
- $L_4 = \{a^m b^n c^{m+n} | m > 0, n \geq 0\}$
- $L_5 = \{M\#x | M halts\ on x\}$. Here, M is a binary encoding of a Turing Machine and x is a binary input to the Turing Machine.

Course Outcome 2 (CO2):

(i) Design a DFA for the language $L = \{axb | x \in \{a,b\}^*\}$

(ii) Write a Regular Expression for the language:$L = \{x \in \{a,b\}^* | third\ last\ symbol\ in\ x\ is\ b\}$

(iii) Write a Regular Grammar for the language:$L = \{x \in \{0,1\}^* | there\ are\ no\ consecutive\ zeros\ in x\}$

(iv) Show the equivalence classes of the canonical Myhill-Nerode relation induced by the language: $L = \{x \in \{a,b\}^* | x contains\ even\ number\ of a's\ and\ odd\ number\ of b's\}$.

Course Outcome 3 (CO3):

(i) Design a PDA for the language$L = \{ww^R | w \in \{a,b\}^*\}$. Here, the notation w^R represents the reverse of the string w.

(ii) Write a Context-Free Grammar for the language $L = \{a^n b^{2n} | n \geq 0\}$.

Course Outcome 4 (CO4):

(i) Design a Turing Machine for the language $L = \{a^n b^n c^n | n \geq 0\}$

(ii) Design a Turing Machine to compute the square of a natural number. Assume that the input is provided in unary representation.

Course Outcome 5 (CO5): Argue that it is undecidable to check whether a Turing Machine Menters a given state during the computation of a given input x.

Model Question paper

QP CODE: **PAGES:3**

Reg No:______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST301

Course Name: Formal Languages and Automata Theory

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Design a DFA for the language $L = \{x \in \{a,b\}^* | aba \text{ is not a substring in } x\}$.

2. Write a Regular Grammar for the language: $L = \{axb | x \in \{a,b\}^*\}$

3. Write a Regular Expression for the language: $L = \{x \in \{0,1\}^* | \text{there are no consecutive } 1\text{'s in } x\}$

4. Prove that the language $L_1 = \{a^{n!} | n \in N\}$ is not regular.

5. List out the applications of Myhill-Nerode Theorem.

6. Write a Context-Free Grammar for the language: $L = \{x \in \{a,b\}^* | \#_a(x) = \#_b(x)\}$. Here, the notation $\#_1(w)$ represents the number of occurrences of the symbol 1 in the string w.

7. Design a PDA for the language of odd length binary palindromes (no explanation is required, just list the transitions in the PDA).

8. Prove that Context Free Languages are closed under set union.

9. Write a Context Sensitive Grammar for the language $L = \{a^n b^n c^n | n \geq 0\}$ (no explanation is required, just write the set of productions in the grammar).

10. Differentiate between Recursive and Recursively Enumerable Languages.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Draw the state-transition diagram showing an NFA N for the following language L. Obtain the DFA D equivalent to N by applying the subset construction algorithm. **(7)**

$$L = \{x \in \{a,b\}^* \mid the\ second\ last\ symbol\ in\ x\ is\ b\}$$

(b) Draw the state-transition diagram showing a DFA for recognizing the following language: **(7)**

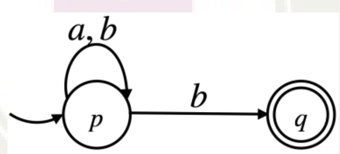
$$L = \{x \in \{0,1\}^* \mid x\ is\ a\ binary\ representation\ of\ a\ natural\ number\ which\ is\ a\ \text{multiple of } 5\}$$

OR

12. (a) Write a Regular grammar G for the following language L defined as: $L = \{x \in \{a,b\}^* \mid x\ does\ not\ conatin\ consecutive\ b's\}$. **(7)**

(b) Obtain the DFA A_G over the alphabet set $\Sigma = \{a,b\}$, equivalent to the regular grammar G with start symbol S and productions: $S \rightarrow aA$ and $A \rightarrow aA|bA|b$. **(7)**

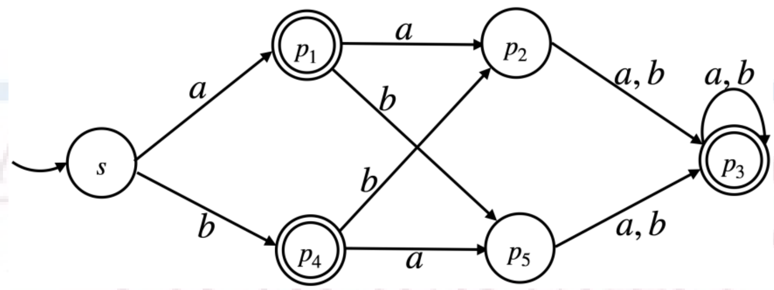
13. (a) Using Kleen's construction, obtain the regular expression for the language represented by the following NFA **(8)**



(b) Using pumping lemma for regular languages, prove that the language $L = \{a^n b^n \mid n \geq 0\}$ is not regular. **(7)**

OR

14. (a) Obtain the minimum-state DFA from the following DFA. **(8)**



(b) Using ultimate periodicity for regular languages, prove that the language $L = \{a^{n^2} | n \geq 0\}$ is not regular. **(6)**

15. (a) Show the equivalence classes of the canonical Myhill-Nerode relation for the language of binary strings with odd number of $1's$ and even number of 0s. **(7)**

(b) With an example, explain ambiguity in Context Free Grammar **(7)**

OR

16. (a) Convert the Context-Free Grammar with productions: $\{S \rightarrow aSb|\epsilon\}$ into Greibach Normal form. **(8)**

(b) Convert the Context-Free Grammar with productions: $\{S \rightarrow aSa|bSb|SS|\epsilon\}$ into Chomsky Normal form. **(6)**

17. (a) Design a PDA for the language $L = \{a^m b^n c^{m+n} | n \geq 0, m \geq 0\}$. Also illustrate the computation of the PDA on a string in the language **(7)**

(b) With an example illustrate how a multi-state PDA can be transformed into an equivalent single-state PDA. **(7)**

OR

18. (a) Using pumping lemma for context-free languages, prove that the language: $L = \{ww | w \in \{a, b\}^*\}$ is not a context-free language. **(6)**

(b) With an example illustrate how a CFG can be converted to a single-state PDA **(8)**

19. (a) Design a Turing machine to obtain the sum of two natural numbers a and b, both represented in unary on the alphabet set $\{1\}$. Assume that initially the tape contains $\vdash 1^a 0 1^b \ \flat^{\omega}$. The Turing Machine should halt with $\vdash 1^{a+b} \ \flat^{\omega}$ as the tape content. Also, illustrate the computation of your Turing Machine on the input $a = 3$and $b = 2$. **(7)**

(b) With an example illustrate how a CFG can be converted to a single-state PDA. **(7)**

OR

20. (a) Design a Turing machine to obtain the sum of two natural numbers $a$and b, both represented in unary on the alphabet set $\{1\}$. Assume that initially the tape contains $\vdash 1^a 0 1^b \ \flat^{\omega}$. The Turing Machine should halt with $\vdash 1^{a+b} \ \flat^{\omega}$ as the tape content. Also, illustrate the computation of your Turing Machine on the input $a = 3$and $b = 2$. **(7)**

(b) Write a context sensitive grammar for the language $L = \{a^n b^n c^n | n \geq 0\}$. Also illustrate how the the string $a^2 b^2 c^2$ can be derived from the start symbol of the proposed grammar. **(7)**

Teaching Plan

Sl. No	Topic	No. of Hours (45 hrs)
Module - 1 (Introduction to Formal Language Theory and Regular Languages)		**9 Hours**
1.1	Introduction to formal language theory – Alphabets, strings, concatenation of strings, Languages	1 Hour
1.2	Deterministic Finite State Automata (DFA) – Example DFA (Proof of correctness of construction not required)	1 Hour
1.3	Formal definition of DFA, Language accepted by the class of DFA	1 Hour
1.4	Nondeterministic Finite State Automata (NFA) – Example NFA	1 Hour
1.5	Formal definition of NFA, NFA with □ transitions - examples, formal definition	1 Hour
1.6	Equivalence of DFA and NFA with and without □ transitions - Subset construction	1 Hour
1.7	Regular Grammar (RG) – Example RGs, derivation of sentences	1 Hour
1.8	Formal definition of RG, Language represented by a RG	1 Hour
1.9	Equivalence of RG and DFA	1 Hour
Module - 2 (More on Regular Languages)		**9 Hours**
2.1	Regular Expression (RE) - Example REs and formal definition	1 Hour
2.2	Conversion of RE to NFA with □ transition	1 Hour
2.3	Conversion of NFA with □ transition to RE (Kleen’s construction)	1 Hour
2.4	Homomorphisms	1 Hour
2.5	Pumping Lemma for regular languages	1 Hour
2.6	Ultimate periodicity	1 Hour
2.7	Closure Properties of Regular Languages (proof not required)	1 Hour

2.8	DFA state minimization - Quotient construction	1 Hour
2.9	State Minimization Algorithm - Example	1 Hour
	Module - 3 (Myhill-Nerode Relations and Context Free Grammars)	**10 Hours**
3.1	Myhill-Nerode Relations (MNR) - Example, Properties of MyhillNerode Relation	1 Hour
3.2	Conversion of DFA to MNR (Proof of correctness not required)	1 Hour
3.3	Conversion of MNR to DFA(Proof of correctness not required)	1 Hour
3.4	Myhill-Nerode Theorem (MNT)	1 Hour
3.5	Applications of MNT	1 Hour
3.6	Context Free Grammar (CFG) - Example CFGs and formal definition	1 Hour
3.7	Proving correctness of CFGs	1 Hour
3.8	Derivation Trees and ambiguity	1 Hour
3.9	Chomsky Normal Form	1 Hour
3.10	Greibach Normal Form	1 Hour
	Module - 4 (More on Context-Free Languages)	**8 Hours**
4.1	Nondeterministic Pushdown Automata (PDA) – Example PDAs, formal definition	1 Hour
4.2	Acceptance criteria - equivalence	1 Hour
4.3	Deterministic PDA	1 Hour
4.4	Conversion of CFG to PDA (No proof required)	1 Hour
4.5	Conversion of PDA to CGF - Part I (No proof required)	1 Hour
4.6	Conversion of PDA to CGF - Part II (No proof required)	1 Hour
4.7	Pumping Lemma for context-free languages (No proof required)	1 Hour
4.8	Closure Properties of Context Free Languages	1 Hour

Module - 5 (Context Sensitive Languages, Turing Machines)		**9 Hours**
5.1	Context Sensitive Grammar (CSG) - Examples, formal definition	1 Hour
5.2	Linear Bounded Automata (LBA) - Example LBA, formal definition	1 Hour
5.3	Turing Machine (TM) - TM as language acceptors - examples, formal definition	1 Hour
5.4	TM as transducers - examples	1 Hour
5.5	Robustness of the standard TM model - Multi-tape TMs, Nondeterministic TM	1 Hour
5.6	Universal Turing Machine	1 Hour
5.7	Halting Problem of TM - proof of its undecidability	1 Hour
5.8	Recursive and Recursively Enumerable Languages	1 Hour
5.9	Chomsky classification of formal languages	1 Hour

CST 303	COMPUTER NETWORKS	Category	L	T	P	Credit	Year of Introduction
		PCC	3	1	0	4	2019

Preamble: Study of this course provides the learners a clear understanding of how computer networks from local area networks to the massive and global Internet are built, how they allow computers to share information and communicate with one another. This course covers the physical aspects of computer networks, layers of OSI Reference model, and inter-networking. The course helps the learners to compare and analyze the existing network technologies and choose a suitable network design for a given system.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to

CO#	Course Outcomes
CO1	Explain the features of computer networks, protocols, and network design models **(Cognitive Knowledge: Understand)**
CO2	Describe the fundamental characteristics of the physical layer and identify the usage in network communication **(Cognitive Knowledge: Apply)**
CO3	Explain the design issues of data link layer, link layer protocols, bridges and switches **(Cognitive Knowledge: Understand)**
CO4	Illustrate wired LAN protocols (IEEE 802.3) and wireless LAN protocols (IEEE 802.11) **(Cognitive Knowledge: Understand)**
CO5	Select appropriate routing algorithms, congestion control techniques, and Quality of Service requirements for a network **(Cognitive Knowledge: Apply)**
CO6	Illustrate the functions and protocols of the network layer, transport layer, and application layer in inter-networking **(Cognitive Knowledge: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔										✔
CO2	✔	✔	✔									✔
CO3	✔	✔	✔									✔
CO4	✔	✔	✔									✔
CO5	✔	✔	✔	✔								✔
CO6	✔	✔	✔			✔						✔

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and teamwork
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Test 1 (Marks in percentage)	Test 2 (Marks in percentage)	End Semester Examination (Marks in percentage)
Remember	40	30	30

Understand	**50**	**50**	**50**
Apply	**10**	**20**	**20**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	**50**	**100**	**3**

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**
Continuous Assessment Test : **25 marks**
Continuous Assessment Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus. The second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module - 1 (Introduction and Physical Layer)

Introduction – Uses of computer networks, Network hardware, Network software. Reference models – The OSI reference model, The TCP/IP reference model, Comparison of OSI and TCP/IP reference models.

Physical Layer – Modes of communication, Physical topologies, Signal encoding, Repeaters and hub, Transmission media overview. Performance indicators – Bandwidth, Throughput, Latency, Queuing time, Bandwidth–Delay product.

Module - 2 (Data Link Layer)

Data link layer - Data link layer design issues, Error detection and correction, Sliding window protocols, High-Level Data Link Control(HDLC)protocol. Medium Access Control (MAC) sublayer –Channel allocation problem, Multiple access protocols, Ethernet, Wireless LANs - 802.11, Bridges & switches - Bridges from 802.x to 802.y, Repeaters, Hubs, Bridges, Switches, Routers and Gateways.

Module - 3 (Network Layer)

Network layer design issues. Routing algorithms - The Optimality Principle, Shortest path routing, Flooding, Distance Vector Routing, Link State Routing, Multicast routing, Routing for mobile hosts. Congestion control algorithms. Quality of Service (QoS) - requirements, Techniques for achieving good QoS.

Module - 4 (Network Layer in the Internet)

IP protocol, IP addresses, Internet Control Message Protocol (ICMP), Address Resolution Protocol (ARP), Reverse Address Resolution Protocol (RARP), Bootstrap Protocol (BOOTP), Dynamic Host Configuration Protocol (DHCP). Open Shortest Path First(OSPF) Protocol, Border Gateway Protocol (BGP), Internet multicasting, IPv6, ICMPv6.

Module – 5 (Transport Layer and Application Layer)

Transport service – Services provided to the upper layers, Transport service primitives. User Datagram Protocol (UDP). Transmission Control Protocol (TCP) – Overview of TCP, TCP segment header, Connection establishment &release, Connection management modeling, TCP retransmission policy, TCP congestion control.

Application Layer –File Transfer Protocol (FTP), Domain Name System (DNS), Electronic mail, Multipurpose Internet Mail Extension (MIME), Simple Network Management Protocol

(SNMP), World Wide Web(WWW) – Architectural overview.

Text Books

1. Andrew S. Tanenbaum, Computer Networks, 4/e, PHI (Prentice Hall India).
2. Behrouz A Forouzan, Data Communication and Networking, 4/e, Tata McGraw Hill

Reference Books

1. Larry L Peterson and Bruce S Dave, Computer Networks – A Systems Approach, 5/e, Morgan Kaufmann.
2. Fred Halsall, Computer Networking and the Internet, 5/e.
3. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, 6/e.
4. Keshav, An Engineering Approach to Computer Networks, Addison Wesley, 1998.
5. W. Richard Stevens. TCP/IP Illustrated Volume 1, Addison-Wesley, 2005.
6. William Stallings, Computer Networking with Internet Protocols, Prentice-Hall, 2004.
7. Request for Comments (RFC) Pages - IETF -https://www.ietf.org/rfc.html

Course Level Assessment Questions

Course Outcome1 (CO1)

1. Compare TCP/IP and OSI reference model.
2. The purpose of physical layer is to transport a raw bit stream from one machine to another. Justify.

Course Outcome2 (CO2)

1. Write the physical and transmission characteristics of Optical Fibre Cable guided transmission media.
2. The distance between the sender and receiver systems is about 200 KM. The speed of transmission is 2GB/s. Find out the propagation time?

Course Outcome3 (CO3)

1. Ethernet frames must be at least 64 bytes long to ensure that the transmitter is still going in the event of a collision at the far end of the cable. Fast Ethernet has the same 64-byte minimum frame size but can get the bits out ten times faster. How is it possible to maintain the same minimum frame size?
2. What do you mean by bit stuffing?

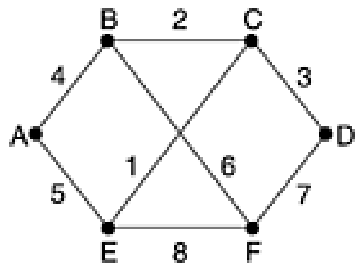
Course Outcome4 (CO4)

1. Draw and explain the frame format for Ethernet.
2. Give the differences between CSMA/CD and CSMA/CA protocol.

Course Outcome5 (CO5)

1. Consider the given subnet in which distance vector routing is used, and the vectors just come in to router C as follows: from B: (5, 0, 8, 12, 6, 2); from D: (16, 12, 6, 0, 9, 10);

and from E: (7, 6, 3, 9, 0, 4). The measured delays from C to B, D, and E, are 6, 3, and 5, respectively. What is C's new routing table? Give both the outgoing line to use and the expected delay.



2. Illustrate the leaky bucket congestion control technique.

Course Outcome 6 (CO6)

1. How do you subnet the Class C IP Address 206.16.2.0 so as to have 30 subnets. What is the subnet mask for the maximum number of hosts? How many hosts can each subnet have?
2. Give the architecture of World Wide Web.

Model Question Paper

QP CODE: ___ **PAGES:**

Reg No:_______________

Name:_________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 303

Course Name : Computer Networks

Max Marks: 100 **Duration: 3 Hours**

PART-A

(Answer All Questions. Each question carries 3 marks)

1. What does "negotiation" mean when discussing network protocols in a layered architecture? Give an example.

2. Define simplex, half-duplex, and full-duplex transmission modes. Give one example for each.

3. Data link protocols almost always put the CRC in a trailer rather than in a header. Why?

4. An 8-bit byte with binary value 10101111 is to be encoded using an even-parity Hamming code. What is the binary value after encoding?

5. Illustrate the Count to Infinity problem in routing.

6. Describe two major differences between the warning bit method and the Random Early Detection (RED) method.

7. The Protocol field used in the IPv4 header is not present in the fixed IPv6 header. Why?

8. How many octets does the smallest possible IPv6 (IP version 6) datagram contain?

9. Can Transmission Control Protocol(TCP) be used directly over a network (e. g. an Ethernet) without using IP? Justify your answer.

10. When Web pages are sent out, they are prefixed by MIME headers. Why?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) With a neat diagram, explain Open Systems Interconnection (OSI) Reference Model. **(8)**

(b) Compare Twisted Pair, Coaxial Cable and Optical Fibre guided transmission media. **(6)**

OR

12. (a) Consider two networks providing reliable connection-oriented service. One of them offers a reliable byte stream and the other offers a reliable message stream. Are they identical? Justify your answer. **(8)**

(b) Sketch the waveform in Manchester and Differential Manchester Encoding for the bitstream 11000110010. **(6)**

13. (a) A bit stream 10011101 is transmitted using the standard CRC method. The generator polynomial is $\square^{3} + 1$. Show the actual bit string transmitted. Suppose the third bit from the left is inverted during transmission. Show that this error is detected at the receiver's end. **(8)**

(b) Explain the working of High-Level Data Link Control (HDLC) protocol. **(6)**

OR

14. (a) Explain the working of IEEE 802.11 MAC sublayer. **(10)**

(b) Distinguish between Bridges and Switches. **(4)**

15. (a) Illustrate Distance Vector Routing algorithm with an example. **(8)**

(b) Explain the characteristics of Routing Information Protocol (RIP). **(6)**

OR

16. (a) A computer on a 6-Mbps network is regulated by a token bucket. The token bucket is filled at a rate of 1 Mbps. It is initially filled to capacity with 8 megabits. How long can the computer transmit at the full 6 Mbps? **(8)**

(b) Explain how routing is performed for mobile hosts. **(6)**

17. (a) Explain the address resolution problem using Address Resolution Protocol (ARP) and Reverse Address Resolution Protocol (RARP)with an example network. **(10)**

(b) A network on the Internet has a subnet mask of 255.255.240.0. What is the maximum number of hosts it can handle? **(4)**

OR

18. (a) How do you subnet the Class C IP address 195.1.1.0 so as to have 10 subnets with a maximum of 12 hosts in each subnet. **(6)**

(b) Draw IPv6 Datagram format and explain its features. **(8)**

19. (a) Distinguish the header formats of Transmission Control protocol (TCP) and User Datagram Protocol (UDP). **(8)**

(b) Explain the principal Domain Name System (DNS) resource record types for **(6)**

IPv4.

OR

20. (a) What is the role of Simple Mail Transfer Protocol (SMTP) in E- mail? **(6)**

(b) With the help of a basic model, explain the working of World Wide Web (WWW). **(8)**

Teaching Plan

No	Contents	No of Lecture Hrs
Module – 1 (Introduction and Physical Layer) (10 hrs)		
1.1	Introduction, Uses of computer networks.	1 hour
1.2	Network Hardware, Local Area Networks (LAN), Metropolitan Area Networks (MAN), Wide Area Networks (WAN), Wireless networks, Home networks, Internetworks.	1 hour
1.3	Network Software, Protocol hierarchies, Design issues for the layers.	1 hour
1.4	Connection-oriented and Connectionless services, Service primitives, Relationship of services to protocols.	1 hour
1.5	Reference models, The OSI reference model.	1 hour
1.6	The TCP/IP reference model, Comparisonof OSI and TCP/IP reference models.	1 hour
1.7	Physical layer, Modes of communication, Simplex, Half-duplex, and Full-duplex, Physical topologies, Mesh, Star, Bus, Ring, Hybrid.	1 hour
1.8	Signal encoding, Manchester, Differential Manchester.	1 hour
1.9	Transmission media overview, Guided media (twisted pair, coaxial and fiber optic media), Unguided/wireless media (radio, microwave, and infrared).	1 hour
1.10	Performance indicators, Bandwidth (in Hertz and in Bits per Seconds),	1 hour

	Throughput, Latency (Delay), Queuing time, Bandwidth-Delay product.	
Module 2 – (Data Link Layer) (10 hrs)		
2.1	Data link layer design issues.	1 hour
2.2	Error detection and correction, Error correcting codes	1 hour
2.3	Error detecting codes.	1 hour
2.4	Sliding window protocols.	1 hour
2.5	High-Level Data Link Control(HDLC) protocol.	1 hour
2.6	Medium Access Control (MAC) sublayer, Channel allocation problem, Multiple access protocols.	1 hour
2.7	Ethernet, Ethernet cabling, Manchester encoding, Ethernet MAC sublayer protocol, Binary Exponential Backoff algorithm.	1 hour
2.8	Ethernet performance, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, IEEE 802.2: Logical Link Control.	1 hour
2.9	Wireless LANs, 802.11 protocol stack, Physical layer, MAC Sublayer protocol, Frame structure.	1 hour
2.10	Bridges &switches, Bridges from 802.x to 802.y, Repeaters, Hubs, Bridges, Switches, Routers, and Gateways.	1 hour
Module 3 - (Network Layer) (8 hrs)		
3.1	Network layer design issues.	1 hour
3.2	Routing algorithms, The Optimality Principle, Shortest path routing, Flooding.	1 hour
3.3	Distance Vector Routing.	1 hour
3.4	Link State Routing.	1 hour
3.5	Multicast routing, Routing for mobile hosts.	1 hour

3.6	General principles of congestion control, Congestion prevention policies, Congestion control in virtual circuit subnets.	1 hour
3.7	Congestion control algorithms, Congestion control in Datagram subnets, Load shedding, Jitter control.	1 hour
3.8	Quality of Service, Requirements, Techniques for achieving good Quality of Service.	1 hour
Module 4 – (Network Layer in the Internet) (9 hrs)		
4.1	Network layer in the Internet, Internet Protocol (IP).	1 hour
4.2	IP Addresses, Subnets, Classless Inter-Domain Routing (CIDR).	1 hour
4.3	IP Addresses, Network Address Translation (NAT).	1 hour
4.4	Internet Control Message Protocol (ICMP), Address Resolution Protocol (ARP), Reverse Address Resolution Protocol (RARP).	1 hour
4.5	Bootstrap Protocol (BOOTP), Dynamic Host Configuration Protocol (DHCP).	1 hour
4.6	Open Shortest Path First (OSPF) protocol.	1 hour
4.7	Border Gateway Protocol (BGP).	1 hour
4.8	Internet multicasting.	1 hour
4.9	IPv6, Header format, Extension headers, Internet Control Message Protocol version 6 (ICMPv6).	1 hour
Module 5 - (Transport Layer and Application Layer) (8 hrs)		
5.1	Transport Service, Services provided to the upper layers, Transport service primitives. User Datagram Protocol (UDP).	1 hour
5.2	Transmission Control Protocol (TCP), TCP segment header, Connection establishment &release, Connection management modeling.	1 hour
5.3	TCP retransmission policy, TCP congestion control.	1 hour
5.4	Application layer, File Transfer Protocol (FTP).	1 hour

5.5	Domain Name System (DNS).	1 hour
5.6	Electronic Mail, Multipurpose Internet Mail Extension (MIME).	1 hour
5.7	Simple Network Management Protocol (SNMP).	1 hour
5.8	World Wide Web, Architectural overview.	1 hour

CDT305	DATA ANALYTICS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	3	1	0	4	2020

Preamble: This course helps the learner to understand the basic concepts of data analytics. This course covers mathematics for data analytics, predictive and descriptive analytics of data, classification, and clustering & text analytics. It enables the learners to perform data analysis on a real world scenario using appropriate tools.

Prerequisite: Database, Programming Languages

Course Outcomes: After the completion of the course the student will be able to

CO 1	Explain the key concepts of data analytics (Cognitive Knowledge Level: Understand)
CO 2	Apply appropriate techniques to convert raw data into suitable format for practical data analytics tasks (Cognitive Knowledge Level: Apply)
CO 3	Extend the concept of association rule mining in real world scenario (Cognitive Knowledge Level: Understand)
CO 4	Select appropriate clustering and classification algorithms for various applications and extend data analytics methods to the new domains of data (Cognitive Knowledge Level: Apply)
CO 5	Understand the basics of text analytics and text classification (Cognitive Knowledge Level: Understand)

Mapping of course outcomes with program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✔	✔										✔
CO2	✔	✔										✔
CO3	✔	✔	✔									✔
CO4	✔	✔	✔									✔

CO5	✔	✔										✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks**
	Test1 (percentage)	**Test2 (percentage)**	
Remember	40	40	40
Understand	40	40	40
Apply	20	20	20
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance: 10 marks
Continuous Assessment Tests : 25 marks
Continuous Assessment Assignment: 15 marks

Internal Examination Pattern:
Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

SYLLABUS

Module- 1(Introduction to Data Analytics)

Introduction to Data Analytics – Analytics Process Model, Analytical Model Requirements. Data Analytics Life Cycle overview, Association of two variables - Discrete variables, Ordinal and Continuous variable, Probability calculus - probability distributions , Hypothesis Testing - Basic definitions.
Proximity measures -Data Objects, Attribute types, Dissimilarity and Similarity measures.

Module- 2 (Data Preprocessing)

Statistical description of data- Central tendency, dispersion, Range, Quartiles, Variance, Standard Deviation, and Interquartile Range, graphic displays.

Data Preprocessing – Cleaning, Integration, Reduction, Transformation, Discretization.

Module -3 (Mining Frequent Patterns)

Mining Frequent Patterns-Associations and Correlations, Apriori, FP-growth, Pattern Evaluation Method. Advanced Pattern Mining - Rare patterns, Meta rule guided mining of Association Rules.

Module- 4 (Classification and Clustering)

Classification - General Approach to classification, Decision tree induction, Attribute selection measures, Naive Bayes Classification. Clustering-K-Means, Agglomerative, Divisive, BIRCH, DBSCAN.

Module- 5 (Text Processing)

Text Processing - Boolean retrieval, Example IR problem, inverted index, processing Boolean queries, tokenization, stemming, phrase queries, vector space model, finite automata and language model, query likelihood model, naïve bayes text classification.

Text Books:

1. Christian Heumann and Michael Schomaker, "Introduction to Statistics and DataAnalysis", Springer, 2016
2. Jiawei Han and Micheline Kamber, Data Mining Concepts and Techniques, Third Edition, Elsevier, 2012.

Reference Books:

1. Christopher D Manning, Raghavan, P., and Schutze, H.. Introduction to Information Retrieval. Cambridge University Press
2. Mining Text Data. Charu C. Aggarwal and ChengXiang Zhai, Springer, 2012.
3. Bart Baesens," Analytics in a Big Data World: The Essential Guide to Data Science and its Business Intelligence and Analytic Trends" John Wiley & Sons, 2013.
4. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, " Introduction To Data Mining",Person Education, 2007.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1): Given two objects represented by the tuples (22, 1, 42, 10) and (20, 0, 36, 8), compute the dissimilarity between the tuples.

Course Outcome 2 (CO2): Suppose that the data for analysis includes the attributes age. The age values for the data tuples are 13, 15, 16, 16, 19, 20, 20, 21, 22, 22, 25, 25, 25, 25, 30, 33, 33, 35, 35, 35, 35, 36, 40, 45, 46, 52, 70. Construct the five-number summary for the dataset.

Course Outcome 3(CO3): Find the frequent item sets in the database using *apriori* algorithm.

Course Outcome 4 (CO4): What are decision trees? Explain how decision trees are useful in data mining.

Course Outcome 5 (CO5): Explain Boolean Retrieval with an example.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

***Course Code:* CDT 305**

Course Name: Data Analytics

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Define Data analytics. What are the different types of attributes?
2. Compare any three probability distributions.
3. What is dimensionality reduction?
4. Explain the methods to determine correlation.
5. Draw and explain the conditional FP-tree.

6. Explain join and prune step in *Apriori* algorithm..

7. State and explain Bayes Theorem.

8. What is Clustering? Explain the taxonomy of Clustering methods.

9. Explain Naïve Bayes Text Classification.

10. Explain about Inverted Index

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain with a neat diagram the steps involved in the process of the Knowledge Discovery from data. **(10)**

(b) Discuss the different OLAP operations. **(4)**

OR

12. (a) Discuss any five implementation issues associated with data mining. **(6)**

(b) Given two objects represented by the tuples (22, 1, 42, 10) and (20,0,36,8) ,compute dissimilarity between the tuples. **(8)**

13. (a) Analyze the methods of normalization with an example. **(6)**

(b) Explain the methods used to handle noisy data. Given the values for attribute age as 13,15,16,16,19,20,20,21,22,22, 35, 35 **(8)**
i) Illustrate smoothing by bin means and bin boundaries.
ii) Determine the outlier in the above database

OR

14. (a) Suppose that the data for analysis includes the attributes age. The age values for the data tuples are 13, 15, 16, 16, 19, 20, 20, 21, 22, 22, 25, 25, 25, 25, 30, 33, 33, 35,35, 35, 35, 36, 40, 45, 46, 52, 70. Construct the five-number summary for the dataset. **(8)**

(b) Explain Data Transformation in detail . **(6)**

15. (a) Consider a database having 10 transactions and min_sup 2 **(10)**

a) Find the frequent itemsets in the database using Apriori algorithm.

TID	ITEMS BOUGHT
T1	{jam, biscuit, milk}
T2	{chocolate, butter, jam}
T3	{jam, milk, juice}
T4	{chocolate, butter, juice}
T5	{biscuit, juice, milk}
T6	{jam, milk, chocolate, butter}
T7	{chocolate, butter, milk}
T8	{biscuit, milk}
T9	{jam, milk, chocolate, butter}
T10	{biscuit, juice}

(b) b) List the disadvantages of Apriori algorithm. Briefly explain a solution for the limitation of Apriori technique. **(4)**

OR

16. (a) How are support and confidence measures used in generating association rules. **(4)**

(b) Find all frequent itemsets using FP-growth. Let min sup=60% and min conf=80%. Compare the efficiency with Apriori algorithms. **(10)**

TID	ITEMS BOUGHT
T100	{ M, O, N, K, E, Y }
T200	{ D, O, N, K, E, Y }
T300	{ M, A, K, E }
T400	{ M, U, C, K, Y }
T500	{ C, O, O, K, I, E }

17. a What are decision trees? Explain how decision trees are useful in data mining. **(4)**

b The training data for a classifier is given below. Using a Bayesian Classifier to classify the tuple (Red, SUV, Domestic) as stolen or not stolen. **(10)**

No	Color	Type	Origin	Stolen
1	Red	Sports	Domestic	Yes
2	Red	Sports	Domestic	No
3	Red	Sports	Domestic	Yes

4	Yellow	Sports	Domestic	No
5	Yellow	Sports	Imported	Yes
6	Yellow	SUV	Imported	No
7	Yellow	SUV	Imported	Yes
8	Yellow	SUV	Domestic	No
9	Red	SUV	Imported	No
10	Red	Sports	Imported	Yes

(8

18. (a) Explain about Attribute Subset Selection Measures with an example. **(7)**

(b) Describe each of the following
i) BIRCH
ii) DBSCAN

(7)

19. (a) Differentiate tokenization and stemming with an example. **(7)**

(b) Describe language models for IR. **(7)**
i) Finite automata and language model
ii) Query likelihood model

OR

20. (a) Explain Boolean Retrieval with an example. **(7)**

21. (b) Describe the vector space model . **(7)**

Teaching Plan

CDT305 Data Analytics		**45 Hours**
Module- 1(Introduction to Data Analytics)		**(10 hours)**
1.1	Introduction to Data Analytics – Analytics Process Model,	1 hour
1.2	Analytical Model Requirements	1 hour
1.3	Data Analytics Life Cycle	1 hour
1.4	Association of two variables	1 hour

1.5	Probability distributions	1 hour
1.6	Probability distributions	1 hour
1.7	Hypothesis Testing	1 hour
1.8	Basic definitions.	1 hour
1.9	Data Objects ,Attribute types	1 hour
1.10	Dissimilarity and Similarity measures	1 hour
Module- 2 (Data Preprocessing)		**(10 hours)**
2.1	**Central tendency**	1 hour
2.2	**Dispersion, Range**	1 hour
2.3	Quartiles, Variance	1 hour
2.4	Standard Deviation, Interquartile Range	1 hour
2.5	**Graphic displays**	1 hour
2.6	Cleaning	1 hour
2.7	Integration	1 hour
2.8	Reduction	1 hour
2.9	**Transformation**	1 hour
2.10	**Discretization**	1 hour
Module -3 (Mining Frequent Patterns)		**(7 hours)**
3.1	**Mining Frequent Patterns**	1 hour
3.2	Associations and Correlations	1 hour
3.3	Apriori algorithm	1 hour
3.4	FP-growth algorithm	1 hour
3.5	**Multi Dimensional Space**	1 hour
3.6	**Rare patterns**	1 hour
3.7	**Meta rule guided mining of association rules**	1 hour
Module- 4 (Classification and Clustering)		**(9 hours)**
4.1	General Approach to classification	1 hour
4.2	Decision tree induction	1 hour
4.3	Attribute selection measures	1 hour

4.4	Naive Bayes Classification	1 hour
4.5	K-Means	1 hour
4.6	Agglomerative Approach for clustering	1 hour
4.7	Divisive Approach	1 hour
4.8	Hierarchical - BIRCH Algorithm	1 hour
4.9	Density Based - DBSCAN Algorithm	1 hour
Module- 5 (Text Processing)		**(9 hours)**
5.1	Boolean Retrieval	1 hour
5.2	Example IR Problem	1 hour
5.3	Inverted Index	1 hour
5.4	Processing Boolean Queries, Tokenization	1 hour
5.5	Stemming, Phrase Queries	1 hour
5.6	Vector Space Model	1 hour
5.7	Finite Automata And Language Model	1 hour
5.8	Query Likelihood Model	1 hour
5.9	Naïve Bayes Text Classification	1 hour

CDT307	BIG DATA PROCESSING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	3	1	0	4	2020

Preamble: The purpose of the syllabus is to get an overview of storage, retrieval and processing of big data. This course aims at providing a foundation in various tools and techniques employed to handle Big Data, and cover the various technologies of Big Data such as Map Reduce, Hadoop, Hbase, Pig, Hive and Spark. As data continues to grow it is known that via big data solutions, organizations generate insights and make well-informed decisions, discover trends, and improve productivity.

Prerequisite: Database, Programming Languages

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand big data and trivial data and build and maintain reliable, scalable, distributed systems (Cognitive Knowledge Level: Understand)
CO 2	Infer knowledge about the distributed storage and processing of large datasets and extend the effective data storage mechanisms using HDFS and HBase (Cognitive Knowledge Level: Understand)
CO 3	Model the distributed processing of large data sets across clusters using simple programming models (Cognitive Knowledge Level: Apply)
CO 4	Identify the basics of stream computing and build applications using Hive (Cognitive Knowledge Level: Apply)
CO 5	Build applications using Pig and spark (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	✔											✔
CO2	✔	✔	✔									✔
CO3	✔	✔	✔									✔
CO4	✔	✔	✔									✔

CO5	✔	✔										✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks**
	Test1 (percentage)	**Test2 (percentage)**	
Remember	40	40	40
Understand	40	40	40
Apply	20	20	20
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance: 10 marks
Continuous Assessment Tests : 25 marks
Continuous Assessment Assignment: 15 marks

Internal Examination Pattern:
Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

SYLLABUS

Module 1(Introduction to Big data and R)

Introduction to Big data -Evolution of Big data, Big data characteristics, RDBMS and Big Data, History of Hadoop, Hadoop Ecosystem, Core Components.

Introduction to R – Features of R Language, Vectors, Filtering, Creating Matrices , Applying Functions to Matrix Rows and Columns, Lists , Creating List , General List Operations, Data Frames , Creating Data Frames , Matrix like Operations in Frames , Applying Functions to Data Frames ,Reading and Writing Files.

Module 2 (Hadoop Distributed File System)

HDFS- Architecture, Using HDFS Files, HDFS Design, Blocks, Namenodes and Data nodes, Basic File system Operations, Hadoop Specific File Types, Anatomy of a file read, Anatomy of a file write. HBase- HBase Architecture, HBase Schema Design.

Module 3 (MapReduce Programming)

Data Processing with MapReduce: Execution Pipeline, Runtime Coordination and Task Management in MapReduce, Designing MapReduce implementations: Using MapReduce as a framework for parallel processing, Face Recognition Example - Simple Data Processing with MapReduce, Inverted Indexes Example, Road Enrichment Example.

Module 4 (Stream Data Model and Hive)

Introduction to Stream - Concepts, Stream Data Model and Architecture, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream. Hive - Features, Data types and file formats, primitive and collection data types, HiveQL, Creating tables, Dropping Tables, Alter table.

Module 5 (Pig and Spark)

Pig -Installing and Execution, Data Model, Pig Latin: Structure , Functions.

Spark- History of spark, Storage layers for spark, Core spark concepts, RDD basics, RDD Operations.

Text Book

1. Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich ,Professional Hadoop Solutions
2. Tom White ,Hadoop: The Definitive Guide, O'Reilly Media 3rd Edition

Reference Books

1. Jure Leskovec, Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2014
2. BIG DATA, Black Book TM, DreamTech Press, 2016 Edition
3. Seema Acharya, Subhasni Chellappan, “Big Data And Analytics”, Wiley Publications
4. Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia, Learning Spark, O'Reilly
5. Nathan Marz and James Warren, “BIG DATA- Principles and Best Practices of Scalable Real-time Systems”
6. Jason Rutherglen, Dean Wampler, Edward Capriolo, Programming Hive, O'Reilly
7. Norman Matloff , “The Art of R Programming: A Tour of Statistical Software Design”, NoStarch Press
8. Jared P. Lander, “R for Everyone: Advanced Analytics and Graphics”, Addison-Wesley Data & Analytics Series

Sample Course Level Assessment Questions

Course Outcome 1 (CO1): With the help of a neat diagram, explain the core components of Hadoop Ecosystem.
Course Outcome 2 (CO2): Discuss on the general guidelines for HBase Schema Design.
Course Outcome 3(CO3): Given a links graph and terrain model, convert two dimensional (x,y) links into three-dimensional (x, y, z) links. Implement the following problem by using Map Reduce.
Course Outcome 4 (CO4): Discuss on how to count distinct elements in a Stream.
Course Outcome 5 (CO5): Draw the Spark architecture and explain the role of different components.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 2**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: : CDT307

Course Name: Big Data Processing

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. How are big data and hadoop related to each other?

2. Discuss the general list operations in R with example.

3. Write a brief note on features and column families of HBase.

4. Compare the specific file types of HDFS.

5. How does Map Reduce Framework provide support for application development?

6. Describe the Map Reduce job implementation in the case of Face Recognition example.

7. Briefly explain about Filtering Streams.

8. Make a note on partitioned and managed tables in Hive.

9. Identify the ways in which a pig program can be executed.

10. List the ways in which Spark RDD can be created. **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) With a neat diagram explain the core components of Hadoop Ecosystem **(12)**

(b) List the newer capabilities and components beyond core components in Hadoop Ecosystem. **(2)**

OR

12. (a) Explain in detail about the Matrix handling in R. **(10)**

(b) Write a short note about how the different types of files can be read and written using R. **(4)**

13. (a) Explain the HDFS Architecture with a neat diagram. **(8)**

(b) In addition to ordinary files, HDFS also introduces specialized file types to provide much richer functionalities. Explain in detail about the Hadoop specific File Types. **(6)**

14. (a) Explain the data model and architecture of HBase. (10)

(b) Discuss on the general guidelines for HBase Schema Design. (4)

15. (a) Discuss in detail about the Road Enrichment (8)

(b) How can MapReduce be used to solve linear equations? (6)

OR

16. (a) Given a links graph and terrain model, convert two dimensional (x,y) links into three-dimensional (x, y, z) links. Implement the following problem using Map Reduce. (9)

(b) Explain the common Map Reduce Design Gotchas. (5)

17. (a) Explain in detail the Stream Data Model and its architecture. (9)

(b) Write the syntax to create a table and partition in Hive. (5)

OR

18. (a) Describe about Data Types and File Formats in Hive. (10)

(b) Discuss on how to count distinct elements in a Stream. (4)

19. (a) Write about Pig Latin Structure and functions (10)

(b) Discuss the Storage layers for Spark. (4)

OR

20. (a) Compare in detail about the datatypes used in Pig. (6)

(b) Draw the Spark architecture and explain the role of different components . (8)

Teaching Plan

	CDT 307 Big Data Processing	**45 hours**
	Module -1 (Introduction to Big data and R)	**(10 hours)**
1.1	Evolution of Big data, Big data characteristics	1 hour
1.2	RDBMS and Big Data, Issues with Relational Model	1 hour
1.3	History of Hadoop	1 hour
1.4	Hadoop Ecosystem and Core Components	1 hour
1.5	Features of R Language, Vectors	1 hour
1.6	Filtering and Creating Matrices	1 hour
1.7	Applying Functions to Matrix Rows and Columns	1 hour
1.8	Creating List and General List Operations	1 hour
1.9	Creating Data Frames and Matrix like Operations in Frames	1 hour
1.10	Applying Functions to Data Frames and Reading and Writing Files	1 hour
	Module- 2 (HDFS)	**(9 hours)**
2.1	**HDFS Architecture**	1 hour
2.2	**UsingHDFS Files ,HDFS Design**	1 hour
2.3	Blocks, Namenodes and Data nodes	1 hour
2.4	Basic File system Operations	1 hour
2.5	**Hadoop Specific File Types**	1 hour
2.6	Anatomy of a file read	1 hour
2.7	Anatomy of a file write	1 hour
2.8	HBase Architecture	1 hour
2.9	HBase Schema Design	1 hour
	Module -3 (MapReduce Programming)	**(9 hours)**

3.1	**Execution pipeline**	1 hour
3.2	Runtime Coordination and Task Management in MapReduce	1 hour
3.3	Using MapReduce as a framework for parallel processing	1 hour
3.4	Face Recognition	1 hour
3.5	**Simple Data Processing with MapReduce**	1 hour
3.6	**MapReduce programs**	1 hour
3.7	**Inverted Indexes Example**	1 hour
3.8	**Building joins with MapReduce**	1 hour
3.9	**Road Enrichment Example**	1 hour
	Module- 4 (Stream Data Model and Hive)	**(9 hours)**
4.1	Introduction to Stream Concepts	1 hour
4.2	Stream Data Model and Architecture	1 hour
4.3	Sampling Data in a Stream	1 hour
4.4	Filtering Streams	1 hour
4.5	Counting Distinct Elements in a Stream	1 hour
4.6	Features	1 hour
4.7	Data types and file formats	1 hour
4.8	primitive and collection data types	1 hour
4.9	HiveQL, Creating tables ,Dropping Tables, Alter table	1 hour
	Module- 5 (Pig and Spark)	**(8 hours)**
5.1	Pig -Installing and Execution	1 hour
5.2	Data Model	1 hour
5.3	Pig Latin: Structure	1 hour
5.4	Functions	1 hour
5.5	History of spark, Storage layers for spark	1 hour
5.6	Core spark concepts	1 hour
5.7	RDD basics	1 hour
5.8	RDD Operations	1 hour

CST 309	MANAGEMENT OF SOFTWARE SYSTEMS	Category	L	T	P	Credit	Year of Introduction
		PCC	3	0	0	3	2019

Preamble: This course provides fundamental knowledge in the Software Development Process. It covers Software Development, Quality Assurance, Project Management concepts and technology trends. This course enables the learners to apply state of the art industry practices in Software development.

Prerequisite: Basic understanding of Object Oriented Design and Development.

Course Outcomes: After the completion of the course the student will be able to

CO1	Demonstrate Traditional and Agile Software Development approaches **(Cognitive Knowledge Level: Apply)**
CO2	Prepare Software Requirement Specification and Software Design for a given problem. **(Cognitive Knowledge Level**: **Apply**)
CO3	Justify the significance of design patterns and licensing terms in software development, prepare testing, maintenance and DevOps strategies for a project. **(Cognitive Knowledge Level: Apply**)
CO4	Make use of software project management concepts while planning, estimation, scheduling, tracking and change management of a project, with a traditional/agile framework**.** **(Cognitive Knowledge Level: Apply**)
CO5	Utilize SQA practices, Process Improvement techniques and Technology advancements in cloud based software models and containers & microservices. **(Cognitive Knowledge Level: Apply**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔	✔		✔						✔
CO2	✔	✔	✔	✔		✔				✔	✔	✔
CO3	✔	✔	✔	✔				✔		✔	✔	✔
CO4	✔	✔	✔	✔		✔			✔	✔	✔	✔
CO5	✔	✔	✔	✔		✔						✔

	Abstract POs defined by National Board of Accreditation		
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (Percentage)	Test2 (Percentage)	
Remember	30	30	30
Understand	40	40	50
Apply	30	30	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment Tests : **25 marks**

Continuous Assessment Assignment : **15 marks** (Each student shall identify a software development problem and prepare Requirements Specification, Design Document, Project Plan and Test case documents for the identified problem as the assignment.)

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks.

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

Syllabus

Module 1 : Introduction to Software Engineering (7 hours)

Introduction to Software Engineering - Professional software development, Software engineering ethics. Software process models - The waterfall model, Incremental development. Process activities - Software specification, Software design and implementation, Software validation, Software evolution. Coping with change - Prototyping, Incremental delivery, Boehm's Spiral Model. Agile software development - Agile methods, agile manifesto - values and principles. Agile development techniques, Agile Project Management. Case studies : An insulin pump control system. Mentcare - a patient information system for mental health care.

Module 2 : Requirement Analysis and Design (8 hours)

Functional and non-functional requirements, Requirements engineering processes. Requirements elicitation, Requirements validation, Requirements change, Traceability Matrix. Developing use cases, Software Requirements Specification Template, Personas, Scenarios, User stories, Feature identification. Design concepts - Design within the context of software engineering, Design Process, Design concepts, Design Model. Architectural Design - Software Architecture, Architectural Styles, Architectural considerations, Architectural Design Component level design - What is a component?, Designing Class-Based Components, Conducting Component level design, Component level design for web-apps. Template of a Design Document as per “IEEE Std 1016-2009 IEEE Standard for Information Technology Systems Design Software Design Descriptions”. Case study: The Ariane 5 launcher failure.

Module 3 : Implementation and Testing (9 hours)

Object-oriented design using the UML, Design patterns, Implementation issues, Open-source development - Open-source licensing - GPL, LGPL, BSD. Review Techniques - Cost impact of Software Defects, Code review and statistical analysis. Informal Review, Formal Technical Reviews, Post-mortem evaluations. Software testing strategies - Unit Testing, Integration Testing, Validation testing, System testing, Debugging, White box testing, Path testing, Control Structure testing, Black box testing, Testing Documentation and Help facilities. Test automation, Test-driven development, Security testing. Overview of DevOps and Code Management - Code management, DevOps automation, Continuous Integration, Delivery, and Deployment (CI/CD/CD). Software Evolution - Evolution processes, Software maintenance.

Module 4 : Software Project Management (6 hours)

Software Project Management - Risk management, Managing people, Teamwork. Project Planning, Software pricing, Plan-driven development, Project scheduling, Agile planning. Estimation techniques, COCOMO cost modeling. Configuration management, Version management, System building, Change management, Release management, Agile software management - SCRUM framework. Kanban methodology and lean approaches.

Module 5 : Software Quality, Process Improvement and Technology trends (6 hours)

Software Quality, Software Quality Dilemma, Achieving Software Quality Elements of Software Quality Assurance, SQA Tasks , Software measurement and metrics. Software Process Improvement(SPI), SPI Process CMMI process improvement framework, ISO 9001:2000 for Software. Cloud-based Software - Virtualisation and containers, Everything as a service(IaaS, PaaS), Software as a service. Microservices Architecture - Microservices, Microservices architecture, Microservice deployment.

Text Books

1. Book 1 - Ian Sommerville, Software Engineering, Pearson Education, Tenth edition, 2015.
2. Book 2 - Roger S. Pressman, Software Engineering : A practitioner’s approach, McGraw Hill publication, Eighth edition, 2014
3. Book 3 - Ian Sommerville, Engineering Software Products: An Introduction to Modern Software Engineering, Pearson Education, First Edition, 2020.

References

1. IEEE Std 830-1998 - IEEE Recommended Practice for Software Requirements SpeciÞcations
2. IEEE Std 1016-2009 IEEE Standard for Information Technology—Systems Design—Software Design Descriptions

3. David J. Anderson, Kanban, Blue Hole Press 2010
4. David J. Anderson, Agile Management for Software Engineering, Pearson, 2003
5. Walker Royce, Software Project Management : A unified framework, Pearson Education, 1998
6. Steve. Denning, The age of agile, how smart companies are transforming the way work gets done. New York, Amacom, 2018.
7. Satya Nadella, Hit Refresh: The Quest to Rediscover Microsoft's Soul and Imagine a Better Future for Everyone, Harper Business, 2017
8. Henrico Dolfing, Project Failure Case Studies: Lessons learned from other people's mistakes, Kindle edition
9. Mary Poppendieck, Implementing Lean Software Development: From Concept to Cash, Addison-Wesley Signature Series, 2006
10. StarUML documentation - https://docs.staruml.io/
11. OpenProject documentation - https://docs.openproject.org/
12. BugZilla documentation - https://www.bugzilla.org/docs/
13. GitHub documentation - https://guides.github.com/
14. Jira documentation - https://www.atlassian.com/software/jira

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What are the advantages of an incremental development model over a waterfall model?
2. Illustrate how the process differs in agile software development and traditional software development with a socially relevant case study. (Assignment question)

Course Outcome 2 (CO2):

1. How to prepare a software requirement specification?
2. Differentiate between Architectural design and Component level design.
3. How does agile approaches help software developers to capture and define the user requirements effectively?
4. What is the relevance of the SRS specification in software development?
5. Prepare a use case diagram for a library management system.

Course Outcome 3 (CO3):

1. Differentiate between the different types of software testing strategies.
2. Justify the need for DevOps practices?
3. How do design patterns help software architects communicate the design of a complex system effectively?

4. What are the proactive approaches one can take to optimise efforts in the testing phase?

Course Outcome 4 (CO4):

1. Illustrate the activities involved in software project management for a socially relevant problem?
2. How do SCRUM, Kanban and Lean methodologies help software project management?
3. Is rolling level planning in software project management beneficial? Justify your answer.
4. How would you assess the risks in your software development project? Explain how you can manage identified risks?

Course Outcome 5 (CO5):

1. Justify the importance of Software Process improvement?
2. Explain the benefits of cloud based software development, containers and microservices.
3. Give the role of retrospectives in improving the software development process.
4. Illustrate the use of project history data as a prediction tool to plan future socially relevant projects.

Model Question Paper

QP CODE:

Reg No:______________

Name :______________ **PAGES : 3**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 309

Course Name: Management of Software Systems

Duration: 3 Hrs **Max. Marks :100**

PART A

Answer all Questions. Each question carries 3 marks

1. Why professional software that is developed for a customer is not simply the programs that have been developed and delivered.
2. Incremental software development could be very effectively used for customers who do not have a clear idea about the systems needed for their operations. Justify.
3. Identify any four types of requirements that may be defined for a software system
4. Describe software architecture
5. Differentiate between GPL and LGPL?
6. Compare white box testing and black box testing.
7. Specify the importance of risk management in software project management?
8. Describe COCOMO cost estimation model.
9. Discuss the software quality dilemma
10. List the levels of the CMMI model? **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Compare waterfall model and spiral model

(8)

(b) Explain Agile ceremonies and Agile manifesto **(6)**

12. (a) Illustrate software process activities with an example. **(8)**

(b) Explain Agile Development techniques and Agile Project Management **(6)**

13. (a) What are functional and nonfunctional requirements? Imagine that you are developing a library management software for your college, list eight functional requirements and four nonfunctional requirements. **(10)**

(b) List the components of a software requirement specification? **(4)**

OR

14. (a) Explain Personas, Scenarios, User stories and Feature identification? **(8)**

(b) Compare Software Architecture design and Component level design **(6)**

15. (a) Explain software testing strategies. **(8)**

(b) Describe the formal and informal review techniques. **(6)**

OR

16. (a) Explain Continuous Integration, Delivery, and Deployment CI/CD/CD) **(8)**

(b) Explain test driven development **(6)**

17. (a) What is a critical path and demonstrate its significance in a project schedule with the help of a sample project schedule. **(8)**

(b) Explain plan driven development and project scheduling. **(6)**

OR

18. (a) Explain elements of Software Quality Assurance and SQA Tasks. **(6)**

(b) What is algorithmic cost modeling? What problems does it suffer from when **(8)** compared with other approaches to cost estimation?

19. (a) Explain elements of Software Quality Assurance and SQA Tasks. **(8)**

(b) Illustrate SPI process with an example. **(6)**

OR

20. (a) Compare CMMI and ISO 9001:2000. **(8)**

(b) How can Software projects benefit from Container deployment and Micro service deployment? **(6)**

Teaching Plan

No	Contents	No of Lecture Hrs
Module 1 : Introduction to Software Engineering (7 hours)		
1.1	Introduction to Software Engineering.[Book 1, Chapter 1]	1 hour
1.2	Software process models [Book 1 - Chapter 2]	1 hour
1.3	Process activities [Book 1 - Chapter 2]	1 hour
1.4	Coping with change [Book 1 - Chapter 2, Book 2 - Chapter 4]	1 hour
1.5	Case studies : An insulin pump control system. Mentcare - a patient information system for mental health care. [Book 1 - Chapter 1]	1 hour
1.6	Agile software development [Book 1 - Chapter 3]	1 hour
1.7	Agile development techniques, Agile Project Management.[Book 1 - Chapter 3]	1 hour
Module 2 : Requirement Analysis and Design (8 hours)		
2.1	Functional and non-functional requirements, Requirements engineering processes [Book 1 - Chapter 4]	1 hour
2.2	Requirements elicitation, Requirements validation, Requirements change, Traceability Matrix [Book 1 - Chapter 4]	1 hour
2.3	Developing use cases, Software Requirements Specification Template [Book 2 - Chapter 8]	1 hour

2.4	Personas, Scenarios, User stories, Feature identification [Book 3 - Chapter 3]	1 hour
2.5	Design concepts [Book 2 - Chapter 12]	1 hour
2.6	Architectural Design [Book 2 - Chapter 13]	1 hour
2.7	Component level design [Book 2 - Chapter 14]	1 hour
2.8	Design Document Template. Case study: The Ariane 5 launcher failure. [Ref - 2, Book 2 - Chapter 16]	1 hour
Module 3 : Implementation and Testing (9 hours)		
3.1	Object-oriented design using the UML, Design patterns [Book 1 - Chapter 7]	1 hour
3.2	Implementation issues, Open-source development - Open-source licensing - GPL, LGPL, BSD [Book 1 - Chapter 7]	1 hour
3.3	Review Techniques - Cost impact of Software Defects, Code review and statistical analysis. [Book 2 - Chapter 20]	1 hour
34	Informal Review, Formal Technical Reviews, Post-mortem evaluations. [Book 2 - Chapter 20]	1 hour
3.5	Software testing strategies - Unit Testing, Integration Testing, Validation testing, System testing and Debugging (basic concepts only). [Book 2 - Chapter 22]	1 hour
3.6	White box testing, Path testing, Control Structure testing, Black box testing. Test documentation [Book 2 - Chapter 23]	1 hour
3.7	Test automation, Test-driven development, Security testing. [Book 3 - Chapter 9]	1 hour
3.8	DevOps and Code Management - Code management, DevOps automation, CI/CD/CD. [Book 3 - Chapter 10]	1 hour
3.9	Software Evolution - Evolution processes, Software maintenance. [Book 1 - Chapter 9]	1 hour
Module 4 : Software Project Management (6 hours)		
4.1	Software Project Management - Risk management, Managing people, Teamwork [Book 1 - Chapter 22]	1 hour
4.2	Project Planning - Software pricing, Plan-driven development, Project scheduling, Agile planning [Book 1 - Chapter 23]	1 hour
4.3	Estimation techniques [Book 1 - Chapter 23]	1 hour
4.4	Configuration management [Book 1 - Chapter 25]	1 hour

4.5	Agile software management - SCRUM framework [Book 2 - Chapter 5]	1 hour
4.6	Kanban methodology and lean approaches.[Ref 9 - Chapter 2]	1 hour
Module 5 : Software Quality, Process Improvement and Technology trends (6 hours)		
5.1	Software Quality, Software Quality Dilemma, Achieving Software Quality. [Book 2 - Chapter 19]	1 hour
5.2	Elements of Software Quality Assurance, SQA Tasks , Software measurement and metrics. [Book 3 - Chapter 21]	1 hour
5.3	Software Process Improvement (SPI), SPI Process [Book 2 - Chapter 37]	1 hour
5.4	CMMI process improvement framework, ISO 9001:2000 for Software. [Book 2 - Chapter 37]	1 hour
5.5	Cloud-based Software - Virtualisation and containers, IaaS, PaaS, SaaS.[Book 3 - Chapter 5]	1 hour
5.6	Microservices Architecture - Microservices, Microservices architecture, Microservice deployment [Book 3 - Chapter 6]	1 hour

CDL331	DATA ANALYTICS LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3	3	2019

Preamble: The course aims to offer students a hands-on experience on data analytics concepts using problem-oriented learning. The data analytics tool is used for the purpose of acquainting the students with the algorithms and computational paradigms that allow computers to find patterns and regularities in databases, perform prediction and forecasting, and generally improve their performance through interaction with data. Data analytics has become increasingly important in the enterprise as a means for analyzing and shaping business processes and improving decision-making and business results.

Prerequisite: Fundamental knowledge in python and Data Analytics

Course Outcomes: At the end of the course, the student should be able to

CO1	Illustrate the data mining concepts using a data mining toolkit and visualize the result.**(Cognitive knowledge: Understand)**
CO2	Implement the data pre-processing tasks in data sets. **(Cognitive knowledge: Apply)**
CO3	Implement the algorithms for supervised data mining tasks such association rule mining, classification, clustering and regression.**(Cognitive knowledge: Apply)**
CO4	Implement the algorithms for unsupervised data mining tasks **Cognitive knowledge: Apply)**
CO5	Implement the algorithms for text mining.**(Cognitive knowledge: Apply)**

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔		✔			✔		✔		✔
CO2	✔	✔	✔		✔			✔		✔		✔
CO3	✔	✔	✔		✔			✔		✔		✔
CO4	✔	✔	✔		✔			✔		✔		✔
CO5	✔	✔	✔		✔			✔		✔		✔

Abstract Pos defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and teamwork
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern:

Bloom's Category	Continuous Assessment Test(Internal Exam) Marks in percentage	EndSemester Examination Marks in percentage
Remember	20	20
Understand	20	20
Apply	60	60
Analyse		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**75**	**75**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : 15 marks
Continuous Evaluation in Lab : 30 marks
Continuous Assessment Test : 15 marks
Viva Voce : 15 marks

Internal Examination Pattern: The marks will be distributed as Algorithm30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

End Semester Examination Pattern: The percentage of marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva30 marks. Total 75 marks.

Operating System to Use in Lab : Linux
Compiler/Software to Use in Lab : Weka or any open source tool
Programming Language to Use in Lab : Python, R

Fair Lab Record:

All Students attending the Big Data Lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record, the right-hand page should contain Experiment Heading, Experiment Number, Date of experiment, Aim of the Experiment and the operations performed on them, Details of experiment including algorithm and result of Experiment. The left-hand page should contain a print out of the code used for experiment and sample output obtained for a set of input.

SYLLABUS

DATA ANALYTICS LAB

* mandatory

1) Familiarize Weka tool or any other data analytics tool and perform an explorative data analysis. *
2) Find the dissimilarity and similarity between the nominal and numeric attributes. *
3) Implement an algorithm to find similarity between documents.
4) Find correlation between numeric and nominal attributes. *
5) Implement Apriori algorithm for finding frequent patterns.*
6) Implement algorithms for mining association rules.
7) Implement FP growth algorithm for finding frequent patterns.
8) Implement k-means clustering algorithm. *
9) Evaluate Information Gain of an attribute in the dataset.
10) Implement Decision Tree classifier. *
11) Implement Naïve Bayes classifier. *
12) Implement outlier detection algorithms.
13) Implement back propagation algorithm. *
14) Implement a micro project. *

DATA ANALYTICS LAB - PRACTICE QUESTIONS

1) Write a program in python to rank a query point based on Euclidean, Manhattan and Minkowski distance measures in a 2D data set.
2) Write a program in python to represent a set of documents as vectors.
3) Write a program in python to rank documents based on cosine similarity.
4) Write a program in python to convert a Decision Tree into "if –then -else rules".
5) Write a program in python to implement the PAM algorithm.
6) Write a program in python to mine association rules using apriori algorithm.
7) Write a program in python to perform weight and bias updation of multilayer perceptron using back propagation learning. Perform 2 epochs.
8) Write a program in python to implement text classification using Naïve Bayes algorithm.
9) Write a program in python to find the split point of a numeric attribute using information gain measure.

10) Write a program in python to perform single linkage.
11) Write a program in python to perform complete linkage.
12) Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
13) Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.

CSL 333	DATABASE MANAGEMENT SYSTEMS LAB	Category	L	T	P	Credits	Year of introduction
		PCC	0	0	3	2	2019

Preamble:

The Database Management Systems course is intended to impart the elementary concepts of a database management system to students and equip them to design and implement a database application based on those concepts. This course helps the learners to get practical exposure on database creation, SQL queries creation, transaction processing and NoSQL & MongoDB based operations. The course enables the students to create, manage and administer the databases, develop necessary tools for the design and development of the databases, and to understand emerging technologies to handle Big Data.

Prerequisite: A sound knowledge of the basics of relational DBMS.

Course Outcomes: After the completion of the course the student will be able to

CO#	Course Outcomes
CO1	Design database schema for a given real world problem-domain using standard design and modeling approaches. **(Cognitive Knowledge Level: Apply)**
CO2	Construct queries using SQL for database creation, interaction, modification, and updation. **(Cognitive Knowledge Level: Apply)**
C03	Design and implement triggers and cursors. (Cognitive Knowledge Level: **Apply**)
C04	Implement procedures, functions, and control structures using PL/SQL**. (Cognitive Knowledge Level: Apply)**
CO5	Perform CRUD operations in NoSQL Databases. **(Cognitive Knowledge Level: Apply)**
C06	Develop database applications using front-end tools and back-end DBMS. **(Cognitive Knowledge Level: Create)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔		✔			✔		✔		✔
CO2	✔	✔	✔		✔			✔		✔		✔
CO3	✔	✔	✔	✔	✔			✔		✔		✔
CO4	✔	✔	✔	✔	✔			✔		✔		✔
CO5	✔	✔	✔		✔			✔		✔		✔
CO6	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern:

Bloom's Category	**Continuous Assessment Test (Internal Exam)Percentage**	**End Semester Examination Percentage**
Remember	**20**	**20**
Understand	**20**	**20**
Apply	**60**	**60**
Analyse		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	75	75	3 hours

Continuous Internal Evaluation Pattern:

Attendance : **15 marks**
Continuous Evaluation in Lab : **30 marks**
Continuous Assessment Test : **15 marks**
Viva-voce : **15 marks**

Internal Examination Pattern : The marks will be distributed as Schema/Logic: 30 marks, Program/Queries: 20 marks, Output: 20 marks, and Viva: 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

End Semester Examination Pattern:
The marks will be distributed as Schema/Logic: 30 marks,
Program/Queries: 20 marks, Output: 20 marks, and Viva: 30 marks. Total 100 marks will be converted out of 75 for the End Semester Examination.

DBMS software: Oracle, MySQL, SQL Server, PostgreSQL, MongoDB.
Front end Tool: Java

Fair Lab Record:
All Students attending the DBMS Lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record, the right hand page should contain Experiment Heading, Experiment Number, Date of Experiment, Aim of Experiment, Schemas/Menu & Form Design, and Query questions. The left hand page should contain Queries and sample output(relations created, Form, and Menu Output) obtained for a set of input.

Syllabus

1. Design a database schema for an application with ER diagram from a problem description **.
2. Creation, modification, configuration, and deletion of databases using UI and SQL Commands **.
3. Creation of database schema - DDL (create tables, set constraints, enforce relationships, create indices, delete and modify tables). Export ER diagram from the database and verify relationships** (with the ER diagram designed in step 1).

4. Database initialization - Data insert, Data import to a database (bulk import using UI and SQL Commands)**.
5. Practice SQL commands for DML (insertion, updating, altering, deletion of data, and viewing/querying records based on condition in databases)**.
6. Implementation of built-in functions in RDBMS**.
7. Implementation of various aggregate functions in SQL**.
8. Implementation of Order By, Group By & Having clause **.
9. Implementation of set operators nested queries, and join queries **.
10. Implementation of queries using temp tables.
11. Practice of SQL TCL commands like Rollback, Commit, Savepoint **.
12. Practice of SQL DCL commands for granting and revoking user privileges **.
13. Practice of SQL commands for creation of views and assertions ** .
14. Implementation of various control structures like IF-THEN, IF-THEN-ELSE, IF-THEN-ELSIF, CASE, WHILE using PL/SQL **.
15. Creation of Procedures, Triggers and Functions**.
16. Creation of Packages **.
17. Creation of Cursors **.
18. Creation of PL/SQL blocks for exception handling **.
19. Database backup and restore using commands.
20. Query analysis using Query Plan/Show Plan.
21. Familiarization of NoSQL Databases and CRUD operations**.
22. Design a database application using any front end tool for any problem selected. The application constructed should have five or more tables**.

** mandatory

Text Books

1. Elmasri R. and S. Navathe, Database Systems: Models, Languages, Design and Application Programming, Pearson Education, 2013.
2. Sliberschatz A., H. F. Korth and S. Sudarshan, Database System Concepts, 6/e, McGraw Hill, 2011.

References

1. Adam Fowler, NoSQL for Dummies, John Wiley & Sons, 2015
2. NoSQL Data Models: Trends and Challenges (Computer Engineering: Databases and Big Data), Wiley, 2018

Practice Questions

Design a normalized database schema for the following requirement.

The requirement: A library wants to maintain the record of books, members, book issue, book return, and fines collected for late returns, in a database. The database can be loaded with book information. Students can register with the library to be a member. Books can be issued to students with a valid library membership. A student can keep an issued book with him/her for a maximum period of two weeks from the date of issue, beyond which a fine will be charged. Fine is calculated based on the delay in days of return. For 0-7 days: Rs 10, For 7 – 30 days: Rs 100, and for days above 30 days: Rs 10 will be charged per day.

Sample Database Design

BOOK (**Book_Id**, Title, Language_Id, MRP, Publisher_Id, Published_Date, Volume, Status) // Language_Id, Publisher_Id are FK (Foreign Key)

AUTHOR(Author_Id, Name, Email, Phone_Number, Status)

BOOK_AUTHOR(Book_Id, Author_Id) // many-to-many relationship, both columns are PKFK (Primary Key and Foreign Key)

PUBLISHER(Publisher_id, Name, Address)

MEMBER(Member_Id, Name, Branch_Code, Roll_Number, Phone_Number, Email_Id, Date_of_Join, Status)

BOOK_ISSUE(Issue_Id, Date_Of_Issue, Book_Id, Member_Id, Expected_Date_Of_Return, Status) // Book+Id and Member_Id are FKs

BOOK_RETURN(Issue_Id, Actual_Date_Of_Return, LateDays, LateFee) // Issue_Id is PK and FK

LANGUAGE(Language_id, Name) //Static Table for storing permanent data

LATE_FEE_RULE(FromDays, ToDays, Amount) // Composite Key

EXERCISES

1. Create a normalized database design with proper tables, columns, column types, and constraints
2. Create an ER diagram for the above database design.
3. Write SQL commands to
    a. Create a database by name *Library.* Drop the database and re-create it.
    b. Create DDL statements and create the tables and constraints (from the design) in the database created in step-a (*Library*)

Notes: [Create a script file and execute it. Create the script file in such a way that,,if the table exists, drop the tables and recreate)]

c. Create and execute DROP TABLE command in tables with and without FOREIGN KEY constraints.
d. Create and execute ALTER TABLE command in tables with data and without data.
e. Create and execute SQL commands to build indices on Member_Id and Book_Id on table Book_Issue.
f. Create and execute GRANT/REVOKE commands on tables.
g. Create and execute SQL commands to insert data into each of the tables designed
h. Learn and execute bulk import of data to tables from CSV files (insert 1000 records of books into the BOOK table from a CSV file).
i. Create and execute UPDATE/DELETE commands on tables. Try to update/delete rows with Primary and Foreign Keys. Try bulk updates or deletes using SQL UPDATE statement

4. Write SQLQuery to retrieve the following information
   a. Get the number of books written by a given author
   b. Get the list of publishers and the number of books published by each publisher
   c. Get the names of authors who jointly wrote more than one book.
   d. Get the list of books that are issued but not returned
   e. Get the list of students who reads only 'Malayalam' books
   f. Get the total fine collected for the current month and current quarter
   g. Get the list of students who have overdue (not returned the books even on due date)
   h. Calculate the fine (as of today) to be collected from each overdue book.
   i. Members who joined after Jan 1 2021 but has not taken any books
5. Book return should insert an entry into the Book_Return table and also update the status in Book_Issue table as 'Returned'. Create a database *TRANSACTION* to do this operation (stored procedure).
6. Create a database view 'Available_Books', which will list out books that are currently available in the library
7. Create a database procedure to add, update and delete a book to the Library database (use parameters).
8. Use cursors and create a procedure to print Books Issue Register (page wise – 20 rows in a page)
9. Create a history table (you may use the same structure without any keys) for the MEMBER table and copy the original values of the row being updated to the history table using a TRIGGER.
10. NoSQL Exercise
    a. Practice Mongo DB CRUD operations. Refer: https://docs.mongodb.com/manual/crud/

b. You may use a MongoDB local installation or cloud MongoDB services like MongoDB Atlas for this exercise
c. For documentation: Refer: https://docs.mongodb.com/manual/introduction/

11. Application Development Problem examples:
1) Inventory Control System.
2) Material Requirement Processing.
3) Hospital Management System.
4) Railway Reservation System.
5) Personal Information System.
6) Web Based User Identification System.
7) Timetable Management System.
8) Hotel Management System.

SEMESTER V

MINOR

CST 381	CONCEPTS IN SOFTWARE ENGINEERING	Category	L	T	P	Credit	Year of Introduction
		VAC	3	1	0	4	2019

Preamble: This course provides fundamental knowledge in the Software Development Process. It covers Software Development, Quality Assurance and Project Management concepts. This course enables the learners to apply state of the art industry practices in Software development.

Prerequisite: Basic understanding of Object Oriented Design and Development.

Course Outcomes: After the completion of the course the student will be able to

CO1	Differentiate Traditional and Agile Software Development approaches **(Cognitive Knowledge Level: Understand)**
CO2	Prepare Software Requirement **Specification** and Software Design for a given problem. **(Cognitive Knowledge Level: Apply**)
CO3	Justify the significance of design patterns and licensing terms in software development, prepare testing, maintenance and DevOps strategies for a project. **(Cognitive Knowledge Level: Apply**)
CO4	Make use of software project management concepts while planning, estimation, scheduling, tracking and change management of a project, with proper application of SCRUM, Kanban and Lean frameworks. (**Cognitive Knowledge Level: Apply**)
CO5	Utilize SQA practices, Process Improvement techniques and Technology improvements **namely** cloud based software model and containers & microservices in a Software Development Process. (Cognitive Knowledge Level: **Apply**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔	✔		✔						✔
CO2	✔	✔	✔	✔		✔				✔	✔	✔

CO3	✓	✓	✓	✓				✓		✓	✓	✓
CO4	✓	✓	✓	✓		✓			✓	✓	✓	✓
CO5	✓	✓	✓	✓		✓						✓

	Abstract POs defined by National Board of Accreditation		
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks**
	Test1 (Percentage)	**Test2 (Percentage)**	
Remember	**30**	**30**	**30**
Understand	**30**	**30**	**30**

Apply	**40**	**40**	**40**
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment Tests : **25 marks**

Continuous Assessment Assignment : **15 marks** (Each student shall identify a software development problem and prepare Requirements Specification, Design Document, Project Plan and Test case documents for the identified problem as the assignment.)

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks.

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

Syllabus

Module 1 : Introduction to Software Engineering (8 hours)

Introduction to Software Engineering - Professional software development, Software engineering ethics. Software process models - The waterfall model, Incremental development. Process activities - Software specification, Software design and implementation, Software validation, Software evolution. Coping with change - Prototyping, Incremental delivery, Boehm's Spiral Model. Agile software development - Agile methods, agile manifesto - values and principles. Agile development techniques, Agile Project Management. Case studies : An insulin pump control system. Mentcare - a patient information system for mental health care.

Module 2 : Requirement Analysis and Design (10 hours)

Functional and non-functional requirements, Requirements engineering processes. Requirements elicitation, Requirements validation, Requirements change, Traceability Matrix. Developing use cases, Software Requirements Specification Template, Personas, Scenarios, User stories, Feature identification. Design concepts - Design within the context of software engineering, Design Process, Design concepts, Design Model. Architectural Design - Software Architecture, Architectural Styles, Architectural considerations, Architectural Design Component level design - What is a component?, Designing Class-Based Components, Conducting Component level design, Component level design for web-apps. Template of a Design Document as per "IEEE Std 1016-2009 IEEE Standard for Information Technology Systems Design Software Design Descriptions". Case study: The Ariane 5 launcher failure.

Module 3 : Implementation and Testing (12 hours)

Object-oriented design using the UML, Design patterns, Implementation issues, Open-source development - Open-source licensing - GPL, LGPL, BSD. Review Techniques - Cost impact of Software Defects, Code review and statistical analysis. Informal Review, Formal Technical Reviews, Post-mortem evaluations. Software testing strategies - Unit Testing, Integration Testing, Validation testing, System testing, Debugging, White box testing, Path testing, Control Structure testing, Black box testing, Testing Documentation and Help facilities. Test automation, Test-driven development, Security testing. Overview of DevOps and Code Management - Code management, DevOps automation, CI/CD/CD. Software Evolution - Evolution processes, Software maintenance.

Module 4 : Software Project Management (8 hours)

Software Project Management - Risk management, Managing people, Teamwork. Project Planning, Software pricing, Plan-driven development, Project scheduling, Agile planning. Estimation techniques, COCOMO cost modeling. Configuration management, Version management, System building, Change management, Release management, Agile software management - SCRUM framework. Kanban methodology and lean approaches.

Module 5 : Software Quality and Process Improvement (6 hours)

Software Quality, Software Quality Dilemma, Achieving Software Quality Elements of Software Quality Assurance, SQA Tasks , Software measurement and metrics. Software Process Improvement(SPI), SPI Process CMMI process improvement framework, ISO 9001:2000 for Software.

Text Books

1. Book 1 - Ian Sommerville, Software Engineering, Pearson Education, Tenth edition, 2015.
2. Book 2 - Roger S. Pressman, Software Engineering : A practitioner's approach, McGraw Hill publication, Eighth edition, 2014
3. Book 3 - Ian Sommerville, Engineering Software Products: An Introduction to Modern Software Engineering, Pearson Education, First Edition, 2020.

References

1. IEEE Std 830-1998 - IEEE Recommended Practice for Software Requirements Specifications
2. IEEE Std 1016-2009 IEEE Standard for Information Technology—Systems Design—Software Design Descriptions
3. David J. Anderson, Kanban, Blue Hole Press 2010
4. David J. Anderson, Agile Management for Software Engineering, Pearson, 2003
5. Walker Royce, Software Project Management : A unified framework, Pearson Education, 1998
6. Steve. Denning, The age of agile, how smart companies are transforming the way work gets done. New York, Amacom, 2018.
7. Satya Nadella, Hit Refresh: The Quest to Rediscover Microsoft's Soul and Imagine a Better Future for Everyone, Harper Business, 2017
8. Henrico Dolfing, Project Failure Case Studies: Lessons learned from other people's mistakes, Kindle edition
9. Mary Poppendieck, Implementing Lean Software Development: From Concept to Cash, Addison-Wesley Signature Series, 2006
10. StarUML documentation - https://docs.staruml.io/
11. OpenProject documentation - https://docs.openproject.org/

12. BugZilla documentation - https://www.bugzilla.org/docs/
13. GitHub documentation - https://guides.github.com/
14. Jira documentation - https://www.atlassian.com/software/jira

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What are the advantages of an incremental development model over a waterfall model?
2. Compare agile software development with traditional software development?

Course Outcome 2 (CO2):

1. How to prepare a software requirement specification?
2. Differentiate between Architectural design and Component level design.
3. How do agile approaches help software developers to capture and define the user requirements effectively?
4. What is the relevance of the SRS specification in software development?
5. Prepare a use case diagram for a library management system.

Course Outcome 3 (CO3):

1. Differentiate between the different types of software testing strategies.
2. What are the benefits of DevOps?
3. How do design patterns help software architects communicate the design of a complex system effectively?
4. What are the proactive approaches one can take to optimise efforts in the testing phase?

Course Outcome 4 (CO4):

1. What are the activities involved in software project management?
2. What is the need for SCRUM, Kanban and Lean methodologies?
3. What are the benefits of rolling level planning in software project management and how would you implement it?
4. How would you assess the risks in your software development project? How would you plan for risk mitigation and contingency?

Course Outcome 5 (CO5):

1. What is the importance of Software Process improvement?
2. How will retrospectives help in improving the software development process?
3. What are the important skills required for the SQA role?
4. How would you use project history data as a prediction tool to plan future projects?

Model Question Paper

QP CODE:

Reg No:_______________

Name :_______________

PAGES : 3

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION(MINOR), MONTH & YEAR

Course Code: CST 381

Course Name: Concepts in Software Engineering

Duration: 3 Hrs **Max. Marks : 100**

PART A

Answer all Questions. Each question carries 3 Marks

1. Explain why professional software that is developed for a customer is not simply the programs that have been developed and delivered

2. Incremental software development could be very effectively used for customers who do not have a clear idea about the systems needed for their operations. Discuss.

3. Identify and briefly describe four types of requirements that may be defined for a computer based system.

4. Describe software architecture in your own words.

5. What are the major differences between GPL and LGPL?

6. Compare between white box testing and black box testing.

7. What is the importance of risk management in software project management?

8. Explain COCOMO cost estimation model

9. Describe the software quality dilemma in your own words

10. Which are the levels of the CMMI model?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 marks)

11. (a) Compare between waterfall model and spiral model **(8)**

    (b) Explain Agile methods and Agile manifesto **(6)**

OR

12. (a) Explain software process activities **(7)**

    (b) Explain Agile Development techniques and Agile Project Management. **(7)**

13. (a) What are functional and nonfunctional requirements? Imagine that you are developing a library management software for your college, identify at least 8 functional requirements and 4 nonfunctional requirements. **(10)**

    (b) What are the contents of a software requirement specification? **(4)**

OR

14. (a) Explain Personas, Scenarios, User stories and Feature identification? **(8)**

    (b) Compare between Software Architecture design and Component level design **(6)**

15. (a) Describe the formal and informal review techniques in detail. **(6)**

    (b) Explain various software testing strategies. **(8)**

OR

16. (a) Explain DevOps CI/CD/CD in detail. **(8)**

    (b) Explain test driven development. **(6)**

17. (a) What is a critical path and demonstrate its significance in a project schedule with the help of a sample project schedule. **(6)**

    (b) Explain plan driven development and project scheduling **(6)**

OR

18. (a) Explain the SCRUM framework. **(8)**

(b) What is algorithmic cost modeling? What problems does it suffer from when compared with other approaches to cost estimation? **(6)**

19. (a) Explain elements of Software Quality Assurance and SQA Tasks. **(8)**

(b) Explain the SPI process. **(6)**

OR

20. (a) Compare between CMMI and ISO 9001:2000 **(8)**

(b) Compare Quality Control and Quality Assurance. **(6)**

Teaching Plan [44 hours]		
	Module 1 : Introduction to Software Engineering (8 hours)	**Hours**
1.1	Introduction to Software Engineering. [Book 1, Chapter 1]	1 hour
1.2	Software process models [Book 1 - Chapter 2]	1 hour
1.3	Process activities [Book 1 - Chapter 2]	1 hour
1.4	Coping with change [Book 1 - Chapter 2, Book 2 - Chapter 4]	1 hour
1.5	Agile software development [Book 1 - Chapter 3]	1 hour
1.6	Agile development techniques [Book 1 - Chapter 3]	1 hour
1.7	Agile Project Management.[Book 1 - Chapter 3]	1 hour
1.8	Case studies : An insulin pump control system. Mentcare - a patient information system for mental health care. [Book 1 - Chapter 1]	1 hour
	Module 2 : Requirement Analysis and Design (10 hours)	
2.1	Functional and non-functional requirements, Requirements engineering processes [Book 1 - Chapter 4]	1 hour

2.2	Requirements elicitation, Requirements validation, Requirements change, Traceability Matrix [Book 1 - Chapter 4]	1 hour
2.3	Developing use cases, Software Requirements Specification Template [Book 2 - Chapter 8]	1 hour
2.4	Personas, Scenarios [Book 3 - Chapter 3]	1 hour
2.5	User stories, Feature identification [Book 3 - Chapter 3]	1 hour
2.6	Design concepts [Book 2 - Chapter 12]	1 hour
2.7	Architectural Design [Book 2 - Chapter 13]	1 hour
2.8	Component level design [Book 2 - Chapter 14]	1 hour
2.9	Component level design, Design Document Template. [Book 2 - Chapter 14, Ref - 2]	1 hour
2.10	Case study: The Ariane 5 launcher failure. [Book 2 - Chapter 16]	1 hour
Module 3 : Implementation and Testing (12 hours)		
3.1	Object-oriented design using the UML, Design patterns [Book 1 - Chapter 7]	1 hour
3.2	Implementation issues, Open-source development - Open-source licensing - GPL, LGPL, BSD [Book 1 - Chapter 7]	1 hour
3.3	Review Techniques - Cost impact of Software Defects, Code review. [Book 2 - Chapter 20]	1 hour
34	Informal Review, Formal Technical Reviews, Post-mortem evaluations. [Book 2 - Chapter 20]	1 hour
3.5	Software testing strategies [Book 2 - Chapter 22]	1 hour
3.6	Software testing strategies [Book 2 - Chapter 22]	1 hour
3.7	White box testing, Path testing, Control Structure testing [Book 2 - Chapter 23]	1 hour
3.8	Black box testing. Test documentation [Book 2 - Chapter 23]	1 hour
3.9	Test automation, Test-driven development [Book 3 - Chapter 9]	1 hour
3.10	Security testing. DevOps and Code Management [Book 3 - Chapter 9, Chapter 10]	1 hour
3.11	DevOps and Code Management - Code management, DevOps automation, CI/CD/CD. [Book 3 - Chapter 10]	1 hour

3.12	Software Evolution - Evolution processes, Software maintenance. [Book 1 - Chapter 9]	1 hour
Module 4 : Software Project Management (8 hours)		
4.1	Software Project Management - Risk management, Managing people, Teamwork [Book 1 - Chapter 22]	1 hour
4.2	Project Planning - Software pricing, Plan-driven development, Project scheduling, Agile planning [Book 1 - Chapter 23]	1 hour
4.3	Estimation techniques [Book 1 - Chapter 23]	1 hour
4.4	Configuration management [Book 1 - Chapter 25]	1 hour
4.5	Agile software management - SCRUM framework [Book 2 - Chapter 5]	1 hour
4.6	Agile software management - SCRUM framework [Book 2 - Chapter 5]	1 hour
4.7	Kanban methodology and lean approaches. [Ref 9 - Chapter 2]	1 hour
4.8	Kanban methodology and lean approaches.[Ref 9 - Chapter 2]	1 hour
Module 5 : Software Quality, Process Improvement and Technology trends (6 hours)		
5.1	Software Quality, Software Quality Dilemma, Achieving Software Quality. [Book 2 - Chapter 19]	1 hour
5.2	Elements of Software Quality Assurance, SQA Tasks [Book 3 - Chapter 21]	1 hour
5.3	Software measurement and metrics. [Book 3 - Chapter 21]	1 hour
5.4	Software Process Improvement(SPI), SPI Process[Book 2 - Chapter 37]	1 hour
5.5	Software Process Improvement(SPI), SPI Process[Book 2 - Chapter 37]	1 hour
5.6	CMMI process improvement framework, ISO 9001:2000 for Software. [Book 2 - Chapter 37]	1 hour

CST 383	CONCEPTS IN MACHINE LEARNING	Category	L	T	P	Credit	Year of introduction
		VAC	3	1	0	4	2019

Preamble: This course enables the learners to understand the fundamental concepts and algorithms in machine learning. The course covers the standard and most popular supervised learning algorithms such as linear regression, logistic regression, decision trees, Bayesian learning & the naive Bayes algorithm, support vector machines& kernels, basic clustering algorithms and dimensionality reduction methods. This course helps the students to provide machine learning based solutions to real world problems.

Prerequisite: Familiarity with basics in linear algebra, probability and Python programming.

	Course Outcomes
CO1	Illustrate Machine Learning concepts and basic parameter estimation methods.**(Cognitive Knowledge Level: Apply)**
CO2	Demonstrate supervised learning concepts (regression, linear classification). **(Cognitive Knowledge Level**: **Apply**)
CO3	Illustrate the concepts of Multilayer neural network and Support Vector Machine **(Cognitive Knowledge Level: Apply**)
CO4	Describe unsupervised learning concepts and dimensionality reduction techniques. (**Cognitive Knowledge Level**: **Apply**)
CO5	Solve real life problems using appropriate machine learning models and evaluate the performance measures (**Cognitive Knowledge Level: Apply**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓							✓
CO2	✓	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓	✓							✓

CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓	✓	✓						✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks**
	Test1 (Percentage)	**Test2 (Percentage)**	
Remember	**30**	**30**	**30**
Understand	**30**	**30**	**30**
Apply	**40**	**40**	**40**
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment Tests : **25 marks**

Continuous Assessment Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module-1 (Overview of machine learning)

Machine learning paradigms-supervised, semi-supervised, unsupervised, reinforcement learning. Basics of parameter estimation - maximum likelihood estimation(MLE) and maximum a posteriori estimation(MAP). Introduction to Bayesian formulation.

Module-2 (Supervised Learning)

Regression - Linear regression with one variable, Linear regression with multiple variables, solution using gradient descent algorithm and matrix method, basic idea of overfitting in regression. Linear Methods for Classification- Logistic regression, Perceptron, Naive Bayes, Decision tree algorithm ID3.

Module-3 (Neural Networks (NN) and Support Vector Machines (SVM))

NN - Multilayer feed forward network, Activation functions (Sigmoid, ReLU, Tanh), Backpropagation algorithm.

SVM - Introduction, Maximum Margin Classification, Mathematics behind Maximum Margin Classification, Maximum Margin linear separators, soft margin SVM classifier, non-linear SVM, Kernels for learning non-linear functions, polynomial kernel, Radial Basis Function(RBF).

Module-4 (Unsupervised Learning)

Clustering - Similarity measures, Hierarchical Agglomerative Clustering, K-means partitional clustering, Expectation maximization (EM) for soft clustering. Dimensionality reduction – Principal Component Analysis, factor Analysis, Multidimensional scaling, Linear Discriminant Analysis.

Module-5 (Classification Assessment)

Classification Performance measures - Precision, Recall, Accuracy, F-Measure, Receiver Operating Characteristic Curve(ROC), Area Under Curve(AUC. Bootstrapping, Cross Validation, Ensemble methods, Bias-Variance decomposition. Case Study: Develop a classifier for face detection.

Text Book

1. Ethem Alpaydin, Introduction to Machine Learning, 2nd edition, MIT Press 2010.
2. Mohammed J. Zaki and Wagner Meira, Data Mining and Analysis: Fundamental Concepts and Algorithms, Cambridge University Press, First South Asia edition, 2016.
3. Jake VanderPlas, Python Data Science Handbook, O'Reilly Media, 2016
4. Tom Mitchell, Machine Learning, McGraw-Hill, 1997.

Reference Books

1. Christopher Bishop. Neural Networks for Pattern Recognition, Oxford University Press, 1995.
2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective, MIT Press 2012.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements Of Statistical Learning, Second edition Springer 2007.
4. P. Langley, Elements of Machine Learning, Morgan Kaufmann, 1995.
5. Richert and Coelho, Building Machine Learning Systems with Python.
6. Davy Cielen, Arno DB Meysman and Mohamed Ali. Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, Dreamtech Press 2016.

Sample Course Level Assessment Questions

Course Outcome1(CO1):

1. A coin is tossed 100 times and lands heads 62 times. What is the maximum likelihood estimate for $\boldsymbol{\theta}$, the probability of heads.
2. Suppose data $x_1, \ldots, x_n$ are independent and identically distributed drawn from an exponential distribution $exp(\lambda)$. Find the maximum likelihood for λ.
3. Suppose $x_1, \ldots, x_n$ are independent and identically distributed(iid) samples from a distribution with density

$$f_X(x \mid \theta) = \begin{cases} \dfrac{\theta x^{\theta-1}}{3^\theta}, & 0 \le x \le 3 \\ 0, & \text{otherwise} \end{cases}$$

   Find the maximum likelihood estimate(MLE) for $\boldsymbol{\theta}$.
4. Find the maximum likelihood estimator (MLE) and maximum a posteriori (MAP) estimator for the mean of a univariate normal distribution. Assume that we have N samples, $x_1, \ldots, x_N$ independently drawn from a normal distribution with known variance σ^2 and unknown mean μ and the prior distribution for the mean is itself a normal distribution with mean v and variance β^2. What happens to the MLE and MAP estimators as the number of samples goes to infinity.

Course Outcome 2 (CO2):

1. Explain the difference between (batch) gradient descent and stochastic gradient descent. Give an example of when you might prefer one over the other.
2. Suppose that you are asked to perform linear regression to learn the function that outputs y, given the D-dimensional input x. You are given N independent data points, and that all the D attributes are linearly independent. Assuming that D is around 100, would you prefer the closed form solution or gradient descent to estimate the regressor?
3. Suppose you have a three class problem where class label $y \in 0, 1, 2$ and each training example X has 3 binary attributes $X_1, X_2, X_3 \in 0, 1$. How many parameters (probability distribution) do you need to know to classify an example using the Naive Bayes classifier?

Course Outcome 3 (CO3):

1. What are support vectors and list any three properties of the support vector classifier solution?
2. Why do you use kernels to model a projection from attributes into a feature space, instead of simply projecting the dataset directly?
3. Describe how Support Vector Machines can be extended to make use of kernels. Illustrate with reference to the Gaussian kernel $K(x, y) = e^{-z}$, where $z = (x-y)^2$.

4. Briefly explain one way in which using tanh instead of logistic activations makes optimization easier.
5. ReLU activation functions are most used in neural networks instead of the tanh activation function. Draw both activation functions and give a) an advantage of the ReLU function compared to the tanh function. b) a disadvantage of the ReLU function compared to the tanh function.

Course Outcome 4(CO4):

1. Describe cluster analysis? Identify two applications where cluster analysis can be applied to multimedia data?
2. Given two objects represented by the tuples (22, 1, 42, 10) and (20, 0, 36, 8):

(i) Compute the Euclidean distance between the two objects.

(ii) Compute the Manhattan distance between the two objects.

3. Use PCA to reduce the dimension from 2 to 1 for the design matrix ***X***.

$$X = \begin{bmatrix} 6 & -4 \\ -3 & 5 \\ -2 & 6 \\ 7 & -3 \end{bmatrix}$$

4. What is Principal Component Analysis (PCA)? Which eigen value indicates the direction of largest variance?
5. Suppose that one runs a principal component analysis on a data set and tells that the percentage of variance explained by the first 3 components is 80%. How is this percentage of variance explained?

Course Outcome 5 (CO5):

1. Suppose that you are contacted by a food processing company that wants you to develop a classifier that detects whether a rat is present in an image. You collect a large dataset of images by crawling the web, and have annotators determine which images contain rats. This set of images can then be used as the training set for your classifier.
   a. Suggest a machine learning method to use for this classification task and evaluate its performance.
   b. After you have delivered your solution to the company, they get back to you and complain that when they evaluate on a new test set, they get precision and recall values that are much lower than what you reported to them. Explain what might have gone wrong and propose remedial measures .
2. A real estate firm would like to build a system that predicts the sale prices of a house. They create a spreadsheet containing information about 1,500 house sales in the Kochi

area. In addition to the price, there are 10 features describing the house, such as number of bedrooms, total indoor area, lot area, a swimming pool, location, etc. Explain how you would implement a machine learning model that would solve this prediction task. Give all steps you would carry out when developing it. Explain why the model you built is probably useless in the long run.

3. For a classifier, the confusion matrix is given by:

	+	-
+	9	9
-	1	5

What is the precision, recall and accuracy of that classifier?

Model Question Paper

QP CODE: PAGES:3

Reg No:_______________

Name:_________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION(MINOR), MONTH & YEAR

Course Code: CST 383

Course Name: CONCEPTS IN MACHINE LEARNING

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Define supervised learning? Name special cases of supervised learning depending on whether the inputs/outputs are categorical, or continuous.
2. Differentiate between Maximum Likelihood estimation (MLE) and Maximum a Posteriori (MAP) estimation?
3. What is overfitting and why is it a problem? Give an example of a method to reduce the risk of overfitting.
4. Specify the basic principle of gradient descent algorithm.
5. Suppose that you have a linear support vector machine(SVM) binary classifier. Consider a point that is currently classified correctly, and is far away from the decision boundary. If you

remove the point from the training set, and re-train the classifier, will the decision boundary change or stay the same? Justify your answer.

6. Mention the primary motivation for using the kernel trick in machine learning algorithms?
7. Expectation maximization (EM) is designed to find a maximum likelihood setting of the parameters of a model when some of the data is missing. Does the algorithm converge? If so, do you obtain a locally or globally optimal set of parameters?
8. Illustrate the strength and weakness of k-means algorithm.
9. Classifier A attains 100% accuracy on the training set and 70% accuracy on the test set. Classifier B attains 70% accuracy on the training set and 75% accuracy on the test set. Which one is a better classifier. Justify your answer.
10. How does bias and variance trade-off affect machine learning algorithms?

(10x3=30)

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. a) Suppose that X is a discrete random variable with the following probability mass function: where $0 \leq \theta \leq 1$ is a parameter. The following 10 independent observations

X	0	1	2	3
$P(X)$	$2\theta/3$	$\theta/3$	$2(1-\theta)/3$	$(1-\theta)/3$

were taken from such a distribution: ***(3, 0, 2, 1, 3, 2, 1, 0, 2, 1)***. What is the maximum likelihood estimate of θ. **(6)**

b) A gamma distribution with parameters α, β has the following density function, where $\Gamma(t)$ is the gamma function.

$$p(x) = \frac{\beta^{\alpha}}{\Gamma(\alpha)} x^{\alpha-1} e^{-\beta x}$$

If the posterior distribution is in the same family as the prior distribution, then we say that the prior distribution is the conjugate prior for the likelihood function. Using the Gamma distribution as a prior, show that the Exponential distribution is a conjugate prior of the Gamma distribution. Also, find the maximum a posteriori estimator for the parameter of the Exponential distribution as a function of α and β. **(8)**

OR

12. a) Traffic between 8AM and 9AM at a certain place was measured by counting the number of vehicles that passed at that time. Suppose the counts follow a Poisson process. A random sample of 9 observations was collected, having observed the following number of vehicles: (95, 100, 80, 70, 110, 98, 97, 90, 70). Derive the maximum likelihood estimator for the

average number of vehicles that pass by that place between 8 AM and 9 AM, and compute the corresponding estimate using the given sample. **(7)**

b) Find the maximum a posteriori (MAP) estimator for the mean of a univariate normal distribution. Assume that we have N samples, $x_1,..., x_N$ independently drawn from a normal distribution with known variance σ^2 and unknown mean μ and the prior distribution for the mean is itself a normal distribution with mean v and variance β^2. **(7)**

13.a) Derive the gradient descent training rule assuming for the target function $o_d = w_0 + w_1x_1 + ... + w_nx_n$. Define explicitly the squared cost/error function E, assuming that a set of training examples D is provided, where each training example $d \in D$ is associated with the target output t_d. **(10)**

b) How can we interpret the output of a two-class logistic regression classifier as a probability? **(4)**

OR

14. a) In a two-class logistic regression model, the weight vector $w = [4, 3, 2, 1, 0]$. We apply it to some object that we would like to classify; the vectorized feature representation of this object is $x = [-2, 0, -3, 0.5, 3]$. What is the probability, according to the model, that this instance belongs to the positive class? **(6)**

b) The following dataset can be used to train a classifier that determines whether a given person is likely to own a car or not. There are three features: education level (primary, secondary, or university); residence (city or country); gender (female, male).

education	residence	gender	has car?
sec	country	female	yes
univ	country	female	yes
prim	city	male	no
univ	city	male	no
sec	city	female	no
sec	country	male	yes
prim	country	female	yes
univ	country	male	yes
sec	city	male	yes
prim	city	female	no
univ	city	female	no
prim	country	male	yes

Find the root attribute and justify your answer **(8)**

15. a) Consider a support vector machine whose input space is 2-D, and the inner products are computed by means of the kernel ***K(x, y) = (x.y + 1)^2-1***, where ***x.y***denotes the ordinary inner product. Show that the mapping to feature space that is implicitly defined by this kernel is the mapping to 5-D given by **(10)**

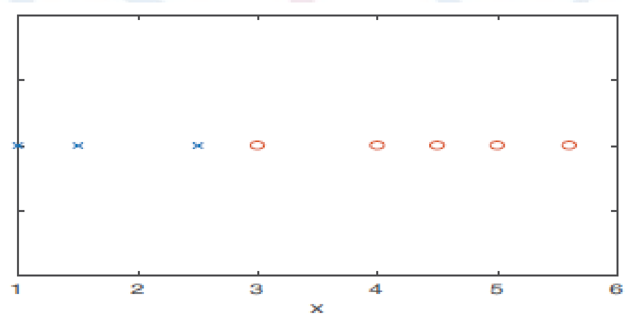
$$\mathbf{x} = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \rightarrow \phi(\mathbf{x}) = \begin{bmatrix} x_1^2 \\ x_2^2 \\ \sqrt{2}\, x_1 x_2 \\ \sqrt{2}\, x_1 \\ \sqrt{2}\, x_2 \end{bmatrix}.$$

b) What is the basic idea of a Support Vector Machine? **(4)**

OR

16. a) Explain how back propagation can be used to solve XOR problem which is not linearly separable. **(8)**

b) Consider the following one dimensional training data set, 'x' denotes negative examples and 'o' positive examples. The exact data points and their labels are given in the table. Suppose a SVM is used to classify this data. Indicate which are the support vectors and mark the decision boundary. Find the equation of the hyperplane. (6)



x	1	1.5	2.5	3	4	4.5	5	5.6
y	-1	-1	-1	1	1	1	1	1

17. a)Suppose that we have the following data (one variable). Use single linkage Agglomerative clustering to identify the clusters.
Daa: (2, 5, 9, 15, 16, 18, 25, 33, 33, 45). **(8)**

b) Given two objects represented by the tuples (22, 1, 42, 10) and (20, 0, 36, 8):

(i) Compute the Euclidean distance between the two objects.

(ii) Compute the Manhattan distance between the two objects.

(iii) Compute the Minkowski distance between the two objects, using p = 3 **(6)**

OR

18. a) Suppose that we have the following data:

a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*
(2,0)	(1,2)	(2,2)	(3,2)	(2,3)	(3,3)	(2,4)	(3,4)	(4,4)	(3,5)

Identify the cluster by applying the k-means algorithm, with k = 2. Try using initial cluster centers as far apart as possible. **(10)**

b) List the steps involved in Principal Component Analysis. **(4)**

19. a) Suppose the dataset had 9700 cancer-free images from 10000 images from cancer patients. Find precision, recall and accuracy ? Is it a good classifier? Justify. **(8)**

Actual Class\ Predicted class	**cancer = yes**	**cancer = no**	**Total**
cancer = yes	90	210	300
cancer = no	140	9560	9700
Total	230	9770	10000

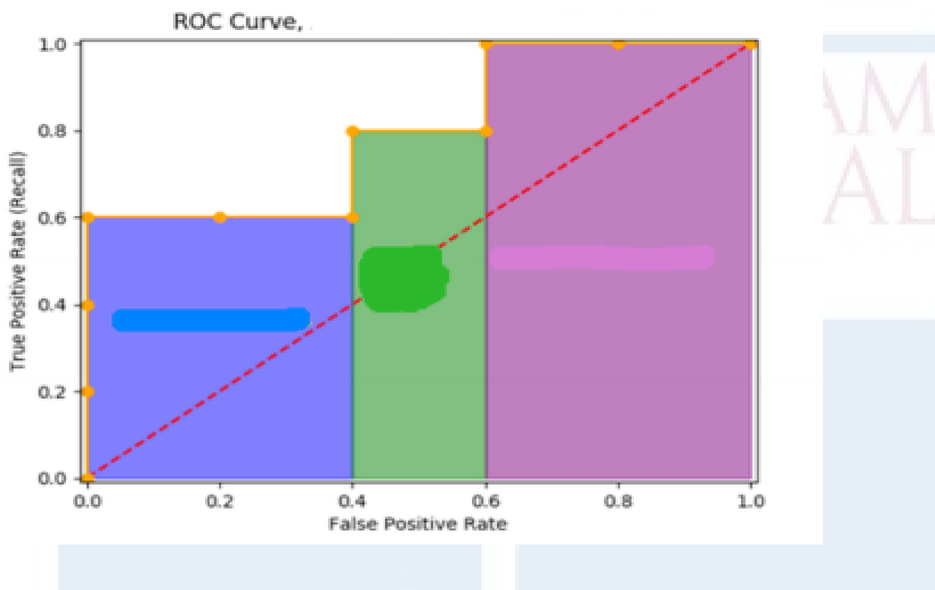
b) Suppose that you have a classification problem where our feature representation contains about 10,000,000 features. We would like to develop a classifier that can be deployed in a mobile phone, so preferably it should have a small memory footprint. Discuss one solution for how this can be done. **(6)**

OR

20. a) What are ROC space and ROC curve in machine learning? In ROC space, which points correspond to perfect prediction, always positive prediction and always negative prediction? Why? **(6)**

b)Suppose there are three classifiers A,B and C. The (FPR, TPR) measures of the three classifiers are as follows – A (0, 1), B (1, 1) , C (1,0.5). Which can be considered as a perfect classifier? Justify your answer. **(4)**

c) Given the following ROC Curve? Find the AUC? **(4)**



Teaching Plan

No	Contents	No of Lecture Hrs
Module 1 :Overview of machine learning (7 hours)		
1.1	Supervised, semi-supervised, unsupervised learning, reinforcement learning (Text Book (TB) 1: Chapter 1)	1hour
1.2	Maximum likelihood estimation(MLE) (TB 1: Section 4.2)	1hour
1.3	Maximum likelihood estimation (MLE)- example (TB 1: Section 4.2)	1hour
1.4	Maximum a posteriori estimation(MAP) (TB 4: Section 6.2)	1hour
1.5	Maximum a posteriori estimation(MAP)-example (TB 4: Section 6.2)	1hour
1.6	Bayesian formulation (TB 1: Section 14.1, 14.2)	1hour
1.7	Bayesian formulation -example (TB 1: Section 14.1, 14.2)	1hour
Module 2 : Supervised Learning (8 hours)		

2.1	Linear regression with one variable (TB 1: Section 2.6)	1hour
2.2	Multiple variables, Solution using gradient descent algorithm and matrix method (No derivation required) (TB 1: Section 5.8)	1hour
2.3	Overfitting in regression, Lasso and Ridge regularization	1hour
2.4	Logistic regression	1hour
2.5	Perceptron	1hour
2.6	Naive Bayes (TB 2: Section 18.2)	1hour
2.7	Decision trees (TB 2: Chapter 19)	1hour
2.8	Decision trees- ID3 algorithm (TB 2: Chapter 19)	1hour
Module 3 : Neural Networks and Support Vector Machines (TB 2: Chapter 21) (11 hours)		
3.1	Multilayer Feed forward Network, Activation Functions (Sigmoid, ReLU, Tanh)	1hour
3.2	Back Propagation Algorithm	1hour
3.3	Illustrative Example for Back Propagation	1hour
3.4	Introduction, Maximum Margin Hyperplane,	1hour
3.5	Mathematics behind Maximum Margin Classification	1hour
3.6	Formulation of maximum margin hyperplane and solution	1hour
3.7	Soft margin SVM	1hour
3.8	Solution of Soft margin SVM	1hour
3.9	Non-linear SVM	1hour
3.10	Kernels for learning non-linear functions and properties of kernel functions.	1hour
3.11	Example Kernels functions- Linear, RBF, Polynomial.	1hour
Module 4 : Unsupervised Learning (10 hours)		
4.1	Similarity measures- Minkowski distance measures(Manhattan, Euclidean), Cosine Similarity	1hour
4.2	Clustering - Hierarchical Clustering (TB 2: Chapter 14)	1hour
4.3	K-means partitional clustering (TB 2: Chapter 13)	1hour
4.4	Expectation maximization (EM) for soft clustering (TB 2: Chapter 13)	1hour
4.5	Expectation maximization (EM) for soft clustering (TB 2: Chapter 13)	1hour

4.6	Dimensionality reduction – Principal Component Analysis (TB 1: Section 6.3)	1hour
4.7	Dimensionality reduction – Principal Component Analysis (TB 1: Section 6.3)	1hour
4.8	Factor Analysis (TB 1: Section 6.4)	1hour
4.9	Multidimensional scaling (TB 1: Section 6.5)	1hour
4.10	Linear Discriminant Analysis (TB 1: Section 6.6)	1hour
Module 5 : Classification Assessment (8 hours)		
5.1	Performance measures - Precision, Recall, Accuracy, F-Measure, ROC, AUC. (TB 2: Chapter 22.1)	1hour
5.2	Boot strapping, Cross validation	1hour
5.3	Ensemble methods- bagging	1hour
5.4	Ensemble methods- boosting	1hour
5.5	Bias-Variance decomposition (TB 2: Chapter 22.3)	1hour
5.6	Bias-Variance decomposition (TB 2: Chapter 22.3)	1hour
5.7	Face detection (TB 3: Chapter 5 Section Application: A Face Detection Pipeline)	1hour
5.8	Face detection (TB 3: Chapter 5 Section Application: A Face Detection Pipeline)	1hour

CST 385	CLIENT SERVER SYSTEMS	Category	L	T	P	Credit	Year of Introduction
		VAC	3	1	0	4	2019

Preamble:

The syllabus is prepared with the view of preparing the Engineering Graduates to build effective Client/Server applications. This course aims at providing a foundation in decentralized computer systems, using the client/server model. The course content is decided to cover the essential fundamentals which can be taught within the given slots in the curriculum.

Prerequisite: **Basic knowledge in Computer**

Course Outcomes: After the completion of the course the student will be able to

	Course Outcomes
CO 1	Identify the basics of client/server systems and the driving force behind the development of client/server systems**(Cognitive Knowledge Level: Understand)**
CO 2	Outline the architecture and classifications of client/server systems**(Cognitive Knowledge Level: Understand)**
CO 3	Summarize the client/server network services for an application**(Cognitive Knowledge Level: Understand)**
CO 4	Identify management services and issues in network **(Cognitive Knowledge Level: Understand)**
CO 5	Outline the Client/Server technology in respect of databases and Client/Server database architecture **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓										✓
CO3	✓	✓										✓
CO4	✓											✓
CO5	✓	✓										✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Percentage)	Test 2 (Percentage)	
Remember	**40**	**40**	**40**
Understand	**40**	**40**	**40**
Apply	**20**	**20**	**20**
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment Test 1 (for theory, for 2 hrs) : **20 marks**

Continuous Assessment Test 2 (for lab, internal examination, for 2hrs) : **20 marks**

Internal Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 5 questions with 2 questions from each module (2.5 modules x 2 = 5), having 3 marks for each question. Students should answer all questions. Part B also contains 5 questions with 2 questions from each module (2.5 modules x 2 = 5), of which a student should answer any one. The questions should not have sub-divisions and each one carries 7 marks.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Computing in client server architecture over Mainframe architecture has certain advantages and disadvantages. Describe at least three advantages and disadvantages for each architecture.

Course Outcome 2 (CO2):

1. Explain the role of mainframe-centric model in Client/Server computing?

Course Outcome 3(CO3):

1. Describe the client server system development methodology? Explain different phases of System Integration Life-Cycle.

Course Outcome 4 (CO4):

1. Explain about network management and remote system management. How can security be provided to the network?

Course Outcome 5 (CO5):

1. Explain various types of Client/Server Database Architecture

Syllabus

Module – 1 (Introduction)

Introduction to Client/Server computing - Basic Client/Server Computing Model, Server for Every Client- File Server, Print Server, Application Server, Mail Server, Directory Services Server, Web Server, Database Server, Transaction Servers. Client/Server-Fat or Thin, Stateless or Stateful, Servers and Mainframes, Client/Server Functions. Driving Forces behind Client/Server Computing- Business Perspective, Technology Perspective.

Module -2 (Client/Server Classification)

Client/Server Types-Single Client/Single Server, Multiple Clients/Single Server, Multiple Clients/Multiple Servers, Integration With Distributed Computing, Alternatives To Client/Server Systems. Classification of Client/Server Systems- Two-Tier Computing, Middleware, Three-Tier Computing- Model View Controller (MVC), Principles behind Client/Server Systems.Client/Server Topologies. Existing Client/Server Architecture. Architecture for Business Information System.

Module -3 (Client/Server Application Components)

Client- Services, Request for services, RPC, Windows services, Print services, Remote boot services, other remote services, Utility Services. Server- Detailed server functionality, Network operating system, Available platforms, Server operating system. Organizational Expectations, Improving performance of client/server applications, Single system image, Downsizing and Rightsizing, Advantages and disadvantages of Client/Server computing, Applications of Client/Server.

Module -4 (Client/ Server Systems Services and Support)

Services and Support- System administration, Availability, Reliability, Scalability, Observability, Agility, Serviceability. Software Distribution, Performance, Network management. Remote Systems Management- RDP, Telnet, SSH, Security. LAN and Network Management issues.

Module -5(Client/Server Technology and Databases)

Client/Server Technology and Databases **-** Storing Data, Database System Architectures. Client/Server In Respect Of Databases- Client/Server Databases, Client/Server Database Computing, Database Computing Vs. Mainframe, PC/File Server Computing. Client/Server Database Architecture - Process-Per-Client Architecture, Multi-Threaded Architecture, Hybrid Architecture. Database Middleware Component - Application Programming Interface, Database Translator, Network Translator.

Text Book

1. Patrick Smith &Steve Guengerich, Client / Server Computing, PHI

2. Subhash Chandra Yadav, Sanjay Kumar Singh, An Introduction to Client/Server Computing, New Age International Publishers

Reference Books

1. Jeffrey D.Schank, "Novell's Guide to Client-Server Application & Architecture" Novell Press

2. Robert Orfali, Dan Harkey, Jeri Edwards, Client/Server Survival Guide, Wiley-India Edition, Third Edition

3. Dawna Travis Dewire, Client Server Computing — McGraw Hill

4. W.H.Inman, Developing Client Server Applications, BPB

Model Question Paper

QP CODE: **PAGES: ___**

Reg No:_______________

Name:_________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION(MINOR), MONTH & YEAR

Course Code: CST 385

Course Name : Client Server Systems

Max Marks: 100 **Duration: 3 Hours**

PART-A

(Answer All Questions. Each question carries 3 marks)

1. Differentiate between Stateful and Stateless servers
2. List the different phases and activities of client/server system development methodology.
3. How does transmission protocol work in client/server applications?
4. List any six services in single system image environment.
5. Specify the role of the client in Client/Server computing and also list any six services provided by the client.
6. Why do most RPC system support call by value semantics for parameter passing?
7. What do you mean by a thin client network? List three advantages of the Thin

Client Network system.

8. How are connectivity and interoperability between .client/server achieved?

9. One disadvantage of the Client/Server system is lack of control in a Database Management environment. Justify.

10. Explain the DBMS concept in client/server architecture.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Differentiate between Transaction server and Data server system with examples. **(7)**

(b) Computing in client server architecture over Mainframe architecture has certain advantages and disadvantages. Describe at least three advantages and disadvantages for each architecture. **(7)**

OR

12. (a) Explain various Clients/Server system development tools. **(6)**

(b) Classify and describe the driving forces that drive the move to Client/Server computing. **(8)**

13. (a) Explain the role of mainframe-centric model in Client/Server computing? **(5)**

(b) Describe the three types of Client/Server systems in existence **(9)**

OR

14. (a) List and explain the general forces behind the architecture for business information systems **(7)**

(b) Explain the different distribution styles. **(7)**

15. (a) Illustrate the concept of rightsizing and downsizing in Client/Server Computing **(7)**

(b) What is client server system development methodology? Explain the **(7)** different phases of System Integration Life-Cycle.

OR

16. (a) In Client/Server computing, explain the following with examples **(10)**
    - i. Dynamic Data Exchange
    - ii. RPC, Remote Procedure Call
    - iii. Remote Boot Service
    - iv. Diskless Computer
    - v. Object-linking and embedding

    (b) Explain the functions and features of Network Operating System **(4)**

17. (a) Explain about network management and remote system management. How can security be provided to the network ? **(10)**

    (b) In client server architecture, what do you mean by Availability, Reliability, Serviceability and Security? Explain with examples. **(4)**

OR

18. (a) Client server is modular infrastructure, this is intended to improve Usability, Flexibility, Interoperability and Scalability. Explain each term with an example, in each case how it helps to improve the functionality of client server architecture. **(7)**

    (b) Explain about network management and remote system management. How can security be provided to network? **(7)**

19. (a) Explain the different types of Client/Server Database Architecture **(9)**

    (b) List and explain the main components of Database middleware **(5)**

OR

20. (a) Discuss types of database utilities, tools and their functions **(7)**

    (b) Discuss about the role of traditional and web databases in handling client/server based applications. **(7)**

Teaching Plan

Module- 1(Introduction)		**(10 hours)**
1.1	Basic Client/Server Computing Model	1 hour
1.2	Server for Every Client- File Server, Print Server	1 hour
1.3	Application Server, Mail Server, Directory Services Server	1 hour
1.4	Web Server, Database Server	1 hour
1.5	Transaction Servers	1 hour
1.6	Client/Server-Fat or Thin	1 hour
1.7	Stateless or Stateful	1 hour
1.8	Servers and Mainframes	1 hour
1.9	Client/Server Functions	1 hour
1.10	Driving Forces behind Client/Server Computing- Business Perspective, Technology Perspective	1 hour
Module- 2 (Client/Server Classification)		**(10 hours)**
2.1	Client/Server Types-Single Client/Single Server	1 hour
2.2	Multiple Clients/Single Server, Multiple Clients/Multiple Servers	1 hour
2.3	Integration With Distributed Computing	1 hour
2.4	Alternatives To Client/Server Systems	1 hour
2.5	Classification of Client/Server Systems- Two-Tier Computing, Middleware	1 hour
2.6	Three-Tier Computing- Model View Controller (MVC)	1 hour
2.7	Principles behind Client/Server Systems.	1 hour
2.8	Client/Server Topologies	1 hour
2.9	Existing Client/Server Architecture	1 hour
2.10	Architecture for Business Information System	1 hour
Module -3 (Client/Server Application Components)		**(9 hours)**
3.1	The client: Services, Request for services, RPC	1 hour
3.2	Windows services, Print services, Remote boot services	1 hour

3.3	Utility Services & Other Services	1 hour
3.4	Server- Detailed server functionality, Network operating system	1 hour
3.5	Available platforms, Server operating system	1 hour
3.6	Organizational Expectations, Improving performance of client/server applications	1 hour
3.7	Single system image, Downsizing and Rightsizing	1 hour
3.8	Advantages and disadvantages of Client/Server computing	1 hour
3.9	Applications of Client/Server	1 hour
Module -4 (Client/ Server Systems Services and Support)		**(8 hours)**
4.1	Services and Support, System administration	1 hour
4.2	Availability, Reliability	1 hour
4.3	Scalability, Observability, Agility	1 hour
4.4	Serviceability, Software Distribution	1 hour
4.5	Performance	1 hour
4.6	Network management	1 hour
4.7	Remote Systems Management- RDP, Telnet, SSH	1 hour
4.8	Security, LAN and Network Management issues	1 hour
Module -5(Client/Server Technology and Databases)		**(8 hours)**
5.1	Client/Server Technology and Databases - Storing Data	1 hour
5.2	Database System Architectures	1 hour
5.3	Client/Server In Respect Of Databases- Client/Server Databases	1 hour
5.4	Client/Server Database Computing	1 hour
5.5	Database Computing Vs. Mainframe, PC/File Server Computing	1 hour
5.	Client/Server Database Architecture - Process-Per-Client Architecture	1 hour
5.7	Multi-Threaded Architecture, Hybrid Architecture	1 hour
5.8	Database Middleware Component - Application Programming Interface, Database Translator, Network Translator	1 hour

SEMESTER V

HONOURS

CST 393	CRYPTOGRAPHIC ALGORITHMS	Category	L	T	P	Credit	Year of Introduction
		VAC	3	1	0	4	2019

Preamble:

The course on Cryptographic Algorithms aims at exploring various algorithms deployed in offering confidentiality, integrity, authentication and non-repudiation services. This course covers classical encryption techniques, symmetric and public key crypto-system, key exchange and management, and authentication functions. The concepts covered in this course enable the learners in effective use of cryptographic algorithms for real life applications.

Prerequisite: A sound background in Number Theory.

Course Outcomes: After the completion of the course the student will be able to

CO1	Identify the security services provided for different types of security attacks. (**Cognitive Knowledge Level : Understand**)
CO2	Summarize the classical encryption techniques for information hiding. (**Cognitive Knowledge Level: Apply**)
CO3	Illustrate symmetric / asymmetric key cryptographic algorithms for secure communication.(**Cognitive Knowledge Level: Apply**)
CO4	Interpret key management techniques for secure communication.(**Cognitive Knowledge Level: Understand)**
CO5	Summarize message authentication functions in a secure communication scenario.(**Cognitive Knowledge Level: Understand**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO11	PO1 2
CO1	✓	✓	✓									✓

CO2	✓	✓	✓		✓	✓						✓
CO3	✓	✓	✓	✓	✓	✓						✓
CO4	✓	✓	✓	✓	✓	✓						✓
CO5	✓	✓	✓	✓	✓	✓						✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (Percentage)	Test2 (Percent	

		age)	
Remember	**30**	**30**	**30**
Understand	**30**	**30**	**30**
Apply	**40**	**40**	**40**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment Tests : **25 marks**

Continuous Assessment Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks.

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1 (Introduction to the Concepts of Security)

Need for security, Security approaches, Principles of security, Types of attacks, OSI Security Architecture, Classical encryption techniques - Substitution techniques, Transposition techniques. Stream cipher, Block cipher, Public key cryptosystems vs. Symmetric key cryptosystems, Encrypting communication channels.

Module-2 (Symmetric Key Cryptosystems)

Overview of symmetric key cryptography, Block cipher principles, Data Encryption Standard (DES), Differential and Linear cryptanalysis, Double DES, Triple DES, International Data Encryption Algorithm (IDEA), Advanced Encryption Algorithm (AES),Block cipher modes of operation, Stream cipher, RC4.

Module-3 (Public Key Cryptosystems)

Principles of public key cryptosystems, RSA algorithm, RSA illustration, Attacks, ElGamal cryptographic system, Knapsack algorithm, Diffie-Hellman key exchange algorithm, Elliptical curve cryptosystems.

Module-4 (Key Management)

Symmetric key distribution using symmetric encryption, Symmetric key distribution using asymmetric encryption, Distribution of public keys, Generating keys, transferring keys, Verifying keys, Updating keys, Storing keys, Backup keys, Compromised keys, Public key infrastructure.

Module – 5 (Authentication)

Authentication requirements, Authentication functions, Message authentication codes (MAC), Hash functions, Security of Hash functions and MAC, Message Digest 5 (MD5), Secure Hash Algorithm (SHA)-512, Hash-based Message Authentication Code (HMAC), Cipher-based Message Authentication Code (CMAC), X.509 Authentication services.

Text Books

1. William Stallings, Cryptography and Network Security Principles and Practice, Pearson Edu, 6e.
2. Bruice Schneier, Applied Cryptography Protocols, Algorithms and source code in C, Wiley,2e.

References

1. Behrouz A. Forouzan, Cryptography and Network Security, McGraw Hill, 2e.

2. Johannes A. Buchmann, Introduction to Cryptography, Springer, 2e.

3. DouglasR. Stinson, Cryptography Theory and Practice, 3e,Chapman & Hall/CRC, 2006.

4. Bernard Menezes, Network Security and Cryptography, Cengage Learning, 2011.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Consider an automated teller machine (ATM) in which users provide a personal identification number (PIN) and a card for account access. Give examples of confidentiality, integrity, and availability requirements associated with the system and, in each case, indicate the degree of importance of the requirement.

2. Discuss the different security services provided for preventing security attacks.

Course Outcome 2 (CO2):

1. The encryption key in a transposition cipher is (3,2,6,1,5,4). Find the decryption key

2.Discuss the process of encryption in Vernam cipher

Course Outcome 3 (CO3):

1. Devise a meet-in-the-middle attack for a triple DES.

2. Write an algorithm for the InvSubBytes transformation and implement using python (**Assignment**)
3. Consider the following elliptic curve signature scheme. We have a global elliptic curve, prime *p*, and "generator" G. Alice picks a private signing key X_A and forms the public verifying $Y_A = X_AG$. To sign a message *M*:
   - Alice picks a value k
   - Alice sends Bob *M*, k and the signature $S = M - kX_AG$.
   - Bob verifies that $M=S+kY_A$.

   Show that the verification process produces an equality if the signature is valid.
4. Write an algorithm to add two points on an elliptic curve over GF(*p*) and implement using Python. **(Assignment)**
5. Write an algorithm for encryption using knapsack cryptosystem and implement using Java. **(Assignment)**

Course Outcome4 (CO4):

1. List four general categories of schemes for the distribution of public keys.
2. What are the essential ingredients of a public-key directory?

Course Outcome 5 (CO5):

1. State the value of the length field in SHA-512 if the length of the message is 1919 bits and 1920 bits.
2. Write an algorithm in pseudo code for HMAC and implement using Python (**Assignment**)

Model Question Paper

QP CODE:

Reg No:______________

Name :______________ **PAGES : 3**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION(HONORS), MONTH & YEAR

Course Code: CST 393

Course Name: Cryptographic Algorithms

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. State the two approaches in attacking a cipher.

2. Define Substitution Cipher. Encrypt using one time pad M = HONORS and K = CIPHER.

3. Specify the purpose of S-Boxes in Data Encryption Standard (DES).

4. Differentiate between diffusion and confusion.

5. Perform encryption using RSA Algorithm for the following p=7; q=11; e=13; M=5.

6. Is Diffie-Hellman key exchange protocol vulnerable? Justify.

7. List the techniques for distribution of public keys.

8. Define a certificate authority and its relation to public key cryptography.

9. Distinguish between integrity and message authentication.

10. What types of attacks are addressed by message authentication?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) With a neat sketch, Explain OSI Security architecture model. **(8)**

(b) How does link encryption differ from end-to-end encryption? Explain. **(6)**

OR

12. (a) Encrypt the text "cryptography" using the Hill Cipher with the key $\begin{pmatrix} 9 & 4 \\ 5 & 7 \end{pmatrix}$. Show the calculations. **(8)**

(b) Illustrate the steps involved in encrypting a plain text using playfair cipher with an example. **(6)**

13. (a) With a neat sketch, explain a single round in DES. **10**

(b) Explain encryption and decryption using 2 keys and 3 keys of triple DES. **(4)**

OR

14. (a) Explain the block cipher modes i) Cipher feedback mode ii) Output feedback mode. **(8)**

(b) Describe the four types of transformations in AES. **(6)**

15. (a) Write an algorithm for generating public and private key using Elliptical curve cryptography. **(10)**

(b) The equation $y^2=x^3+x+1$, the calculation is done modulo 13. Add two points R= P+Q, where P= (4,2) and Q= (10,6). **(4)**

OR

16. User A and B use the Diffie-Hellman key exchange technique with a common prime q=71 and primitive root alpha=7.

(a) If user A has private key X_A =3, What is A's public key Y_A? **(7)**

(b) If user B has private key X_B =6, What is A's public key Y_B? **(7)**

17. (a) Define a session key and show how a KDC can create can create a session key between Alice and Bob. **(7)**

(b) What are the requirements for the use of a public-key certificate scheme? **(7)**

OR

18. (a) What are the core components of a PKI? Briefly describe each component. **(8)**

(b) Describe the following (i) Updating keys (ii) Compromised Keys. **(6)**

19. (a) Describe how SHA-512 logic produce message digest **(10)**

(b) Distinguish between HMAC and CMAC **(4)**

OR

20. (a) Specify the format for X.509 certificate. Explain the steps required to obtain user's certificate. **(7)**

(b) With suitable block diagrams, explain the types of functions that may be used to produce an authenticator. **(8)**

Teaching Plan

No	Contents	No of Lecture Hrs
Module - 1 (Introduction to the Concepts of Security) (9 hrs)		
1.1	Need for security, Security approaches	1 hour
1.2	Principles of security, Types of attacks	1 hour
1.3	OSI Security Architecture	1 hour
1.4	Classical encryption techniques: Substitution techniques(Caesar cipher, Monoalphabetic cipher, Playfair cipher)	1 hour
1.5	Classical encryption techniques: Substitution techniques (Hill cipher, Polyalphabetic cipher, One-time pad)	1 hour
1.6	Classical encryption techniques: Transposition techniques	1 hour
1.7	Stream cipher, Block cipher	1 hour
1.8	Public- key cryptosystems vs. Symmetric key cryptosystems	1 hour
1.9	Encrypting communication channels	1 hour
Module - 2 (Symmetric key cryptosystems) (11 hrs)		
2.1	Overview of symmetric key cryptography	1 hour
2.2	Block cipher principles	1 hour
2.3	Data Encryption Standard (DES)	1 hour
2.4	DES design criteria	1 hour
2.5	Differential and Linear cryptanalysis	1 hour
2.6	Double DES, Triple DES	1 hour

2.7	IDEA	1 hour
2.8	Advanced Encryption Algorithm (AES structure)	1 hour
2.9	Advanced Encryption Algorithm (Transformations)	1 hour
2.10	Block cipher modes of operation	1 hour
2.11	Stream cipher, RC4	1 hour
Module - 3 (Public key cryptosystems) (8 hrs)		
3.1	Principles of public key cryptosystems	1 hour
3.2	RSA algorithm	1 hour
3.3	RSA illustration, Attacks	1 hour
3.4	ElGamal cryptographic system	1 hour
3.5	Knapsack algorithm	1 hour
3.6	Diffie-Hellman key exchange algorithm	1 hour
3.7	Elliptical curve cryptosystems(Elliptical curve arithmetic)	1 hour
3.8	Elliptical curve cryptosystems (Elliptical curve algorithm)	1 hour
Module - 4 (Key Management) (8 hrs) [Text book-2]		
4.1	Symmetric key distribution using symmetric encryption	1 hour
4.2	Symmetric key distribution using asymmetric encryption	1 hour
4.3	Distribution of public keys	1 hour
4.4	Generating keys, Transferring keys	1 hour

4.5	Verifying keys, Updating keys	1 hour
4.6	Storing keys, Backup keys	1 hour
4.7	Compromised keys	1 hour
4.8	Public key infrastructure	1 hour
Module - 5 (Authentication) (9 hrs)		
5.1	Authentication requirements	1 hour
5.2	Authentication functions	1 hour
5.3	Message Authentication Codes (MAC)	1 hour
5.4	Hash functions	1 hour
5.5	Security of Hash functions and MAC	1 hour
5.6	MD5	1 hour
5.7	SHA-512	1 hour
5.8	HMAC, CMAC	1 hour
5.9	X.509 Authentication services	1 hour

AIT395	COMPUTATIONAL BIOLOGY	CATEGORY	L	T	P	Credit	Year of Introduction
		VAC	3	1	0	4	2020

Preamble: This course helps the learners to understand concepts in Genomics, Proteomics Computational Biology, Next Generation Sequencing, NGS Data Analysis and Systems biology. It enables the learners to understand various Next Generation Sequencing Techniques, analysis and interpretation of the NGS Data. Also, course introduces computational and mathematical analysis and modeling of complex biological systems and Systems Biology

Prerequisite: Basic background in Bioinformatics

Course Outcomes: After the completion of the course, the student will be able to

CO 1	Describe the basic concepts of genomics, microarray, protein structure determination and prediction(**Cognitive knowledge level: Understand**)
CO 2	Explain the fundamental aspects drug discovery and molecular modelling (**Cognitive knowledge level: Apply)**
CO 3	Demonstrate Networks in Biology, types of networks and its representation (**Cognitive knowledge level : Apply)**
CO 4	Explain Next Generation sequencing Technologies and DNA Protein interaction analysis(**Cognitive knowledge level: Understand)**
CO 5	Illustrate Next Generation sequence analysis, Mapping approaches and algorithms (**Cognitive knowledge level: Understand**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	√										✓
CO2	✓	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓			✓							✓

PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	Test1 (%)	Test2 (%)	
Remember	**30**	**30**	**30**
Understand	**50**	**50**	**50**
Apply	**20**	**20**	**20**
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests (Average of Series Tests 1& 2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS`

Module -01 (Genomics and Proteomics)

Genes, Genes in genomes, Genomes of prokaryotes and Eukaryotes, Protein-coding genes, RNA, Single-nucleotide polymorphisms, Microarray, Analysis of microarray data, Proteins and peptides, Experimental Protein structure identification, computational methods for protein structure prediction, Homology modelling, Protein folding and fold recognition.

Module-02 (Computer Aided Drug Discovery)

Drug discovery pipeline, Drug target identification & validation, Active site identification, pharmacophore, Lead/Ligand identification, lead compound optimization, Binding energy calculation, Energy Minimization. Molecular modelling in drug discovery, concept of Molecular Dynamics, concept of Absorption, Distribution, Metabolism and Excretion (ADME), Quantitative Structure-Activity Relationships.

Module-03 (Network Biology)

Transcriptional Regulatory Networks, Genes and DNA Regulatory Regions, Genetic Interaction Map, Protein Interaction Networks, Experimental methodologies to obtain Protein Interaction Data, Computational methods to Predict Protein-Protein Interactions, Visualization of Protein Interaction Networks,Metabolic Networks, Interacting Partners, Mathematical Representation

Module-04 (Next Generation Sequencing and analysis)

A Typical NGS Experimental Workflow, Next-Generation Sequencing (NGS) Technologies, Illumina Reversible Dye-Terminator Sequencing, Ion Torrent Semiconductor Sequencing, Pacific Biosciences Single Molecule Real-Time (SMRT) Sequencing, RNA-sequencing (RNA Seq), Protein-DNA Interaction Analysis (ChIP-Seq)

Module-05 (NGS Data Analysis)

Base Calling, FASTQ File Format, and Base Quality Score, NGS Data Quality Control and Preprocessing, Reads Mapping, Mapping Approaches and Algorithms, Selection of Mapping Algorithms and Reference Genome Sequences, SAM/BAM as the Standard Mapping File Format, Mapping File Examination and Operation, Tertiary Analysis

Books

1. Lesk, Arthur M. Introduction to Bioinformatics. United Kingdom, Oxford University Press, 2019.
2. Biological Networks. Singapore, World Scientific Publishing Company, 2007.
3. Wang, Xinkun. Next-Generation Sequencing Data Analysis. United States, CRC Press, 2016.

References

1. Tiwary, Basant K.. Bioinformatics and Computational Biology: A Primer for Biologists. Singapore, Springer Singapore, 2021.
2. Benfey, Philip N.. Quickstart Molecular Biology: An Introductory Course for Mathematicians, Physicists, and Computational Scientists. United States, Cold Spring Harbor Laboratory Press, 2014.
3. Baxevanis, Andreas D., Gary D. Bader, and David S. Wishart, eds. *Bioinformatics*. John Wiley & Sons, 2020.
4. Shaik, Noor Ahmad, et al. *Essentials of Bioinformatics, Volume I.* Springer, 2019
5. Selzer, Paul M., Richard J. Marhöfer, and Andreas Rohwer, *Applied bioinformatics. An introduction–Springer, Verlag,*, 2008.
6. S C Rastogi, N Mendiratta and P Rastogi, *Bioinformatics: Methods and Applications* , PHI Learning Private Limited, New Delhi, 2015.
7. D E Krane and M L Raymer, *Fundamental Concepts of Bioinformatics*, Pearson Education, 2006.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Compare and contrast the genomes of Prokaryotes and Eukaryotes
2. Summarize the method of DNA microarray and its analysis.
3. Using the online tool SWISS-MODEL, develop model of Homo sapiens (Human) Leptin protein and interpret your result

Course Outcome 2 (CO2):

1. Explain the process of computer aided drug discovery and various step involved in it
2. Explain the process of molecular modelling in drug discovery

Course Outcome 3 (CO3):

1. Differentiate between Transcriptional and protein interaction networks
2. From the STRING database identify the interactions of Homo sapiens TP53 protein and interpret your result

Course Outcome 4 (CO4):

1. Summarize Next Generation Sequencing methods.
2. Explain The Protein- DNA interaction analysis with the help of ChIP-Seq
3. What can RNA-seq reveal?

Course Outcome 5 (CO5):

1. Illustrate the process involved in Data Quality control and preprocessing in Next Generation Sequencing
2. Explain the mapping algorithms and reference genome sequences

TEACHING PLAN

No	Contents	No of Lecture (45Hrs)
	Module -01 (Genomics and Phylogenetics) (9hrs)	
1.1	Genes, Genes in genomes.	1
1.2	Genomes of prokaryotes and Eukaryotes	1
1.3	Protein-coding genes, RNA, Single-nucleotide polymorphisms	1
1.4	Microarrays	1
1.5	Analysis of microarray data	1
1.6	Proteins and peptides	1
1.7	Experimental Protein structure identification	1
1.8	Computational methods for protein structure prediction	1
1.9	Homology modelling, Protein folding and fold recognition	1
	Module-02 (Computer Aided Drug Discovery)(9hrs)	
2.1	Drug discovery pipeline	1
2.2	Drug target identification & validation	1
2.3	Active site identification, pharmacophore	1
2.4	Lead/Ligand identification	1
2.5	lead compound optimization, Binding energy calculation, Energy Minimization	1
2.6	Molecular modelling in drug discovery	1

2.7	Concept of Molecular Dynamics	1
2.8	Concept of Absorption, Distribution, Metabolism and Excretion (ADME)	1
2.9	Quantitative Structure-Activity Relationship	1
Module-03 (Network Biology)(9hrs)		
3.1	Transcriptional Regulatory Networks	1
3.2	Genes and DNA Regulatory Regions,	1
3.3	Genetic Interaction Map,	1
3.4	Protein Interaction Networks	1
3.5	Experimental methodologies to obtain Protein Interaction Data	1
3.6	Computational methods to Predict Protein-Protein Interactions	1
3.7	Visualization of Protein Interaction Networks	1
3.8	Metabolic Networks- Interacting Partners	
3.9	Metabolic Networks- Mathematical Representation	
Module-04 (Next Generation Sequencing and analysis) (8hrs)		
4.1	A Typical NGS Experimental Workflow	1
4.2	Next-Generation Sequencing (NGS) Technologies	1
4.3	Next-Generation Sequencing (NGS) Technologies	1
4.4	Illumina Reversible Dye-Terminator Sequencing	1
4.5	Ion Torrent Semiconductor Sequencing	1
4.6	Pacific Biosciences Single Molecule Real-Time (SMRT) Sequencing	1
4.7	RNA-sequencing (RNA Seq)	1
4.8	Protein-DNA Interaction Analysis (ChIP-Seq)	1
Module-05 (NGS Data Analysis)(10hrs)		
5.1	NGS data,FASTQ File Format	1
5.2	Base Calling, Base Quality Score	1
5.3	NGS Data Quality Control	1
5.4	NGS data Preprocessing	1
5.5	Reads Mapping, Mapping Approaches and Algorithms,	1

5.6	Selection of Mapping Algorithms and Reference Genome Sequences	1
5.7	SAM/BAM as the Standard Mapping	1
5.8	Mapping File Examination and Operation	1
5.9	Tertiary Analysis	1
5.10	Demonstration of NGS Data Analysis	1

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES: 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AIT395

Course Name: COMPUTATIONAL BIOLOGY

Max. Marks: 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Distinguish between Genes, Genes in genomes.
2. What are the structural features of Eukaryotic cells?
3. What are SNPs and why are they important?
4. How do you identify the active site of a protein?
5. What is protein energy minimization?
6. List any three types of biochemical networks with one line description
7. What are reversible Dye-Terminators in NGS sequencing?
8. What is the difference between the DNA sent for Whole Exome sequencing vs ChIP sequencing?
9. List any three features of FastQ file format.
10. What is SAM format? How is BAM different from SAM? **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) With the help of a neat diagram, explain a prokaryotic gene structure. Is a promoter at the upstream or downstream of a transcription unit? **(7)**

    (b) What is homology modeling? Discuss the steps involved in the same **(7)**

OR

12. (a) Explain the design of a microarray experiment, detailing the various phases. **(7)**

(b) What experimental method is used to determine the tertiary protein structure? What are the computational methods? **(7)**

13. (a) Illustrate the computational drug discovery pipeline with a suitable flowchart **(7)**

(b) What is Molecular modeling in drug discovery? Explain the process of molecular modelling. **(7)**

OR

14. (a) Explain the scoring functions in molecular docking. **(7)**

(b) Explain lead compound optimization, Binding energy calculation, Energy Minimization in the process of Computer aided drug discovery **(7)**

15. (a) What is transcriptional control and why is it important? Explain how transcriptional regulatory networks plays an important role in gene expression and control? **(7)**

(b) Explain how the computational methods helps in identifying the Protein–Protein Interactions **(7)**

OR

16. (a) How the Protein–Protein Interactions are identified by using experimental methods. **(7)**

(b) What is metabolic network? What are type of data are needed for metabolic network reconstruction? **(7)**

17. (a) Explain any two next-generation sequencing techniques with their steps. **(7)**

(b) How do you interpret a FastQC report? **(7)**

OR

18. (a) What are the steps in RNA sequencing?Why is RNA-seq better than microarrays? **(7)**

(b) illustrate the steps involved in mapping protein-DNA interactions using ChIP-sequencing **(7)**

19. (a) How do you interpret per base sequence quality?What is the purpose of mapping reads to a reference genome? **(7)**

(b) Explain any three mapping algorithms for the NGS. **(7)**

OR

20. (a) Illustrate steps involved in the NGS data Preprocessing and Quality Control **(7)**

(b) Discuss the significance of NGS in clinical diagnosis. **(7)**

AIT397	ADVANCED CONCEPTS IN COMPUTER VISION	Category	L	T	P	Credit	Year of Introduction
		VAC	3	1	0	4	2020

Preamble: This course enables the learners to understand the advanced concepts in computer vision. The course covers the basics of image processing, imaging geometry, image segmentation, feature extraction, object recognition and classification and common applications of computer vision. This course helps the students to design solutions for complex real-life problems.

Prerequisite: A sound knowledge of Mathematics and concepts of any programming language.

Course Outcomes: After the completion of the course the student will be able to

CO1	Illustrate the concepts of image formation and image model. **(Cognitive Knowledge Level: Understand)**
CO2	Demonstrate various feature extraction and edge detection techniques. **(Cognitive Knowledge Level: Apply**
CO3	Apply edge-based and region-based image segmentation techniques. **(Cognitive Knowledge Level: Apply)**
CO4	Understand and implement image recognition and classification methods. **(Cognitive Knowledge Level: Apply)**
CO5	Explain the various applications of computer vision. **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PO1 2
CO1	✔		✔		✔							✔
CO2	✔	✔	✔	✔	✔	✔						✔
CO3	✔	✔	✔	✔	✔	✔						✔
CO4	✔	✔	✔	✔	✔	✔						✔
CO5	✔	✔	✔	✔	✔	✔						✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember	**30**	**30**	**30**
Understand	**30**	**30**	**30**
Apply	**40**	**40**	**40**

Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3**

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests(Average of Internal Tests 1 & 2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

Syllabus

Module – 1 (Image Formation and Processing)

Image formation and Image model- Components of a vision system- Cameras- camera model and camera calibration-Radiometry- Light in space- Light in surface - Sources, shadows and shading.

Fundamentals of Image processing: Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels.

Module - 2(Feature Extraction)

Points and Patches – Feature detectors, feature descriptors, feature matching, feature tracking. **Edges –** edge detection, edge linking. **Lines** - Successive approximation, Hough transforms, Vanishing points.

Module - 3 **(Image Segmentation)**

Classification of segmentation techniques, Edge detection, Edge linking, Thresholding, Region growing, Region splitting and merging, Watershed based segmentation. Shadow detection and removal. Image processing using OpenCV - blending, smoothing, and reshaping.

Module - 4 (**Image Recognition and Classification**)

Shape based object classification, Motion based object classification, Viola Jones Object Detection Framework, Object classification using CNNs, use of RCNN for object classification.

Module - 5 (**Applications**)

Speech and Handwriting Recognition, Automatic Face Recognition, Video Segmentation and Keyframe Extraction, Real-Time Hand Pose Recognition.

Text Books

1. David A. Forsyth & Jean Ponce, Computer vision – A Modern Approach, Prentice Hall, 2002.
2. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer.
3. Maheshkumar H Kolekar, "Intelligent Video Surveillance Systems: An Algorithmic Approach", CRC Press.

4. Francesco Camastra, Alessandro Vinciarelli, “Machine Learning for Audio, Image and Video Analysis: Theory and Applications”, Springer 2015.

Reference Books

1. Reinhard Klette, “Concise Computer Vision: An Introduction into Theory and Algorithms”, Springer London, 2014.

2. Olivier Faugeras, “Three-Dimensional Computer Vision”, The MIT Press, 1993.

Course Level Assessment Questions

Course Outcome1 (CO1):

1.Explain the components of a visual system.

2.Elaborate on the image formation model.

Course Outcome 2(CO2):

1. Explain edge linking through Hough Transform.
2. Discuss how feature extraction is done in image processing.

Course Outcome 3(CO3):

1. Compare the following methods for image segmentation: a) multiple thresholding, b) global thresholding c) local thresholding.
2. Justify the role of region growing, region splitting and region merging operations in any of the computer vision applications.

Course Outcome 4(CO4): .

1. Explain convolution stage and pooling stage of a typical CNN layer.
2. Illustrate Viola Jones object detection framework.

Course Outcome 5(CO5):

1. Elaborate on how computer vision helps in automatic face recognition applications.
2. Discuss how computer vision helps in tackling complex real world problems.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 3**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AIT397

Course Name: Advanced Concepts in Computer Vision

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Explain the working of a pinhole camera, Derive the expression for pinhole perspective projection.

2. Illustrate “foreshortening” with a neat diagram.

3. Explain edge linking through Hough Transform.

4. Illustrate any two techniques for vanishing point detection in an image.

5. Compare following methods for image segmentation
   a, multiple thresholding, b, global thresholding c, local thresholding.

6. Draw the flowchart of foreground-pixel extraction by edge-based shadow removal

7. Why is a convolutional neural network preferred over a dense neural network for an image classification task?

8. Assess the relevance of selective search algorithm in RCNN for object classification

9. Draw the diagram which shows the general scheme of a recognition system.

10. Illustrate steps in feature extraction from handwritten images.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11.	(a)	State different limitations of pinhole cameras and how to overcome these limitations.	**(9)**
	(b)	What are shadows? Differentiate umbra from penumbra. How is a self shadow different from a cast shadow?	**(5)**
		OR	
12.	(a)	Explain the local shading model.How are area sources different from line sources?	**(7)**
	(b)	Define Camera Calibration. Explain intrinsic and extrinsic parameters of a camera.	**(7)**
13.	(a)	Assess the role of adaptive non-maximal suppression (ANMS) in feature detection.	**(4)**
	(b)	Illustrate following techniques: i) Bias and gain normalization (MOPS). ii) Gradient location-orientation histogram (GLOH)	**(10)**
		OR	
14.	(a)	Illustrate any 2 techniques in Successive approximation.	**(4)**
	(b)	Compare Scale invariant feature transform (SIFT) and PCA-SIFT.	**(5)**
15.	(a)	Illustrate Gradient operator and Laplacian operator with one example for each.	**(10)**
	(b)	Illustrate Watershed Algorithms.	**(4)**

OR

16. (a) With the help of a diagram illustrate region splitting and merging. **(7)**

(b) Compare blending, smoothing, and reshaping functions using OpenCV. **(7)**

17. (a) Differentiate between convolution stage and pooling stage of a typical CNN layer. **(8)**

(b) Assess the role of dispersedness in shape based object classification. **(6)**

OR

18. (a) Illustrate Viola Jones object detection framework. **(8)**

(b) Explain the steps in motion based object classification. **(6)**

19. (a) Illustrate shot boundary detection through pixel-based approaches and block-based approaches . **(7)**

(b) Explain different approaches in keyframe extraction problems. **(7)**

OR

20. (a) Illustrate shot boundary detection through histogram-based approaches and clustering-based approaches. **(6)**

(b) Illustrate HMM training in speech and handwriting recognition. **(8)**

TEACHING PLAN

No	Contents	No. of Lecture Hours (42 hrs)
Module – 1 (Image Formation and Processing) (8 hours)		
1.1	Image formation and Image model-Introduction	1 hour
1.2	Components of a vision system- Cameras-Camera model	1 hour
1.3	Camera calibration	1 hour
1.4	Radiometry- Light in space-Light in surface	1 hour
1.5	Sources-Shadows and shading	1 hour
1.6	Fundamentals of Image processing: Basic steps of Image processing system	1 hour
1.7	Sampling and quantization of an Image	1 hour
1.8	Basic relationship between pixels.	1 hour
Module-2(Feature Extraction) (8 hours)		
2.1	**Points and Patches** – Feature detectors	1 hour
2.2	Feature descriptors	1 hour
2.3	Feature matching	1 hour
2.4	Feature tracking.	1 hour
2.5	**Edges –** edge detection, edge linking.	1 hour
2.6	**Lines** - Successive approximation	1 hour
2.7	Hough transforms	1 hour
2.8	Vanishing points	1 hour

Module-3(Image Segmentation)(9 hours)		
3.1	Classification of segmentation techniques, Edge detection	1 hour
3.2	Edge linking	1 hour
3.3	Thresholding, Region growing	2 hours
3.4	Region splitting and merging	1 hour
3.5	Watershed based segmentation.	1 hour
3.6	Shadow detection and removal	1 hour
3.7	Image processing using OpenCV - blending	1 hour
3.8	Smoothing, and reshaping	1 hour
Module-4(Image Recognition and Classification) (9 hours)		
4.1	Shape based object classification	1 hour
4.2	Motion based object classification	2 hours
4.3	Viola Jones Object Detection Framework	2 hours
4.4	Object classification using CNNs	2 hours
4.6	Use of RCNN for object classification.	2 hours
Module-5(Applications)(8 hours)		
5.1	Speech and Handwriting Recognition	1 hour
5.2	Handwriting Recognition	1 hour
5.3	Automatic Face Recognition	2 hours
5.4	Video Segmentation	2 hours
5.5	Keyframe Extraction	1 hour
5.6	Real-Time Hand Pose Recognition.	1 hour

SEMESTER VI

CST 302	COMPILER DESIGN	Category	L	T	P	Credit	Year of Introduction
		PCC	3	1	0	4	2019

Preamble:

The purpose of this course is to create awareness among students about the phases of a compiler and the techniques for designing a compiler. This course covers the fundamental concepts of different phases of compilation such as lexical analysis, syntax analysis, semantic analysis, intermediate code generation, code optimization and code generation. Students can apply this knowledge in design and development of compilers.

Prerequisite: Sound knowledge in Data Structures, Formal Languages & Automata Theory.

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the phases in compilation process(lexical analysis, syntax analysis, semantic analysis, intermediate code generation, code optimization and code generation) and model a lexical analyzer **(Cognitive Knowledge Level: Apply)**
CO2	Model language syntax using Context Free Grammar and develop parse tree representation using leftmost and rightmost derivations (**Cognitive Knowledge Level: Apply)**
CO3	Compare different types of parsers(Bottom-up and Top-down) and construct parser for a given grammar **(Cognitive Knowledge Level: Apply)**
CO4	Build Syntax Directed Translation for a context free grammar, compare various storage allocation strategies and classify intermediate representations **(Cognitive Knowledge Level: Apply)**
CO5	Illustrate code optimization and code generation techniques in compilation **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔	✔	✔							✔
CO2	✔	✔	✔	✔	✔							✔
CO3	✔	✔	✔	✔	✔							✔
CO4	✔	✔	✔	✔								✔
CO5	✔	✔	✔	✔								✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks**
	Test 1 (Marks)	**Test 2 (Marks)**	
Remember	**20**	**20**	**20**
Understand	**40**	**40**	**40**
Apply	**40**	**40**	**40**
Analyze			

Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment - Test : **25 marks**

Continuous Assessment - Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module - 1 (Introduction to compilers and lexical analysis)

Analysis of the source program - Analysis and synthesis phases, Phases of a compiler. Compiler writing tools. Bootstrapping. Lexical Analysis **-** Role of Lexical Analyser, Input Buffering, Specification of Tokens, Recognition of Tokens.

Module - 2 (Introduction to Syntax Analysis)

Role of the Syntax Analyser – Syntax error handling. Review of Context Free Grammars - Derivation and Parse Trees, Eliminating Ambiguity. Basic parsing approaches - Eliminating left recursion, left factoring. Top-Down Parsing - Recursive Descent parsing, Predictive Parsing, LL(1) Grammars.

Module - 3 (Bottom-Up Parsing)

Handle Pruning. Shift Reduce parsing. Operator precedence parsing (Concept only). LR parsing - Constructing SLR, LALR and canonical LR parsing tables.

Module - 4 (Syntax directed translation and Intermediate code generation)

Syntax directed translation - Syntax directed definitions, S-attributed definitions, L-attributed definitions, Bottom-up evaluation of S-attributed definitions. Run-Time Environments - Source Language issues, Storage organization, Storage-allocation strategies. Intermediate Code Generation - Intermediate languages, Graphical representations, Three-Address code, Quadruples, Triples.

Module 5 – (Code Optimization and Generation)

Code Optimization - Principal sources of optimization, Machine dependent and machine independent optimizations, Local and global optimizations. Code generation - Issues in the design of a code generator, Target Language, A simple code generator.

Text Books

1. Aho A.V., Ravi Sethi and D. Ullman. Compilers – Principles Techniques and Tools, Addison Wesley, 2006.

Reference Books

1. D.M.Dhamdhere, System Programming and Operating Systems, Tata McGraw Hill & Company, 1996.
2. Kenneth C. Louden, Compiler Construction – Principles and Practice, Cengage Learning Indian Edition, 2006.

3. Tremblay and Sorenson, The Theory and Practice of Compiler Writing, Tata McGraw Hill & Company,1984.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1) Explain the phases of a compiler with a neat diagram.

2) Define a token. Identify the tokens in the expression a := b + 10.

Course Outcome 2 (CO2):

1) Illustrate the process of eliminating ambiguity, left recursion and left factoring the grammar.

2) Is the following grammar ambiguous? If so eliminate ambiguity.

$E \rightarrow E + E \mid E*E \mid (E) \mid id$

Course Outcome 3 (CO3):

1. What are the different parsing conflicts in the SLR parsing table?
2. Design a recursive descent parser for the grammar

   $E \rightarrow E + T \mid T$

   $T \rightarrow T*F \mid F$

   $F \rightarrow (E) \mid id$

3. Construct canonical LR(0) collection of items for the grammar below.

   $S \rightarrow L = R$

   $S \rightarrow R$

   $L \rightarrow * R$

   $L \rightarrow id$

   $R \rightarrow L$

   Also identify a shift reduce conflict in the LR(0) collection constructed above.

Course Outcome 4 (CO4):

1. Write the quadruple and triple representation of the following intermediate code

   R1 = C * D

   R2 = B + R1

   A = R2

   B[0] = A

2. Differentiate S-attributed Syntax Directed Translation(SDT) and L-attributed SDT. Write S - attributed SDT for a simple desktop calculator

Course Outcome 5 (CO5):

1. List out the examples of function preserving transformations.
2. What are the actions performed by a simple code generator for a typical three-address statement of the form x: = y op z.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION , MONTH & YEAR

Course Code: CST 302

Course Name: Compiler Design

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Specify the analysis and synthesis parts of compilation.
2. Define the terms token, lexemes and patterns with examples.
3. Is the grammar S --> S | (S) S / Ɛ ambiguous? Justify your answer.
4. What is left recursive grammar? Give an example. What are the steps in removing left recursion?
5. Compare different bottom-up parsing techniques.
6. What are the possible actions of a shift reduce parser.

7. Differentiate synthesized and inherited attributes with examples.

8. Translate a[i] = b * c – b * d, to quadruple.

9. What is the role of peephole optimization in the compilation process

10. What are the issues in the design of a code generator

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain the different phases of a compiler with a running example. **(9)**

(b) List and explain any three compiler construction tools. **(5)**

OR

12. (a) What is a regular definition? Give the regular definition of an unsigned integer **(7)**

(b) Express the role of transition diagrams in recognition of tokens. **(7)**

13. (a) What is Recursive Descent parsing? List the challenges in designing such a parser? **(4)**

(b) Consider the following grammar **(10)**

E-→E or T | T

T→ T and F |F

F→not F | (E) | true | false

(i) Remove left recursion from the grammar.

(ii) Construct a predictive parsing table.

(iii) Justify the statement "The grammar is LL (1)".

OR

14. (a) What is Recursive Descent parsing? List the problems in designing such a parser **(4)**

(b) Design a recursive descent parser for the grammar S→cAd, A→ab/ b **(5)**

Find the FIRST and FOLLOW of the non-terminals S, A and B in the grammar **(5)**

S→aABe

A→Abc | b

B→d

15. (a) Construct the LR(0) set of items and their GOTO function for the grammar **(10)**

S→S S + | S S * | a

(b) Is the grammar SLR? Justify your answer **(4)**

OR

16. (a) Identify LR(1) items for the grammar **(7)**

S→ CC

C→ cC | d

(b) Construct LALR table for the above grammar **(7)**

17. (a) Design a Syntax Directed Translator(SDT) for the arithmetic expression (4 * 7 + 19) * 2 and draw an annotated parse tree for the same. **(8)**

(b) Consider the grammar with following translation rules and E as the start symbol **(6)**

E → E1 # T {E.value=E1.value x T.value ;}

| T{E.value=T.value ;}

T → T1 & F{ T.value=T1.value + F.value ;}

| F{T.value= F.value ; }

F → num { F.value=num. lvalue ;}

Compute E.value for the root of the parse tree for the expression

2#3 & 5# 6 &7

OR

18. (a) Write Syntax Directed Translator (SDT) and parse tree for infix to postfix translation of an expression. **(8)**

(b) Explain the storage allocation strategies. **(6)**

19. (a) Describe the principal sources of optimization **(7)**

(b) Illustrate the optimization of basic blocks with examples. **(7)**

OR

20. (a) Write the Code Generation Algorithm and explain the *getreg* function **(6)**

(b) Generate target code sequence for the following statement **(8)**

d := (a-b)+(a-c)+(a-c).

Teaching Plan

No	Contents	No. of Lecture Hours
Module - 1(Introduction to Compilers and lexical analyzer) (8 hours)		
1.1	Introduction to compilers, Analysis of the source program	1 hour
1.2	Phases of the compiler – Analysis Phases	1 hour
1.3	Phases of the Compiler - Synthesis Phases	1 hour
1.4	Symbol Table Manager and Error Handler	1 hour
1.5	Compiler writing tools, bootstrapping	1 hour
1.6	The role of Lexical Analyzer , Input Buffering	1 hour
1.7	Specification of Tokens	1 hour
1.8	Recognition of Tokens	1 hour

Module – 2 (Introduction to Syntax Analysis) (10 hours)		
2.1	Role of the Syntax Analyser, Syntax error handling	1 hour
2.2	Review of Context Free Grammars	1 hour
2.3	Parse Trees and Derivations	1 hour
2.4	Grammar transformations, Eliminating ambiguity	1 hour
2.5	Eliminating left recursion	1 hour
2.6	Left factoring the grammar	1 hour
2.7	Recursive Descent parsing	1 hour
2.8	First and Follow	1 hour
2.9	Predictive Parsing table constructor	1 hour
2.10	LL(1) Grammars	1 hour
Module - 3 (Bottom up parsing) (9 hours)		
3.1	Bottom-up parsing - Handle Pruning	1 hour
3.2	Shift Reduce parsing	1 hour
3.3	Operator precedence parsing (Concept only)	1 hour
3.4	LR parsing , SLR Grammar, items	1 hour
3.5	Augmented Grammar, Canonical collection of LR(0) items	1 hour
3.6	SLR Parser Table Construction	1 hour
3.7	Constructing Canonical LR Parsing Tables	1 hour
3.8	Constructing LALR Parsing Tables	1 hour
3.9	LALR parser	1 hour
Module - 4 (Syntax Directed Translation and Intermediate code Generation) (9 hours)		
4.1	Syntax directed definitions	1 hour
4.2	S- attributed definitions, L- attributed definitions	1 hour
4.3	Bottom- up evaluation of S- attributed definitions.	1 hour
4.4	Source Language issues	1 hour
4.5	Storage organization	1 hour

4.6	Storage- allocation strategies	1 hour
4.7	Intermediate languages , Graphical representations	1 hour
4.8	Three-Address code	1 hour
4.9	Quadruples, Triples	1 hour
Module - 5 (Code Optimization and Generation) (9 hours)		
5.1	Principal sources of optimization	1 hour
5.2	Machine dependent optimizations	1 hour
5.3	Machine independent optimizations	1 hour
5.4	Local optimizations	1 hour
5.5	Global optimizations	1 hour
5.6	Issues in the design of a code generator – Lecture 1	1 hour
5.7	Issues in the design of a code generator – Lecture 2	1 hour
5.8	Target Language	1 hour
5.9	Design of a simple code generator.	1 hour

CDT304	MACHINE LEARNING CONCEPTS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	3	1	0	4	2020

Preamble: This course enables the learners to understand the fundamental concepts and algorithms in machine learning. The course covers the standard and most popular supervised learning algorithms such as linear regression, logistic regression, decision trees, Bayesian learning & the naive Bayes algorithm, support vector machines & kernels, basic clustering algorithms and dimensionality reduction methods. This course helps the students to provide machine learning based solutions to real world problems.

Prerequisite: Basic Knowledge in Data Analytics

Course Outcomes: After the completion of the course the student will be able to

CO 1	Differentiate various learning approaches and to interpret the concepts of supervised learning **(Cognitive Knowledge Level: Understand)**
CO 2	Illustrate the working of classifier models and identify the classifier model for typical machine learning applications **(Cognitive Knowledge Level: Understand)**
CO 3	Apply theoretical foundations of trees to identify the best split and understand the concept of probabilistic models **(Cognitive Knowledge Level: Apply)**
CO 4	Compare the different dimensionality reduction techniques **(Cognitive Knowledge Level: Understand)**
CO 5	Design systems that uses the appropriate graph models of machine learning **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO11	PO1 2
CO1	✔	✔										✔
CO2	✔	✔		✔								✔
CO3	✔	✔	✔	✔								✔
CO4	✔	✔	✔	✔								✔
CO5	✔	✔										✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (percentage)	Test2 (percentage	
Remember	40	40	40
Understand	40	40	40
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance: 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

SYLLABUS

Module 1 (Introduction to Machine Learning)

Introduction to Machine Learning- Examples of Machine Learning applications, Learning Associations, Classification, Regression, Unsupervised Learning, Reinforcement Learning. Supervised learning- Input representation, Hypothesis class, Version space, Vapnik-Chervonenkis(VC) Dimension. Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

Module 2 (Linear Models)

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP– Deriving Back-Propagation – Radial Basis Functions and Splines –RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

Module 3 (Tree and Probabilistic Models)

Ensemble Learning – Entropy, Information Gain, Gain Ratio, Classification by Regression (CART), Regression model, Boosting , Bagging , Different ways to Combine Classifiers. Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Vector Quantization – Self Organizing Feature Map.

Module 4 (Dimensionality Reduction and Evolutionary Models)

Dimensionality Reduction – Linear Discriminant Analysis, Principal Component Analysis, Factor Analysis, Independent Component Analysis, Least Squares Optimization. Evolutionary Learning – Genetic algorithms, Genetic Offspring, Genetic Operators, Using Genetic Algorithms.

Module 5 (Graphical Models)

Graphical Models -Markov Chain, Monte Carlo Methods, Markov Random Fields, Hidden Markov Models, Bayesian Networks. Clustering Methods - K-means, Expectation-Maximization Algorithm.

Text Books:

1. Stephen Marsland, Machine Learning – An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series.
2. Tom M Mitchell, ―Machine Learning, First Edition, McGraw Hill Education

Reference Books:

1. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
2. Ethem Alpaydın, Introduction to Machine Learning (Adaptive Computation and Machine Learning), MIT Press, 2004.
3. Margaret H. Dunham. Data Mining: introductory and Advanced Topics, Pearson, 2006
4. Mitchell. T, Machine Learning, McGraw Hill.
5. Ryszard S. Michalski, Jaime G. Carbonell, and Tom M. Mitchell, Machine Learning: An Artificial Intelligence Approach, Tioga Publishing Company.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1): Explain the different methods of learning. Enumerate the concepts in a supervised approach.

Course Outcome 2 (CO2): Explain the different output activation functions. How sequential and batch training is implemented.

Course Outcome 3(CO3): What is the purpose of the neighborhood function in the SOM? How does it change the learning?

Course Outcome 4 (CO4): Discuss genetic algorithm with an example. Explain crossover, mutation, chromosome and generations.

Course Outcome 5 (CO5): Use K-means algorithm to cluster the points (2,10), (5,2), (8,16), (6,8), (4,12), (10,8).

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 2**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

***Course Code:* CDT 304**

e Name: Machine Learning Concepts

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. How to overcome 'curse of dimensionality' in machine learning applications?
2. Write short notes on overfitting.
3. Discuss the gradient descent approach.
4. Discuss the need for bias in multi layer perceptrons. Justify your answer.
5. Explain the terms Entropy, Information Gain and Gain Ratio.
6. List out the features of vector quantization.

7. State the reason why people who are interested in neural networks are interested in PCA.

8. Explain Kernel PCA Algorithm.

9. What is the significance of graphical models ?

10. Explain the taxonomy of clustering. **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain the different methods of learning. Enumerate the concepts in supervised approach. **(10)**

(b) How prediction is done by linear regression for a data set. **(4)**

OR

12. (a) Discuss the concept of Vapnik-Chervonenkis Dimension. **(6)**

(b) Given an example for linear separable problem. **(8)**

13. (a) Derive the back-propagation algorithm. **(8)**

(b) Explain how a multi-layer perceptron can solve the XOR problem. **(6)**

14. (a) Explain the different output activation functions. How sequential and batch training is implemented. **(4)**

(b) Explain the forward and backward pass of back propagation learning. **(8)**

15. (a) Explain the different algorithms to combine classifiers. **(8)**

(b) List the advantages and disadvantages of Gaussian Mixture Models. **(6)**

OR

16. (a) A simplistic intruder detection system for a computer network consists of an attempt to categorize users according to (i) the time of day they log in, (ii) the length of time they log in for, (iii) the types of programs they run while logged in, (iv) number of programs they run while logged in. Suggest how you would train a SOM. **(9)**

(b) What is the purpose of the neighborhood function in the SOM? How does it change the learning? **(5)**

17. (a) Explain the steps of Principal Components Analysis Algorithm. **(6)**

(b) Explain the algorithm of Linear Discriminant Analysis. **(8)**

OR

18. (a) Discuss genetic algorithms with an example. Explain crossover, mutation, chromosome and generations. **(10)**

(b) Describe Least Squares Optimization algorithm. **(4)**

19. (a) Use K-means algorithm to cluster the points (2,10), (5,2), (8,16), (6,8), (4,12), (10,8) to two clusters. **(6)**

(b) State the principle of Hidden Markov Model and explain the different types of HMM model with a neat sketch. **(8)**

OR

20. (a) Explain the concept of inference in Bayesian Networks with an example. **(8)**

(b) Construct a Bayesian Network simulating a teacher entering and leaving a class. **(6)**

Teaching Plan

	CDT 304 Machine Learning Concepts	**45 Hours**
	Module- 1(Introduction to Machine Learning)	**(9 hours)**
1.1	Introduction to Machine Learning	1 hour
1.2	Examples of Machine Learning applications	1 hour
1.3	Learning Associations, Classification	1 hour
1.4	Regression, Unsupervised Learning	1 hour
1.5	Reinforcement Learning	1 hour
1.6	Input representation, Hypothesis class	1 hour
1.7	Version space, Vapnik-Chervonenkis (VC) Dimension	1 hour
1.8	Perceptron	1 hour
1.9	Linear Separability – Linear Regression	1 hour
	Module 2 (Linear Models)	**(9 hours)**
2.1	**Multi-layer Perceptron**	1 hour
2.2	**Going Forward – Going Backward**	1 hour
2.3	Back Propagation Error	1 hour
2.4	Multi-layer Perceptron in Practice – Examples of using the MLP	1 hour
2.5	**Deriving Back-Propagation**	1 hour
2.6	Radial Basis Functions and Splines	1 hour
2.7	RBF Network	1 hour
2.8	Curse of Dimensionality – Interpolations and Basis Functions	1 hour
2.9	**Support Vector Machines**	1 hour
	Module 3 (Tree and Probabilistic Models)	**(10 hours)**
3.1	**Entropy, Information Gain, Gain Ratio**	1 hour
3.2	Classification by Regression (CART)	1 hour
3.3	Regression Model	1 hour
3.4	Boosting	1 hour
3.5	**Bagging**	1 hour
3.6	**Different ways to Combine Classifiers**	1 hour
3.7	**Data into Probabilities, Basic Statistics**	1 hour
3.8	**Gaussian Mixture Models**	1 hour
3.9	**Nearest Neighbor Methods**	1 hour

3.10	Vector Quantization – Self Organizing Feature Map	1 hour
Module 4 (Dimensionality Reduction and Evolutionary Models)		**(8 hours)**
4.1	Linear Discriminant Analysis	1 hour
4.2	Principal Component Analysis	1 hour
4.3	Factor Analysis	1 hour
4.4	Independent Component Analysis	1 hour
4.5	Least Squares Optimization	1 hour
4.6	Genetic algorithms	1 hour
4.7	Genetic Offspring	1 hour
4.8	Genetic Operators, Using Genetic Algorithms	1 hour
Module 5 (Graphical Models)		**(9 hours)**
5.1	Markov Chain	1 hour
5.2	Monte Carlo Methods	1 hour
5.3	Sampling	1 hour
5.4	Hidden Markov Models	1 hour
5.5	Markov Random Fields	1 hour
5.6	Bayesian Network	1 hour
5.7	K-means	1 hour
5.8	Expectation-Maximization Algorithm(Lecture 1)	1 hour
5.9	Expectation-Maximization Algorithm (Lecture 2)	1 hour

CST 306	ALGORITHM ANALYSIS AND DESIGN	Category	L	T	P	Credit	Year of Introduction
		PCC	3	1	0	4	2019

Preamble:

The course introduces students to the design of computer algorithms, as well as analysis of algorithms. Algorithm design and analysis provide the theoretical backbone of computer science and are a must in the daily work of the successful programmer. The goal of this course is to provide a solid background in the design and analysis of the major classes of algorithms. At the end of the course students will be able to develop their own versions for a given computational task and to compare and contrast their performance.

Prerequisite:

Strong Foundation in Mathematics, Programming in C, Data Structures and Graph Theory.

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Analyze any given algorithm and express its time and space complexities in asymptotic notations. **(Cognitive Level: Apply)**
CO2	Derive recurrence equations and solve it using Iteration, Recurrence Tree, Substitution and Master's Method to compute time complexity of algorithms. **(Cognitive Level: Apply)**
CO3	Illustrate Graph traversal algorithms & applications and Advanced Data structures like AVL trees and Disjoint set operations. **(Cognitive Level: Apply)**
CO4	Demonstrate Divide-and-conquer, Greedy Strategy, Dynamic programming, Branch-and Bound and Backtracking algorithm design techniques (**Cognitive Level: Apply)**
CO5	Classify a problem as computationally tractable or intractable, and discuss strategies to address intractability **(Cognitive Level: Understand)**
CO6	Identify the suitable design strategy to solve a given problem. **(Cognitive Level: Analyze)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔	✔								✔
CO2	✔	✔	✔	✔								✔
CO3	✔	✔	✔	✔								✔
CO4	✔	✔	✔	✔								✔
CO5	✔	✔										√
CO6	✔	✔	✔	✔								✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40

Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests (Average of SeriesTests1& 2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1 (Introduction to Algorithm Analysis)

Characteristics of Algorithms, Criteria for Analysing Algorithms, Time and Space Complexity - Best, Worst and Average Case Complexities, Asymptotic Notations - Big-Oh (O), Big- Omega (Ω), Big-Theta (Θ), Little-oh (o) and Little- Omega (ω) and their properties. Classifying functions by their asymptotic growth rate, Time and Space Complexity Calculation of simple algorithms.

Analysis of Recursive Algorithms: Recurrence Equations, Solving Recurrence Equations – Iteration Method, Recursion Tree Method, Substitution method and Master's Theorem (Proof not required).

Module–2 (Advanced Data Structures and Graph Algorithms)

Self Balancing Tree - AVL Trees (Insertion and deletion operations with all rotations in detail, algorithms not expected); Disjoint Sets- Disjoint set operations, Union and find algorithms.

DFS and BFS traversals - Analysis, Strongly Connected Components of a Directed graph, Topological Sorting.

Module–3 (Divide & Conquer and Greedy Strategy)

The Control Abstraction of Divide and Conquer- 2-way Merge sort, Strassen's Algorithm for Matrix Multiplication-Analysis. The Control Abstraction of Greedy Strategy- Fractional Knapsack Problem, Minimum Cost Spanning Tree Computation- Kruskal's Algorithms - Analysis, Single Source Shortest Path Algorithm - Dijkstra's Algorithm-Analysis.

Module-4 (Dynamic Programming, Back Tracking and Branch & Bound))

The Control Abstraction- The Optimality Principle- Matrix Chain Multiplication-Analysis, All Pairs Shortest Path Algorithm - Floyd-Warshall Algorithm-Analysis. The Control Abstraction of Back Tracking – The N Queen's Problem. Branch and Bound Algorithm for Travelling Salesman Problem.

Module-5 (Introduction to Complexity Theory)

Tractable and Intractable Problems, Complexity Classes – P, NP, NP- Hard and NP-Complete Classes- NP Completeness proof of Clique Problem and Vertex Cover Problem- Approximation algorithms- Bin Packing, Graph Coloring. Randomized Algorithms (Definitions of Monte Carlo and Las Vegas algorithms), Randomized version of Quick Sort algorithm with analysis.

Text Books

1. T.H.Cormen, C.E.Leiserson, R.L.Rivest, C. Stein, Introduction to Algorithms, 2^{nd} Edition, Prentice-Hall India (2001)
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", 2^{nd} Edition, Orient Longman Universities Press (2008)

3. Sara Baase and Allen Van Gelder —Computer Algorithms, Introduction to Design and Analysis, 3rd Edition, Pearson Education (2009)

Reference Books

1. Jon Kleinberg, Eva Tardos, "Algorithm Design", First Edition, Pearson (2005)
2. Robert Sedgewick, Kevin Wayne, "Algorithms",4th Edition Pearson (2011)
3. GIlles Brassard, Paul Brately, "Fundamentals of Algorithmics", Pearson (1996)
4. Steven S. Skiena, "The Algorithm Design Manual", 2nd Edition, Springer(2008)

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Is $2^{n+1} = O(2^n)$? Is $2^{2n} = O(2^n)$? Justify your answer.
2. What is the need of asymptotic analysis in calculating time complexity? What are the notations used for asymptotic analysis?
3. Calculate the time complexity for addition of two matrices.
4. Define time complexity and space complexity. Write an algorithm for adding n natural numbers and analyse the time and space requirements of the algorithm.

Course Outcome 2 (CO2):

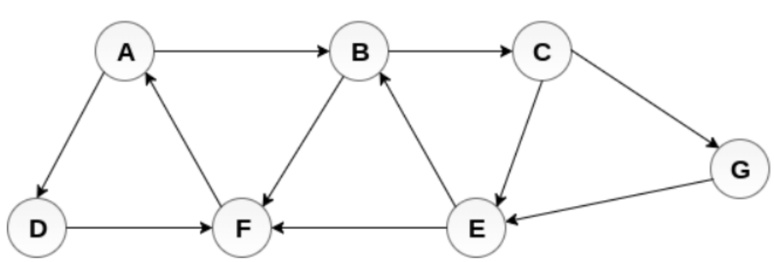
1. State Master's theorem for solving recurrences.
2. Solve the recurrence T(n) = 3T(n-2), using iteration method
3. State the conditions in recurrences where Master Theorem is not applicable.
4. Solve the following recurrence equations using Master's theorem.

    a) $T(n) = 8T(n/2) + 100 n^2$

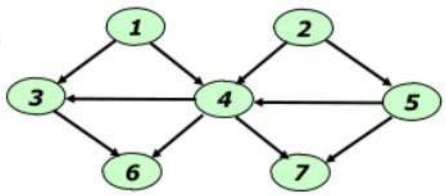
    b) $T(n) = 2T(n/2) + 10 n$
5. Using Recursion Tree method, Solve T(n)= 2T(n/10)+ T(9n/10)+n. Assume constant time for small values of n.

Course Outcome 3 (CO3):

1. Explain the rotations performed for insertion in AVL tree with example.
2. Write down BFS algorithm and analyse the time complexity. Perform BFS traversal on the given graph starting from node A. If multiple node choices are available for next travel, choose the next node in alphabetical order.

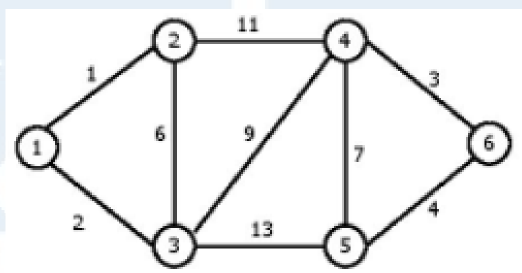


3. Find the minimum and maximum height of any AVL-tree with 7 nodes? Assume that the height of a tree with a single node is 0. (3)
4. Find any three topological orderings of the given graph.

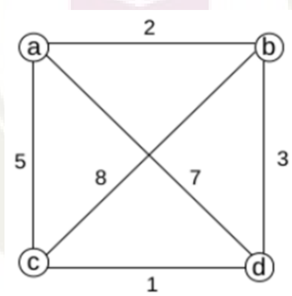


Course Outcome 4 (CO4):

1. Give the control abstraction for Divide and Conquer method.
2. Construct the minimum spanning tree for the given graph using Kruskal's algorithm. Analyse the complexity of the algorithm.



3. Compare Divide and Conquer and Dynamic programming methodologies
4. What is Principle of Optimality?
5. Define Travelling Salesman Problem (TSP). Apply branch and bound algorithm to solve TSP for the following graph, assuming the start city as 'a'. Draw the state space tree.



Course Outcome 5 (CO5):

1. Compare Tractable and Intractable Problems
2. With the help of suitable code sequence convince Vertex Cover Problem is an example of NP-Complete Problem

3. Explain Vertex Cover problem using an example. Suggest an algorithm for finding Vertex Cover of a graph.
4. Write short notes on approximation algorithms.
5. Compare Conventional quick sort algorithm and Randomized quicksort with the help of a suitable example?

Course Outcome 6 (CO6): (CO attainment through assignment only, not meant for examinations)

Choosing the best algorithm design strategy for a given problem after applying applicable design strategies – Sample Problems Given.

1. Finding the Smallest and Largest elements in an array of ‘n’ numbers
2. Fibonacci Sequence Generation.
3. Merge Sort
4. Travelling Sales Man Problem
5. 0/1 Knapsack Problem

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 306

Course Name: Algorithm Analysis and Design

Max. Marks : 100 **Duration: 3 Hours**

PART A

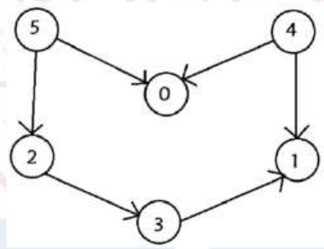
Answer All Questions. Each Question Carries 3 Marks

1. Define asymptotic notation? Arrange the following functions in increasing order of asymptotic growth rate.

$n^3, 2^n, \log n^3, 2^{100}, n^2 \log n, n^n, \log n, n^{0.3}, 2^{\log n}$

2. State Master's Theorem. Find the solution to the following recurrence equations using Master's theorem.
   a) $T(n) = 8T(n/2) + 100\, n^2$
   b) $T(n) = 2T(n/2) + 10\, n$

3. Find any two topological ordering of the DAG given below.



4. Show the UNION operation using linked list representation of disjoint sets.

5. Write the control abstraction of greedy strategy to solve a problem.

6. Write an algorithm based on divide-and-conquer strategy to search an element in a given list. Assume that the elements of list are in sorted order.

7. List the sequence of steps to be followed in Dynamic Programming approach.

8. Illustrate how optimal substructure property could be maintained in Floyd-Warshall algorithm.

9. Differentiate between P and NP problems.

10. Specify the relevance of approximation algorithms.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Define Big O, Big Ω and Big Θ Notation and illustrate them graphically. **(7)**

(b) Solve the following recurrence equation using recursion tree method **(7)**

$T(n) = T(n/3) + T(2n/3) + n$, where $n>1$

$T(n) = 1$, Otherwise

OR

12. (a) Explain the iteration method for solving recurrences and solve the following recurrence equation using iteration method. **(7)**

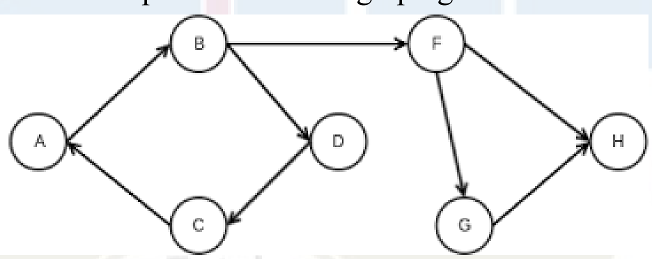
$$T(n) = 3T(n/3) + n;\ T(1) = 1$$

(b) Determine the time complexities of the following two functions fun1( ) and fun2( ). **(7)**

i)
```
int fun1(int n)
{
    if (n <= 1) return n;
    return 2*fun1(n-1);
}
```
ii)
```
int fun2 (int n)
{
    if (n <= 1) return n;
    return fun2 (n-1) + fun2 (n-1)
}
```

13. (a) Write DFS algorithm and analyse its time complexity. Illustrate the classification of edges in DFS traversal. **(7)**

(b) Find the strongly connected components of the digraph given below: **(7)**



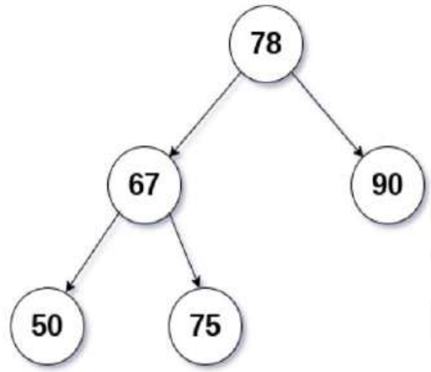
OR

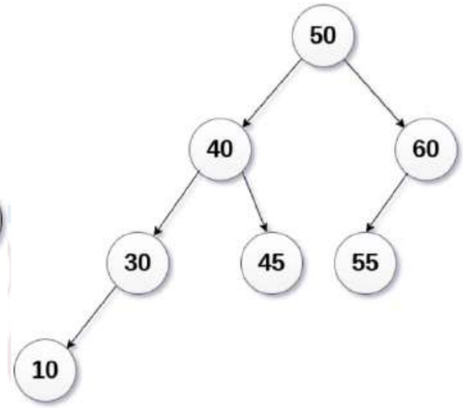
14. (a) Illustrate the advantage of height balanced binary search trees over binary search trees? Explain various rotations in AVL trees with example. **(7)**

(b) Perform the following operations in the given AVL trees. **(7)**

i) Insert 70

ii) Delete 55





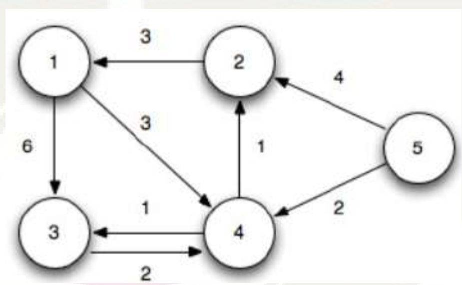
15. (a) State Fractional Knapsack Problem and write Greedy Algorithm for Fractional Knapsack Problem. **(7)**

(b) Find the optimal solution for the following Fractional Knapsack problem. Given the number of items(n) = 7, capacity of sack(m) = 15, W={2,3,5,7,1,4,1} and P = {10,5,15,7,6,18,3} **(7)**

OR

16. (a) Write and explain merge sort algorithm using divide and conquer strategy using the data {30, 19, 35, 3, 9, 46, 10}. Also analyse the time complexity. **(7)**

(b) Write the pseudo code for Dijkstra's algorithm. Compute the shortest distance from vertex 1 to all other vertices using Dijkstra's algorithm. **(7)**



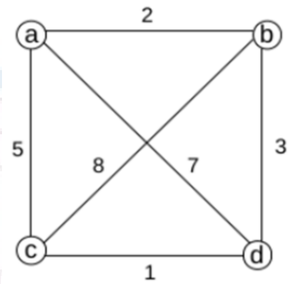
17. (a) Write Floyd-Warshall algorithm and analyse its complexity. **(5)**

(b) Write and explain the algorithm to find the optimal parenthesization of matrix chain product whose sequence of dimension is 4x10,10x3, 3x12,12x20. **(9)**

OR

18. (a) Explain the concept of Backtracking method using 4 Queens problem. **(7)**

(b) Define Travelling Salesman Problem (TSP). Apply branch and bound algorithm to solve TSP for the following graph, assuming the start city as ‘a’. Draw the state space tree. **(7)**



19. (a) State bin packing problem? Explain the first fit decreasing strategy **(7)**

(b) Prove that the Clique problem is NP-Complete. **(7)**

OR

20. (a) Explain the need for randomized algorithms. Differentiate Las Vegas and Monte Carlo algorithms. **(6)**

(b) Explain randomized quicksort and analyse the expected running time of randomized quicksort with the help of a suitable example? **(9)**

Teaching Plan

No	Topic	No. of Hours (45 hrs)
Module -1 (Introduction to Algorithm Analysis) 9 hrs.		
1.1	Introduction to Algorithm Analysis: Characteristics of Algorithms.	1 hour
1.2	Criteria for Analysing Algorithms, Time and Space Complexity - Best, Worst and Average Case Complexities.	1 hour
1.3	Asymptotic Notations - Properties of Big-Oh (O), Big- Omega (Ω), Big-Theta (Θ), Little-Oh (o) and Little- Omega (ω).	1 hour
1.4	Illustration of Asymptotic Notations	1 hour

1.5	Classifying functions by their asymptotic growth rate	1 hour
1.6	Time and Space Complexity Calculation of algorithms/code segments.	1 hour
1.7	Analysis of Recursive Algorithms: Recurrence Equations, Solving Recurrence Equations – Iteration Method.	1 hour
1.8	Recursion Tree Method	1 hour
1.9	Substitution method and Master's Theorem and its Illustration.	1 hour
Module-2 (Advanced Data Structures and Graph Algorithms) 10 Hrs.		
2.1	Self Balancing Trees - Properties of AVL Trees, Rotations of AVL Trees	1 hour
2.2	AVL Trees Insertion and Illustration	1 hour
2.3	AVL Trees Deletion and Illustration	1 hour
2.4	Disjoint set operations.	1 hour
2.5	Union and find algorithms.	1 hour
2.6	Illustration of Union and find algorithms	1 hour
2.7	Graph Algorithms: BFS traversal, Analysis.	1 hour
2.8	DFS traversal, Analysis.	1 hour
2.9	Strongly connected components of a Directed graph.	1 hour
2.10	Topological Sorting.	1 hour
Module-3 (Divide & Conquer and Greedy Method) 8 Hrs		
3.1	Divide and Conquer: The Control Abstraction.	1 hour
3.2	2-way Merge Sort, Analysis.	1 hour
3.3	Strassen's Algorithm for Matrix Multiplication, Analysis	1 hour

3.4	Greedy Strategy: The Control Abstraction.	1 hour
3.5	Fractional Knapsack Problem.	1 hour
3.6	Minimum Cost Spanning Tree Computation- Kruskal's Algorithm, Analysis.	1 hour
3.7	Single Source Shortest Path Algorithm - Dijkstra's Algorithm	1 hour
3.8	Illustration of Dijkstra's Algorithm-Analysis.	1 hour
Module-4 (Dynamic Programming, Back Tracking and Branch and Bound) 8 Hrs.		
4.1	Dynamic Programming: The Control Abstraction, The Optimality Principle.	1 hour
4.2	Matrix Chain Multiplication-Analysis.	1 hour
4.3	Illustration of Matrix Chain Multiplication-Analysis.	1 hour
4.4	All Pairs Shortest Path Algorithm- Analysis and Illustration of Floyd-Warshall Algorithm.	1 hour
4.5	Back Tracking: The Control Abstraction .	1 hour
4.6	Back Tracking: The Control Abstraction – The N Queen's Problem.	1 hour
4.7	Branch and Bound:- Travelling salesman problem.	1 hour
4.8	Branch and Bound:- Travelling salesman problem.	1 hour
Module-5 (Introduction to Complexity Theory) 10 Hrs		
5.1	Introduction to Complexity Theory: Tractable and Intractable Problems.	1 hour
5.2	Complexity Classes – P, NP.	1 hour
5.3	NP- Hard and NP-Complete Problems.	1 hour
5.4	NP Completeness Proof of Clique Problem.	1 hour

5.5	NP Completeness Proof of Vertex Cover Problem.	1 hour
5.6	Approximation algorithms- Bin Packing Algorithm and Illustration.	1 hour
5.7	Graph Colouring Algorithm and Illustration.	1 hour
5.8	Randomized Algorithms (definitions of Monte Carlo and Las Vegas algorithms).	1 hour
5.9	Randomized Version of Quick Sort Algorithm with Analysis.	1 hour
5.10	Illustration of Randomized Version of Quick Sort Algorithm with Analysis.	1 hour

CDT308	COMPREHENSIVE COURSE WORK	Category	L	T	P	Credit	Year of Introduction
		PCC	1	0	0	1	2019

Preamble: The objective of this Course work is to ensure the comprehensive knowledge of each studentinthemostfundamentalcorecoursesinthecurriculum.Five core courses credited from semesters 3, 4 and 5 are chosen for the detailed study in this course work. This course helps the learner to become competent in cracking GATE, placement tests and other competitive examinations

Prerequisite:

1. **Data Structures**
2. **Operating Systems**
3. **Computer Organization and Architecture**
4. **Database Management Systems**
5. **Data Analytics**

Course Outcomes: After the completion of the course the student will be able to

CO1:	Comprehend the concepts and applications of data structures (Cognitive Knowledge Level: **Understand)**
CO2 :	Comprehend the concepts, functions and algorithms in Operating System (Cognitive Knowledge Level: **Understand)**)
CO3:	Comprehend the organization and architecture of computer systems (Cognitive Knowledge Level: **Understand)**
CO4:	Comprehend the fundamental principles of database design and manipulation (Cognitive Knowledge Level: **Understand)**
CO5:	Comprehend the concepts in data analytics (Cognitive Knowledge Level: **Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓										✓
CO3	✓	✓										✓
CO4	✓	✓										✓
CO5	✓	✓										✓

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	10
Understand	20
Apply	20
Analyse	
Evaluate	
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	0	50	1 hour

End Semester Examination Pattern: Objective Questions with multiple choice, a maximum of four options. Question paper include fifty questions of one mark each, distributed equally from all the five identified courses.

SYLLABUS

Full Syllabus of all five selected Courses.

1. **Data Structures**
2. **Operating Systems**
3. **Computer Organization and Architecture**
4. **Database Management Systems**
5. **Data Analytics**

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**DATA STRUCTURES**	
1.1	Mock Test on Module 1, Module 2 and Module 3	1 hour
1.2	Mock Test on Module 4 and Module 5	1 hour
1.3	Feedback and Remedial class	
2	**OPERATING SYSTEMS**	
2.1	Mock Test on Module 1 and Module 2	1 hour
2.2	Mock Test on Module 3, Module 4 and Module 5	1 hour
2.3	Feedback and Remedial class	1 hour
3	**COMPUTER ORGANIZATION AND ARCHITECTURE**	
3.1	Mock Test on Module 1, Module 2 and Module 3	1 hour
3.2	Mock Test on Module 4 and Module 5	1 hour
4	**DATABASE MANAGEMENT SYSTEMS**	
4.1	Mock Test on Module 1, Module 2 and Module 3	1 hour
4.2	Mock Test on Module 4 and Module 5	1 hour
4.3	Feedback and Remedial class	

5	**DATA ANALYTICS**	
5.1	Mock Test on Module 1, Module 2 and Module 3	1 hour
5.2	Mock Test on Module 4 and Module 5	1 hour
5.3	Feedback and Remedial class	1 hour

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 9**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CDT308

Course Name: Comprehensive Course Work

Max. Marks: 50 **Duration: 1 Hour**

Objective type questions with multiple choices. Mark one correct answer for each question. Each Question Carries 1 Mark

1. Consider the following sequence of operations on an empty stack.
   push(22); push(43); pop(); push(55); push(12); s=pop();
   Consider the following sequence of operations on an empty queue.
   enqueue(32);enqueue(27); dequeue(); enqueue(38); enqueue(12); q=dequeue();
   The value of s+q is ___________
   (A) 44 (B) 54 (C) 39 (D) 70

2. A B-tree of order (degree)5 and of height 3 will have a minimum of ___ keys.
   A. 624
   B. 249
   C. 124
   D. 250

3. Construct a binary search tree by inserting 8, 6, 12, 3, 10, 9 one after another. To make the resulting tree as AVL tree which of the following is required?
   (A) One right rotation only
   (B) One left rotation followed by two right rotations
   (C) One left rotation and one right rotation

(D) The resulting tree itself is AVL

4. In a complete 4-ary tree, every internal node has exactly 4 children or no child. The number of leaves in such a tree with 6 internal nodes is:
(A) 20 (B) 18 (C) 19 (D) 17

5. Select the postfix expression for the infix expression *a+b-c+d*(e/f)*.
(A) ab+c-d+e*f/ (B) ab+c-def/*+
(C) abc-+def/*+ (D) ab+c-def/*+

6. Consider a hash table of size seven, with starting index zero, and a hash function (2x + 5)mod7. Assuming the hash table is initially empty, which of the following is the contents of the table when the sequence 1, 4, 9, 6 is inserted into the table using closed hashing? Note that '_' denotes an empty location in the table.
(A) 9, _, 1, 6, _, _, 4 (B) 1, _, 6, 9, _, _, 4
(C) 4, _, 9, 6, _, _, 1 (D) 1, _, 9, 6, _, _, 4

7. **Compute the time complexity of the following function:**
```
void function(int n)
{
        int count = 0;
        for (int i=n/2; i<=n; i++)
                for (int j=1; j<=n; j = j + 2)
                        for (int k=1; k<=n; k = k * 2)
                                count++;
}
```
A. $O(n^2 logn)$
B. $O(n\ log^2 n)$
C. $O(n^3)$
D. $O(n\ logn^2)$

8. How many distinct binary search trees can be created out of 6 distinct keys?
(A) 7 (B) 36 (C) 140 (D) 132

9. Which tree traversal performed on a binary search tree, results in ascending order listing of the keys?
A. Pre-order
B. In-order
C. Post-order
D. Level-order

10. You are given pointers to first and last nodes of a singly linked list, which of the following operations are dependent on the length of the linked list?
(A) Delete the first element
(B) Insert a new element as a first element

(C) Add a new element at the end of the list
(D) Delete the last element of the list

11. Suppose a disk has 400 cylinders, numbered from 0 to 399. At some time the disk arm is at cylinder 58, and there is a queue of disk access requests for cylinder 66, 349, 201, 110, 38, 84, 226, 70, 86. If Shortest-Seek Time First (SSTF) is being used for scheduling the disk access, the request for cylinder 86 is serviced after servicing ____________ number of requests.
(A) 1 (B) 2 (C)3 (D)4

12. If frame size is 4KB then a paging system with page table entry of 2 bytes can address _______ bytes of physical memory.
(A) 2^12 (B) 2^16 (C) 2^18 (D) 2^28

13. Calculate the internal fragmentation if page size is 4KB and process size is 103KB.
(A) 3KB (B) 4KB (C) 1KB (D) 2KB

14. Which of the following scheduling policy is likely to improve interactiveness?
(A) FCFS (B) Round Robin
(C) Shortest Process Next (D) Priority Based Scgeduling

15. Consider the following program

```
        Semaphore X=1, Y=0
Void A ( )                      Void B ( )
{                               {
        While (1)                       While (1)
        {                               {
        P(X);                           P(Y);
        Print'1';                       P(X);
        V(Y);                           Print'0';
        }                               V(X);
}                                       }
                                }
```

The possible output of the program:
(A) Any number of 0's followed by any number of 1's.
(B) Any number of 1's followed by any number of 0's.
(C) 0 followed by deadlock
(D) 1 followed by deadlock

16. In a system using single processor, a new process arrives at the rate of 12 processes per minute and each such process requires 5 seconds of service time. What is the percentage of CPU utilization?
(A) 41.66 (B) 100.00 (C) 240.00 (D) 60.00

17. A system has two processes and three identical resources. Each process needs two resources to proceed. Then
(A) Deadlock is possible (B) Deadlock is not possible

(C) Starvation may be present (D) Thrashing

18. Which of the following is true with regard to Round Robin scheduling technique?
(A) Responds poorly to short process with small time quantum.
(B) Works like SJF for larger time quantum
(C) Does not use a prior knowledge of burst times of processes.
(D) Ensure that the ready queue is always of the same size.

19. Thrashing can be avoided if
(A) the pages, belonging to working set of programs, are in main memory
(B) the speed of CPU is increased
(C) the speed of I/O processor is increased
(D) none of the above

20. The circular wait condition can be prevented by
(A) using thread
(B) defining a linear ordering of resource types
(C) using pipes
(D) all of the above

21. Consider the following processor design characteristics.
I. Register-to-register arithmetic operations only
II. Variable instruction format
III. Hardwired control unit
Which of the characteristics above are used in the design of a RISC processor?

(A) I only (B) I and II only (C) I and III only (D) I, II and III

22. A 64-bit processor can support a maximum memory of 8 GB, where the memory is word-addressable (one word is of 64 bits). The size of the address bus of the processor is atleast ____ bits.
(A) 30 (B) 31 (C) 32 (D) None

23. The stage delays in a 4-stage pipeline are 900, 450, 400 and 350 picoseconds. The first stage (with delay 900 picoseconds) is replaced with a functionally equivalent design involving two stages with respective delays 600 and 550 picoseconds. The throughput increase of the pipeline is _______ percent.
(A) 38 (B) 30 (C) 58 (D) 50

24. Consider a direct mapped cache of size 256 Kilo words with block size 512 words. There are 6 bits in the tag. The number of bits in block (index) and word (offset) fields of physical address are is:
(A) block (index) field = 6 bits, word (offset) field = 9 bits
(B) block (index) field = 7 bits, word (offset) field = 8 bits
(C) block (index) field = 9 bits, word (offset) field = 9 bits
(D) block (index) field = 8 bits, word (offset) field = 8 bits

25. The memory unit of a computer has 1 Giga words of 64 bits each. The computer has

instruction format, with 4 fields: an opcode field; a mode field to specify one of 12 addressing modes; a register address field to specify one of 48 registers; and a memory address field. If an instruction is 64 bits long, how large is the opcode field?
(A) 34 bits (B) 24 bits (C) 20 bits (D) 14 bits

26. A computer has 64-bit instructions and 28-bit address. Suppose there are 252 two-address instructions. How many 1-address instructions can be formulated?
(A) 2^24 (B) 2^26 (C) 2^28 (D) 2^30

27. Determine the number of clock cycles required to process 200 tasks in a six-segment pipeline.(Assume there were no stalls),each segment takes 1 cycle.
(A) 1200 cycles (B) 206 cycles (C) 207 cycles (D) 205 cycles

28. Match the following Lists:

P.DMA	1.Priority Interrupt
Q. Processor status Word	2.I/O Transfer
R. Daisy chaining	3.CPU
S. Handshaking	4.Asynchronous Data Transfer

(A) P-1, Q-3, R-4, S-2 (B) P-2, Q-3, R-1, S-4
(C) P-2, Q-1, R-3, S-4 (D) P-4, Q-3, R-1, S-2

29. Pipelining improves performance by:
(A) decreasing instruction latency
(B) eliminating data hazards
(C) exploiting instruction level parallelism
(D) decreasing the cache miss rate

30. The advantage of .... is that it can reference memory without paying the price of having a full memory address in the instruction.
(A) Direct addressing (B) Indexed addressing
(C) Register addressing (D) Register Indirect addressing

31. Let E1, E2 and E3 be three entities in an E/R diagram with simple single-valued attributes. R1 and R2 are two relationships between E1 and E2, where R1 is one-to-many, R2 is many-to-many. R3 is another relationship between E2 and E3 which is many-to-many. R1, R2 and R3 do not have any attributes of their own. What is the minimum number of tables required to represent this situation in the relational model?
(A) 3 (B) 4 (C) 5 (D) 6

32. Identify the minimal key for relational scheme R(U, V, W, X, Y, Z) with functional dependencies F = {U → V, V → W, W → X, VX → Z}
(A) UV (B) UW (C) UX (D) UY

33. It is given that: "Every student need to register one course and each course registered by many students", what is the cardinality of the relation say "Register" from the "Student" entity to the "Course" entity in the ER diagram to implement the given requirement.

(A) M:1 relationship (B) M:N relationship
(C) 1:1 relationship (D) option (B) or(C)

34. Consider the relation branch(branch_name, assets, branch_city)
SELECT DISTINCT T.branch_name FROM branch T, branch S WHERE T.assets>L.assets AND S.branch_city = "TVM" .
Finds the names of
(A) All branches that have greater assets than all branches located in TVM.
(B) All branches that have greater assets than some branch located in TVM.
(C) The branch that has the greatest asset in TVM.
(D) Any branch that has greater asset than any branch located in TVM.

35. Consider the following relation instance, where "A" is primary Key.

A1	A2	A3	A4
1	1	1	Null
5	2	5	1
9	5	13	5
13	13	9	15

Which one of the following can be a foreign key that refers to the same relation?
(A) A2 (B) A3 (C) A4 (D) ALL

36. A relation R(ABC) is having the tuples(1,2,1),(1,2,2),(1,3,1) and (2,3,2). Which of the following functional dependencies holds well?
(A) A → BC (B) AC → B (C) AB → C (D) BC → A

37. Consider a relation R with attributes A, B, C, D and E and functional dependencies A→BC, BC→E, E→DA. What is the highest normal form that the relation satisfies?
(A) BCNF (B) 3 NF (C) 2 NF (D) 1 NF

38. For the given schedule S, find out the conflict equivalent schedule.
S : r1(x); r2(Z) ; r3(X); r1(Z); r2(Y); r3(Y);W1(X); W2(Z); W3(Y); W2(Y)
(A) T1→T2→T3 (B) T2->T1->T3
(C) T3→T1→T2 (D) Not conflict serializable

39. Specialization is __________ process.
(A) top-down (B) bottom up
(C) Both (A) and (B) (D) none of these

40. If D1, D2, .., Dn are domains in a relational model, then the relation is a table, which is a subset of
(A) D1+D2+ … +Dn (B) D1×D2× … ×Dn
(C) D1 ∪ D2 ∪ ⋯ ∪Dn (D) D1–D2– … –Dn

41. Data Analytics uses ___ to get insights from data.

(A)Statistical figures (B)Numerical aspects

(C)Statistical methods (D)None of the mentioned above

42. Amongst which of the following is / are the branch of statistics which deals with the development of statistical methods is classified as ___.

(A)Industry statistics (B)Economic statistics

(C)Applied statistics (D)None of the mentioned above

43. Linear Regression is the supervised machine learning model in which the model finds the best fit ___ between the independent and dependent variable.

(A)Linear line (B)Nonlinear line

(C)Curved line (D)All of the mentioned above

44. The process of quantifying data is referred to as ___.

(A)Decoding (B)Structure

(C)Enumeration (D)Coding

45. Data Analysis is a process of,

(A)Inspecting data (B)Data Cleaning

(C)Transforming of data (D)All of the mentioned above

46. On which of the following platforms does Hadoop run?

(A)Debian (B)Cross-platform

(C)Bare metal (D)Unix-like

47. Data in ____ bytes size is called big data

(A)Meta (B)Giga

(C)Tera (D)Peta

48.Choose the primary characteristics of big data among the following

(A)Value (B)Variety

(C)Volume (D)All of the above

49. Which of the following is not a part of the data science process.

(A)Communication building (B)Discovery

(C)Operationalize (D)Model planning

50. All of the following accurately describe Hadoop, except

(A)Open source (B)Java-based

(C)Real-time (D)Distributed computing approach

QNo	Ans. Key	QNo	Ans. Key	QNo	Ans. Key	QNo	Ans. Key	QNo	Ans. Key
1	(C)	11	(C)	21	(C)	31	(C)	41	(C)
2	(B)	12	(D)	22	(A)	32	(D)	42	(C)
3	(A)	13	(C)	23	(D)	33	(A)	43	(A)
4	(C)	14	(B)	24	(C)	34	(B)	44	(C)
5	(D)	15	(D)	25	(B)	35	(B)	45	(D)
6	(D)	16	(B)	26	(D)	36	(D)	46	(B)
7	(A)	17	(B)	27	(D)	37	(A)	47	(D)
8	(D)	18	(C)	28	(B)	38	(D)	48	(D)
9	(B)	19	(A)	29	(C)	39	(A)	49	(A)
10	(D)	20	(B)	30	(D)	40	(B)	50	(C)

CDL332	BIG DATA PROCESSING LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3	3	2020

Preamble: The purpose of the course is to offer the students a hands-on experience on Big Data concepts using open source technologies such as Hadoop, Map Reduce, Hive, Pig and Apache Spark. The hands-on experience with R Programming language helps in statistical analysis and equip the students with data driven solutions for the next-generation data management. As data continues to grow it is known that via big data solutions, organizations generate insights and make well-informed decisions, discover trends, and improve productivity and the learner will be able to work on and solve data processing problems.

Prerequisite: Fundamental knowledge in Java programming, Statistics and Python along with topics covered in the course **Big Data Processing (CST 357)**.

Course Outcomes: At the end of the course, the student should be able to:

CO1	Illustrate the setting up of and Installing Hadoop in one of the three operating modes.**(Cognitive knowledge:Understand)**
CO2	Implement the file management tasks in Hadoop and explore the shell commands **(Cognitive knowledge: Apply)**
CO3	Implement different tasks using Hadoop Map Reduce programming model.**(Cognitive knowledge: Apply)**
CO4	Implement Pig Scripting operations and Spark Application functionalities.**(Cognitive knowledge: Apply)**
CO5	Implement data extraction from files and other sources and perform various data manipulation tasks on them using R Program.**(Cognitive knowledge:Apply)**

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔			✔			✔		✔		✔
CO2	✔	✔	✔		✔			✔		✔		✔
CO3	✔	✔	✔		✔			✔		✔		✔
CO4	✔	✔	✔		✔			✔		✔		✔
CO5	✔	✔	✔		✔			✔		✔		✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and teamwork
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern:

Bloom's Category	**Continuous Assessment Test(Internal Exam) Marks in percentage**	**End Semester Examination Marks in percentage**
Remember	20	20
Understand	20	20
Apply	60	60
Analyse		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESEDurati on
150	75	75	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 15 marks
Continuous Evaluation in Lab	: 30 marks
Continuous Assessment Test	: 15 marks
Viva Voce	: 15 marks

Internal Examination Pattern: The marks will be distributed as Algorithm30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

End Semester Examination Pattern: The percentage of marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva30 marks. Total 75 marks.

Operating System to Use in Lab : Linux
Compiler/Software to Use in Lab :
Programming Language to Use in Lab : Java, R, Python

Fair Lab Record:
All Students attending the Big Data Lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record, the right-hand page should contain Experiment Heading, Experiment Number, Date of experiment, Aim of the Experiment and the operations performed on them, Details of experiment including algorithm and result of Experiment. The left-hand page should contain a print out of the code used for experiment and sample output obtained for a set of input.

SYLLABUS

BIG DATA PROCESSING LAB

* Mandatory

1. Perform setting up and Installing Hadoop in any of the three operating modes: Standalone, Pseudo distributed, Fully distributed.*
2. Explore the various shell commands in Hadoop.
3. Implement the following file management tasks in Hadoop:
    - Adding Files and Directories
    - Retrieving Files
    - Deleting Files
4. Implement a word count program using Map Reduce.
5. Write a R program to find the factorial and check for palindromes.*
6. Write a R program to solve linear regression and make predictions.*
7. Write a R program to solve logistic regression.*
8. Implement statistical operations using R.*
9. Implement a program to find variance, covariance and correlation between different types of attributes.*
10. Implement SVM/Decision tree Classifier.*
11. Implement clustering algorithm.*
12. To explore Hive with its basic commands
13. Write Pig Latin scripts to sort, group, join, project, and filter your data.
14. Install, Deploy and configure Apache Spark.

BIG DATA PROCESSING LAB - PRACTICE QUESTIONS

1. Write a MapReduce Program to retrieve data from documents.
2. Write word count program that only count the words starting with 'a'
3. Write a word count program that only counts the words whose length is longer than 10.
4. Using the structure of the Word Count program, write a Hadoop program that calculates the average word length of all words that start with each character.
5. Implement matrix multiplication with Hadoop Map Reduce
6. Write a Map Reduce program for removing stop words from the given text files.
7. Write a MapReduce Program to count the number of lines in a document.
8. Write Pig Latin script to count the number of occurrences of each word in an input text file.

9. Write a program to simulate Singular Value Decomposition
10. Write a program to simulate PCA.
11. Write a single Spark application that:
    a. Transposes the original Amazon food dataset, obtaining a Pair RDD of the type: user-id – list of the product-ids reviewed by user-id
    b. Counts the frequencies of all the pairs of products reviewed together;
    c. Writes on the output folder all the pairs of products that appear more than once and their frequencies.
    d. The pairs of products must be sorted by frequency..
12. Write a program to implement a stop word elimination problem. Input: A large textual file containing one sentence per line. A small file containing a set of Stop Words (One Stop Word per line) Output:A textual file containing the same sentences of the large input file without the words appearing in the small file
13. Implement matrix multiplication with Map Reduce.
14. Implement basic Pig Latin Scripts based on different scenarios.
15. Implement Frequent Item set algorithm
16. Implement Clustering algorithm
17. Implement Page Rank algorithm
18. Implement Bloom Filter
19. Write a R program to create a sequence of numbers from 20 to 50 and find the mean of numbers from 20 to 60 and sum of numbers from 51 to 91.
20. Write a R program to create a vector which contains 10 random integer values between -50 and +50.
21. Write a R program to find the maximum and the minimum value of a given vector.
22. Write a R program to get the unique elements of a given string and unique numbers of vectors.
23. Write a R program to create a list of random numbers in normal distribution and count occurrences of each value.
24. Write a R program to read the .csv file and display the content.
25. Write a R program to create an array, passing in a vector of values and a vector of dimensions. Also provide names for each dimension.
26. Write a R program to create a simple bar plot of five subjects’ marks.

27. Write a R program to compute the sum, mean and product of a given vector element.
28. Write a R program to create a Data Frames which contain details of 5 employees and display the details.

CDD324	MINI PROJECT	CATEGORY	L	T	P	CREDITS
		PWS	0	0	3	2

Preamble: The objective of this course is to apply the fundamental concepts of Data Science / Machine Learning principles for the effective development of an application/research project. Mini project enables the students to boost their skills, widen the horizon of thinking and their ability to resolve real life problems. The students are expected to design and develop a software/hardware project to innovatively solve a real-world problem.

Prerequisite :A sound knowledge in any programming language and Subjects studied up to sixth semester.

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Identify technically and economically feasible problems of social relevance **(Cognitive Knowledge Level: Apply)**
CO2	Identify and survey the relevant literature for getting exposed to related solutions **(Cognitive Knowledge Level: Apply)**
CO3	Perform requirement analysis and identify design methodologies and develop adaptable and reusable solutions of minimal complexity by using modern tools and advanced programming techniques (**Cognitive Knowledge Level: Apply)**
CO4	Prepare technical report and deliver presentation**(Cognitive Knowledge Level: Apply)**
CO5	Apply engineering and management principles to achieve the goal of the project **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	75	75	3

Split-up of Continuous Internal Evaluation :

Attendance **10 marks**

Project Guide **15 marks**

Project Report **10 marks**

Evaluation by the Committee (will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement) **40 marks**

Split-up of End Semester Examination:

The marks will be distributed as

Presentation : 30 marks

Demonstration : 20 marks

Viva : 25 marks.

Total : 75 marks.

Course Plan

Student Groups with 3 or 4 members should identify a topic of interest in consultation with Faculty/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Innovative design concepts, performance, scalability, reliability considerations, aesthetics/ergonomic, user experience and security aspects taken care of in the project shall be given due weight.

The progress of the mini project is evaluated based on a minimum of two reviews. The review committee may be constituted with the Head of the Department or a senior faculty, Mini Project coordinator and project guide as the members. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight. The internal evaluation shall be made based on the progress/outcome of the project, reports and a viva-voce examination, conducted internally by a 3-member committee. A project report is required at the end of the semester. The product/application has to be demonstrated for its full design specifications.

Guidelines for the Report preparation

A bonafide report on mini project shall be submitted within one week after the final presentation. Minimum number of pages should be 40.

- Use Times New Roman font for the entire Report – Chapter / Section Title –Times New Roman 18, Bold; Heading 2 – Times New Roman 16, Bold; Heading 3 – Times New Roman 14,Bold; Body- Times New Roman12, Normal.
- Line Spacing – Between Heading 2 – 3 lines, between lines in paragraph 1.5 lines.
- Alignments – Chapter / Section Title – Center, Heading 2 & 3 should be LeftAligned. Ensure that all body text is paragraph justified.
- Figures & Tables – Ensure that all Figures and Tables are suitably numbered and given proper names/headings. Write figure title under the figure and table title above the table
- Suggestive order of documentation:
    i. Top Cover
    ii. Title page
    iii. Certification page
    iv. Acknowledgement
    v. Abstract
    vi. Table of Contents
    vii. List of Figures and Tables
    viii. Chapters
    ix. Appendices, if any
    x. References/Bibliography

SEMESTER VI

PROGRAM ELECTIVE I

CAT312	CONCEPTS IN GRAPH THEORY	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2020

Preamble: This course introduces fundamental concepts in Graph Theory, including properties and characterisation of graph/trees and graph theoretic algorithms, which are widely used in Mathematical modelling and has got applications across Computer Science and other branches in Engineering

Prerequisite: Basic understanding of Discrete Mathematical Structures

Course Outcomes: After the completion of the course the students will be able to

CO1	Explain vertices and their properties, types of paths, classification of graphs and trees & their properties. **(Cognitive Knowledge Level: Understand)**
CO2	Demonstrate the fundamental theorems on Eulerian and Hamiltonian graphs. **(Cognitive Knowledge Level: Understand)**
CO3	Illustrate the working of Prim's and Kruskal's algorithms for finding minimum cost spanning tree and Dijkstra's algorithm for finding shortest paths. **(Cognitive Knowledge Level: Apply)**
CO4	Explain planar graphs, their properties and an application for planar graphs. **(Cognitive Knowledge Level: Apply)**
CO5	Illustrate how one can represent a graph in a computer. **(Cognitive Knowledge Level: Apply)**
CO6	Explain the Vertex Color problem in graphs and illustrate an example application for vertex coloring. **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔									✔
CO2	✔	✔	✔	✔								✔
CO3	✔	✔	✔	✔								✔
CO4	✔	✔	✔	✔								✔
CO5	✔	✔	✔									✔
CO6	✔	✔	✔									✔

Abstract POs defined by National Board of Accreditation			
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PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests(Average of Internal Tests 1 & 2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

Module – 1 (Introduction to Graphs)

Introduction- Basic definition – Application of graphs – finite, infinite and bipartite graphs – Incidence and Degree – Isolated vertex, pendant vertex and Null graph. Paths and circuits – Isomorphism, sub graphs, walks, paths and circuits, connected graphs, disconnected graphs andcomponents..

Module - 2 (Eulerian and Hamiltonian graphs)

Euler graphs, Operations on graphs, Hamiltonian paths and circuits, Travelling salesman problem. Directed graphs – types of digraphs, Digraphs and binary relation, Directed paths, Fleury's algorithm

Module - 3 (**Trees and Graph Algorithms**)

Trees – properties, pendant vertex, Distance and centres in a tree - Rooted and binary trees, counting trees, spanning trees, Prim's algorithm and Kruskal's algorithm, Dijkstra's shortest path algorithm.

Module - 4 (**Connectivity and Planar Graphs**)

Vertex Connectivity, Edge Connectivity, Cut set and Cut Vertices, Fundamental circuits, Planar graphs, Kuratowski's theorem (proof not required), Different representations of planar graphs, Euler's theorem, Geometric dual.

Module - 5 (**Graph Representations and VertexColourin**g)

Matrix representation of graphs- Adjacency matrix, Incidence Matrix, Circuit Matrix, Path Matrix. Coloring- Chromatic number, Chromatic polynomial, Four color problem and Five color theorem. Greedy colouring algorithm.

Text Books

1. Narsingh Deo, Graph theory, PHI,1979

Reference Books

1. R. Diestel, *Graph Theory,* free online edition, 2016: diestel-graph-theory.com/ basic.html.
2. Douglas B. West, Introduction to Graph Theory, Prentice Hall IndiaLtd.,2001
3. Robin J. Wilson, Introduction to Graph Theory, Longman GroupLtd.,2010
4. J.A. Bondy and U.S.R. Murty. Graph theory withApplications

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Differentiate a walk, path and circuit in agraph.
2. Is it possible to construct a graph with 12 vertices such that two of the vertices have degree 3 and the remaining vertices have degree 4?Justify
3. Provethatasimplegraphwithnverticesmustbeconnected,ifithasmorethan $\frac{(n-1)(n-2)}{2}$edges.
4. Prove the statement: If a graph (connected or disconnected) has exactly two odd degree, then there must be a path joining these two vertices.

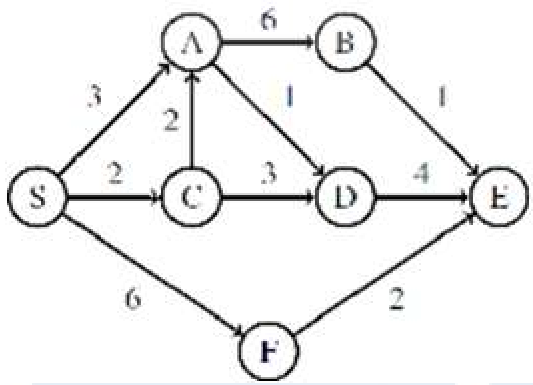
Course Outcome 2(CO2):

1. Define Hamiltonian circuit and Euler graph. Give one example foreach.
2. Define directed graphs. Differentiate between symmetric digraphs and asymmetric digraphs.
3. Prove that a connected graph G is an Euler graph if all vertices of G are of evendegree.

4. Prove that a graph G of n vertices always has a Hamiltonian path if the sum of the degrees of every pair of vertices Vi,Vj in G satisfies the condition $d(Vi)+d(Vj)=n-1$

Course Outcome 3(CO3):

1. Discuss the centre of a tree with suitable example.
2. Define binary tree. Then prove that number of pendant vertices in a binary tree is $\underline{(n+1)}2$
3. Prove that a tree with n vertices has n edges.
4. Run Dijkstra's algorithm on the following directed graph, starting at vertex ***S***.



Course Outcome 4(CO4): .

1. Define edge connectivity, vertex connectivity and separable graphs. Give an example for each.
2. Prove the statement: Every cut set in a connected graph G must also contain at least one branch of every spanning tree of G.

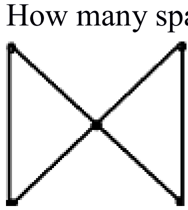
Course Outcome 5(CO5):

1. Show that if ***A(G)*** is an incidence matrix of a connected graph ***G*** with ***n*** vertices, then rank of ***A(G)*** is $n-1$.
2. Show that if ***B*** is a cycle matrix of a connected graph ***G*** with ***n*** vertices and ***m*** edges, then rank ***B*** $=m-n+1$.
3. Derive the relations between the reduced incidence matrix, the fundamental cycle matrix, and the fundamental cut-set matrix of a graph ***G***.
4. Characterize simple, self-dual graphs in terms of their cycle and cut-set matrices.

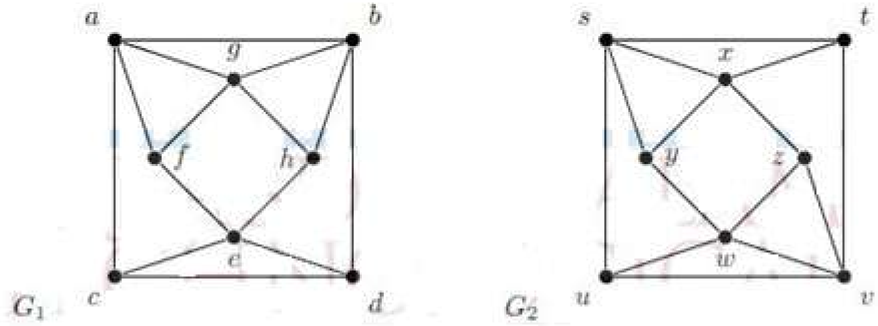
Course Outcome 6 (CO6):

1. Show that an n vertex graph is a tree iff its chromatic polynomial is $Pn(\lambda) = \lambda\,(\lambda-1)n-1$
2. Define Path matrix and Circuit matrix with an example each.

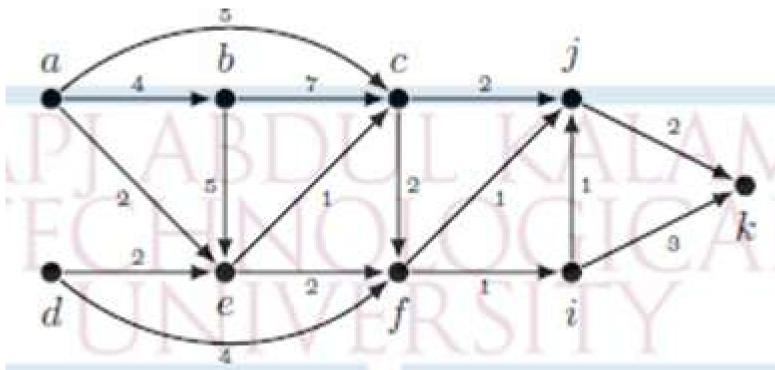
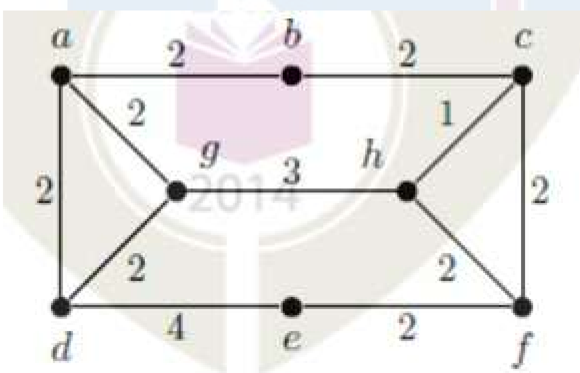
Model Question Paper
QP CODE:
Reg No: _______________
Name: _________________ **PAGES : 4**
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR
Course Code: CAT312
Course Name: Concepts in Graph Theory
Max. Marks : 100 **Duration: 3 Hours**
PART A
Answer All Questions. Each Question Carries 3 Marks

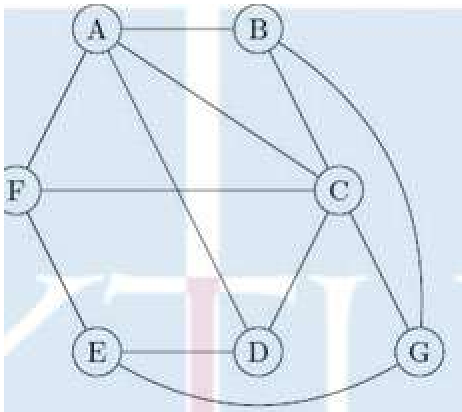
1.	Construct a simple graph of 12 vertices with two of them having degree 1, three having degree 3 and the remaining seven having degree10.	**(3)**
2.	What is the largest number of vertices in a graph with 35 edges, if all vertices are of degree at least 3 ?	**(3)**
3.	Define a Euler graph. Give an example of Eulerian graph which is not Hamiltonian	**(3)**
4.	Give an example of a strongly connected simple digraph without a directed Hamiltonianpath.	**(3)**
5.	What is the sum of the degrees of any tree of***n*** vertices?	**(3)**
6.	How many spanning trees are there for thefollowinggraph 	**(3)**

7.		Show that in a simple connected planar graph ***G*** having ***V***-vertices, ***E***-edges, and no triangles ***E <= 3V -6***	**(3)**
8.		Let G be the following disconnected planar graph. Draw its dual G*,andthe dual of the dual (G*)*.  G	**(3)**
9.		Consider the circuit matrix ***B*** and incidence matrix ***A*** of a simple connected graph whose columns are arranged using the same order of edges. Prove that every row of ***B*** is orthogonal to every row of ***A***?	**(3)**
10.		A graph is *critical* if the removal of any one of its vertices (and the edgesadjacent to that vertex) results in a graph with a lower chromatic number. how that ***Kn*** is critical for all ***n > 1***.	**(10x3=30)**
		Part B **(Answer any one question from each module. Each question carries 14 Marks)**	
11.	(a)	Prove that for any simple graph with at least two vertices has two vertices of the same degree.	**(6)**
	(b)	Prove that in a complete graph with ***n*** vertices there are **(n-1)/2** edge disjoint Hamiltonian circuits and ***n >= 3***	**(8)**
		OR	
12.	(a)	Determine whether the following graphs ***G1 = (V1, E1)*** and ***G2 = (V2, E2)*** are isomorphic or not. Give justification.	**(6)**



	(b)	Prove that a simple graph with n vertices and k components can have atmost (n-k)(n-k+1)/2 edges.	**(8)**
13.	(a)	Let***S***beasetof5elements.Constructagraph***G***whoseverticesaresubsets of ***S*** of size 2 and two such subsets are adjacent in ***G*** if they are disjoint. i. Draw the graph***G***. ii. How many edges must be added to ***G*** in order for ***G*** to have a Hamiltoniancycle?	**(8)**
	(b)	Let ***G*** be a graph with exactly two connected components, both being Eulerian. What is the minimum number of edges that need to be added to ***G*** to obtain an Eulerian graph?	**(6)**
		OR	
14.	(a)	Show that a ***k***-connected graph with no hamiltonian cycle has an independent set of size ***k +1***.	**(8)**
	(b)	i. Let ***G*** be a graph that has exactly two connected components, both being Hamiltonian graphs. Find the minimum number of edges that one needs to add to ***G*** to obtain a Hamiltoniangraph. **i.** For which values of ***n*** the graph ***Qn*** (hyper-cube on ***n*** vertices) is Eulerian.	**(6)**
15.	(a)	A tree ***T*** has at least one vertex ***v*** of degree 4, and at least one vertex ***w*** of degree 3. Prove that ***T*** has at least 5leaves.	**(5)**
	(b)	Write Dijkstra's shortest path algorithm. Consider the following weighted directed graph ***G.*** Find the shortest path	**(9)**

		between ***a*** and every other vertices in ***G*** using Dijkstra's shortest path algorithm.  	
OR			
16.	(a)	Define pendent vertices in a binary tree? Prove that the number of pendent vertices in a binary tree with ***n*** vertices is ***(n+1)/2***	**(5)**
	(b)	Write Prim's algorithm for finding minimum spanning tree. Find a minim um spanning tree in the following weighted graph, using Prim'salgorithm. Determine the number of minimum spanning trees for the given graph.  	**(9)**
17.	(a)	i.State and prove Euler's Theorem relating the number of faces, edges and vertices for a planar graph. **ii.**If ***G*** is a 5-regular simple graph and **|*V*| = 10**, prove that ***G*** is non-planar.	**(9)**
	(b)	Let ***G*** be a connected graph and ***e*** an edge of ***G***. Show that ***e*** is a cut-edge if and only if ***e*** belongs to every spanning tree.	**(5)**
OR			

18.	(a)	State Kuratowski's theorem, and use it to show that the graph G below is not planar. Draw G on the plane without edges crossing. Your drawing should use the labelling of the vertices given.  	**(9)**
	(b)	Let ***G*** be a connected graph and ***e*** an edge of ***G***. Show that ***e*** belongs to a loop if and only if ***e*** belongs to no spanningtree.	**(5)**
19.	(a)	Definethecircuitmatrix***B(G)***ofaconnectedgraph***G***with***n***verticesand***e*** edges with an example. Prove that the rank of ***B(G)*** is ***e-n+1***	**(7)**
	(b)	Give the definition of the chromatic polynomial ***PG(k)***. Directly from the definition, prove that the chromatic polynomials of ***Wn*** and ***Cn*** satisfy the identity ***PWn(k) = k PCn-1 (k – 1).***	**(7)**
OR			
20.	(a)	Prove that the rank of an incidence matrix of a connected graph with ***n*** vertices is***n-1.***	**(3)**
	(b)	i. A graph ***G*** has chromatic polynomial ***PG(k) = k4-4k3+5k2-2k***. How many vertices and edges does ***G*** have? Is ***G*** bipartite? Justify your answers. i. State and prove Five Color Theorem.	**(11)**

Teaching Plan

No	Contents	No. of Lecture Hours (36 hrs)
Module-1 (Introduction to Graphs) (5 hours)		
1.1	Introduction- Basic definition – Application of graphs – finite and infinite graphs, bipartite graphs,	1 hour
1.2	Incidence and Degree – Isolated vertex, pendent vertex and Null graph,	1 hour
1.3	Paths and circuits, Isomorphism	1 hour
1.4	Sub graphs, walks, Paths and circuits	1 hour
1.5	Connected graphs, Disconnected graphs and components	1 hour
Module-2 (Eulerian and Hamiltonian graphs) (7 hours)		
2.1	Euler graphs	1 hour
2.2	Operations on graphs	1 hour
2.3	Hamiltonian paths and circuits	1 hour
2.4	Hamiltonian paths and circuits, Travelling salesman problem	1 hour
2.5	Directed graphs – types of digraphs,	1 hour
2.6	Digraphs and binary relation, Directed paths	1 hour
2.7	Fleury's algorithm	1 hour
Module-3 (Trees and Graph Algorithms) (8 hours)		
3.1	Trees – properties	1 hour
3.2	Trees – properties, pendent vertex	1 hour
3.3	Distance and centres in a tree	1 hour
3.4	Rooted and binary tree	1 hour
3.5	Counting trees	1 hour
3.6	Spanning trees, Fundamental circuits	1 hour
3.7	Prim's algorithm	1 hour
	Kruskal's algorithm	

3.8	Dijkstra's shortest path algorithm	1 hour
Module-4 (Connectivity and Planar Graphs) (9 hours)		
4.1	Vertex Connectivity, Edge Connectivity	1 hour
4.2	Cut set and Cut Vertices	1 hour
4.3	Fundamental circuits	1 hour
4.4	Fundamental circuits	1 hour
4.5	Planar graphs	1 hour
4.6	Kuratowski's theorem	1 hour
4.7	Different representations of planar graphs	1 hour
4.8	Euler's theorem	1 hour
4.9	Geometric dual	1 hour
Module-5 (Graph Representations and VertexColouring) (7 hours)		
5.1	Matrix representation of graphs- Adjacency matrix, Incidence Matrix	1 hour
5.2	Circuit Matrix, Path Matrix	1 hour
5.3	Coloring- chromatic number,	1 hour
5.4	Chromatic polynomial	1 hour
5.5	Four color problem	1 hour
5.6	Five color Theorem and proof	1 hour
5.7	Greedy coloring algorithm.	1 hour

AIT322	CONCEPTS IN COMPUTER GRAPHICS AND IMAGE PROCESSING	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2019

Preamble: The purpose of this course is to make awareness about strong theoretical relationships between computer graphics and image processing. This course helps the learner to understand three-dimensional environment representation in a computer, transformation of 2D/3D objects, basic mathematical techniques and algorithms used to build useful applications, imaging, and image processing techniques. The study of computer graphics and image processing develops the ability to create image processing frameworks for different domains and develops algorithms for emerging display technologies.

Prerequisite: A sound knowledge of Mathematics and a programming language.

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Describe the working principles of graphics devices**(Cognitive Knowledge level: Understand)**
CO2	Illustrate line drawing, circle drawing and polygon filling algorithms(Cognitive Knowledge level: Apply)
CO3	Demonstrate geometric representations, transformations on 2D & 3D objects, clipping algorithms and projection algorithms(Cognitive Knowledge level: Apply)
CO4	Summarize visible surface detection methods(Cognitive Knowledge level: Understand)
CO5	Summarize the concepts of digital image representation, processing and demonstrate pixel relationships(Cognitive Knowledge level: Apply)
CO6	Solve image enhancement and segmentation problems using spatial domain techniques(Cognitive Knowledge level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓								✓
CO4	✓		✓									✓
CO5	✓	✓	✓	✓								
CO6	✓	✓	✓	✓		✓						✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember	**30**	**30**	**30**
Understand	**30**	**30**	**30**
Apply	**40**	**40**	**40**

Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests(Average of SeriesTests1& 2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one full question. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

Module – 1 (Basics of Computer graphics and Algorithms)

Basics of Computer Graphics and its applications. Video Display devices- Refresh Cathode Ray Tubes, Random Scan Displays and systems, Raster scan displays and systems. Line drawing algorithms- DDA, Bresenham's algorithm. Circle drawing algorithms- Midpoint Circle generation algorithm, Bresenham's algorithm.

Module – 2 (Filled Area Primitives and transformations)

Filled Area Primitives- Scan line polygon filling, Boundary filling and flood filling. Two dimensional transformations-Translation, Rotation, Scaling, Reflection and Shearing, Composite transformations, Matrix representations and homogeneous coordinates. Basic 3D transformations.

Module - 3 (Clipping and Projections)

Window to viewport transformation. Cohen Sutherland Line clipping algorithm.Sutherland Hodgeman Polygon clipping algorithm. Three-dimensional viewing pipeline. Projections-Parallel and Perspective projections. Visible surface detection algorithms- Depth buffer algorithm, Scan line algorithm.

Module - 4 (Fundamentals of Digital Image Processing)

Introduction to Image processing and applications. Image as 2D data. Image representation ingrayscale, Binary and Colour images. Fundamental steps in image processing. Components of image processing system.Coordinate conventions. Sampling and quantization. Spatial and Gray Level Resolution. Basic relationship between pixels– neighbourhood, adjacency, connectivity.

Module - 5 (Image Enhancement in Spatial Domain and Image Segmentation)

Basic gray level transformation functions- Log transformations, Power-Law transformations, Contrast stretching. Histogram equalization. Basics of spatial filtering - Smoothing spatial filter- Linear and nonlinear filters, and Sharpening spatial filters-Gradient and Laplacian.

Fundamentals of Image Segmentation.Thresholding-Basics of Intensity thresholding and Global Thresholding. Region based Approach- Region Growing, Region Splitting and Merging. Edge Detection - Edge Operators- Sobel and Prewitt.

Text Book

1. Donald Hearn and M. Pauline Baker, Computer Graphics, PHI, 2e, 1996
2. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing. Pearson, 4e, 2017

References

1) William M. Newman and Robert F. Sproull, Principles of Interactive Computer Graphics. McGraw Hill, 2001
2) Zhigang Xiang and Roy Plastock, Computer Graphics (Schaum's outline Series), McGraw Hill, 2019.

3) David F. Rogers , Procedural Elements for Computer Graphics, Tata McGraw Hill,2001.
4) M. Sonka, V. Hlavac, and R. Boyle, Image Processing, Analysis, and Machine Vision, Thomson India Edition, 4e, 2017.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Compare the working principle of raster scan systems and random scan systems.
2. How much time is spent scanning across each row of pixels during screen refresh on a raster system with resolution of 1280*1024 and a refresh rate of 60 frames per second?

Course Outcome 2 (CO2):

1. Rasterize the line with end points(2,3) and (5,8) using Bresenham's line drawing algorithm.
2. Explain how the 4-connected area filling approach differs from 8- connected area filling in boundary filling algorithm

Course Outcome 3 (CO3):

1. Rotate a triangle ABC 45 degree counter clockwise about the pivot point (10,3), where the position vector of the coordinate ABC is given as A(4,1), B(5,2) and C(4,3).
2. Given a clipping window A(20,20), B(60,20), C(60,40) and D(20,40). Using Cohen Sutherland algorithm, find the visible portion of the line segment joining the points P(40,80) and Q(120,30)

Course Outcome 4 (CO4):

1. Explain scan line algorithm for detecting visible surfaces in an object.

Course Outcome 5 (CO5):

1. Give an image representation model and describe how the representation changes in grayscale, binary and colour images.
2. Consider an image segment shown below.

   3 1 2 1 (q)

   2 2 0 2

   1 2 1 1

   (p) 1 0 1 2

   (a) Let V={0,1} and compute the length of the shortest 4-,8- and m- path between p and q. If a particular path does not exist between these two points , explain why?

   (b) Repeat for V={1,2}.

3. The spatial resolution of an image is given by 128 X 128.What is its storage requirements if it is represented by 64 gray levels?

Course Outcome 6 (CO6):

1. A skilled medical technician is charged with the job of inspecting a certain class of monochrome images generated by electronic microscope. To facilitate the inspection, the technician uses image processing aids. However when he examines the images he finds the following problems.
   (a) Presence of bright isolated dots that are not of interest.
   (b) Lack of sharpness
   (c) Poor contrast

   Identify the sequence of preprocessing steps that the technician may use to overcome the above mentioned problems and explain it.
2. A 4x4, 4 bits/pixel original image is given by

$$\begin{pmatrix} 10 & 12 & 8 & 9 \\ 10 & 12 & 12 & 14 \\ 12 & 13 & 10 & 9 \\ 14 & 12 & 10 & 12 \end{pmatrix}$$

   (a) Apply histogram equalisation to the image by rounding the resulting image pixels to integers
   (b) Sketch the histogram of the original image and the histogram-equalised image.
3. You have Sobel operator and Laplacian operator for edge detection. Which operator will you select for edge detection in the case of noisy image? Explain.**(Assignment)**

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AIT322

Course Name: Concepts in Computer Graphics and Image Processing

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Justify the approach of using integer arithmetic in Bresenham's line drawing algorithm.

2. Consider a raster system with a resolution of 1024*1024. What is the size of the raster needed to store 4 bits per pixel? How much storage is needed if 8 bits per pixel are to be stored?

3. Show that two successive reflections about either of the coordinate axes is equivalent to a single rotation about the coordinate origin.

4. Determine a sequence of basic transformations that are equivalent to the x-direction shearing matrix.

5. Find the window to viewport normalization transformation with window lower left corner at (1,1) and upper right corner at (2,6).

6. Find the orthographic projection of a unit cube onto the x=0, y=0 and z=0 plane.

7. Define Sampling and Quantization of an image.

8. Give any three applications of digital image processing.

9. A captured image appears very dark because of wrong lens aperture setting. Describe an enhancement technique which is appropriate to enhance such an image.

10. Suggest an approach of thresholding that should be used in case of uniform illumination.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11.	(a)	Write Midpoint circle drawing algorithm and use it to plot a circle with radius=20 and center is (50,30).	**(10)**
	(b)	Draw the architecture of raster scan display systems and explain its working principle.	**(4)**
		OR	
12.	(a)	Derive the initial decision parameter of Bresenham's line drawing algorithm and use the algorithm to rasterize a line with endpoints (2,2) and (10,10).	**(10)**
	(b)	Explain the working principle of color CRT monitors with suitable illustrations.	**(4)**
13.	(a)	Compare boundary fill algorithm and flood fill algorithm.	**(5)**
	(b)	Reflect a triangle ABC about the line 3x-4y+8=0. The position vector of the coordinate ABC is given as A(4,1), B(5,2) and C(4,3).	**(9)**
		OR	
14.	(a)	Explain the need of using vanishing points in projections.	**(4)**
	(b)	Explain Cohen-Sutherland line clipping algorithm. Use the algorithm to clip line P1(70, 20) and P2(100,10) against a window lower left hand corner (50,10) and upper right hand corner (80,40).	**(10)**

15. (a) Describe Sutherland Hodegman polygon clipping algorithm and what are its limitations. **(7)**

(b) Explain how visible surfaces can be detected using depth buffer algorithm. **(7)**

OR

16. (a) Describe Sutherland Hodegman polygon clipping algorithm and what are its limitations. **(7)**

(b) Explain how visible surfaces can be detected using depth buffer algorithm. **(7)**

17. (a) Explain the components of an image processing system with suitable diagram **(9)**

(b) Define Resolution of an image. Explain the spatial and gray level resolution of an image with an example. **(5)**

OR

18. (a) Define 4-adjacency, 8 adjacency and m-adjacency. Consider the image segment shown. **(7)**

4 2 3 2 (q)
3 3 1 3
2 3 2 2
(p) 2 1 2 3

Let V={1,2} and compute the length of the shortest 4- ,8- and m- path between p and q. If a particular path does not exist between these two points, explain why?

(b) Using any one application, explain the steps involved in image processing. **(7)**

19. (a) A 5x5 image patch is shown below. Compute the value of the marked pixel if it is smoothened by a 3x3 average filterand median filter. **(4)**

$$f(m,n)=\begin{pmatrix} 0 & 1 & 2 & 3 & 2 \\ 5 & 6 & 7 & 8 & 4 \\ 4 & 3 & 2 & 1 & 2 \\ 8 & 7 & 6 & 5 & 3 \\ 1 & 5 & 3 & 7 & 6 \end{pmatrix}$$

(b) Define Image segmentation and describe in detail method of edge and region **(10)** based segmentation technique.

OR

20. (a) Distinguish between smoothing and sharpening filters in terms of **(10)**

- **(i)** Functionality
- **(ii)** Types
- **(iii)** Applications
- **(iv)** Mask Coefficients

(b) Describe how an image is segmented using split and merge technique in association with the region adjacency graph. **(8)**

TEACHING PLAN

No	Contents	No of Lecture Hrs (36 hrs)
Module – 1 (Basics of Computer Graphics and Algorithms) (8 hrs)		
1.1	Basics of Computer Graphics and applications	1 hour
1.2	Refresh Cathode Ray Tubes	1 hour
1.3	Random Scan Displays and systems,Raster scan displays and systems	1 hour
1.4	DDA Line drawing Algorithm	1 hour
1.5	Bresenham's line drawing algorithm	1 hour
1.6	Midpoint Circle generation algorithm	1 hour
1.7	Bresenham's Circle generation algorithm	1 hour
1.8	Illustration of line drawing and circle drawing algorithms	1 hour
Module - 2 (Filled Area Primitives and transformations) (8 hrs)		
2.1	Scan line polygon filling	1 hour
2.2	Boundary filling and flood filling	1 hour
2.3	Basic 2D transformations-Translation, Rotation and Scaling	1 hour

2.4	Reflection and Shearing	1 hour
2.5	Composite transformations	1 hour
2.6	Matrix representations and homogeneous coordinates	1 hour
2.7	Basic 3D transformation-Translation and scaling	1 hour
2.8	Basic 3D transformation-Rotation	1 hour
Module - 3 (Clipping and Projections) (7 hrs)		
3.1	Window to viewport transformation	1 hour
3.2	Cohen Sutherland Line clipping algorithm	1 hour
3.3	Sutherland Hodgeman Polygon clipping algorithm	1 hour
3.4	Practice problems on Clipping algorithms	1 hour
3.5	Three-dimensional viewing pipeline, Projections-Parallel projections,Perspective projections	1 hour
3.6	Visible surface detection algorithms- Depth buffer algorithm	1 hour
3.7	Scan line visible surface detection algorithm	1 hour
Module - 4 (Fundamentals of Digital Image Processing) (6 hrs)		
4.1	Introduction to Image processing-Image as a 2D data, Image representation-Gray scale, Binary and Colour images.	1 hour
4.2	Fundamental steps in image processing and applications	1 hour
4.3	Components of image processing system	1 hour
4.4	Coordinate conventions, Sampling and quantization, Spatial and Gray Level Resolution	1 hour
4.5	Basic relationship between pixels – neighbourhood, adjacency, connectivity	1 hour
4.6	Illustration of basic relationship between pixels– neighbourhood, adjacency, connectivity	1 hour

Module - 5 (Image Enhancement in spatial domain and Image Segmentation) (7 hrs)		
5.1	Basic gray level transformation functions- Log transformations, Power law transformation, Contrast stretching	1 hour
5.2	Histogram equalization with illustration	1 hour
5.3	Basics of spatial filtering, Smoothing spatial filter- Linear and nonlinear filters	1 hour
5.4	Sharpening spatial filtering-Gradient filter mask, Laplacian Filter Mask	1 hour
5.5	Fundamentals of Image Segmentation, Basics of Intensity thresholding, Basic Global Thresholding	1 hour
5.6	Region Based Approach- Region Growing, Region Splitting and Merging	1 hour
5.7	Basics of Edge Detection- Sobel and Prewitt edge detection masks	1 hour

CST 332	FOUNDATIONS OF SECURITY IN COMPUTING	Category	L	T	P	Credit	Year Of Introduction
		PEC	2	1	0	3	2019

Preamble: The purpose of this course is to create awareness among learners about the fundamentals of security and number theory. This course covers Integer & Modular Arithmetic, Primes & Congruences, Discrete Logarithms & Elliptic Curve Arithmetic and an overview of computer security. The concepts covered in this course enable the learners in effective use of cryptographic algorithms and to identify the security threats in computing.

Prerequisite: A sound knowledge in Mathematics, Discrete Computational Structures, Operating Systems and Database Systems.

Course Outcomes: After the completion of the course, the student will be able to

CO1	Illustrate the operations and properties of algebraic structures, integer arithmetic and modular arithmetic. **(Cognitive Knowledge Level: Understand)**
CO2	Use the concepts of prime numbers and factorization for ensuring security in computing systems **(Cognitive Knowledge Level: Apply)**
CO3	Illustrate the concepts of Linear Congruence, Primitive Roots, Discrete Logarithms and Elliptic Curve Arithmetic **(Cognitive Knowledge Level: Apply)**
CO4	Summarize the threats and attacks related to computer and program security **(Cognitive Knowledge Level: Understand)**
CO5	Outline the key aspects of operating system and database security **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓								✓
CO4	✓	✓	✓			✓		✓				✓
CO5	✓	✓	✓			✓		✓				✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Test 1 (%)	Test 2 (%)	End Semester Examination (%)
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyse			

Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3**

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment Test : **25 marks**

Continuous Assessment Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1 (Modular Arithmetic)

Integer arithmetic - Integer division, Divisibility, Greatest Common Divisor (GCD), Euclid's algorithm for GCD, Extended Euclid's algorithm, Linear Diophantine Equations. Modular arithmetic - Operations, Properties. Algebraic structures - Groups, Rings, Fields, Finite fields, GF(p), GF (2^n).

Module-2 (Prime Numbers and Factorization)

Prime numbers - Prime numbers and prime-power factorization, Fermat and Mersenne primes, Fermat's theorem, Applications, Euler's theorem, Euler's totient function, Applications. Primality testing – Deterministic algorithms and Probabilistic algorithms. Factorization - Fermat's factorization, Pollard p-1 method.

Module-3 (Linear Congruence, Primitive Roots and Elliptic Curve Arithmetic)

Linear congruence - Simultaneous linear congruence, Chinese Remainder Theorem (CRT). Congruence with a prime - Power modulus, Arithmetic modulo p, Pseudoprimes and Carmichael numbers, Solving congruence modulo prime powers. Primitive roots - Existence of primitive roots for primes, Discrete logarithms. Elliptic curve arithmetic – Prime curves, Binary curves, Addition of two points, Multiplication of a point by a constant.

Module-4 (Computer and Program Security)

Introduction to computer security – Threats, Vulnerabilities, Controls. Browser attack types, Web attacks targeting users, Email attack types. Introduction to program security - Non-malicious programming oversights, Malware.

Module-5 (Operating System and Database Security)

Operating system security – Security in operating system, Security in design of operating system. Database security – Security requirements of databases, Reliability and integrity, Database disclosure.

Text Books

1. Behrouz A Forouzan, Cryptography and Network Security, 3/e, Tata McGraw-Hill.
2. Charles P Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, Security in Computing, 5/e, Prentice Hall.
3. G.A. Jones & J.M. Jones, Elementary Number Theory, Springer UTM, 2007

References

1. William Stallings, Cryptography and Network Security Principles and Practices, 4/e, Pearson Ed.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Find the n- bit word that is represented by the polynomial $x^2 + 1$ in $GF(2^5)$.
2. Solve the linear Diophantine equation $21x + 14y = 35$.

Course Outcome 2 (CO2):

1. Prove that a Carmichael number cannot be the product of two distinct primes.
2. Use the Pollard p-1 method to find a factor of 57247159 with the bound B=8.

Course Outcome 3 (CO3):

1. Find an integer that has a remainder of 3 when divided by 7 and 13, but is divisible by 12.
2. In the elliptic curve E(1,2) over the field GF(11), find the equation of the curve and all the points on the curve.

Course Outcome 4 (CO4):

1. List three controls that could be applied to detect or prevent off-by-one errors.
2. How does fake email messages act as spam?

Course Outcome 5 (CO5):

1. Discuss the importance of auditability and access control in database security.
2. Explain the various factors which can make data sensitive.

Model Question Paper

QP CODE: **PAGES: ___**

Reg No:_______________
Name:_________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 332
Course Name : FOUNDATIONS OF SECURITY IN COMPUTING

Max Marks: 100 **Duration: 3 Hours**

PART A
(Answer All Questions. Each question carries 3 marks)

1. List the four properties of divisibility with examples.
2. Find gcd (401,700) using Euclid's algorithm.
3. Use Fermat's Little theorem to show that 91 is not a prime.
4. If m is relatively prime to n , show that $\Phi(mn) = \Phi(m)\ \Phi(n)$.
5. Solve the congruence relation 103x ≡ 57 (mod 211).
6. Find a solution for the congruence $3x \equiv 5 \bmod 7^3$
7. What are the problems created by an off-by-one error?
8. How does a clickjacking attack succeed?
9. Explain the significance of correctness and completeness in the design of operating systems.
10. How does the two-phase update technique help the database manager in handling failures?

(10x3=30)

Part B
(Answer any one question from each module. Each question carries 14 Marks)

11. (a) For the group G = < Z_6*, x>, prove that it is an Abelian group. Also show the result of 5 x 1 and 1 ÷ 5. **(6)**

(b) Find a particular and the general solution to the following linear Diophantine equations. **(8)**
i) 19 x+13y = 20 ii) 40 x + 16 y =88

OR

12. (a) Describe the properties of modular arithmetic and modulo operator. **(6)**

(b) Using Extended Euclidean algorithm, find the multiplicative inverse of (i) 131 in Z_{180} and (ii) 23 in Z_{100}. **(8)**

13. (a) State and prove Fermat's theorem. **(6)**

(b) Explain Fermat's factorization method and use it to factor 809009. **(8)**

OR

14. (a) Define Euler's totient function. Prove that, Ø(pq)=(p-1)(q-1) where p and q are prime numbers. **(7)**

(b) Define Fermat primes. Show that any two distinct Fermat numbers are relatively prime. **(7)**

15. (a) Using Chinese Remainder Theorem, solve the system of congruence, x ≡2(mod 3), x ≡3(mod 5), x ≡2(mod 7). **(7)**

(b) Define Carmichael number and show that a Carmichael number must be the product of at least three distinct primes. **(7)**

OR

16. (a) For the group G = <Z_{19*}, x>, find the primitive roots in the group. **(6)**

(b) Consider the elliptic curve $y^2 = x^3 + x + 1$ defined over Z_{23}. If P = (3, 10) and Q = (9,7) are two points on the elliptic curve, find 2P and P + Q. **(8)**

17. (a) Distinguish the terms vulnerability, threat and control. **(4)**

(b) With the help of suitable examples, explain the security problems created by incomplete mediation and time-of-check to time-of use. **(10)**

OR

18. (a) Differentiate between man-in-the-browser attack and page-in-the-middle attack. **(4)**

(b) Explain the four aspects of malicious code infection. **(10)**

19. (a) List any six computer security related functions addressed by operating systems. **(6)**

(b) How does a kernelized design support in enforcing security mechanisms? **(8)**

OR

20. (a) Explain any four security requirements of databases. **(4)**

(b) How can database disclosure be prevented? With the help of suitable examples, explain any six types of disclosure. **(10)**

Teaching Plan

No	Contents	No.of Lecture Hrs
	Module-1 (Modular Arithmetic) (6 hrs)	
1.1	Integer arithmetic, Integer division, Divisibility, Greatest Common Divisor (GCD)	1
1.2	Euclid's algorithm for GCD, Extended Euclid's algorithm	1
1.3	Linear Diophantine Equations	1
1.4	Modular arithmetic operations, Properties of modular arithmetic	1
1.5	Groups, Rings and Fields	1
1.6	Finite fields – GF(p), GF(2^n)	1
	Module-2 (Prime Numbers and Factorization) (7 hrs)	
2.1	Prime numbers and prime-power factorization	1
2.2	Fermat and Mersenne primes	1
2.3	Fermat's theorem, Applications – Exponentiation, Multiplicative inverse	1
2.4	Euler's theorem, Euler's totient function, Applications	1
2.5	Primality testing – Deterministic algorithms – Divisibility algorithm	1

2.6	Primality testing – Probabilistic algorithms-Fermat test, Square root test, Miller - Rabin test	1
2.7	Factorization - Fermat's factorization, Pollard p-1 method	1
Module-3 (Linear Congruence, Primitive Roots and Elliptic Curve Arithmetic) (7 hrs)		
3.1	Linear congruence, Simultaneous linear congruence	1
3.2	Chinese Remainder Theorem (CRT)	1
3.3	Congruence with a Prime-Power Modulus, Arithmetic modulo p	1
3.4	Pseudo-primes and Carmichael numbers	1
3.5	Solving congruence modulo prime powers	1
3.6	Primitive roots, Existence of primitive roots for primes, Discrete logarithms	1
3.7	Elliptic curve arithmetic – Prime curves, Binary curves, Addition of two points, Multiplication of a point by a constant	1
Module-4 (Computer and Program Security) (7 hrs) (Text book2: Chapters 1, 3, 4)		
4.1	Threats, Vulnerabilities, Controls	1
4.2	Browser attack types	1
4.3	Web attacks targeting users	1
4.4	Email attack types	1
4.5	Non-malicious programming oversights (Lecture 1)	1
4.6	Non-malicious programming oversights (Lecture 2)	1
4.7	Malware – Four aspects of infection	1
Module-5 (Operating System and Database Security) (8 hrs)(Text book2: Chapters 5, 7)		
5.1	Security in operating system (Lecture 1)	1
5.2	Security in operating system (Lecture 2)	1
5.3	Security in design of operating system (Lecture 1)	1

5.4	Security in design of operating system (Lecture 2)	1
5.5	Security requirements of databases	1
5.6	Reliability & integrity	1
5.7	Database disclosure (Lecture 1)	1
5.8	Database disclosure (Lecture 2)	1

CST 342	AUTOMATED VERIFICATION	Category	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course is intended to impart the basic theory and algorithm for an automatic verification process namely model checking. This course covers finite-state modelling of hardware/software, linear-time properties, classification of linear-time properties, Linear Temporal Logic (LTL) - a formal language for property specification, LTL model checking algorithm and model checking case studies. This course enables the learners to prove correctness of a hardware/software used in safety critical systems in domains such as avionics, health care and automotive.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO1	Illustrate an application for model checking. **(Cognitive Knowledge Level: Understand)**
CO2	Describe finite-state modelling for hardware and software. **(Cognitive Knowledge Level: Understand)**
CO3	Identify linear-time properties required to represent the requirements of a system. **(Cognitive Knowledge Level: Apply)**
CO4	Specify a given linear-time property in Linear Temporal Logic (LTL). **(Cognitive Knowledge Level: Apply)**
CO5	Perform LTL model checking using the tool Symbolic Analysis Laboratory (SAL). **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓							✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓								✓
CO4	✓	✓	✓	✓								✓
CO5	✓	✓	✓	✓	✓	✓						✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test : 25 marks
Continuous Assessment Assignment : 15 marks (Out 15, 10 marks shall be given for a model checking project to be implemented in SAL.)

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module - 1 (Introduction to Model Checking)

System Verification – Hardware and Software Verification, Model Checking, Characteristics of Model Checking.

Transition Systems – Transition System, Direct Predecessors and Successors, Terminal State, Deterministic Transition System.

Executions - Execution Fragment, Maximal and Initial Execution Fragment, Execution, Reachable States.

Module - 2 (Linear Time Properties)

Linear-Time (LT) Properties - Deadlock. Linear-Time Behavior - Paths and State Graph, Path Fragment, Maximal and Initial Path Fragment, Path. Traces - Trace and Trace Fragment, LT Properties - LT Property, Satisfaction Relation for LT Properties, Trace Equivalence and LT Properties. Safety Properties and Invariants - Invariants, Safety Properties, Trace Equivalence and Safety properties. Liveness Properties - Liveness Property, Safety vs. Liveness Properties. Fairness - Fairness, Unconditional, Weak and Strong Fairness, Fairness Strategies, Fairness and Safety. (Definition and examples only for all topics - no proof required).

Module - 3 (Regular Properties)

Regular Properties - Model Checking Regular Safety properties - Regular Safety property, Verifying Regular Safety Properties. Automata on Infinite Words - ω-Regular Languages and Properties, Nondeterministic Buchi Automata (NBA), Deterministic Buchi Automata (DBA), Generalised Buchi Automata (Definitions only). Model Checking ω-Regular Properties - Persistence Properties and Product, Nested Depth-First Search (Only algorithms required).

Module - 4 (Linear Time Logic)

Linear Temporal Logic (LTL) - Syntax, Semantics, Equivalence of LTL Formulae, Weak Until, Release and Positive Normal Form, Fairness, Safety and Liveness in LTL (Definitions only). Automata Based LTL Model Checking (Algorithms and examples only).

Module - 5 (Model Checking in SAL)

Introduction **-** Introduction to the tool Symbolic Analysis Laboratory (SAL).

The Language of SAL - The expression language, The transition Language, The module language, SAL Contexts.

SAL Examples - Mutual Exclusion, Peterson's Protocol, Synchronous Bus Arbiter, Bounded Bakery protocol, Bakery Protocol, Traffic Signalling System.

Text Books

1. Christel Baier and Joost-Pieter Katoen, Principles of Model Checking, The MIT Press. (Modules 1 - 4)
2. Leonardo de Moura, Sam Owre and N. Shankar, The SAL Language Manual, SRI International (http://sal.csl.sri.com/doc/language-report.pdf, Chapters 1, 3, 4, 5, 6, 7) (Module 5)

Reference Materials

1. SAL Examples (http://sal.csl.sri.com/examples.shtml) (Module 5)

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Illustrate how model checking can make a system design reliable, based on a required set of properties/constraints.

Course Outcome 2 (CO2):

1. Consider a message delivery system. The sender *s* is trying to send a series of messages to the receiver *r* in such a way that the $(i+1)^{st}$ message is sent only after the i^{th} message is delivered. There is a possibility of error in sending a message and in that case, *s* keeps on

trying until it is able to send the message. Show a finite state transition system modeling this system.

Course Outcome 3 (CO3):

1. Consider a shared memory segment *s* protected using a mutex lock variable *m*. Two processes p_1 and p_2 are trying to access *s*. List the Linear Time properties of the system which will ensure safety, liveness and fairness.

Course Outcome 4 (CO4):

1. Show the LTL specifications of the safety, liveness and fairness properties listed for the assessment question given in CO3.

Course Outcome 5 (CO5):

1. Model the system mentioned in the question given in CO3 in SAL and verify that the system is correct with respect to the LTL properties shown as the answer for CO4.

Model Question paper

QP CODE: **PAGES: 3**

Reg No:_______________ **Name :_______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST342

Course Name: Automated Verification

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all questions. Each question carries 3 marks.

1. Define model checking. Show the schematic diagram of the model checking approach.

2. Show a transition system modeling a coffee/Tea vending machine.

3. Define invariant as a Linear Time (LT) property. Give an example

4. List any three Linear Time properties in the Mutual Exclusion problem of processes.

5. Illustrate the construction of a product automaton from two automata.

6. Differentiate between Deterministic Buchi Automaton and Non-deterministic Buchi Automaton.

7. Specify the following statements about traffic lights in Linear Temporal Logic (LTL).
    a. Once red, the light can not become green immediately.
    b. Once red, the light always becomes green eventually after being yellow for some time.

8. What is Positive Normal Form (PNF) in LTL? Give an example.

9. List any three applications of the tool Symbolic Analysis Laboratory (SAL).

10. What is a SAL context? Give an example.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain in detail the various phases of the model checking process. **(8)**

(b) Explain the strengths and weaknesses of model checking. **(6)**

OR

12. (a) Define and illustrate the following terms of a transition system. **(14)**
    a. Execution Fragment
    b. Maximal and Initial Execution Fragment
    c. Execution
    d. Reachable States

13. (a) With an example, explain the satisfaction relation for LT properties. **(7)**

(b) What is trace equivalence in Transition Systems? Give an example to show that if two transition systems satisfy the trace equivalence property, then they satisfy the same set of LT properties. **(7)**

OR

14. (a) Give the transition system for the fault tolerant variant of the dining philosophers problem. **(4)**

(b) With a suitable example, explain the algorithms to check whether a Transition System satisfies an invariant or not. **(10)**

15. (a) Explain Regular Safety Properties with a suitable example. **(7)**

(b) Illustrate an algorithm for verifying Regular Safety Properties. **(7)**

OR

16. (a) Explain ω-Regular Properties. **(4)**

(b) Illustrate how ω-Regular Properties are verified. **(10)**

17. (a) Explain the syntax of Linear Temporal Logic (LTL). **(7)**

(b) Explain the semantics of LTL. **(7)**

OR

18. (a) With an example, give the difference between until and weak until in LTL. **(4)**

(b) With a suitable example, explain automata based LTL model checking. **(10)**

19. (a) Explain Peterson's protocol. What are the LTL properties to be verified to ensure its correctness? **(8)**

(b) Write a SAL script for the verification of Peterson's protocol. **(6)**

OR

20. (a) Show the SAL model corresponding to Bakery protocol. **(8)**

(b) List any three Linear Time properties of this model and show their LTL **(6)**

Teaching Plan

Module 1 (Introduction to Model Checking)		**4 Hours**
1.1	**System Verification** – Hardware and Software Verification, Model Checking, Model Checking	1 Hour
1.2	**Transition Systems** – Transition System, Direct Predecessors and Successors, Terminal State, Deterministic Transition System	1 Hour
1.3	**Executions** - Execution Fragment, Maximal and Initial Execution Fragment	1 Hour
1.4	Execution, Reachable States	1 Hour
Module 2 (Linear Time Properties)		**8 Hours**
2.1	Linear-Time (LT) Properties - Deadlock	1 Hour
2.2	Linear-Time Behavior - Paths and State Graph, Path Fragment, Maximal and Initial Path Fragment, Path	1 Hour
2.3	Traces - Trace and Trace Fragment	1 Hour
2.4	LT Property, Satisfaction Relation for LT Properties, Trace Equivalence and LT Properties	1 Hour
2.5	Invariants	1 Hour
2.6	Safety Properties, Trace Equivalence and Safety properties	1 Hour
2.7	Liveness Property, Safety vs. Liveness Properties	1 Hour
2.8	Fairness, Unconditional, Weak and Strong Fairness, Fairness Strategies, Fairness and Safety	1 Hour
Module 3 (Regular Properties)		**9 Hours**
3.1	**Regular Properties** - Model Checking Regular Safety properties - Regular Safety property	1 Hour
3.2	Verifying Regular Safety Properties	1 Hour
3.3	Automata on Infinite Words - ω -Regular Languages and Properties	2 Hour

3.4	Nondeterministic Buchi Automata (NBA), Deterministic Buchi Automata (DBA), Generalised Buchi Automata	1 Hour
3.5	Model Checking ω-Regular Properties - Persistence Properties and Product - Lecture 1	1 Hour
3.6	Persistence Properties and Product - Lecture 2	1 Hour
3.7	Nested Depth-First Search (Lecture 1)	1 Hour
3.8	Nested Depth-First Search (Lecture 2)	1 Hour
	Module 4 (Linear Time Logic)	**7 Hours**
4.1	**Linear Temporal Logic –** Linear Temporal Logic (LTL) - Syntax	1 Hour
4.2	Semantics - Lecture 1	1 Hour
4.3	Equivalence of LTL Formulae, Weak Until	1 Hour
4.4	Release and Positive Normal Form	1 Hour
4.5	Fairness, Safety and Liveness in LTL	1 Hour
4.6	Automata Based LTL Model Checking (Lecture 1)	1 Hour
4.7	Automata Based LTL Model Checking (Lecture 2)	1 Hour
	Module 5 (Model Checking in SAL)	**7 Hours**
5.1	Introduction - Introduction to the tool Symbolic Analysis Laboratory (SAL).	1 Hour
5.2	The Language of SAL - The expression language, The transition Language	1 Hour
5.3	The module language, SAL Contexts.	1 Hour
5.4	SAL Examples - Mutual Exclusion	1 Hour
5.5	Peterson's Protocol, Synchronous Bus Arbiter	1 Hour
5.6	Bounded Bakery protocol, Bakery Protocol	1 Hour
5.7	Traffic Signalling System	1 Hour

ADT342	DATA VISUALIZATION	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: The syllabus is prepared with the view of facilitating the learner to get an overview of data visualization. This course aims at providing fundamental knowledge in various data visualization techniques using R programming language and D3. It also deals with security aspects involved in data visualization. The learner will be able to understand the process and security aspects involved in data visualization and apply the tools in solving complex problems.

Prerequisite: Programming experience in any language and basic knowledge in R.

Course Outcomes: After the completion of the course the student will be able to:

CO 1	Summarize the key techniques and theory used in visualization **(Cognitive Knowledge Level : Understand)**
CO 2	Design and use various methodologies present in data visualization. **(Cognitive Knowledge Level : Understand)**
CO 3	Employ appropriate processes and tools for data visualization. **(Cognitive Knowledge Level : Apply)**
CO 4	Use interactive data visualization to make inferences. **(Cognitive Knowledge Level : Apply)**
CO 5	Recognize the process involved and security issues present in data visualization. **(Cognitive Knowledge Level : Understand)**

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	✔											✔
CO2	✔	✔	✔									✔
CO3	✔	✔	✔	✔	✔							✔
CO4	✔	✔	✔	✔	✔							✔
CO5	✔	✔										✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (percentage)	Test2 (percentage)	
Remember	40	40	40
Understand	40	40	40
Apply	20	20	20
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance: 10 marks
Continuous Assessment Tests : 25 marks
Continuous Assessment Assignment: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

SYLLABUS

Module 1 (Introduction to Data Visualization)

Introduction to Visualization – Need and purpose, External representation – Interactivity – Difficulty in Validation, Data Abstraction: Dataset types – Attribute types – Semantics, Task Abstraction – Analyze, Produce, Search, Query, Four levels of validation – Validation approaches – Validation examples. Marks and Channels. Data Visualization tools.

Module 2 (Arranging Spatial Data and Networks)

Arrange tables: Categorical regions – Spatial axis orientation – Spatial layout density, Arrange spatial data: Geometry – Scalar fields – Vector fields – Tensor fields. Arrange networks and trees: Connections, Matrix views – Containment, Map color: Color theory, Color maps and other channels.

Module 3 (Data Visualization using R)

Basic and Interactive Plots: scatter plot, interactive scatter plot, bar plot, line plot, interactive Gantt/timeline chart, Merging histograms, interactive bubble plot, waterfall plot, Heat Maps and Dendrograms: simple dendrogram, dendrograms with colors and labels, heat map, heat map with customized colors, three-dimensional heat map and a stereo map, tree map. Maps: regional maps, choropleth maps, contour maps, maps with bubbles, Integrating text with maps, shapefiles, cartograms, Pie Chart and Its Alternatives, Adding the Third Dimension: 3D scatter plot, 3D pie chart, 3D histogram, 3D contour plot.

Module 4 (Interactive Data Visualization using D3)

Drawing with data: Drawing divs, SVG's, Making a bar chart, scatterplot – Scales - Axes – Updates, Transition and Motion – Modernizing the bar chart, Updating data, transitions, Interactivity – Layouts – Geomapping – Framework – D3.js, tableau.

Module 5 (Security Data Visualization)

Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization - Attacking and defending visualization systems – Creating security visualization system.

Text Books

1. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014
2. Atmajitsinh Gohil, "R Data Visualization Cookbook", PACKT, 2015.
3. Scott Murray, "Interactive data visualization for the web", O‟Reilly Media, Inc., 2013.
4. Greg Conti, "Security Data Visualization: Graphical Techniques for Network Analysis", NoStarch Press Inc, 2007.

Reference Books

1. A Julie Steele and Noah Iliinsky, Designing Data Visualizations: Representing Informational Relationships, O'Relly.
2. Andy Kirk, Data Visualization: A Successful Design Process, PAKT.
3. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1): Explain the four levels of validation in Data Visualization.

Course Outcome 2 (CO2): Discuss the different methods to arrange spatial data.

Course Outcome 3(CO3): Write sample code in R to generate a simple pie chart showing data on brain injury across different branches of the military:

Military Branch	Army	Navy	Air Force	Marines
No:	179718	41370	41914	44280

Also draw the resultant pie chart.

Course Outcome 4 (CO4): Given a dataset: [5, 10, 13, 19, 21, 25, 22, 18, 15, 13, 11, 12, 15, 20, 18, 17, 16, 18, 23, 25] to plot a bar graph. This dataset was later modified as [11, 12, 15, 20, 18, 17, 16, 18, 23, 25, 5, 10, 13, 19, 21, 25, 22, 18, 15, 13]. Write the sample code in d3 to update the contents of a bar chart with new data values.

Course Outcome 5 (CO5): Explain Intrusion detection log visualization.

Model Question Paper

QPCODE: PAGES: 3

RegNo:__________

Name :__________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

***Course Code:* ADT 342**

Course Name: Data Visualization

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. What is data visualization? Why do we use it? Illustrate the need of data visualization.
2. Why do data semantics and data types matter in data visualization?
3. Describe the HSL system.
4. Describe scatterplot with an example.
5. How is the waterfall plot constructed in R?
6. Compare chloropleth maps and cartograms.
7. Illustrate the use of ease() and delay() functions in transitions with an example.
8. Specify any three types of D3 layouts?
9. Describe port scan visualization.
10. What is meant by vulnerability assessment in visualization? (10x3=30)

Part B

Answer any one Question from each module. Each question carries 14 Marks

11.a "Splitting the complex problem of visualization design into four cascading levels provides an analysis framework that lets you address different concerns separately". Explain the four cascading levels with a diagram? (10 marks)

11.b What are the threats to validity at each of the levels? (4 marks)

OR

12.a	Define marks and channels. Explain how visual channels control the appearance of marks. How are these visual channels and marks used for encoding various chart types?	(8 marks)
12.b	Illustrate Various data visualization tools.	(6 marks)
13.a	Differentiate between node-link diagrams and matrix views. Also specify the costs and benefits of each.	(8 marks)
13.b	Explain Treemaps and GrouseFlocks.	(6 marks)
	OR	
14.a	What is colour mapping? Explain the different types of colour maps.	(8 marks)
14.b	Explain scalar fields, vector fields and tensor fields.	(6 marks)
15.a	What is a dendrogram? Write the R code to construct a dendrogram.	(7 marks)
15.b	What is a pie chart? What are its limitations? Write the steps involved in its construction in R.	(7 marks)
	OR	
16.a	Why do we need a 3D scatter plot? Write the sample code to generate a 3D scatter plot in R.	(7 marks)
16.b	What are shape files? Why do we use them? Write the step-by-step procedure to construct a shape file.	(7 marks)
17.a	Given a data set = [5, 10, 13, 19, 21, 25, 22, 18, 15, 13,11, 12, 15, 20, 18, 17, 16, 18, 23, 25]; Write the D3 code to plot the given data set as bar chart with dual encoding of the data values in terms of both height and color. The data bars should have centered labels. Also plot the resultant bar graph for the given data set.	(7 marks)
17.b	Given another data set dataset = [[5, 20], [480, 90], [250, 50], [100, 33], [330,95], [410, 12], [475, 44], [25, 67], [85, 21], [220, 88]]; where [[]] indicate an array within another array. Plot this data set and specify the name of the plot obtained	(7 marks)
	OR	
18.a	What are named transitions? Explain with an example.	(7 marks)
18.b	What are tooltips? Explain with an example. What are the different types of tooltips?	(7 marks)
19.a	Write about firewall log visualization.	(7 marks)
19.b	Discuss in detail about intrusion detection log visualization.	(7 marks)
	OR	
20.a	Describe the concept of attacking and defending visualization systems.	(7 marks)
20.b	Describe about security visualization system.	(7 marks)

(14X5=70)

Teaching Plan

No	Contents	No. of Lecture Hours (35)
	Module - 1 (Introduction to Data Visualization)	**(6 hours)**
1.1	Introduction to Visualization – Need and purpose	1 hour
1.2	Data Abstraction: Dataset types	1 hour
1.3	Attribute types – Semantics	1 hour
1.4	Task Abstraction, Four levels of validation	1 hour
1.5	Validation approaches	1 hour
1.6	Data Visualization tools	1 hour
	Module - 2 (Arranging Spatial Data and Networks)	**(7 hours)**
2.1	Arrange tables: Categorical regions – Spatial axis orientation	1 hour
2.2	Spatial layout density	1 hour
2.3	Arrange spatial data: Geometry – Scalar fields	1 hour
2.4	Vector fields – Tensor fields	1 hour
2.5	Arrange networks and trees: Connections, Matrix views – Containment	1 hour
2.6	Map color: Color theory, Color maps and other channels	1 hour
2.7	Map color	1 hour
	Module - 3 (Data Visualization using R)	**(8 hours)**
3.1	Basic and Interactive Plots: scatter plot, interactive scatter plot	1 hour
3.2	Interactive Gantt/timeline chart, Merging histograms, interactive bubble plot, waterfall plot	1 hour
3.3	Heat Maps and Dendrograms : simple dendrogram, dendrograms with colors and labels, heat map	1 hour
3.4	heat map with customized colors, three-dimensional heat map and a stereo map, tree map	1 hour
3.5	Maps: regional maps, choropleth maps, contour maps	1 hour
3.6	maps with bubbles, Integrating text with maps, shape files, cartograms	1 hour
3.7	Pie Chart and Its Alternatives	1 hour
3.8	Adding the Third Dimension: 3D scatter plot, 3D pie chart, 3D histogram, 3D contour plot.	1 hour

Module- 4 (Interactive Data Visualization using D3)		**(8 hours)**
4.1	Drawing with data	1 hour
4.2	Scales	1 hour
4.3	Axes	1 hour
4.4	Updates, Transition and Motion – Modernizing the bar chart	1 hour
4.5	Updating data, transitions	1 hour
4.6	Interactivity	1 hour
4.7	Layouts	1 hour
4.8	Geomapping	1 hour
Module- 5 (Security Data Visualization)		**(6 hours)**
5.1	Port scan visualization	1 hour
5.2	Vulnerability assessment and exploitation	1 hour
5.3	Firewall log visualization	1 hour
5.4	Intrusion detection log visualization	1 hour
5.5	Attacking and defending visualization systems	1 hour
5.6	Creating security visualization system	1 hour

AIT362	PROGRAMMING IN R	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: The objective of this course is to enable the learner to make use of R Programming language to perform analysis and extraction of information from data irrespective of the quantity. It encompasses the R programming environment, syntax, data representations, data processing, statistical analysis and visualization. This course facilitates the learner to develop modular software solutions to perform statistical analysis and data extraction.

Prerequisite: Fundamental concepts in programming in C and Probability and Statistical Modeling

Course Outcomes: After the completion of the course the student will be able to:

CO 1	Illustrate uses of conditional and iterative statements in R programs. (Cognitive Knowledge level: Apply)
CO 2	Write, test and debug R programs (Cognitive Knowledge level: Apply)
CO 3	Illustrate the use of Probability distributions and basic statistical functions. (Cognitive Knowledge level: Apply)
CO 4	Visualize different types of data (Cognitive Knowledge level: Apply)
CO 5	Comprehend regression modeling using R (Cognitive Knowledge level: Understand)

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	✔	✔	✔		✔							✔
CO2	✔	✔	✔		✔							✔
CO3	✔	✔	✔	✔	✔							✔
CO4	✔	✔	✔	✔	✔							✔
CO5	✔	✔			✔							✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (percentage)	Test2 (percentage)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance: 10 marks
Continuous Assessment Tests : 25 marks
Continuous Assessment Assignment: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

SYLLABUS

Module -1 (Introduction to R)

The R Environment - Command Line Interface and Batch processing, R Packages, Variables, Data Types, Vectors- vector operations and factor vectors, List- operations, Data Frames, Matrices and arrays, Control Statements- Branching and looping - For loops, While loops, Controlling loops. Functions- Function as arguments, Named arguments

Module -2(Reading and writing data)

Importing data from Text files and other software, Exporting data, importing data from databases- Database Connection packages, Missing Data - NA, NULL

Combining data sets, Transformations, Binning Data, Subsets, summarizing functions. Data Cleaning, Finding and removing Duplicates, Sorting.

Module -3 (Statistics with R)

Analyzing Data, Summary statistics, Statistical Tests- Continuous Data, Discrete Data, Power tests, Common distributions- type arguments. Probability distributions, Normal distributions

Module -4(Data Visualization)

R Graphics- Overview, Customizing Charts, Graphical parameters, Basic Graphics functions, Lattice Graphics - Lattice functions, Customizing Lattice Graphics, Ggplot.

Module - 5 (Regression Models)

Building linear models - model fitting, Predict values using models, Analyzing the fit, Refining the model, Regression- types, Unusual observation and corrective measures, Comparison of models, Generalized linear models - Logistic Regression, Poisson Regression, Nonlinear least squares

Text Book

1. Joseph Adler, " R in a Nutshell", Second edition,O'reilly,2012

Reference Books

1. Jared P Lander, R for Everyone- Advanced analytics and graphics, Addison Wesley data analytics series, Pearson
2. Norman matloff, The art of R programming, A Tour of Statistical, Software Design, O'reilly
3. Robert Kabacoff, R in action, Data analysis and graphics with R, Manning
4. Garret Grolemund, Hands-on programming with R, Write your own functions and simulations, O'reilly

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What is Coercion? How is it done in R?
2. Write a program to find the factorial of a number.
3. Write a program to compute roots of a quadratic equation.

Course Outcome 2 (CO2):

1. Write a program to read data from a table 'table123' in a database named 'db123' and display the values .
2. Explain Data cleaning in R
3. How missing data is handled in R?

Course Outcome 3(CO3):

1. Explain summary function in R
2. Illustrate how statistical testing is performed in R
3. Describe about probability distributions.

Course Outcome 4 (CO4):

1. Illustrate the use of ggplot() and various data visualization tools using appropriate datasets

Course Outcome 5 (CO5):

1. Illustrate the steps to predict the weight of a person when his height is unknown using linear regression for the data given below.

Height	151	174	138	186	128	136	179	163	152	130
Weight	63	81	56	91	47	57	76	72	62	48

Model Question Paper

QP CODE: PAGES:3

Reg No:__________

Name :__________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

***Course Code:* AIT 362**

Course Name: Programming in R

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Write a R program to add element "23" to the vector (24,56,67) in the second position.
2. Discuss the general list operations in R with example.
3. Calculate the cumulative sum and cumulative product for the given data 23, 1, 7,2,8,10, 17 using R Program.
4. Explain aggregate function in R.
5. List the applications of R programming.
6. Illustrate summary function.
7. List any three graphics functions.
8. Explain Lattice function.
9. Suppose that you have a dataset D1 and you design a linear regression model of degree 3 polynomial and you found that the training and testing error is "0" or in other terms it perfectly fits the data. What will happen when you fit a degree 2 polynomial in linear regression?
10. Explain logistic regression function in R.

(10x3=30)

Part B

Answer any one Question from each module. Each question carries 14 Marks

11.a	Write a R program to extract every nth element from a vector.	(7 marks)
11.b	Find the Nth highest value of a vector in R.	(7 marks)
	OR	
12.a	Write a R program to create a data frame using two given vectors and display the duplicate elements and unique rows of the said data frame.	(7 marks)

12.b Write a R program to compare two data frames to find the row(s) in the first data frame that are not present in the second data frame. (7 marks)

13.a Write a R program to call the (built-in) dataset air quality. Remove the variables 'Solar.R' and 'Wind' and display the data frame. (7 marks)

13.b Illustrate transformation functions in R. (7 marks)

OR

14.a Write a R program to write the following data to a CSV file. (7 marks)

	Country	Population_1_july_2018	Population_1_july_2019	change_in_percents
1	China	1,427,647,786	1,433,783,686	+0.43%
2	India	1,352,642,280	1,366,417,754	+1.02%
3	United States	327,096,265	329,064,917	+0.60%
4	Indonesia	267,670,543	270,625,568	+1.10%
5	Pakistan	212,228,286	216,565,318	+2.04%

14.b Given a file "auto.csv" of automobile data with the fields index, company, body-style, wheel-base, length, engine-type, num-of-cylinders, horsepower, average-mileage, and price, write R program to print total cars of all companies, Find the average mileage of all companies. (7 marks)

15.a Write a note on data analysis using R. (7 marks)

15.b Explain how statistical test are performed using R functions. (7 marks)

OR

16.a Write R code to generate the probability distribution table for number of successes from a binomial distribution where n=5 and probability of success in each trial is 0.25. (7 marks)

16.b Fit a Poisson distribution with the following data using the following data (7 marks)

X	0	1	2	3	4	5
F	142	156	69	27	5	1

OR

17 Given the sales information of a company as CSV file with the following, fields month_number, face cream, facewash, toothpaste, bathingsoap, shampoo, moisturizer, total_units, total_profit. Write R codes to visualize the data as follows:

a) Toothpaste sales data of each month and show it using a scatter plot. (7 marks)

b) Calculate total sale data for last year for each product and show it using a Pie chart. (7 marks)

OR

18.a Explain ggplot() with and example. (7 marks)

18.b Describe how categorical data is visualized using R. (7 marks)

19.a Illustrate model fitting in simple linear model. (7 marks)

19.b Explain different types of regression. (7 marks)

OR

20.a Describe the unusual observations in the regression model. (7 marks)

20.b Explain corrective measures of unusual observations in regression modelling. (7 marks)

TEACHING PLAN

No	Contents	No of Lecture Hours (35 Hours)
	Module -1 (Introduction to R)	**(8 hours)**
1.1	The R Environment- Command Line Interface and Batch processing, R Packages	1 hour
1.2	Variables, Data Types	1 hour
1.3	Vectors- vector operations and factor vectors	1 hour
1.4	List- List operations, Data Frames	1 hour
1.5	Matrices and arrays	1 hour
1.6	Control Statements- If and else, switch, if else	1 hour
1.7	Loops- For loops, While loops, Controlling loops	1 hour
1.8	Functions- Function as arguments, Named arguments	1 hour
	Module -2(Reading and writing data)	**(8 hours)**
2.1	Importing data from Text files and other software, Exporting data	1 hour
2.2	Importing data from databases- Database Connection packages	1 hour
2.3	Missing Data-NA, NULL	1 hour
2.4	Combining data sets, Transformations	1 hour
2.5	Binning Data, Subsets, summarizing functions	1 hour
2.6	Data Cleaning	1 hour
2.7	Finding and removing Duplicate	1 hour
2.8	Sorting	1 hour
	Module -3 (Statistics with R)	**(6 hours)**
3.1	Analyzing Data	1 hour
3.2	Summary statistics	1 hour
3.3	Statistical Tests- Continuous Data, Discrete Data, Power tests	1 hour
3.4	Common distributions- type arguments	1 hour
3.5	Probability distributions	1 hour
3.6	Normal distributions	1 hour
	Module -4(Data Visualization)	**(6 hours)**
4.1	R Graphics- Overview	1 hour
4.2	Customizing Charts	1 hour
4.3	Graphical parameters, Basic Graphics functions	1 hour
4.4	Lattice Graphics - Lattice functions	1 hour
4.5	Customizing Lattice Graphics	1 hour
4.6	ggplot	1 hour
	Module - 5 (Regression Models)	**(7 hours)**

5.1	Building linear models - model fitting	1 hour
5.2	Predict values using models, Analyzing the fit, Refining the model	1 hour
5.3	Regression- types of regression	1 hour
5.4	Unusual observations and corrective measures	1 hour
5.5	Comparison of models	1 hour
5.6	Generalized linear models -Logistic Regression, Poisson Regression	1 hour
5.7	Nonlinear least squares	1 hour

CDT372	MALWARE ANALYSIS IN DATA SCIENCE	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: The course helps the Engineering Graduates to get an overview of Malware and its different types. Malware analysis in data science focus on means to identify, analyze and classify large scale malware using machine learning techniques. Malware Analysis in Data science helps us to detect malware and anticipate future threats based on available historical data with the help of machine learning methods.

Prerequisite: Machine Learning, Programming Languages

Course Outcomes: After the completion of the course the student will be able to

CO 1	Identify Malware, types and objectives as well as types of malware analysis (Cognitive Knowledge Level: Understand)
CO 2	Analyze malware using static analysis (Cognitive Knowledge Level: Apply)
CO 3	Identify malware behavior using dynamic analysis (Cognitive Knowledge Level: Apply)
CO 4	Explore the machine learning concepts to detect malware (Cognitive Knowledge Level: Apply)
CO 5	Explore the deep learning concepts to detect malware- (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	✔	✔										✔
CO2	✔	✔	✔		✔							✔
CO3	✔	✔	✔		✔							✔
CO4	✔	✔	✔									✔
CO5	✔	✔	✔									✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (percentage)	Test2 (percentage)	
Remember	40	40	40
Understand	40	40	40
Apply	20	20	20
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Tests : 25 marks
Continuous Assessment Assignment :15 marks

Internal Examination Pattern:
Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

Module- 1 (Introduction to Malware Analysis systems)
Introduction: Malware Analysis – goals of Malware Analysis, Malware Types and Classifications - Backdoor, Botnet, Downloader, Information Stealing malware, Launcher, Rootkit, Scareware, Worm or Virus, Malware Analysis techniques – Static and Dynamic Analysis, Malware Characteristics, Data Science and Security

Module- 2 (Static Malware Analysis)
Basic Static Malware Analysis - Antivirus Scanning, Fingerprint for Malware,

Portable Executable File Format, The PE File Headers and Sections, Dissecting the PE Format using pefile, Malware Images, Malware Strings
Advanced Static Malware Analysis - Reverse-Engineering- Disassembly methods, Basics of X86 Assembly Language, Disassembling using Linear Disassembly, Introduction to IDA, Factors that limit Static Analysis

Module -3 (Dynamic Analysis)

Dynamic Analysis: Malware Sandbox, Monitoring with Process Monitor, Basic Tools for Dynamic Analysis

Advanced dynamic analysis: Introduction to Debugger, OllyDbg, Malware Analysis Using OllyDbg, Malware Behavior - malicious activities and techniques, Covert Launching techniques- Process Injection, Process Replacement, Hook Injection, Detours, APC Injection, malware-focused network signatures

Module- 4 (Machine Learning based Malware Detectors)

Steps for building a Machine Learning based Detector, Feature spaces, Decision boundaries, Overfitting and underfitting, Types of Machine Learning Algorithms-Logistic Regression, K-Nearest Neighbors, Decision Trees, Random Forest. Precision, Base Rate, True Positive rate, False Positive rate, ROC Curve.

Case Study: Building a Toy Decision Tree – Based Detector

Module- 5 (Deep Learning Basics)

Introduction to Deep Learning, Building Neural Networks, Training Neural Networks – Back Propagation, Path Explosion, Vanishing Gradient. Types of Neural Networks- Feed Forward, Convolutional, Autoencoder, Generative Adversarial Network, Recurrent Neural Network, ResNet

Text Book:

1. Malware Data Science: Attack Detection and Attribution, by Joshua Saxe, Hillary Sanders, 2018, No Starch Press.
2. Michael Sikorski and Andrew Honig: Practical Malware Analysis, The Hands-On Guide to Dissecting Malicious Software. No Starch Press, 2012. ISBN: 978-1-593-27290-6
3. Monnappa K A: Learning Malware Analysis: Explore the concepts, tools, and techniques to analyze and investigate Windows malware. Packt Publishing. ISBN: 978-1788392501 , Michael Hale Ligh, Steven Adair, Blake Hartstein and Matthew Richard: Malware Analyst's

Reference Books:

1. Chris Eagle: The IDA Pro Book: The Unofficial Guide to the World's Most Popular Disassembler Second Edition. No Starch Press.ISBN: 978-1-59327-289-0
2. Christopher C. Elisan , Advanced Malware Analysis, Tata McGraw Hill, 2015 3.Cameron H. Malin, Eoghan Casey, James M. Aquilina and Curtis W. Rose,

Sample Course Level Assessment Questions

Course Outcome 1 (CO1): Examine Malware and goals of Malware Analysis.

Course Outcome 2 (CO2): Examine how Image Analysis and String Analysis can be used to extract information from Malware samples.

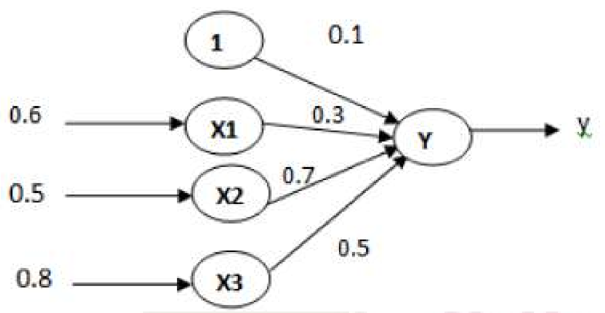
Course Outcome 3 (CO3): Identify the various tools for Dynamic Malware Analysis. Examine the limitations of Dyamic Malware Analysis.

Course Outcome 4 (CO4):

1. Suppose 10000 patients get tested for flu; out of them, 9000 are actually healthy and 1000 are actually sick. For the sick people, a test was positive for 620 and negative for 380. For healthy people, the same test was positive for 180 and negative for 8820. Construct a confusion matrix for the data and compute the accuracy, precision and recall for the data

Course Outcome 5 (CO5):

1. Describe the effect in bias and variance when a neural network is modified with more number of hidden units followed with dropout regularization.
2. Calculate the output of the following neuron Y with the activation function as a) binary sigmoid b) ReLU



Model Question Paper

QP CODE: PAGES:3

Reg No:__________

Name :__________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: **CDT 372**

Course Name: Malware Analysis in Data Science

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1 List the goals of Malware Analysis.

2 Examine how data science can be applied to malware.

3 Define Disassembly in Static Malware Analysis.

4 Examine Malware Fingerprinting.

5 Examine the need of Malware Sandbox in Malware Analysis

6 Differentiate Downloaders and Launchers.

7 List and compare the types of machine learning algorithms.

8 Identify the limitations of Logistic Regression when used for Malware Analysis.

9 Specify the advantages of ReLU over sigmoid activation function.

10 Examine the Vanishing Gradient Problem associated with deep neural networks.

(10x3=30)

Part B

Answer any one Question from each module.

11 Define Malware. Explain the various types of Malwares. (14 marks)

OR

12.a Define Malware Analysis. Discuss the different Malware Analysis Techniques. (8 marks)

12.b Examine how data science can be applied to Malware Analysis. (6 marks)

13.a Define Static Malware Analysis. Analyze the methods employed in Basic Static Malware Analysis. (8 marks)

13.b Examine PE file format and its relevance in Static Malware Analysis. (6 marks)

OR

14.a Examine Disassembling using Linear Disassembly. (8 marks)

14.b Analyze the factors that limit Static Malware Analysis. (6 marks)

15 Explain the most common types of malware behaviors. (14 marks)

OR

16 Describe the various covert launching techniques employed by Malware authors (14 marks)

17.a What are decision trees. Explain how decision trees are useful in Malware Analysis. (8 marks)

17.b Given the following data, construct the ROC curve of the data. (6 marks)

Threshold	**TP**	TN	FP	FN
1	0	25	0	29
2	7	25	0	22
3	18	24	1	11
4	26	20	5	3
5	29	11	14	0
6	29	0	25	0
7	29	0	25	0

OR

18.a Illustrate how K-Nearest Neighbors can be used to detect previously unseen Malware. (8 marks)

18.b Illustrate with an example, the steps to generate a random forest algorithm (6 marks)

19 Discuss the most common types of Neural Networks and their application in Cybersecurity. (14 marks)

OR

20.a Explain how neural networks can be employed for malware Analysis (4 marks)

20.b Analyze the various Activation Functions and their purpose. (10 marks)

(14X5=70)

Teaching Plan

NO	CONTENTS	Total hours (35 hours)
	Module- 1(Introduction to Malware Analysis systems)	**(4hours)**
1.1	Introduction to Malware Analysis, goals of Malware Analysis	1 hour
1.2	Malware Types and Classifications: Backdoor, Botnet, Downloader, Information Stealing malware,	1 hour
1.3	Launcher, Rootkit, Scareware, Worm or Virus	1 hour
1.4	Malware Analysis techniques – Static and Dynamic Analysis, Malware Characteristics , Data Science and Security	1 hour
	Module- 2 (Static Malware Analysis)	**(8hours)**
2.1	Basic Static Malware Analysis - Antivirus Scanning, Fingerprint for Malware	1 hour
2.2	Portable Executable File Format, The PE File Headers and Sections	1 hour
2.3	Dissecting the PE Format using pefile	1 hour
2.4	Malware Images, Malware Strings	1 hour
2.5	Advanced Static Malware Analysis - Reverse-Engineering- Disassembly methods, Basics of X86 Assembly Language	1 hour
2.6	Basics of X86 Assembly Language	1 hour
2.7	Disassembling using Linear Disassembly	1 hour
2.8	Factors that limit Static Analysis	1 hour
	Module -3 (Dynamic Malware Analysis)	**(8hours)**
3.1	Dynamic Analysis: Malware Sandbox, setting up Sandbox	1 hour
3.2	Monitoring with Process Monitor	1 hour
3.3	Basic Tools for Dynamic Analysis	1 hour
3.4	Advanced dynamic analysis : Introduction to Debugger, OllyDbg,	1 hour
3.5	Malware Analysis Using OllyDbg	1 hour

3.6	Malware Behavior - malicious activities and techniques,	1 hour
3.7	Covert Launching techniques- Process Injection, Process Replacement, Hook Injection	1 hour
3.8	Detours, APC Injection, malware-focused network signatures	1 hour
	Module- 4 (Machine Learning based Malware Detectors)	**(8hours)**
4.1	Steps for building a Machine Learning based Detector	1 hour
4.2	Feature spaces, Decision boundaries, Overfitting and underfitting	1 hour
4.3	Types of Machine Learning Algorithms-Logistic Regression	1 hour
4.4	K-Nearest Neighbors	1 hour
4.5	Decision Trees	1 hour
4.6	Random Forest	1 hour
4.7	Precision, Base Rate, True Positive rate, False Positive rate, ROC Curve.	1 hour
4.8	Case Study: Building a Toy Decision Tree – Based Detector	1 hour
	Module- 5 (Deep Learning Basics)	**(7hours)**
5.1	Introduction to Deep Learning	1 hour
5.2	How neural networks work? Common activation functions.	1 hour
5.3	Building Neural Networks	1 hour
5.4	Training Neural Networks - Back Propagation, Path Explosion, Vanishing Gradient.	1 hour
5.5	Types of Neural Networks- Feed Forward, Convolutional,	1 hour
5.6	Autoencoder, Generative Adversarial Network,	1 hour
5.7	Recurrent Neural Network, ResNet	1 hour

SEMESTER VI

MINOR

CST 382	INTRODUCTION TO SOFTWARE TESTING	Category	L	T	P	Credits	Year of Introduction
		VAC	3	1	0	4	2019

Preamble:

This is a course in theoretical computer science that includes test cases for white-box, black-box, and grey-box approaches. This course describes the various techniques for test case design used to test software artifacts, including requirements, design, and code. The course includes different techniques for test case design based on graphs, programming language syntaxes and inputs. The course also covers symbolic execution using PEX tool.

Course Outcomes: After the completion of the course the student will be able to:-

CO1	List a range of different software testing techniques and be able to apply specific unit testing method to the projects using Junit**. (Cognitive Knowledge Level: Understand)**
CO2	Explain mutation testing method for a given piece of code to identify hidden defects that can't be detected using other testing methods. **(Cognitive Knowledge Level: Understand)**
CO3	Explain graph coverage criteria in terms of control flow graph and data flow graph for a given program. **(Cognitive Knowledge Level: Understand**)
CO4	Demonstrate the importance of black-box approaches in terms of domain and functional testing. **(Cognitive Knowledge Level: Understand)**
CO5	Illustrate the use of PEX tool with symbolic execution. **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12
CO1	✔	✔	✔									✔
CO2	✔	✔	✔	✔						✔		✔

CO3	✔	✔	✔	✔						✔		✔
CO4	✔	✔	✔	✔								✔
CO5	✔	✔	✔	✔						✔		✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks**
	Test 1 (Marks)	**Test 2 (Marks)**	
Remember	**30**	**30**	**30**
Understand	**40**	**40**	**40**
Apply	**30**	**30**	**30**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment - Test : **25 marks**

Continuous Assessment - Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module - 1 (Introduction to Software Testing)

Some Popular Errors – Ariane 5, Therac 25, Intel Pentium Bug. What is Software testing? Why should it be tested? Software Quality, Role of Testing. Testing Process - Level 0 thinking, Level 1 thinking, Level 2 thinking, Level 3 thinking, Level 4 thinking. Software Testing Terminologies - Verification, Validation and Testing, Faults, Error and Bug, Test cases, Coverage Criteria. Types of Testing- Unit testing, integration testing, System testing, Acceptance testing, Beta testing, Functional testing, Stress testing, Performance testing, Usability testing and Regression testing. Testing Methods - Black Box testing, White Box testing, Grey Box testing.

Module - 2 (Unit Testing)

Concept of Unit testing. Static Unit testing. Dynamic Unit testing - Control Flow testing, Data Flow testing, Domain testing, Functional Program testing. Mutation testing - Mutation and Mutants, Mutation operators, Mutation score. Junit - Framework for Unit testing. Case Study - Mutation testing using Junit and Muclipse.

Module - 3 (Unit Testing - White Box Approaches)

Overview of Graph Coverage Criteria. Structural Graph Coverage Criteria - Node/vertex coverage, Edge coverage, Edge pair coverage, Path coverage, Complete path coverage, Prime path coverage, Complete round trip coverage, Simple round trip coverage. Data Flow Criteria - du paths, du pairs. Subsumption Relationships among Graph Coverage Criteria. Graph Coverage for Source Code - Control flow graphs for code, CFG: If statement, CFG: If statement with return, CFG: Switch-case, CFG: Loops, CFG: Exceptions (try-catch). Example program – Statistics. Graph Coverage for Design Elements - Call graphs and classes, Class inheritance testing: Coverage criteria, Coverage criteria on inheritance graph, Data flow at the design level, Inter-procedural DU pairs, Coupling du-pairs example. Example - Quadratic Root. Case Study - Graph Based testing using JUnit Framework.

Module - 4 (Unit Testing - Black Box Approaches)

Domain Testing / Input Space Partitioning - Partitions of a set. Input domain modelling - Interface-based approach, Functionality-based approach. Identifying values. Multiple partitions of the inputdomain - All Combinations Coverage (ACoC), Each Choice Coverage (ECC), Pair-wise Coverage, T-wise Coverage, Base Choice Coverage, Multiple Base Choices Coverage. TriTyp example. Functional Testing - Functional Testing Concepts of Howden. Functional testing - Important Steps. Types of Functional testing - Equivalence Class Partitioning, Boundary Value Analysis, Decision Tables, Random Testing. Case Study - Black Box testing approaches using JUnit.

Module - 5 (Grey Box Testing Approaches)

Introduction to Grey Box testing - Why Grey Box testing, Gray Box Methodology, Advantages and Disadvantages. Techniques of Grey Box Testing - Matrix Testing, Regression Testing, Orthogonal Array Testing or OAT, Pattern Testing. An Introduction to PEX - Parameterized Unit Testing, The Testing Problem. Symbolic Execution – Example, Symbolic execution tree. PEX application Case Study – PEX.

Text Books

1. Paul Ammann and JeffOffutt ,Introduction to Software Testing.
2. KshirasagarNaik and PriyadarshiTripathy, Software Testing And Quality Assurance: Theory And Practice.

Reference Materials

1. https://www.csc.ncsu.edu/academics/undergrad/honors/thesis/muclipsebinder.pdf - Muclipse tutorial.
2. King, James C, "Symbolic Execution and Program Testing", Association for Computing Machinery, July 1976.
3.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1): Explain the following types of testing methods with examples.

(i) Balck-box testing.

(ii) White-box testing.

(iii) Grey-box testing.

Course Outcome 2 (CO2): Define 12 mutants for the following method *power*() using effective mutation operators. Try to use each mutation operator at least once. Approximately, how many mutants do you think there would be, if all mutants for *power*() were created?

```
public static int power (int left, int right)
{
//**************************************
// Raises Left to the power of Right
// precondition : Right >= 0
// postcondition: Returns Left**Right
//**************************************
      intrslt;
      rslt = Left;
```

```
        if (Right == 0)
        {
                rslt = 1;
        }
        else
        {
                for (int i = 2; i <= Right; i++)
                rslt = rslt * Left;
        }
        return (rslt);
        }
```

Course Outcome 3 (CO3): Draw the control flow graph and data flow graph of given piece of code.

```
public static double ReturnAverage(int value[],int AS, int MIN, int MAX){
/*
Function: ReturnAverageComputes the averageof all those numbers in the input array in
the positive range [MIN, MAX]. The maximumsize of the array is AS. But, the array size
could be smaller than AS in which case the endof input is represented by -999.
*/
int i, ti, tv, sum;
doubleav;
i = 0; ti = 0; tv = 0; sum = 0;
while (ti< AS && value[i] != -999) {
ti++;
if (value[i] >= MIN && value[i] <= MAX) {
tv++;
sum = sum + value[i];
}
i++;
}
if (tv> 0)
av = (double)sum/tv;
```

else

av = (double) -999;

return (av);

}

Course Outcome 4 (CO4): Explain the following with examples.

1. Input domain modelling.
2. All Combinations Coverage (ACoC)
3. Each Choice Coverage (ECC)
4. Pair-wise Coverage
5. T-wise Coverage
6. Base Choice Coverage
7. Multiple Base Choices Coverage.

Course Outcome 5 (CO5): Draw the symbolic execution tree for the following program code and explain the symbolic execution of testme (α1, α2).

1. int twice (int v) {
2. return 2 ∗ v;
3. }
4. void testme (int x, int y) {
5. z = twice (y);
6. if (z == x){
7. if (x > y + 10)
8. ERROR;
9. }
10. }
11. int main() {
12. x = sym input();
13. y = sym input();
14. testme (x , y);
15. return(0);
16. }

Model Question Paper

QP CODE: **PAGES: 4**

Reg No:_______________ **Name :_______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION(MINOR), MONTH & YEAR

Course Code: CST 382

Course Name: Introduction to Software Testing

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Explain the differences between Validation and Verification.
2. Explain the differences between Fault, Error, and Bug?
3. Define Ground string, Mutation score, and Mutants.
4. What are the functions of Test driver and Test stubs in dynamic unit testing?
5. Define Node coverage, Edge coverage and Prime path coverage in a control flow graph.
6. What are du paths and du pairs in a data flow graph?
7. Explain the two approaches in input domain modelling.
8. Explain the difference between Equivalence Class Partitioning and Boundary Value Analysis.
9. Briefly explain three techniques of Grey box testing.
10. Explain the concept of symbolic execution with the help of a toy example.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain the following types of testing
(i) Black Box testing (ii) White Box testing (iii) Grey Box testing **(14)**

(iv) Unit testing (v) Integration testing (vi) System testing (vii) Acceptance testing

OR

12. (a) Explain the following coverage criterias based on the code fragment given below. (i) Functional coverage (ii) Statement coverage (iii)Conditional coverage (iv)Branch coverage **(8)**

```
int foo (int x, int y){
    int z = 0;
    if ((x > 0) && (y > 0)){
    z = x;}
    return z;
    }
```

(b) Write positive and negative test cases for an ATM Machine? **(6)**

13. (a) Explain Dynamic unit test environment with a neat figure. **(8)**

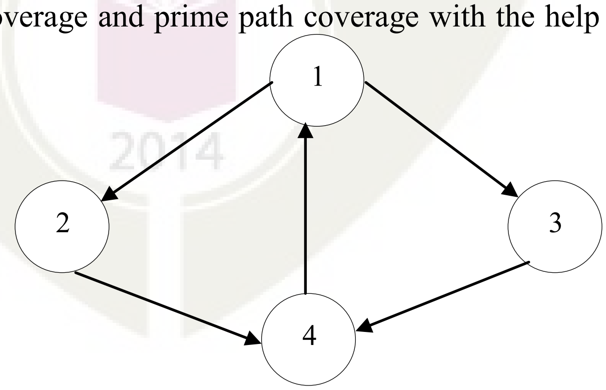
(b) Explain the major difference between control flow testing and data flow testing**.** **(6)**

OR

14. Explain seven types of mutation operators with neat examples. **(14)**

15. (a) Explain touring, side trips and detours with a neat example. **(7)**

(b) Explain simple path coverage and prime path coverage with the help of CFG given below. **(7)**



OR

16. (a) Draw CFG fragment for

(i) Simple *if* (ii) Simple *while* loop (iii) Simple *for* loop **(7)**

(b) Explain the following concepts with examples. **(7)**

(i)Call graph (ii) Inheritance graph (iii) Coupling du-pairs

17. (a) What are the four important steps in functional testing? **(7)**

(b) Briefly explain input domain modelling approaches. **(7)**

OR

18. (a) Consider the triangle classification program with a specification: **(6)**

The program reads floating values from the standard input. The three values A, B, and C are interpreted as representing the lengths of the sides of triangle. The program then prints a message to the standard output that states whether the triangle, if it can be formed, is scalene, isosceles, equilateral, or right angled. Determine the following for the above program:

(i) For the boundary condition $A + B > C$ case (scalene triangle), identify test cases to verify the boundary.

(ii) For the boundary condition $A = C$ case (isosceles triangle), identify test cases to verify the boundary.

(iii) For the boundary condition $A = B = C$ case (equilateral triangle), identify test cases to verify the boundary.

(b) Develop a decision table to generate test cases for this specification. **(8)**

19. (a) Explain the importance of grey box testing, its advantages and disadvantages. **(9)**

(b) Explain the concept of symbolic execution tree. **(5)**

OR

20. (a) Consider the code fragment given below: - **(7)**

```
1. POWER: PROCEDURE(X, Y);
2. Z ← 1;
3. J ← 1;
4. LAB:   IF Y ≥ J THEN
```

5. DO; Z← Z * X;
6. J ← J + 1;
7. GO TO LAB; END;
8. RETURN (Z) ;
9. END;

a) Explain Symbolic execution of POWER (αl, α2).

(b) Explain Execution tree for POWER (αl, α2) in the above code fragment. **(7)**

TEACHING PLAN

Index	Topics	No. of Hours (45)
	Module 1 (Introduction to Software Testing) 9 Hours	
1.1	Some Popular Errors– Ariane 5, Therac 25, Intel Pentium Bug.	1 Hour
1.2	What is Software testing? Why should it be tested? Software Quality, Role of Testing.	1 Hour
1.3	Testing Process - Level 0 thinking, Level 1 thinking, Level 2 thinking, Level 3 thinking, Level 4 thinking.	1 Hour
1.4	Software Testing Terminologies- Verification, Validation and Testing, Faults, Error and Bug, Test cases, Coverage Criteria.	1 Hour
1.5	Types of Testing- Unit testing, integration testing, System testing, Acceptance testing, Beta testing	1 Hour
1.6	Functional testing, Stress testing	1 Hour
1.7	Performance testing, Usability testing and Regression testing.	1 Hour
1.8	Testing Methods - Black Box testing	1 Hour
1.9	Grey Box testing.	1 Hour
Module 2 (Unit testing) 8 Hours		

2.1	Concept of Unit testing.	1 Hour
2.2	Static Unit testing.	1 Hour
2.3	Dynamic Unit testing - Control Flow testing, Data Flow testing	1 Hour
2.4	Domain testing, Functional Program testing.	
2.5	Mutation testing - Mutation and Mutants, Mutation operators, Mutation score.	1 Hour
2.6	Junit - Framework for Unit testing.	1 Hour
2.7	Case Study - Mutation testing using Junit	1 Hour
2.8	Case Study - Mutation testing using Muclipse	1 Hour
Module 3 (Unit Testing:- White Box Approaches) 10 Hours		
3.1	Overview of Graph Coverage Criteria	1 Hour
3.2	Structural Graph Coverage Criteria - Node/vertex coverage, Edge coverage, Edge pair coverage, Path coverage	1 Hour
3.3	Complete path coverage, Prime path coverage, Complete round trip coverage, Simple round trip coverage.	1 Hour
3.4	Data Flow Criteria - du paths, du pairs	1 Hour
3.5	Subsumption Relationships among Graph Coverage Criteria.	1 Hour
3.6	Graph Coverage for Source Code - Control Flow Graphs (CFG) for code, CFG: If statement, CFG: If statement with return, CFG: Switch-case, CFG: Loops, CFG: Exceptions (try-catch). Example program - Statistics	1 Hour
3.7	Graph Coverage for Design Elements - Call graphs and classes, Class inheritance testing: Coverage criteria, Coverage criteria on inheritance graph,	1 Hour

3.8	Data flow at the design level, Inter-procedural DU pairs, Coupling du-pairs example. Example - Quadratic Root	1 Hour
3.9	Case Study - Graph Based testing using JUnit Framework. (Lecture 1)	1 Hour
3.10	Case Study - Graph Based testing using JUnit Framework. (Lecture 2)	1 Hour
Module 4 (Unit Testing:- Black Box Approaches) 9 Hours		
4.1	Domain Testing / Input Space Partitioning - Partitions of a set.	1 Hour
4.2	Input domain modelling - Interface-based approach, Functionality-based approach.	1 Hour
4.3	Identifying values.	1 Hour
4.4	Multiple partitions of the input domain - All Combinations Coverage (ACoC), Each Choice Coverage (ECC), Pair-wise Coverage, T-wise Coverage, Base Choice Coverage, Multiple Base Choices Coverage.	1 Hour
4.5	TriTyp example.	1 Hour
4.6	Functional Testing - Functional Testing Concepts of Howden. Important Steps.	1 Hour
4.7	Types of Functional testing - Equivalence Class Partitioning, Boundary Value Analysis	1 Hour
4.8	Decision Tables, Random Testing.	1 Hour
4.9	Case Study - Black Box testing approaches using JUnit.	1 Hour
Module 5 (Grey Box Testing Approaches) 9 Hours		
5.1	Introduction to Grey Box testing - Why Grey Box testing, Gray Box Methodology, Advantages and Disadvantages.	1 Hour
5.2	Techniques of Grey Box Testing - Matrix Testing, Regression Testing,	1 Hour

5.3	Orthogonal Array Testing or OAT, Pattern Testing.	1 Hour
5.4	An Introduction to Pex - Parameterized Unit Testing, The Testing Problem.	1 Hour
5.5	Symbolic Execution – Example, Symbolic execution tree.	1 Hour
5.6	PEX application.	1 hour
5.7	Case Study – PEX (Lecture 1)	1 Hour
5.8	Case Study – PEX (Lecture 2)	1 Hour
5.9	Case Study – PEX (Lecture 3)	1 Hour

CST 384	CONCEPTS IN DEEP LEARNING	Category	L	T	P	Credits	Year of Introduction
		VAC	3	1	0	4	2019

Preamble:

This course aims to introduce the learner to an overview of the concepts and algorithms involved in deep learning. Deep learning is a subfield of machine learning, a subfield of artificial intelligence. Basic concepts and application areas of machine learning, deep networks, convolutional neural network and recurrent neural network are covered here. This is a foundational program that will help students understand the capabilities, challenges, and consequences of deep learning and prepare them to participate in the development of leading-edge AI technology. They will be able to gain the knowledge needed to take a definitive step in the world of AI.

Prerequisite: Sound knowledge in Basics of linear algebra and probability theory.

CO1	Demonstrate basic concepts in machine learning.**(Cognitive Knowledge Level: Understand)**
CO2	Illustrate the validation process of machine learning models using hyper-parameters and validation sets. **(Cognitive Knowledge Level: Understand)**
CO3	Demonstrate the concept of the feed forward neural network and its training process. **(Cognitive Knowledge Level: Apply)**
CO4	Build CNN and Recurrent Neural Network (RNN) models for different use cases. **(Cognitive Knowledge Level: Apply)**
CO5	Use different neural network/deep learning models for practical applications. **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓	✓	✓						✓
CO5	✓	✓	✓	✓	✓	✓						✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (Percentage)	Test2 (Percentage)	
Remember	**30**	**30**	**30**
Understand	**40**	**40**	**40**
Apply	**30**	**30**	**30**
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment Tests : **25 marks**

Continuous Assessment Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

INTRODUCTION TO DEEP LEARNING

(General Instructions: Instructors are to introduce students to any one software platform and demonstrate the working of the algorithms in the syllabus using suitable use cases and public datasets to give a better understanding of the concepts discussed. Tutorial hour may be used for this purpose)

Module-1 (Introduction)

Key components - Data, models, objective functions, optimization algorithms, Learning algorithm. Supervised learning- regression, classification, tagging, web search, page ranking, recommender systems, sequence learning, Unsupervised learning, Reinforcement learning, Historical Trends in Deep Learning. Other Concepts - overfitting, underfitting, hyperparameters and validation sets, estimators, bias and variance.

Module- 2 (Optimization and Neural Networks)

Neural Networks –Perceptron, Gradient Descent solution for Perceptron, Multilayer perceptron, activation functions, architecture design, chain rule, back propagation, gradient based learning. Introduction to optimization– Gradient based optimization, linear least squares. Stochastic gradient descent, Building ML algorithms and challenges.

Module -3 (Convolutional Neural Network)

Convolutional Neural Networks – convolution operation, motivation, pooling, Structure of CNN, Convolution and Pooling as an infinitely strong prior, variants of convolution functions, structured outputs, data types, efficient convolution algorithms. Practical challenges of common deep learning architectures- early stopping, parameter sharing, dropout. Case study: AlexNet, VGG, ResNet.

Module- 4 (Recurrent Neural Network)

Recurrent neural networks – Computational graphs, RNN design, encoder – decoder sequence to sequence architectures, deep recurrent networks, recursive neural networks, modern RNNs LSTM and GRU, Practical use cases for RNNs.

Module-5 (Application Areas)

Applications – computer vision, speech recognition, natural language processing, common word embedding: continuous Bag-of-Words, Word2Vec, global vectors for word representation (GloVe). Research Areas – autoencoders, representation learning, boltzmann machines, deep belief networks.

Text Book

1. Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, MIT Press 2015 ed.
2. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Dive into Deep Learning, August 2019.
3. Neural Networks and Deep Learning, Aggarwal, Charu C., c Springer International Publishing AG, part of Springer Nature 2018

Reference Books

1. Neural Smithing: Supervised Learning in Feedforward Artificial Neural Networks by Russell Reed, Robert J MarksII, A Bradford Book,2014
2. Practical Convolutional Neural Networks by MohitSewak, Md. Rezaul Karim, PradeepPujari,Packt Publishing 2018
3. Hands-On Deep Learning Algorithms with Python by SudharsanRavichandran,Packt Publishing 2019
4. Deep Learning with Python by Francois Chollet,Manning Publications Co.,2018

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

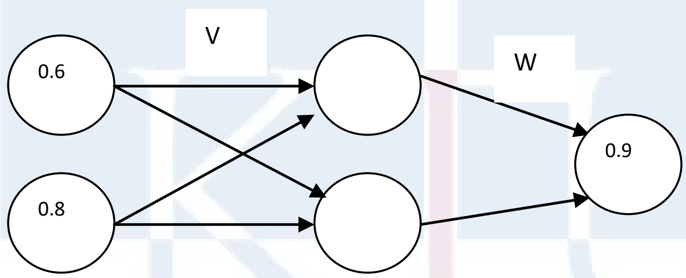
1. Compare regression and classification.
2. Define supervised learning? Distinguish between regression and classification.
3. Discuss the different learning approaches used in machine learning.

Course Outcome 2 (CO2):

1. What are hyperparameters? Why are they needed?
2. What issues are to be considered while selecting a model for applying machine learning in a given problem?

Course Outcome 3 (CO3):

1. Update the parameters V_{11} in the given MLP using back propagation with learning rate as 0.5 and activation function as sigmoid. Initial weights are given as V_{11}= 0.2, V_{12}=0.1, V_{21}=0.1, V_{22}=0.3, V_{11}=0.2, W_{11}=0.5, W_{21}=0.2



2. Draw the architecture of a multi-layer perceptron.
3. Derive update rules for parameters in the multi-layer neural network through the gradient descent.

Course Outcome 4 (CO4):

1. Give two benefits of using convolutional layers instead of fully connected ones for visual tasks.
2. Suppose that a CNN was trained to classify images into different categories. It performed well on a validation set that was taken from the same source as the training set but not on a testing set. What could be the problem with the training of such a CNN? How will you ascertain the problem? How can those problems be solved?
3. Explain how the cell state is updated in the LSTM model from Ct-1 to Ct
4. Show the steps involved in an LSTM to predict stock prices.

Course Outcome 5 (CO5):

1. Explain how the cell state is updated in the LSTM model from Ct-1 to Ct
2. Show the steps involved in an LSTM to predict stock prices.
3. Illustrate the workings of the RNN with an example of a single sequence defined on a vocabulary of four words.

Course Outcome 6 (CO6):

1. Development a deep learning solution for problems in the domain i) natural language processing or ii Computer vision (Assignment
2. Illustrate the workings of the RNN with an example of a single sequence defined on a vocabulary of four words.

Model Question Paper

QP CODE: PAGES:4

Reg No:_______________

Name:_________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION(MINOR), MONTH & YEAR

Course Code: CST 384

Course Name: CONCEPTS IN DEEP LEARNING

Max. Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Distinguish between supervised learning and Reinforcement learning. Illustrate with an example.

2. Differentiate classification and regression.

3. Compare overfitting and underfitting. How it can affect model generalization.

4. Why does a single perceptron cannot simulate simple XOR function? Explain how this limitation is overcome?

5. Illustrate the strengths and weaknesses of convolutional neural networks.

6. Illustrate convolution and pooling operation with an example

7. How many parameters are there in AlexNet? Why the dataset size (1.2 million) is important for the success of AlexNet?

8. Explain your understanding of unfolding a recursive or recurrent computation into a computational graph.

9. Illustrate the use of deep learning concepts in Speech Recognition.

10. What is an autoencoder? Give one application of an autoencoder

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) "A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E." What is your understanding of the terms task, performance and experience. Explain with two example **(10)**

(b) "How does bias and variance trade-off affect machine learning algorithms? **(4)**

OR

12. (a) Illustrate the concepts of Web search, Page Ranking, Recommender systems with suitable examples. **(10)**

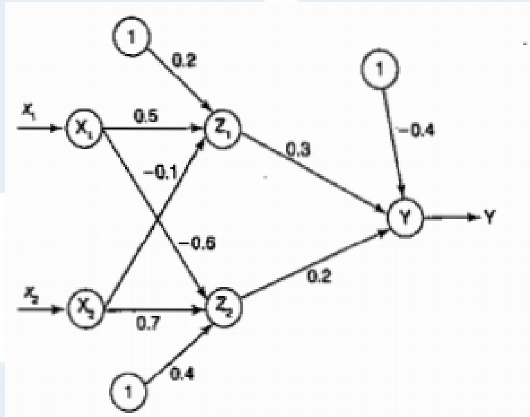
(b) List and discuss the different hyper parameters used in fine tuning the **(4)** traditional machine learning models

13\. (a) How multilayer neural networks learn and encode higher level features from input features. **(7)**

(b) Explain gradient decent and delta rule? Why stochastic approximation to gradient descent is needed? **(7)**

OR

14\. (a) Find the new weights for the network using backpropogation algorithm, the network is given with a input pattern[-1,1] and target output as +1, Use learning rate of alpha=0.3 and bipolar sigmoid function. **(7)**



(b) Write an algorithm for backpropgation which uses stochastic gradient descent method. Comment on the effect of adding momentum to the network. **(7)**

15\. (a) Input to CNN architecture is a color image of size 112x112x3. The first convolution layer comprises of 64 kernels of size 5x5 applied with a stride of 2 and padding 0. What will be the number of parameters? **(5)**

(b) Let X=[-1, 0, 3, 5] W=[.3 ,.5 .2,.1] be the the input of i^{th} layer of a neural network and to apply softmax function. What should be the output of it? **(4)**

(c) Draw and explain the architecture of convolutional network **(5)**

OR

16\. (a) Explain the concept behind i) Early stopping ii) dropout iii) weight decay **(9)**

(b) How backpropagation is used to learn higher-order features in a convolutional Network? **(5)**

17. (a) Explain the working of RNN and discuss how backpropagation through time is used in recurrent networks. **(8)**

(b) Describe the working of a long short term memory in RNNs. **(6)**

OR

18. (a) What is the vanishing gradient problem and exploding gradient problem? **(8)**

(b) Why do RNNs have a tendency to suffer from exploding/vanishing gradient? How to overcome this challenge? **(6)**

19. (a) Explain any two word embedding techniques **(8)**

(b) Explain the merits and demerits of using Auto encoders in Computer Vision. **(6)**

OR

20. (a) Illustrate the use of representation learning in object classification. **(7)**

(b) Compare Boltzmann Machine with Deep Belief Network. **(7)**

Teaching Plan

CONCEPTS IN DEEP LEARNING (45 Hours)		
Module 1 : Introduction (9 hours)		
1.1	Key components - Data, models, objective functions, optimization algorithms. (TB2: Section 1.1-1.2)	1 hour

1.2	Learning algorithm (TB1: Section 5.1), Supervised learning- regression, classification (TB2: Section 1.3.1)	1 hour
1.3	tagging, web search, page ranking (TB2: Section 1.3.1)	1 hour
1.4	Recommender systems, Sequence learning, Unsupervised learning, Reinforcement learning(TB2: Section 1.3.2-1.3.4)	1 hour
1.5	Historical Trends in Deep Learning (TB1: Section 1.2).	1 hour
1.6	Concepts: over-fitting, under-fitting, hyperparameters and validation sets. (TB1: Section 5.2-5.3)	1 hour
1.7	Concepts: Estimators, bias and variance. (TB1: Section 5.4)	1 hour
1.8	Demonstrate the concepts of supervised learning algorithms using a suitable platform.	1 hour
1.9	Demonstrate the concepts of unsupervised using a suitable platform.	1 hour
	Module 2 : Optimization and Neural Networks (9 hours)	
2.1	Perceptron, Stochastic Gradient descent, Gradient descent solution for perceptron (TB3: Section 1.1 - 1.2.1)	1 hour
2.2	Multilayer perceptron (TB3: Section 1.2.2), (TB1: Section 6.1,6.3)	1 hour
2.3	Activation functions- Sigmoid, tanh, Softmax, ReLU, leaky ReLU (TB3: Section 1.2.1.3 - 1.2.1.5)	1 hour
2.4	Architecture design (TB1: Section 6.4, TB3: Section 1.6)	1 hour
2.5	Chain rule, back propagation (TB3: Section 1.3)	1 hour

2.6	Gradient based learning (TB1: Section 6.2)	1 hour
2.7	Gradient based optimization (TB1: Section 4.3)	1 hour
2.8	Linear least squares using a suitable platform. (TB1: Section 4.5)	1 hour
2.9	Building ML Algorithms and Challenges (TB3: 1.4, TB1: 5.10-5.11)	1 hour
Module 3 :Convolution Neural Network (10 hours)		
3.1	Convolution operation, Motivation, pooling (TB1:Section 9.1-9.3)	1 hour
3.2	Structure of CNN (TB3: Section 8.2)	1 hour
3.3	Convolution and Pooling as an infinitely strong prior (TB1: Section 9.4)	1 hour
3.4	Variants of convolution functions – multilayer convolutional network, tensors, kernel flipping, downsampling, strides and zero padding. (TB1: Section 9.5)	1 hour
3.5	Variants of convolution functions - unshared convolutions, tiled convolution, training different networks. (TB1: Section 9.5)	1 hour
3.6	Structured outputs, data types (TB1: Section 9.6-9.7)	1 hour
3.7	Efficient convolution algorithms. (TB1: Section 9.8,9.10)	1 hour
3.8	Practical challenges of common deep learning architectures- early Stopping (TB3: 4.6)	1 hour
3.9	Practical challenges of common deep learning architectures- parameter sharing, drop-out (TB3: Section 4.9, 4.5.4)	1 hour
3.10	Case Study: AlexNet,VGG, ResNet. (TB3: Section 8.4.1-8.4.3,8.4.5)	1 hour

Module 4 :Recurrent Neural Network (8 hours)		
4.1	Computational graphs (TB1: Section 10.1)	1 hour
4.2	RNN (TB1: Section 10.2-10.3)	1 hour
4.3	Encoder – decoder sequence to sequence architectures. (TB1: Section 10.4)	1 hour
4.4	Deep recurrent networks (TB1: Section 10.5)	1 hour
4.5	Recursive neural networks , Modern RNNs, (TB1: Section 10.6, 10.10)	1 hour
4.6	LSTM and GRU (TB1: Section 10.10, TB3: Section 7.5-7.6)	1 hour
4.7	Practical use cases for RNNs. (TB1: Section 11.1-11.4)	1 hour
4.8	Demonstrate the concepts of RNN using a suitable platform.	1 hour
Module 5 : Applications and Research (9 hours)		
5.1	Computer vision. (TB1: Section 12.2)	1 hour
5.2	Speech recognition. (TB1: Section 12.3)	1 hour
5.3	Natural language processing. (TB1: Section 12.4)	1 hour
5.4	Common Word Embedding -: Continuous Bag-of-Words, Word2Vec (TB3: Section 2.6)	1 hour
5.5	Common Word Embedding -: Global Vectors for Word Representation(GloVe) (TB3: Section 2.9.1- Pennigton 2014)	1 hour
5.6	Brief introduction on current research areas- Autoencoders, Representation learning. (TB3: Section 4.10)	1 hour

5.7	Brief introduction on current research areas- representation learning. (TB3: Section 9.3)	1 hour
5.8	Brief introduction on current research areas- Boltzmann Machines, Deep belief networks. (TB1: Section 20.1, TB3 Section 6.3)	1 hour
5.9	Brief introduction on current research areas- Deep belief networks. (TB1: Section 20.3)	1 hour

CST 386	WIRELESS NETWORKS AND IoT APPLICATIONS	Category	L	T	P	Credit	Year of Introduction
		VAC	3	1	0	4	2019

Preamble:

This course equips the learners with fundamental wireless technologies for the Internet of Things(IoT) and the IoT ecosystem. It covers the underlying concepts in wireless networks, communication mechanisms, protocols, hardware, software, and the cloud platforms for IoT. The students will be able to design smart IoT applications for real world problems..

Prerequisite: Sound knowledge in Data Communication, Computer Networks and Programming in C

Course Outcomes: After the completion of the course the students will be able to

CO1	Recognize wireless technologies required for IoT ecosystem **(Cognitive Knowledge Level : Understand)**
CO2	Perceive the concept of IoT and M2M architecture, IoT examples, and Data Management in IoT **(Cognitive Knowledge Level :Apply)**
CO3	Outline the hardware components used in IoT including Sensors, Actuators and development boards **(Cognitive Knowledge Level : understand)**
CO4	Explain the software components of IoT **(Cognitive Knowledge Level :Understand)**
CO5	Demonstrate the protocols used in IoT and build IoT Programs **(Cognitive Knowledge Level : Apply)**
CO6	Build IoT-based smart real-time applications such as Smart Healthcare, Smart Agriculture, Smart Environment and Smart Home **(Cognitive Knowledge Level : Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔									✔
CO2	✔	✔	✔									✔

CO3	✔	✔	✔	✔	✔							✔
CO4	✔	✔	✔	✔	✔							✔
CO5	✔	✔	✔	✔	✔							✔
CO6	✔	✔	✔	✔	✔	✔						

Abstract POs Defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and teamwork
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Blooms Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Percentage)	Test 2 (Percentage)	
Remember	30	30	30
Understand	50	40	40
Apply	20	30	30

Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance **10 marks**
Continuous Assessment Tests **25 marks**
Continuous Assessment Assignment **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus, and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have a maximum 2 subdivisions and carries 14 marks.

Syllabus

Module- 1 (Introduction to IoT and wireless technologies required for IoT)

Internet of Things, Role of Things and the Internet, Wireless IoT. Wireless Networks - Network Topologies, Types of Networks. Role of Wireless Standards in IoT. Protocol Stack - OSI Model, TCP/IP Model, IEEE 802 Reference Model, Protocols for Wireless IoT. Bluetooth - Transceiver, Frequency Channels, Typical Range, Access and Spread Spectrum, Modulation and Data Rate, Error Correction and Detection, Network Topology. ITU G.9959, Zwave, IEEE 802.15.4, Zigbee Specification, Thread, WiFi, 6LowPAN, IPv6, LoRaWAN.

Module- 2 (IoT architecture, Data and Device management)

Internet of Things - IoT Architectural View, Technology Behind IoT - Server End Technology, Sources of Internet of Things, M2M Communication. IoT Application Areas. IoT Examples. IoT Data Management - Device Management Gateways. Design Principles for Web Connectivity - Web Communication Protocols for Connected Devices, Web Connectivity for Connected Devices using Gateways. Internet Connectivity Principles – Internet Connectivity, Internet based communication, IP addressing in the IoT.

Module- 3 (Data Acquiring and Enabling Technologies)

Data Acquiring and Storage for IoT Sevices- Organization of Data, Big data, Acquiring Methods, Management Techniques, Analytics, Storage Technologies. Cloud Computing for Data storage - IoT Cloud based Services using Xively, Nimbits, and Other Platforms. Sensor Technologies for IoT Devices - Sensor Technology, Participatory Sensing, Industrial IoT and Automotive IoT, Actuators for Various Devices, Sensor Data Communication Protocols, Wireless Sensor network Technology

Module-4 (Prototyping the Embedded Devices for IoT)

Embedded Computing Basics, Embedded Hardware Unit. Embedded Platforms for Prototyping - Arduino, Intel Galileo, Intel Edison, Raspberry Pi, BeagleBone, mBed. Prototyping and Designing the Software for IoT Applications- Introduction, Prototyping Embedded DeviceSoftware- Programming using Arduino, Programming for an Arduino Controlled Traffic Control Lights at a Road Junction, Basic Arduino Programs to Blink LED, Find the Distance using Ultrasonic Sensor, Estimate Room Temperature, Measuring Soil Moisture Level

Module 5 (Business Models and Case Studies)

Business Models and Processes using IoT. Value Creation in the Internet of Things. Cloud PaaS- Xively, Nimbits, IBM Bluemix, CISCO IoT, AWS IoT, TCS Connected AWS Platform, Case studies- Smart Home, Smart Environment, Smart healthcare, Smart agriculture

Text Books

1. Daniel Chew, "Wireless Internet of Things -A Guide to the lower layers", IEEE Standards and Association, IEEE Press, Wiley
2. Rajkamal, "Internet of Things : Architecture and Design Principles", McGraw Hill (India) Private Limited.

References

1. ArshadeepBahga, Vijay Madisetti, "Internet of Things: A hands-on approach", University Press, 2015 (First edition)
2. Dieter Uckelmann, Mark Harrison, Michahelles Florian (Ed.), Architecting the internet of things, Springer, 2011
3. Dr. Ovidiu Vermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013
4. Simon Monk, "Programming Arduino: Getting Started with Sketches", McGraw Hill Publications

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Compare Bluetooth and Bluetooth LE power classes
2. Demonstrate Zigbee Specification Protocol Stack

Course Outcome 2 (CO2):

1. What are the major components of IOT system? Briefly explain each
2. Correlate M2M architectural Levels with IOT architectural Levels

Course Outcome 3 (CO3):

1. Describe the use of GPIO pins ?
2. What are actuators ? Mention the roles of actuators in IoT systems

Course Outcome 4(CO4):

1. Identify the role of HBase in Hadoop File System
2. Differentiate Edge computing and Distributed computing
3. Illustrate open protocols, tools and frameworks generally used in M2M

Course Outcome 5(CO5):

1. What do you mean by Arduino sketches?
2. Write an Arduino program to blink LED

Course Outcome 6(CO6):

1. How IoT technology helps TELEMEDICINE in India?
2. How soil moisture can be detected in Smart Agriculture?

Model Question Paper

QP CODE: PAGES :2

Reg No: _______________

Name: _________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION(MINOR), MONTH & YEAR

Course Code: CST 386

Course Name: WIRELESS NETWORKS AND IoT APPLICATIONS

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Illustrate Role of *things* and *internet* in IoT
2. What is Bluetooth? Explain the range and frequency channels of Bluetooth?
3. List any three the features of Constrained Application Protocol (COAP).
4. Compare Raspberry Pi and BeagleBoard boards.
5. Identify the role of HBase in Hadoop File System.
6. Differentiate Edge computing and Distributed computing.
7. Give an example of Raspberry Pi applications for Industrial IoT.
8. What are the on-board functional units in Intel Galileo?
9. Interpret the concept of value creation in IoT.

10. Explain the use of PaaS in IoT Smart applications with any three examples.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Compare various Network topologies used in Wireless Networks. **(8)**

(b) Describe the following wireless technologies on i) *Zigbee* ii) *WiFi* iii) *Thread.* **(6)**

OR

12. (a) Explain protocol stacks used in wireless networks for IoT applications. **(8)**

(b) Illustrate the Architectural design of LoRaWAN. **(6)**

13. (a) Define M2M. Explain M2M architecture. Correlate M2M architectural levels with IoT architectural levels. **(8)**

(b) Compare SOAP and REST protocols. **(6)**

OR

14. (a) Summarize different Online Transactions and Processing techniques. **(8)**

(b) Identify the functions of Device-Management Gateway . **(6)**

15. (a) Define actuators ? Describe the roles of actuators in IoT systems. **(8)**

(b) Explain the usage contexts of analog sensors and digital sensors. **(6)**

OR

16. (a) How data collection, storage & computing services done using Nimbits? **(10)**

(b) List any four features of Xively. **(4)**

17. (a) What do you mean by Arduino sketches? **(4)**

(b) Write an Arduino program to blink LED **(10)**

OR

18. (a) Demonstrate an example of Raspberry Pi applications for Industrial IoT. **(10)**

(b) Compare the features of Arduino-R3 and Arduino Yun boards. **(4)**

19. (a) Explain various tasks of a smart irrigation monitoring service. **(8)**

(b) Demonstrate the tasks of Soil-Moisture monitoring service. **(6)**

OR

20. (a) a) Mr. Kiran Mathew has been a chronic diabetic patient for the past few years. He was under regular check up at the hospital every two weeks. All of a sudden the pandemic like COVID-19 arises in the country and the government issues a lockdown for a period of two months. Illustrate how Mr. Kiran can be monitored by the health care worker using intelligent healthcare techniques. **(10)**

(b) Mention any four sensors used in smart healthcare **(4)**

TEACHING PLAN

No	Contents	No of Lecture Hrs(45)
Module – 1 (Introduction to IoT and wireless technologies required for IoT) (8 hrs) (TB-1, Chapter 1...)		
1.1	Internet Of Things, Role of things and internet ,Wireless IoT	1
1.2	Wireless Networks- Network Topologies-Types of Networks,Role of	1

	Wireless standards in IoT	
1.3	Protocol Stack-OSI Model- TCP/IP Model-IEEE 802 reference model	1
1.4	Protocols for Wireless IoT-Bluetooth-Transceiver, Frequency Channels-Typical Range, Access and Spread Spectrum, Modulation and Data Rate	1
1.5	Error Correction and Detection-Network Topology.	1
1.6	ITU G.9959, Zwave, IEEE 802.15.4, Zigbee Specification	1
1.7	Thread, Wifi, 6LowPAN, IPv6	1
1.8	LoRaWAN	1
Module- 2 (IOT architecture, Data and Device management) (9hrs)		
2.1	Internet of Things -IoT Architectural view	1
2.2	Technology Behind IOT-Server End Technology,Sources of Internet of Things	1
2.3	M2M Communication.	1
2.4	IoT Application Areas. IOT Examples.	1
2.5	IoT Data Management, Device Management Gateways.	1
2.6	Design Principles for Web Connectivity	1
2.7	Web communication protocols for connected devices,	1
2.8	Web connectivity for connected devices using Gateways.	1
2.9	Internet connectivity Principles – Internet Connectivity, Internet based communication, IP addressing in the IoT.	1
Module- 3 (Data Acquiring and Enabling Technologies (8 hrs)		
3.1	Data acquiring and storage for IoT devices- Organization of Data, Big data	1
3.2	Acquiring methods, management techniques, Analytics, Storage technologies.	1
3.3	Cloud computing for Data storage-IoT Cloud based services using Xively,	1

	Nimbits, and other platforms.	
3.4	Cloud computing-Nimbits	1
3.5	Sensor Technologies for IoT Devices-Sensor Technology, Participatory sensing	1
3.6	Industrial IoT and Automotive IoT	1
3.7	Actuators for various devices, Sensor data communication protocols	1
3.8	Wireless Sensor network Technology	1
Module 4(Prototyping the Embedded Devices for IoT)(9hrs)		
4.1	Introduction, Embedded Computing Basics, Embedded Hardware Unit.	1
4.2	Embedded Platforms for Prototyping-Arduino, Intel Galileo	1
4.3	Intel Edison, Raspberry Pi, BeagleBone, mBed	1
4.4	Prototyping and designing the software for IoT applications-Introduction, Prototyping embedded device software	1
4.5	Prototyping and designing the software for IoT applications-Introduction, Prototyping embedded device software	1
4.6	Programming concepts in Arduino	1
4.7	Programming for an arduino controlled traffic control lights at a road junction	1
4.8	Basic Arduino programs to blink LED, Find the distance using ultrasonic sensor	1
4.9	Estimate room temperature, Measuring soil moisture level	1
Module 5 (higher level protocols and case studies)(9 hrs)		
5.1	Business Models and Processes using IOT, Value creation in the Internet of Things.	1

5.2	Xively, Nimbits, IBM Bluemix	1
5.3	CISCO IoT, AWS IoT, TCS Connected AWS Platform	1
5.4	Case Study- Smart Environment	1
5.5	Case Study- Smart Environment	1
5.6	Case study Smart Home	1
5.7	Case study Smart Home	1
5.8	Case study Smart healthcare (Lecture I)	1
5.9	Case study Smart healthcare (Lecture II)	1
5.10	Case study -Smart agriculture (Lecture I)	1
5.11	Case study -Smart agriculture (Lecture II)	1

SEMESTER VI

HONOURS

CST 394	NETWORK SECURITY	Category	L	T	P	Credits	Year of Introduction
		VAC	3	1	0	4	2019

Preamble:

The purpose of this course is to create a better understanding of the network security concepts. This course covers network security standards, email security services, web security mechanisms, firewalls and wireless security mechanisms. This course helps the learner to gain insight into the key aspects of secure network communication and enables to apply in real-life scenarios.

Prerequisite: A sound background in Number Theory and Cryptographic Algorithms.

Course Outcomes: After the completion of the course the student will be able to

CO#	Course Outcomes
CO1	Identify the key aspects of security, intrusion detection systems and digital signature schemes **(Cognitive Knowledge Level: Apply)**
CO2	Explain the security standards used in network communication **(Cognitive Knowledge Level:Understand)**
CO3	Identify the mechanisms in email security services **(Cognitive Knowledge Level: Apply)**
CO4	Summarize the protocols used to provide web security **(Cognitive Knowledge Level: Understand)**
CO5	Explain the fundamental concepts of wireless network security and firewalls **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔	✔								✔
CO2	✔	✔	✔	✔								✔
CO3	✔	✔	✔	✔		✔						✔
CO4	✔	✔	✔	✔	✔	✔						✔
CO5	✔	✔	✔	✔								✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment Tests : **25 marks**

Continuous Assessment Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Network Security Basics)

Introduction to network security - Security requirements, Challenges of security, Network security model. Malicious programs – Worms, Viruses, Trojans, Spyware, Adware. Intrusion Detection Systems (IDS) - Uses, Techniques. Digital signatures - ElGamal, Schnorr, Digital Signature Standard (DSS).

Module – 2 (Network Security Standards)

Kerberos v4 – Configuration, Authentication, Encryption, Message formats. Kerberos v5 – Cryptographic algorithms, Message formats. Public Key Infrastructure (PKI) – Trust models, Revocation. Real-time communication security – Perfect Forward Secrecy (PFS), Denial-of-Service protection, Endpoint identifier hiding, Live partner reassurance. Internet Protocol Security (IPSec) - Authentication Header (AH), Encapsulating Security Payload (ESP), Internet Key Exchange (IKE) phases.

Module – 3 (Email Security)

Introduction to email security - Security services for email, Establishing keys, Privacy, Authentication, Message integrity, Non-repudiation. Privacy Enhanced Mail (PEM) – Encryption, Source authentication and integrity protection, Message formats. Secure/Multipurpose Internet Mail Extensions (S/MIME) – Messages, Differences from PEM. Pretty Good Privacy (PGP) - Encoding, Certificate and key revocation, Anomalies, Object formats.

Module – 4 (Web Security)

Introduction to web security - Web security considerations, Threats. Secure Sockets Layer (SSL) – Architecture, Protocols, Transport Layer Security (TLS) – Differences from SSL. Hypertext Transfer Protocol Secure (HTTPS) – Connection initiation, Closure. Secure Shell (SSH) – Transport layer protocol, User authentication protocol, Connection protocol.

Module – 5 (Wireless Network Security and Firewalls)

IEEE 802.11 Wireless LAN - Network components, Architectural model, Services. IEEE 802.11i wireless LAN security - Services, Phases of operation. Wired Equivalent Privacy (WEP), Wi-Fi Protected Access (WPA), WPA2, Wireless Application Protocol (WAP) – Services, Protocol architecture. Firewalls – Need for firewalls, Packet filters, Circuit-level firewalls, Application layer firewalls.

Text Books

1. C. Kaufman, R. Perlman and M. Speciner, “Network Security: Private Communication in a Public World”, 2/e, PHI.
2. William Stallings, “Cryptography and Network Security Principles and Practice”, 5/e, Pearson

Education Asia.

References

1. Behrouz A. Forouzan, Debdeep Mukhopadhyay, “Cryptography and Network Security”, 3/e, Tata McGraw Hill.
2. Tyler Wrightson, “Wireless Network Security A Beginner’s Guide”, 2012, Tata McGraw Hill.
3. William Stallings, “Network Security Essentials: Applications and Standards”, 4/e, Prentice Hall.
4. Schiller J., Mobile Communications, 2/e, Pearson Education.
5. Roberta Bragg et. al., “Network Security: The Complete Reference”, Tata McGraw Hill.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Using the Schnorr digital signature scheme, let $q = 83$, $p = 997$ and $d = 23$. Find values for e_1 and e_2.
2. The Digital Signature Algorithm (DSA) specifies that if the signature generation process results in a value of zero, a new value of k should be generated and the signature should be recalculated. Give reason.

Course Outcome 2 (CO2):

1. In Kerberos v4, the authenticator field is not of security benefit when asking the Key Distribution Center (KDC) for a ticket for Bob, but useful when logging in as Bob. Give reasons for your answer.
2. How does the stateless cookie protocol provide clogging protection?

Course Outcome 3 (CO3):

1. If Alice is sending an ENCRYPTED message, she first signs the message digest with her private key and then encrypts the message digest with the pre-message secret key. Why this last encryption was considered necessary for encrypted messages and not for MIC-CLEAR or MIC-ONLY?
2. Which security services are considered desirable in the following cases? (i) Sending a purchase order (ii) Sending a ransom note. (iii) Sending a mission description to security officials.
3. Explain the security mechanism used in Gmail communication.

Course Outcome 4 (CO4):

1. Is it possible in SSL for the receiver to reorder SSL record blocks that arrive out of order? If so, how it can be done? If not, why?
2. Describe any five web security threats, their consequences and countermeasures.

Course Outcome 5 (CO5):

1. Explain the security areas addressed by IEEE 802.11i.
2. Describe the advantages and disadvantages of application layer firewalls.

Model Question Paper

QP CODE:
Reg. No:______________
Name:________________ **PAGES : 3**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH. DEGREE (HONORS) EXAMINATION, MONTH &YEAR
Course Code: CST 394

Course Name: Network Security

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Distinguish between signature-based and anomaly-based intrusion detection techniques.

2. A trusted third party is considered as a main component in a network security model. Why?

3. How is endpoint identifier hiding achieved in real-time communication?

4. Show how encryption is used to provide privacy and integrity in Kerberos v5.

5. End-to-end privacy is essential for e-mail security. How is this achieved?

6. List the four steps for preparing an EnvelopedData MIME entity.

7. Show the operation of a Secure Sockets Layer (SSL) Record protocol.

8. For Secure Shell (SSH) packets, what is the advantage of not including the MAC in the scope of packet encryption?

9. List the three security services provided by IEEE 802.11i.

10. Define the terms Access Point, Basic Service Set, Extended Service Set.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Using the ElGamal scheme, let p = 881 and d = 700, find values for e1 and e2. Choose r = 17. Find the value of S1 and S2 if M = 400. **(8)**

(b) Explain the requirements and challenges of network security. **(6)**

OR

12. (a) In ElGamal, Schnorr and DSS, what happens if an attacker can find the value of random secret key used by the signer? Also, what happens if a user uses the same value of random secret key to sign two messages? Explain your answer for each scheme separately. **(8)**

(b) Explain the network security model with the help of a neat diagram. **(6)**

13. (a) Alice wishes to log into Bob's workstation remotely. List the steps involved in this communication if Kerberos v4 is used. **(7)**

(b) How does Diffie-Hellman technique provide perfect forward secrecy using signature keys? **(7)**

OR

14. (a) Explain the algorithm for Message Authentication Code (MAC) calculation and verification in Kerberos v5 rsa-md5-des. **(8)**

(b) Compare the aggressive mode and main mode of Phase 1 Internet Key Exchange (IKE). **(6)**

15. (a) Describe the different methods by which authentication of source is performed in email communication. **(7)**

(b) Explain the Signed data and Clear-signed data functions provided by S/MIME. **(7)**

OR

16. (a) Explain the advantages of Pretty Good Privacy (PGP) over Privacy Enhanced Mail (PEM). **(7)**

	(b)	Define non-repudiation. Describe the different ways by which it is implemented in email communication.	**(7)**
17.	(a)	Describe the significance of pseudo-random function of Transport Layer Security.	**(7)**
	(b)	Explain the four different phases of Secure Sockets Layer (SSL) HandshakeProtocol.	**(7)**

OR

18.	(a)	Describe how connection initiation and connection closure is done in Hyper Text Transfer Protocol Secure (HTTPS).	**(7)**
	(b)	Illustrate the sequence of events in Secure Shell (SSH) transport layer protocol packet exchanges.	**(7)**
19.	(a)	Explain the Discovery phase and Authentication phase of IEEE 802.11i operation.	**(7)**
	(b)	Why are firewalls needed? Compare the features of packet filters and circuit level firewalls.	**(7)**

OR

20.	(a)	Explain the two authentication methods used in Wired Equivalent Privacy (WEP).	**(7)**
	(b)	Describe the three transaction classes provided by Wireless Transaction Protocol.	**(7)**

Teaching Plan

No	Contents	No of Lecture Hrs
Module - 1 (Network Security Basics) (7 hrs)		
1.1	Security requirements, Challenges of security	1
1.2	Network security model	1
1.3	Worms, Viruses, Trojans, Spyware, Adware	1
1.4	Intrusion Detection Systems (IDS) uses, Techniques	1
1.5	ElGamal digital signature	1
1.6	Schnorr digital signature	1
1.7	Digital Signature Standard (DSS)	1
Module - 2 (Network Security Standards) (12 hrs)		
2.1	Kerberos v4 configuration, Authentication	1
2.2	Kerberos v4 encryption	1
2.3	Kerberos v4 message formats	1
2.4	Kerberos v5 cryptographic algorithms – rsa-md5-des, des-mac, des-mac-k	1
2.5	Kerberos v5 cryptographic algorithms - rsa-md4-des, rsa-md4-des-k, Encryption for privacy and integrity	1
2.6	Kerberos v5 message formats	1
2.7	Public Key Infrastructure (PKI) trust models	1
2.8	PKI revocation	1
2.9	Perfect Forward Secrecy (PFS), Denial-of-Service protection	1
2.10	Endpoint identifier hiding, Live partner reassurance	1
2.11	Internet Protocol Security (IPSec) Authentication Header (AH), Encapsulating Security Payload (ESP)	1

2.12	Internet Key Exchange (IKE) phases	1
Module - 3 (Email Security) (9 hrs)		
3.1	Security services for email, Establishing keys, Privacy	1
3.2	Authentication, Message integrity, Non-repudiation	1
3.3	Privacy Enhanced Mail (PEM) encryption, Source authentication	1
3.4	PEM integrity protection, Message formats (Lecture 1)	1
3.5	PEM message formats (Lecture 2)	1
3.6	Secure/Multipurpose Internet Mail Extensions (S/MIME) – Messages, Differences from PEM	1
3.7	Pretty Good Privacy (PGP) encoding, Certificate and key revocation, Anomalies	1
3.8	PGP Object formats (Lecture 1)	1
3.9	PGP Object formats (Lecture 2)	1
Module – 4 (Web Security)(9 hrs)		
4.1	Web security considerations, Threats, Secure Sockets Layer (SSL) architecture	1
4.2	SSL protocols (Lecture 1)	1
4.3	SSL protocols (Lecture 2)	1
4.4	Transport Layer Security (TLS) differences from SSL (Lecture 1)	1
4.5	TLS differences from SSL (Lecture 2)	1
4.6	Hypertext Transfer Protocol Secure (HTTPS) connection initiation, Closure	1
4.7	Secure Shell (SSH) transport layer protocol	1
4.8	SSH user authentication protocol	1
4.9	SSH connection protocol	1

Module - 5 (Wireless Security and Firewalls) (8 hrs)		
5.1	IEEE 802.11 Wireless LAN network components, Architectural model, Services	1
5.2	IEEE 802.11i wireless LAN security services, Phases of operation (Lecture 1)	1
5.3	IEEE 802.11i phases of operation (Lecture 2)	1
5.4	Wired Equivalent Privacy (WEP), Wi-Fi Protected Access (WPA), WPA2	1
5.5	Wireless Application Protocol (WAP) services, Protocol architecture (Lecture 1)	1
5.6	WAP protocol architecture (Lecture 2)	1
5.7	Need for firewalls, Packet filters	1
5.8	Circuit-level firewalls, Application layer firewalls	1

AIT396	MACHINE LEARNING IN COMPUTATIONAL BIOLOGY	CATEGORY	L	T	P	Credit	Year of Introduction
		VAC	3	1	0	4	2020

Preamble: This course is intended to provide the learners a outlook towards application of Machine learning algorithms in the field of computational biology. This course helps the learners to apply the Machine learning methods - clustering algorithms, dimensionality reduction, decision drees, Artificial Neural Network, Support Vector Machine to the computational biology problems. Also the course discuss Challenges of Machine Learning in Computational Biology and Future directions of Machine Learning in Computational Biology.

Prerequisite: Basic background in Bioinformatics and Machine Leaning

Course Outcomes: After the completion of the course, the student will be able to

CO 1	Describe the basic concepts of Machine Leaning, Classification, regression and clustering problems, parameters and measures (**Cognitive knowledge level: Understand**)
CO 2	Demonstrate the clustering algorithm on computational biology problems (**Cognitive knowledge level: Apply)**
CO 3	Explain Dimensionality reduction techniques and Decision Trees in computational biology (**Cognitive knowledge level : Apply)**
CO 4	Illustrate Feature Extraction and Pattern recognition and Classification in the domain of Computational Biology analysis **(Cognitive knowledge level: Apply)**
CO 5	Explain the role and challenges of Machine Learning in Computational (**Cognitive knowledge level: Understand**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔										✔
CO2	✔	✔	✔	✔	✔							✔
CO3	✔	✔	✔	✔	✔							✔
CO4	✔	✔	✔	✔								✔
CO5	✔	✔			✔							✔

PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	Test1 (%)	Test2 (%)	
Remember	**30**	**30**	**30**
Understand	**50**	**50**	**50**
Apply	**20**	**20**	**20**
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests (Average of Series Tests 1& 2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Machine Learning in Computational Biology

Module 1 (Overview of Machine Learning)

Overview of Machine Learning, fitting predictive models to data, Supervised and unsupervised learning, Classification, regression and clustering problems, Loss or cost functions. Parameters and hyperparameters, Training. validation and testing, Inductive bias and the bias variance trade-off, Use of clustering models.

Module 2 (Clustering problems Computational Biology)

Hierarchical Clustering, Partition Clustering, Overview Model-Based Clustering, k-Means clustering, k-Means clustering algorithm, Advantages, Disadvantages, illustrative example of k-Means clustering, Clustering for creating phylogenetic trees, Using Clustering Approach to Identify Patients' Subtypes, Application of clustering algorithms on gene expression data.

Module 3 (Supervised techniques for Computational Biology)

Proteomics Dataset, Data Pre-processing Algorithms, Dimension and Feature Subset Selection, Dimensionality reduction - Principal Component Analysis (PCA), Partial Least Square (PLS), Linear Discriminant Analysis (LDA), Protein Classification, Decision Trees in Bioinformatics, Proteomic Mass Spectra Classification Using Decision Tree Technique.

Module 4 (Machine-Learning Algorithms for Computational Biology)

Machine-Learning Algorithms for Feature Selection from Gene Expression Data, Feature Extraction and Pattern recognition from sequence data, measures of a Feature. Artificial Neural Network (ANN) in Bioinformatics, Genetic Algorithms (GA) in Bioinformatics, Designing ANN for Bioinformatics, ANN in Protein Bioinformatics, Support Vector Machine with Feature Elimination.

Module 5 (Scope of Machine Learning in Computational Biology)

Role of Machine Learning in Computational Biology, Creation and analysis of sequence data, Challenges of Machine Learning in Computational Biology, Data Errors, Mean Square Error Generative versus Discriminative, Approximation Versus Explanation, Single Versus Multiple Methods, Future directions of Machine Learning in Computational Biology.

Text Books

1. Statistical Modelling and Machine Learning Principles for Bioinformatics Techniques, Tools, and Applications. Germany, Springer Singapore, 2020.
2. Yang, ZhengRong. Machine Learning Approaches to Bioinformatics. Singapore, World Scientific Publishing Company, 2010.

References

1. Izadkhah, Habib. Deep Learning in Bioinformatics: Techniques and Applications in Practice. Netherlands, Elsevier Science, 2022.
2. Agapito, Giuseppe, et al. Artificial Intelligence in Bioinformatics: From Omics Analysis to Deep Learning and Network Mining. Netherlands, Elsevier Science, 2022.
3. Data Analytics in Bioinformatics: A Machine Learning Perspective. United States, Wiley, 2021.
4. Michailidis, George, et al. Introduction to Machine Learning and Bioinformatics. United Kingdom, CRC Press, 2008.
5. Zhang, Yanqing, and Rajapakse, Jagath C, Machine Learning in Bioinformatics, Germany, Wiley, 2009.
6. Baldi, Professor Pierre, et al. Bioinformatics, Second Edition: The Machine Learning Approach. India, Bradford, 2001.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Compare and contrast Supervised and unsupervised learning
2. Differentiate Classification with regression with an example
3. Explain the parameters and hyperparameters of a model?
4. Summarize validation and testing in machine learning?

Course Outcome 2 (CO2):

1. Write K-means algorithm and separate {5, 11, 19, 27, 23, 25, 6, 18, 2, 8, 10, 12, 31, 29, 4} into 3 clusters
2. Illustrate application of clustering algorithms on gene expression data
3. Differentiate K-means clustering and hierarchical clustering

Course Outcome 3 (CO3):

1. Illustrate dimensionality reduction methods - Principal Component Analysis (PCA), Partial Least Square (PLS), Linear Discriminant Analysis (LDA)
2. Explain Decision trees in Bioinformatics with a toy example.

Course Outcome 4 (CO4):

1. Explain the process involved in feature extraction and pattern recognition from sequence data
2. Design and implement an ANN model for the prediction of relative solvent accessibility

Course Outcome 5 (CO5):

1. Summarize role of Machine Learning in Computational Biology
2. Explain Challenges of Machine Learning approaches in Computational Biology

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES: 3**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH (Honors) DEGREE EXAMINATION, MONTH & YEAR

Course Code: AIT 396

Course Name: MACHINE LEARNING IN COMPUTATIONAL BIOLOGY

Max. Marks: 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1.	What does the regression line equation tell you?	**(3)**
2.	How do you create a predictive data model using machine learning?	**(3)**
3.	Write the major differences between K-means clustering and hierarchical clustering	**(3)**
4.	List any three resources of Proteomics Datasets	**(3)**
5.	What is the importance of using PCA before applying Machine learning method?	**(3)**
6.	Draw example of an ANN architecture including 4 independent variables, one hidden layer with 3 hidden neurons and 2 dependent variables	**(3)**
7.	What is the role of the Activation functions in Neural Networks?	**(3)**
8.	What is Hinge Loss in SVM?	**(3)**
9.	What is mean square error? how will you evaluate it?	**(3)**
10.	What are discriminative machine learning models?	**(10x3=30)**

Part B
(Answer any one question from each module. Each question carries 14 Marks)

11.	(a)	With example, differentiate Supervised and unsupervised learning	**(7)**

	(b)	What is loss function and cost function in machine Learning. write the difference and example of loss function and cost function	**(7)**
		OR	
12.	(a)	Define Train, Validation, and Test Datasets. how do you divide the data into Train, Validation, and Test Datasets.	**(7)**
	(b)	Explain Classification, regression and clustering methods with examples of each	**(7)**
13.	(a)	Use K Means clustering to cluster the following data into two groups. Assume cluster centroid are m1=2 and m2=4. The distance function used is Euclidean distance. { 2, 4, 10, 12, 3, 20, 30, 11, 25 }	**(7)**
	(b)	Illustrate with a toy example the application of clustering algorithms on gene expression data	**(7)**
		OR	
14.	(a)	Explain the advantages, disadvantages of k-Means clustering	**(7)**
	(b)	What is the advantage of using hierarchical clustering over K means clustering? When to use the hierarchical clustering?	**(7)**
15.	(a)	Explain Dimension and Feature Subset Selection	**(7)**
	(b)	20 physicochemical properties of 100 set of proteins were given with the help of PCA, explain how will you reduce 20x100 in to Five properties (5x100) for the next level analysis	**(7)**
		OR	
16.	(a)	Explain how Linear Discriminant Analysis can be used for the dimensionality reduction with the help of a scenario in computational biology	**(7)**
	(b)	How do decision tree classifiers work? what types of problems can they solve in Computational Biology	**(7)**
17.	(a)	Explain the process of Feature Extraction and Pattern recognition from sequence data	**(7)**
	(b)	Illustrate the design of Artificial Neural Network for solving Computational Biology question	**(7)**
		OR	
18.	(a)	Explain crossover and mutation in genetic algorithm with an example	**(7)**
	(b)	Explain how to construct a support vector machine (SVM) to classify ovarian	**(7)**

		cancer from 30 individuals from the 15 features obtained from each patient.	
19.	(a)	What role does machine learning and have to play in Computational Biology?	**(7)**
	(b)	Explain different kinds of Data Errors in Machine Learning that would happen in case of applying it in to the Computational Biology domain?	**(7)**
		OR	
20.	(a)	What are the advantages and disadvantages of application of machine learning in Computational Biology?	**(7)**
	(b)	"The transformation of huge volume of data into knowledge is the biggest challenge faced in computational biology" How can machine learning techniques help in this?	**(7)**

TEACHING PLAN

No	Contents	No of Lecture (45 Hrs)
	Module 1 (Overview of Machine Learning) (9 hrs)	
1.1	Overview of Machine Learning	1
1.2	Fitting predictive models to data	1
1.3	Supervised and unsupervised learning	1
1.4	Classification, regression and clustering problems	1
1.5	Loss or cost functions	1
1.6	Proteins and peptides	1
1.7	Parameters and hyperparameters	1
1.8	Training. validation and testing	1
1.9	Inductive bias and the bias variance trade-off, Use of clustering models	1
	Module 2 (Clustering problems Computational Biology) (9 hrs)	
2.1	Hierarchical Clustering	1
2.2	Partition Clustering, Overview Model-Based Clustering	1
2.3	k-Means clustering, k-Means clustering algorithm	1
2.4	k-Means clustering advantages, disadvantages	1
2.5	illustrative example of k-Means clustering	1

2.6	Clustering for creating phylogenetic trees	1
2.7	Using Clustering Approach to Identify Patients' Subtypes	1
2.8	Application of clustering algorithms on gene expression data	1
2.9	Application of clustering algorithms on gene expression data	1
Module 3 (Supervised techniques for Computational Biology) (9 hrs)		
3.1	Proteomics Datasets	1
3.2	Data Pre-processing Algorithms	1
3.3	Dimension and Feature Subset Selection	1
3.4	Dimensionality reduction	1
3.5	Principal Component Analysis (PCA)	1
3.6	Partial Least Square (PLS), Linear Discriminant Analysis (LDA)	1
3.7	Protein Classification case study	1
3.8	Decision Trees in Bioinformatics	1
3.9	Proteomic Mass Spectra Classification Using Decision Tree Technique	1

Module 4 (Machine-Learning Algorithms for Computational Biology) (8 hrs)		
4.1	Machine-Learning Algorithms for Feature Selection from Gene Expression Data	1
4.2	Feature Extraction and Pattern recognition from sequence data	1
4.3	Measures of a Feature	1
4.4	Artificial Neural Network (ANN) in Bioinformatics	1
4.5	Genetic Algorithms (GA) in Bioinformatics	1
4.6	Designing ANN for Bioinformatics	1
4.7	Designing ANN for Bioinformatics	1
4.8	ANN in Protein Bioinformatics	1
4.9	Support Vector Machine with Feature Elimination.	1
Module 5 (Scope of Machine Learning in Computational Biology) (10 hrs)		
5.1	Role of Machine Learning in Computational Biology	1
5.2	Creation and analysis of sequence data	1

5.3	Challenges of Machine Learning in Computational Biology	1
5.4	Data Errors in Machine Learning, Mean Square Error	1
5.5	Generative versus Discriminative	1
5.6	Approximation Versus Explanation	1
5.7	Single Versus Multiple Methods	1
5.8	Future directions of Machine Learning in Computational Biology	1
5.9	Future directions of Machine Learning in Computational Biology	1

AIT398	IMAGE AND VIDEO PROCESSING	Category	L	T	P	Credit	Year of Introduction
		VAC	3	1	0	4	2020

Preamble: This course enables the learners to understand how digital images are stored and processed. The learners are exposed to different spatial and frequency domain methods for image enhancement, image restoration techniques, morphological operations that could be performed on digital images and also various image and video compression techniques. The course also gives an introduction to the basics of video processing and video segmentation.

Prerequisite: Advanced Computer Graphics, Advanced Concepts in Computer Vision

Course Outcomes: After the completion of the course the student will be able to

CO1	Summarize the steps of digital image processing and pixel relationships. **(Cognitive Knowledge Level: Understand)**
CO2	Apply spatial and frequency domain methods for image enhancement. **(Cognitive Knowledge Level: Apply**
CO3	Apply restoration techniques and morphological operations on digital images. **(Cognitive Knowledge Level: Apply)**
CO4	Compare different methods for digital image and video compression. **(Cognitive Knowledge Level: Apply)**
CO5	Understand the basics of video processing and video segmentation. **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PO1 2
CO1	✓	✓	✓	✓	✓							✓
CO2	✓	✓	✓	✓	✓	✓						✓
CO3	✓	✓	✓	✓	✓	✓						✓
CO4	✓	✓	✓	✓	✓	✓						✓
CO5	✓											✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	**30**	**30**	**30**
Understand	**30**	**30**	**30**
Apply	**40**	**40**	**40**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hrs**

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests(Average of Internal Tests 1 & 2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A.

Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

SYLLABUS

Module – 1

Fundamentals of Image processing: Basic steps of Image processing system, sampling and quantization of an Image, basic relationship between pixels and connectivity.

Image Enhancement: Spatial Domain methods - Gray level transformations, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters.

Module -2

Image Transforms: Unitary transforms, 2D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms.

Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, homomorphic filtering.

Module - 3

Image Restoration: Image degradation/Restoration model, Noise models, Restoration in presence of noise only - spatial filtering, Periodic Noise reduction by frequency domain filtering.

Morphological Operations: Erosion, Dilation, Opening, Closing, Hit-or-miss transformation, Boundary extraction.

Module - 4

Image compression fundamentals – Coding Redundancy, spatial and temporal redundancy.

Compression models : Lossy and Lossless, Huffman coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, JPEG standards.

Module - 5

Video processing: Basics of Video Processing: Analog video, Digital Video.

Video segmentation: Introduction to video segmentation, Change detection.

Video Compression: Introduction to video compression, video compression based on motion compensation, Search for motion vectors, H.261 standard, Transform coding, predictive coding- MPEG.

Text Books

1. Gonzalez and Woods , "Digital Image Processing", 3rd edition , Pearson, 2009.

2. Li, Ze-Nian, Mark S. Drew, and Jiangchuan Liu. "Fundamentals of multimedia", Pearson Prentice Hall, 2004.

3. Bovik, Alan C. "Handbook of image and video processing", Academic press, 2010.

Reference Books

1. David A. Forsyth & Jean Ponce, Computer vision – A Modern Approach, Prentice Hall, 2002.

2. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer.

3. Maheshkumar H Kolekar, "Intelligent Video Surveillance Systems: An Algorithmic Approach", CRC Press.

4. Francesco Camastra, Alessandro Vinciarelli, "Machine Learning for Audio, Image and Video Analysis: Theory and Applications", Springer 2015.

5. M. Tekalp ,"Digital video Processing", Prentice Hall International

6. Relf, Christopher G.,"Image acquisition and processing with LabVIEW", CRC press

7 Chris Solomon, Toby Breckon ,"Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab", John Wiley & Sons,

8. Yao wang, Joem Ostarmann and Ya – quin Zhang, "Video processing and communication ",1st edition , PHI

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Illustrate how the image is digitized by sampling and quantization.
2. Let V = {1,2} and compute the length of the shortest 4-, 8-, and m path between p and q. If a particular path does not exist between these two points explain why.

3	1	2	1q
2	2	0	2
1	2	1	1
p 1	0	1	2

Course Outcome 2(CO2):

1. Determine whether the given matrix is unitary or not:

$$A = \frac{1}{\sqrt{2}}\begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix}.$$

2. Explain any five properties of 2D Fourier Transform.

Course Outcome 3(CO3):

1. Discuss how restoration is done in digital images.
2. Explain with examples the different morphological operations applied to images.

Course Outcome 4(CO4): .

1. With suitable examples, clearly bring out the need for compression in images and videos.
2. Discuss any one method for finding motion vectors.

Course Outcome 5(CO5):

1. Explain any one technique used for segmenting a video.
2. Compare and contrast analog video and digital video in multimedia.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 3**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AIT 398

Course Name: Image and Video Processing

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Explain bit plane slicing and contrast stretching.

2. Discuss about pixel relationships.

3. Find the 4 order forward and inverse DFT for the following image segment:

1	1	1	1
1	1	1	1
1	1	1	1
1	1	1	1

4. Define DCT. Write the properties of DCT.

5. Discuss hit or miss transformation with appropriate examples.

6. Explain about the morphological operation dilation.

7. Explain the significance of image compression.

8. Distinguish between lossy and lossless compression.

9. Discuss the significance of change detection.

10. Explain how transform coding is used in compression algorithms.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Perform histogram specification of the following 3 bit gray scale image whose gray level distribution is given as follows. **(9)**

Input image

Gray level	0	1	2	3	4	5	6	7
No. of Pixels	8	10	10	2	12	16	4	2

Target image

Gray Level	0	1	2	3	4	5	6	7
No. of Pixels	0	0	0	0	20	20	16	8

(b) Design Laplacian filter for image enhancement in spatial domain. **(5)**

OR

12. (a) What is histogram equalization? Explain the procedure for histogram equalization. **(7)**

(b) Explain the gray level transformation functions: a) image negatives and b) log transformation c) power law transformation. **(7)**

13. (a) Compute the 2D DFT of the 4 X 4 grayscale image given below. **(4)**

(b) Explain about smoothing and sharpening frequency domain filters. **(10)**

OR

14. (a) Explain Butterworth filters for image smoothening and image sharpening. **(4)**

(b) Explain the steps followed in frequency domain filtering? **(5)**

15. (a) Apply opening and closing operation on the image sample A given below with structuring element B **(10)**

$$A=\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix} \text{ and } B=\begin{bmatrix} 1 & 1 & 1 \end{bmatrix}$$

(b) Explain Morphological operations a) opening b) closing with suitable examples. **(4)**

OR

16. (a) Discuss about different noise models. **(7)**

(b) Explain how periodic noise reduction can be done using frequency domain filtering. **(7)**

17. (a) Comment on JPEG compression standard. **(8)**

(b) Discuss on run-length encoding with the help of an example. **(6)**

OR

18. (a) Explain LZW coding with the help of a suitable example. **(8)**

(b) Illustrate the concept of arithmetic coding. **(6)**

19. (a) Compare and contrast MPEG video coding and H.261 standard. **(7)**

(b) Explain video segmentation with an example. **(7)**

OR

20. (a) Illustrate how motion compensation is used in video compression. **(7)**

(b) With the help of a neat block diagram explain predictive coding methods. **(7)**

Teaching Plan

No	**Contents**	**No. of Lecture Hours (44 hrs)**
Module – 1 (7 hours)		
1.1	Fundamentals of Image processing: Basic steps of Image processing system, Sampling and quantization of an Image.	1 hour
1.2	Basic relationship between pixels and connectivity.	1 hour
1.3	Image Enhancement: Gray level transformations	1 hour
1.4	Histogram, Histogram Equalization	1 hour
1.5	Histogram specification	1 hour
1.6	Fundamentals of Spatial Filtering	1 hour
1.7	Smoothing Spatial filters	1 hour
1.8	Sharpening Spatial filters	1 hour
Module-2 (8 hours)		
2.1	Image Transforms: Unitary transforms.	1 hour
2.2	2D Discrete Fourier Transform	1 hour

2.3	Discrete Cosine Transform (DCT)	1 hour
2.4	Discrete Wavelet transforms	1 hour
2.5	Basics of filtering in frequency domain	1 hour
2.6	Image smoothing	1 hour
2.7	Image sharpening	1 hour
2.8	Homomorphic filtering.	1 hour
Module-3 (9 hours)		
3.1	**Image Restoration:** Image degradation/Restoration model	1 hour
3.2	Noise models	1 hour
3.3	Restoration basics	1 hour
3.4	Restoration in presence of noise only - spatial filtering	1 hour
3.5	Periodic Noise reduction by frequency domain filtering.	1 hour
3.6	Morphological Operations: basics	1 hour
3.7	Erosion, Dilation, Opening, Closing	1 hour
3.8	Hit-or-miss transformation	1 hour
3.9	Boundary extraction.	1 hour
Module-4 (10 hours)		
4.1	Image compression fundamentals - Coding Redundancy	1 hour
4.2	Spatial and temporal redundancy.	1 hour
4.3	Compression models : Lossy and Lossless	1 hour
4.4	Huffman coding	1 hour

4.6	Arithmetic coding	1 hour
4.7	LZW coding	1 hour
4.8	Run length coding	1 hour
4.9	Bit Plane coding,	1 hour
4.10	JPEG standards	1 hour
Module-5 (10 hours)		
5.1	Basics of Video Processing: Analog video, Digital Video.	1 hour
5.2	Video segmentation: Introduction to video segmentation	1 hour
5.3	Change detection.	1 hour
5.4	Introduction to video compression	1 hour
5.5	Video compression based on motion compensation	1 hour
5.6	Search for motion vectors	1 hour
5.7	Transform coding	1 hour
5.8	Predictive coding	1 hour
5.9	MPEG standards	1 hour
5.10	H.261 standard	1 hour

COMMON COURSES

(S5 & S6)

MCN 301	DISASTER MANAGEMENT	Category	L	T	P	CREDIT	YEAR OF INTRODUCTION
		Non - Credit	2	0	0	Nil	2019

Preamble: The objective of this course is to introduce the fundamental concepts of hazards and disaster management.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Define and use various terminologies in use in disaster management parlance and organise each of these terms in relation to the disaster management cycle (Cognitive knowledge level: **Understand**).
CO2	Distinguish between different hazard types and vulnerability types and do vulnerability assessment (Cognitive knowledge level: **Understand**).
CO3	Identify the components and describe the process of risk assessment, and apply appropriate methodologies to assess risk (Cognitive knowledge level: **Understand**).
CO4	Explain the core elements and phases of Disaster Risk Management and develop possible measures to reduce disaster risks across sector and community (Cognitive knowledge level: **Apply**)
CO5	Identify factors that determine the nature of disaster response and discuss the various disaster response actions (Cognitive knowledge level: **Understand**).
CO6	Explain the various legislations and best practices for disaster management and risk reduction at national and international level (Cognitive knowledge level: **Understand**).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2				2				2		2
CO2	2	3	2		2	2	3			3		2
CO3	2	3	2	2	2	2	3			3		2
CO4	3	3	3		2	2	3					2
CO5	3	3			2	2	3					2
CO6	3					2	3	3				2

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	**10**	**10**	**20**
Understand	**25**	**25**	**50**
Apply	**15**	**15**	**30**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment - Test : 25 marks

Continuous Assessment - Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A.

Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

MCN 301 Disaster Management

Module 1

Systems of earth

Lithosphere- composition, rocks, soils; Atmosphere-layers, ozone layer, greenhouse effect, weather, cyclones, atmospheric circulations, Indian Monsoon; hydrosphere- Oceans, inland water bodies; biosphere

Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard, exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, disaster risk management, early warning systems, disaster preparedness, disaster prevention, disaster mitigation, disaster response, damage assessment, crisis counselling, needs assessment.

Module 2

Hazard types and hazard mapping; Vulnerability types and their assessment- physical, social, economic and environmental vulnerability.

Disaster risk assessment –approaches, procedures

Module 3

Disaster risk management -Core elements and phases of Disaster Risk Management

Measures for Disaster Risk Reduction – prevention, mitigation, and preparedness.

Disaster response- objectives, requirements; response planning; types of responses.

Relief; international relief organizations.

Module 4

Participatory stakeholder engagement; Disaster communication- importance, methods, barriers; Crisis counselling

Capacity Building: Concept – Structural and Non-structural Measures, Capacity Assessment; Strengthening Capacity for Reducing Risk

Module 5

Common disaster types in India; Legislations in India on disaster management; National disaster management policy; Institutional arrangements for disaster management in India.

The Sendai Framework for Disaster Risk Reduction- targets, priorities for action, guiding principles

Reference Text Book

1. R. Subramanian, Disaster Management, Vikas Publishing House, 2018

2. M. M. Sulphey, Disaster Management, PHI Learning, 2016

3. UNDP, Disaster Risk Management Training Manual, 2016

4. United Nations Office for Disaster Risk Reduction, Sendai Framework for Disaster Risk Reduction 2015-2030, 2015

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?

2. What are disasters? What are their causes?

3. Explain the different types of cyclones and the mechanism of their formation

4. Explain with examples, the difference between hazard and risk in the context of disaster management

5. Explain the following terms in the context of disaster management (a) exposure (b) resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment

Course Outcome 2 (CO2):

1. What is hazard mapping? What are its objectives?

2. What is participatory hazard mapping? How is it conducted? What are its advantages?

3. Explain the applications of hazard maps

4. Explain the types of vulnerabilities and the approaches to assess them

Course Outcome 3 (CO3):

1. Explain briefly the concept of ‘disaster risk’

2. List the strategies for disaster risk management 'before', 'during' and 'after' a disaster
3. What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy

Course Outcome 4 (CO4):

1. What is disaster prevention? Distinguish it from disaster mitigation giving examples
2. What are the steps to effective disaster communication? What are the barriers to communication?
3. Explain capacity building in the context of disaster management

Course Outcome 5 (CO5):

1. Briefly explain the levels of stakeholder participation in the context of disaster risk reduction
2. Explain the importance of communication in disaster management
3. Explain the benefits and costs of stakeholder participation in disaster management
4. How are stakeholders in disaster management identified?

Course Outcome 6 (CO6):

1. Explain the salient features of the National Policy on Disaster Management in India
2. Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction
3. What are Tsunamis? How are they caused?
4. Explain the earthquake zonation of India

Model Question paper

QP CODE: **PAGES:3**

Reg No:______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MCN 301

Course Name: Disaster Management

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?
2. What are disasters? What are their causes?
3. What is hazard mapping? What are its objectives?
4. Explain briefly the concept of 'disaster risk'
5. List the strategies for disaster risk management 'before', 'during' and 'after' a disaster
6. What is disaster prevention? Distinguish it from disaster mitigation giving examples
7. Briefly explain the levels of stakeholder participation in the context of disaster risk reduction
8. Explain the importance of communication in disaster management
9. What are Tsunamis? How are they caused?
10. Explain the earthquake zonation of India

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. a. Explain the different types of cyclones and the mechanism of their formation [10]

b. Explain with examples, the difference between hazard and risk in the context of disaster management
[4]

OR

12. Explain the following terms in the context of disaster management [14]

(a) exposure (b) resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment

13. a. What is participatory hazard mapping? How is it conducted? What are its advantages?

[8]

b. Explain the applications of hazard maps [6]

OR

14. Explain the types of vulnerabilities and the approaches to assess them [14]

15. a. Explain the core elements of disaster risk management [8]

b. Explain the factors that decide the nature of disaster response [6]

OR

16. a. What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy [6]

b. Explain the different disaster response actions [8]

17. a. Explain the benefits and costs of stakeholder participation in disaster management [10]

b. How are stakeholders in disaster management identified? [4]

OR

18. a. What are the steps to effective disaster communication? What are the barriers to communication? [7]

b. Explain capacity building in the context of disaster management [7]

19. Explain the salient features of the National Policy on Disaster Management in India

[14]

OR

20. Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction [14]

Teaching Plan

	Module 1	**5 Hours**
1.1	Introduction about various Systems of earth, Lithosphere-composition, rocks, Soils; Atmosphere-layers, ozone layer, greenhouse effect, weather	1 Hour
1.2	Cyclones, atmospheric circulations, Indian Monsoon; hydrosphere-Oceans, inland water bodies; biosphere	1 Hour
1.3	Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard,	1 Hour
1.4	Exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, Disaster risk management, early warning systems	1 Hour
1.5	Disaster preparedness, disaster prevention, disaster, Mitigation, disaster response, damage assessment, crisis counselling, needs assessment.	1 Hour
	Module 2	**5 Hours**
2.1	Various Hazard types, Hazard mapping; Different types of Vulnerability types and their assessment	1 Hour
2.2	Vulnerability assessment and types, Physical and social vulnerability	1 Hour
2.3	Economic and environmental vulnerability, Core elements of disaster risk assessment	1 Hour
2.4	Components of a comprehensive disaster preparedness strategy approaches, procedures	1 Hour
2.5	Different disaster response actions	1 Hour
	Module 3	**5 Hours**
3.1	Introduction to Disaster risk management, Core elements of Disaster Risk Management	1 Hour
3.2	Phases of Disaster Risk Management, Measures for Disaster Risk Reduction	1 Hour
3.3	Measures for Disaster prevention, mitigation, and preparedness.	1 Hour

3.4	Disaster response- objectives, requirements. Disaster response planning; types of responses.	1 Hour
3.5	Introduction- Disaster Relief, Relief; international relief organizations.	1 Hour
	Module 4	**5 Hours**
4.1	Participatory stakeholder engagement	1 Hour
4.2	Importance of disaster communication.	1 Hour
4.3	Disaster communication- methods, barriers. Crisis counselling	1 Hour
4.4	Introduction to Capacity Building. Concept – Structural Measures, Non-structural Measures.	1 Hour
4.5	Introduction to Capacity Assessment, Capacity Assessment; Strengthening, Capacity for Reducing Risk	1 Hour
	Module 5	**5 Hours**
5.1	Introduction-Common disaster types in India.	1 Hour
5.2	Common disaster legislations in India on disaster management	1 Hour
5.3	National disaster management policy, Institutional arrangements for disaster management in India.	1 Hour
5.4	The Sendai Framework for Disaster Risk Reduction and targets	1 Hour
5.5	The Sendai Framework for Disaster Risk Reduction-priorities for action, guiding principles	1 Hour

HUT 300	Industrial Economics & Foreign Trade	Category	L	T	P	CREDIT
		HSMC	**3**	**0**	**0**	**3**

Preamble: To equip the students to take industrial decisions and to create awareness of economic environment.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the problem of scarcity of resources and consumer behaviour, and to evaluate the impact of government policies on the general economic welfare. (Cognitive knowledge level: **Understand**)
CO2	Take appropriate decisions regarding volume of output and to evaluate the social cost of production. (Cognitive knowledge level: **Apply**)
CO3	Determine the functional requirement of a firm under various competitive conditions. (Cognitive knowledge level: **Analyse**)
CO4	Examine the overall performance of the economy, and the regulation of economic fluctuations and its impact on various sections in the society. (Cognitive knowledge level: **Analyse**)
CO5	Determine the impact of changes in global economic policies on the business opportunities of a firm. (Cognitive knowledge level: **Analyse**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2										3	
CO2	2	2			2	2	3				3	
CO3	2	2	1								3	
CO4	2	2	1			1					3	
CO5	2	2	1								3	

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	**15**	**15**	**30**
Understand	**20**	**20**	**40**
Apply	**15**	**15**	**30**

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment - Test (2 numbers)	: 25 marks
Continuous Assessment - Assignment	: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B.

Part A	: 30 marks
Part B	: 70 marks

Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 3 sub-divisions and carries 14 marks.

SYLLABUS

HUT 300 Industrial Economics & Foreign Trade

Module 1 (Basic Concepts and Demand and Supply Analysis)

Scarcity and choice - Basic economic problems- PPC – Firms and its objectives – types of firms – Utility – Law of diminishing marginal utility – Demand and its determinants – law of demand – elasticity of demand – measurement of elasticity and its applications – Supply, law of supply and determinants of supply – Equilibrium – Changes in demand and supply and its effects – Consumer surplus and producer surplus (Concepts) – Taxation and deadweight loss.

Module 2 (Production and cost)

Production function – law of variable proportion – economies of scale – internal and external economies – Isoquants, isocost line and producer's equilibrium – Expansion path – Technical progress and its implications – Cobb-Douglas production function - Cost concepts – Social cost: private cost and external cost – Explicit and implicit cost – sunk cost - Short run cost curves - long run cost curves – Revenue (concepts) – Shutdown point – Break-even point.

Module 3 (Market Structure)

Perfect and imperfect competition – monopoly, regulation of monopoly, monopolistic completion (features and equilibrium of a firm) – oligopoly – Kinked demand curve – Collusive oligopoly (meaning) – Non-price competition – Product pricing – Cost plus pricing – Target return pricing – Penetration pricing – Predatory pricing – Going rate pricing – Price skimming.

Module 4 (Macroeconomic concepts)

Circular flow of economic activities – Stock and flow – Final goods and intermediate goods - Gross Domestic Product - National Income – Three sectors of an economy- Methods of measuring national income – Inflation- causes and effects – Measures to control inflation- Monetary and fiscal policies – Business financing- Bonds and shares -Money market and Capital market – Stock market – Demat account and Trading account - SENSEX and NIFTY.

Module 5 (International Trade)

Advantages and disadvantages of international trade - Absolute and Comparative advantage theory - Heckscher - Ohlin theory - Balance of payments – Components – Balance of Payments deficit and devaluation – Trade policy – Free trade versus protection – Tariff and non-tariff barriers.

Reference Materials

1. Gregory N Mankiw, 'Principles of Micro Economics', Cengage Publications
2. Gregory N Mankiw, 'Principles of Macro Economics', Cengage Publications
3. Dwivedi D N, 'Macro Economics', Tata McGraw Hill, New Delhi.
4. Mithani D M, 'Managerial Economics', Himalaya Publishing House, Mumbai.
5. Francis Cherunilam, 'International Economics', McGraw Hill, New Delhi.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Why does the problem of choice arise?
2. What are the central problems?
3. How do we solve the basic economic problems?
4. What is the relation between price and demand?
5. Explain deadweight loss due to the imposition of a tax.

Course Outcome 2 (CO2):

1. What is shutdown point?
2. What do you mean by producer equilibrium?
3. Explain break-even point;
4. Suppose a chemical factory is functioning in a residential area. What are the external costs?

Course Outcome 3 (CO3):

1. Explain the equilibrium of a firm under monopolistic competition.
2. Why is a monopolist called price maker?
3. What are the methods of non-price competition under oligopoly?

4. What is collusive oligopoly?

Course Outcome 4 (CO4):

1. What is the significance of national income estimation?
2. How is GDP estimated?
3. What are the measures to control inflation?
4. How does inflation affect fixed income group and wage earners?

Course Outcome 5 (CO5):

1. What is devaluation?
2. Suppose a foreign country imposes a tariff on Indian goods. How does it affect India's exports?
3. What is free trade?
4. What are the arguments in favour of protection?

Model Question paper

QP CODE: **PAGES:3**

Reg No:______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIFTH /SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: HUT 300

Course Name: Industrial Economics & Foreign Trade

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Why does an economic problem arise?

2. What should be the percentage change in price of a product if the sale is to be increased by 50 percent and its price elasticity of demand is 2?

3. In the production function Q= $2L^{1/2}K^{1/2}$ if L=36 how many units of capital are needed to produce 60 units of output?

4. Suppose in the short run AVC 4. Suppose in the short run AVC<P<AC. Will this firm produce or shut down? Give reason.

5. What is predatory pricing?

6. What do you mean by non- price competition under oligopoly?

7. What are the important economic activities under primary sector?

8. Distinguish between a bond and share?

9. What are the major components of balance of payments?

10. What is devaluation? **(10 x 3 = 30 marks)**

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Prepare a utility schedule showing units of consumption, total utility and marginal utility, and explain the law of diminishing marginal utility. Point out any three limitations of the law.

b) How is elasticity of demand measured according to the percentage method? How is the measurement of elasticity of demand useful for the government?

Or

12. a) Explain the concepts consumer surplus and producer surplus.

b) Suppose the government imposes a tax on a commodity where the tax burden met by the consumers. Draw a diagram and explain dead weight loss. Mark consumer surplus, producer surplus, tax revenue and dead weight loss in the diagram.

MODULE II

13. a) What are the advantages of large-scale production?

b) Explain Producer equilibrium with the help of isoquants and isocost line. What is expansion path?

Or

14. a) Explain break-even analysis with the help of a diagram.

b) Suppose the monthly fixed cost of a firm is Rs. 40000 and its monthly total variable cost is Rs. 60000.

i. If the monthly sales is Rs. 120000 estimate contribution and break-even sales.
ii. If the firm wants to get a monthly profit of Rs.40000, what should be the sales?

c) The total cost function of a firm is given as $TC=100+50Q - 11Q^2+Q^3$. Find marginal cost when output equals 5 units.

MODULE III

15. a) What are the features of monopolistic competition?

b) Explain the equilibrium of a firm earning supernormal profit under monopolistic competition.

Or

16. a) Make comparison between perfect competition and monopoly.

b) Explain price rigidity under oligopoly with the help of a kinked demand curve.

MODULE IV

17. a) How is national income estimated under product method and expenditure method?

b) Estimate GDPmp, GNPmp and National income

Private consumption expenditure	= 2000 (in 000 cores)
Government Consumption	= 500
NFIA	= -(300)
Investment	= 800
Net=exports	=700
Depreciation	= 400
Net-indirect tax	= 300

Or

18. a) What are the monetary and fiscal policy measures to control inflation?

b) What is SENSEX?

MODULE V

19. a) What are the advantages of disadvantages of foreign trade?

b) Explain the comparative cost advantage.

Or

20. a) What are the arguments in favour protection?

b) Examine the tariff and non-tariff barriers to international trade.

(5 × 14 = 70 marks)

Teaching Plan

Module 1 (Basic concepts and Demand and Supply Analysis)		7 Hours
1.1	Scarcity and choice – Basic economic problems - PPC	1 Hour
1.2	Firms and its objectives – types of firms	1 Hour
1.3	Utility – Law of diminishing marginal utility – Demand – law of demand	1 Hour
1.4	Measurement of elasticity and its applications	1 Hour
1.5	Supply, law of supply and determinants of supply	1 Hour
1.6	Equilibrium – changes in demand and supply and its effects	1 Hour
1.7	Consumer surplus and producer surplus (Concepts) – Taxation and deadweight loss.	1 Hour
Module 2 (Production and cost)		**7 Hours**
2.1	Productions function – law of variable proportion	1 Hour
2.2	Economies of scale – internal and external economies	1 Hour
2.3	producers equilibrium – Expansion path	1 Hour
2.4	Technical progress and its implications – cob Douglas Production function	1 Hour
2.5	Cost concepts – social cost: private cost and external cost – Explicit and implicit cost – sunk cost	1 Hour
2.6	Short run cost curves & Long run cost curves	1 Hour
2.7	Revenue (concepts) – shutdown point – Break-even point.	1 Hour
Module 3 (Market Structure)		**6 hours**
3.1	Equilibrium of a firm, MC – MR approach and TC – TR approach	1 Hour
3.2	Perfect competition & Imperfect competition	1 Hour
3.3	Monopoly – Regulation of monopoly – Monopolistic competition	1 Hour
3.4	Oligopoly – kinked demand curve	1 Hour
3.5	Collusive oligopoly (meaning) – Non price competition	1 Hour
3.6	Cost plus pricing – Target return pricing – Penetration, Predatory pricing – Going rate pricing – price skimming	1 Hour

Module 4 (Macroeconomic concepts)		**7 Hours**
4.1	Circular flow of economic activities	1 Hour
4.2	Stock and flow – Final goods and intermediate goods – Gross Domestic Product - National income – Three sectors of an economy	1 Hour
4.3	Methods of measuring national income	1 Hour
4.4	Inflation – Demand pull and cost push – Causes and effects	1 Hour
4.5	Measures to control inflation – Monetary and fiscal policies	1 Hour
4.6	Business financing – Bonds and shares – Money market and capital market	1 Hour
4.7	Stock market – Demat account and Trading account – SENSEX and NIFTY	1 Hour
Module 5 (International Trade)		**8 Hours**
5.1	Advantages and disadvantages of international trade	1 Hour
5.2	Absolute and comparative advantage theory	2 Hour
5.3	Heckscher – Ohlin theory	1 Hour
5.4	Balance of payments - components	1 Hour
5.5	Balance of payments deficit and devaluation	1 Hour
5.6	Trade policy – Free trade versus protection	1 Hour
5.7	Tariff and non tariff barriers.	1 Hour

HUT 310	**Management for Engineers**	**Category**	**L**	**T**	**P**	**Credit**
		HMC	**3**	**0**	**0**	**3**

Preamble: This course is intended to help the students to learn the basic concepts and functions of management and its role in the performance of an organization and to understand various decision-making approaches available for managers to achieve excellence. Learners shall have a broad view of different functional areas of management like operations, human resource, finance and marketing.

Prerequisite: Nil

Course Outcomes After the completion of the course the student will be able to

CO1	Explain the characteristics of management in the contemporary context (Cognitive Knowledge level: **Understand**).
CO2	Describe the functions of management (Cognitive Knowledge level: **Understand**).
CO3	Demonstrate ability in decision making process and productivity analysis (Cognitive Knowledge level: **Understand**).
CO4	Illustrate project management technique and develop a project schedule (Cognitive Knowledge level: **Apply**).
CO5	Summarize the functional areas of management (Cognitive Knowledge level: **Understand**).
CO6	Comprehend the concept of entrepreneurship and create business plans (Cognitive Knowledge level: **Understand**).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2				1	2	2	2		2	1	1
CO2	2				1	1		2	1	2	1	1
CO3	2	2	2	2	1							
CO4	2	2	2	2	1						2	1
CO5	2					1	1		1	2	1	
CO6		2	2	2	1	1	1	1	1	1	1	1

Abstract POs defined by National Board of Accreditation			
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Test 1 (Marks in percentage)	Test 2 (Marks in percentage)	End Semester Examination (Marks in percentage)
Remember	15	15	30
Understand	15	15	30
Apply	20	20	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment - Test : 25 marks

Continuous Assessment - Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

HUT 310 Management for Engineers (35 hrs)

Module 1 (Introduction to management Theory- 7 Hours)

Introduction to management theory, Management Defined, Characteristic of Management, Management as an art-profession, System approaches to Management, Task and Responsibilities of a professional Manager, Levels of Manager and Skill required.

Module 2 (management and organization- 5 hours)

Management Process, Planning types , Mission, Goals, Strategy, Programmes, Procedures, Organising, Principles of Organisation, Delegation, Span of Control, Organisation Structures, Directing, Leadership, Motivation, Controlling..

Module 3 (productivity and decision making- 7 hours)

Concept of productivity and its measurement; Competitiveness; Decision making process; decision making under certainty, risk and uncertainty; Decision trees; Models of decision making.

. **Module 4 (project management- 8 hours)**

Project Management, Network construction, Arrow diagram, Redundancy. CPM and PERT Networks, Scheduling computations, PERT time estimates, Probability of completion of project, Introduction to crashing.

Module 5 (functional areas of management- 8 hours)

Introduction to functional areas of management, Operations management, Human resources management, Marketing management, Financial management, Entrepreneurship, Business plans, Corporate social responsibility, Patents and Intellectual property rights.

References:

1. H. Koontz, and H. Weihrich, Essentials of Management: An International Perspective. 8th ed., McGraw-Hill, 2009.
2. P C Tripathi and P N Reddy, Principles of management, TMH, 4th edition, 2008.
3. P. Kotler, K. L. Keller, A. Koshy, and M. Jha, Marketing Management: A South Asian Perspective. 14th ed., Pearson, 2012.
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5. R. D. Hisrich, and M. P. Peters, Entrepreneurship: Strategy, Developing, and Managing a New Enterprise, 4th ed., McGraw-Hill Education, 1997.
6. D. J. Sumanth, Productivity Engineering and Management, McGraw-Hill Education, 1985.
7. K.Ashwathappa, 'Human Resources and Personnel Management', TMH, 3 rd edition, 2005.
8. R. B. Chase, Ravi Shankar and F. R. Jacobs, Operations and Supply Chain Management, 14th ed. McGraw Hill Education (India), 2015.

Sample Course Level Assessment Questions

Course Outcome1 (CO1): Explain the systems approach to management?

Course Outcome 2 (CO2): Explain the following terms with a suitable example Goal, Objective, and Strategy.

Course Outcome 3 (CO3): Mr. Shyam is the author of what promises to be a successful novel. He has the option to either publish the novel himself or through a publisher. The publisher is offering Mr. Shyam Rs. 20,000 for signing the contract. If the novel is successful, it will sell 200,000 copies. Else, it will sell 10,000 copies only. The publisher pays a Re. 1 royalty per copy. A market survey indicates that there is a 70% chance that the novel will be successful. If Mr. Shyam undertakes publishing, he will incur an initial cost of Rs. 90,000 for printing and marketing., but each copy sold will net him Rs. 2. Based on the given information and the decision analysis method, determine whether Mr. Shyam should accept the publisher's offer or publish the novel himself.

Course Outcome 4 (CO4): Explain the concepts of crashing and dummy activity in project management.

Course Outcome 5 (CO5): Derive the expression for the Economic order quantity (EOQ)?

Course Outcome 6 (CO6): Briefly explain the theories of Entrepreneurial motivation.?

Model Question Paper

QP CODE: PAGES: 4

Reg No:_______________ Name:_________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: HUT 310

Course name: Management for Engineers

Max Marks: 100 **Duration: 3 Hours**

PART-A (Answer All Questions. Each question carries 3 marks)

1. "Management is getting things done through other." Elaborate.

2. Comment on the true nature of management. Is it a science or an art?

3. Planning is looking ahead and controlling is looking back. Comment with suitable examples

4. Explain the process of communication?

5. Explain the hierarchy of objectives?

6. Explain the types of decisions?

7. Describe the Economic man model?

8. Explain the concepts of crashing and dummy activity in project management.

9. Differentiate the quantitative and qualitative methods in forecasting.

10. What are the key metrics for sustainability measurement? What makes the measurement and reporting of sustainability challenging?

PART-B (Answer any one question from each module)

11. a) Explain the systems approach to management. **(10)**

b) Describe the roles of a manager **(4)**

OR

12. a) Explain the 14 principles of administrative management? **(10)**

b) Explain the different managerial skills (**4)**

13. a) What are planning premises, explain the classification of planning premises. **(10)**

b) Distinguish between strategy and policy. How can policies be made effective. **(4)**

OR

14 a) Explain three motivational theories. **(9)**

b) Describe the managerial grid. **(5)**

15. a) Modern forest management uses controlled fires to reduce fire hazards and to stimulate new forest growth. Management has the option to postpone or plan a burning. In a specific forest tract, if burning is postponed, a general administrative cost of Rs. 300 is incurred. If a controlled burning is planned, there is a 50% chance that good weather will prevail and burning will cost Rs. 3200. The results of the burning may be either successful with probability 0.6 or marginal with probability 0.4. Successful execution will result in an estimated benefit of Rs. 6000, and marginal execution will provide only Rs. 3000 in benefits. If the weather is poor, burning will be cancelled incurring a cost of Rs. 1200 and no benefit. i) Develop a decision tree for the problem. (ii) Analyse the decision tree and determine the optimal course of action. **(8)**

b) Student tuition at ABC University is $100 per semester credit hour. The Education department supplements the university revenue by matching student tuition, dollars per dollars. Average class size for typical three credit course is 50 students. Labour costs are $4000 per class, material costs are $20 per student, and overhead cost are $25,000 per class. (a) Determine the total factor productivity. (b) If instructors deliver lecture 14 hours per week and the semester lasts for 16 weeks, what is the labour productivity? **(6)**

OR

16. a) An ice-cream retailer buys ice cream at a cost of Rs. 13 per cup and sells it for Rs. 20 per cup; any remaining unsold at the end of the day, can be disposed at a salvage price of Rs. 2.5 per cup. Past sales have ranged between 13 and 17 cups per day; there is no reason to believe that

sales volume will take on any other magnitude in future. Find the expected monetary value and EOL, if the sales history has the following probabilities: **(9)**

Market Size	13	14	15	16	17
Probability	0.10	0.15	0.15	0.25	0.35

b) At Modem Lumber Company, Kishore the president and a producer of an apple crates sold to growers, has been able, with his current equipment, to produce 240 crates per 100 logs. He currently purchases 100 logs per day, and each log required 3 labour hours to process. He believes that he can hire a professional buyer who can buy a better quality log at the same cost. If this is the case, he increases his production to 260 crates per 100 logs. His labour hours will increase by 8 hours per day. What will be the impact on productivity (measured in crates per labour-hour) if the buyer is hired? What is the growth in productivity in this case? **(5)**

17. a) A project has the following list of activities and time estimates:

Activity	**Time (Days)**	**Immediate Predecessors**
A	1	-
B	4	A
C	3	A
D	7	A
E	6	B
F	2	C, D
G	7	E, F
H	9	D
I	4	G, H

(a) Draw the network. (b) Show the early start and early finish times. (c) Show the critical path. **(10)**

b) An opinion survey involves designing and printing questionnaires, hiring and training personnel, selecting participants, mailing questionnaires and analysing data. Develop the precedence relationships and construct the project network. **(4)**

OR

18. a) The following table shows the precedence requirements, normal and crash times, and normal and crash costs for a construction project:

Activity	Immediate Predecessors	Required Time (Weeks)		Cost (Rs.)	
		Normal	Crash	Normal	Crash
A	-	4	2	10,000	11,000
B	A	3	2	6,000	9,000
C	A	2	1	4,000	6,000
D	B	5	3	14,000	18,000
E	B, C	1	1	9,000	9,000
F	C	3	2	7,000	8,000
G	E, F	4	2	13,000	25,000
H	D, E	4	1	11,000	18,000
I	H, G	6	5	20,000	29,000

Draw the network. (b) Determine the critical path. (c) Determine the optimal duration and the associated cost. **(10)**

b) Differentiate between CPM and PERT. **(4)**

19. a) What is meant by market segmentation and explain the process of market segmentation **(8)**

b) The Honda Co. in India has a division that manufactures two-wheel motorcycles. Its budgeted sales for Model G in 2019 are 80,00,000 units. Honda's target ending inventory is 10,00, 000 units and its beginning inventory is 12, 00, 000 units. The company's budgeted selling price to its distributors and dealers is Rs. 40, 000 per motorcycle. Honda procures all its wheels from an outside supplier. No defective wheels are accepted. Honda's needs for extra wheels for replacement parts are ordered by a separate division of the company. The company's target ending inventory is 3,00,000 wheels and its beginning inventory is 2,00,000 wheels. The budgeted purchase price is Rs. 1,600 per wheel.

(a) Compute the budgeted revenue in rupees.

(b) Compute the number of motorcycles to be produced.

Compute the budgeted purchases of wheels in units and in rupees.? **(6)**

OR

20. a) a) "Human Resource Management policies and principles contribute to effectiveness, continuity and stability of the organization". Discuss. (b) What is a budget? Explain how sales budget and production budgets are prepared? **(10)**

b) Distinguish between the following: (a) Assets and Liabilities (b) Production concept and Marketing concept (c) Needs and Wants (d) Design functions and Operational control functions in operations **(4)**

Teaching Plan

Sl.No	TOPIC	SESSION
	Module I	
1.1	Introduction to management	1
1.2	Levels of managers and skill required	2
1.3	Classical management theories	3
1.4	neo-classical management theories	4
1.5	modern management theories	5
1.6	System approaches to Management,	6
1.7	Task and Responsibilities of a professional Manager	7
	Module 2	
2.1	Management process – planning	8
2.2	Mission – objectives – goals – strategy – policies – programmes – procedures	9
2.3	Organizing, principles of organizing, organization structures	10
2.4	Directing, Leadership	11
2.5	Motivation, Controlling	12
	Module III	
3.1	Concept of productivity and its measurement Competitiveness	13
3.2	Decision making process;	14
3.3	Models in decision making	15
3.4	Decision making under certainty and risk	16
3.5	Decision making under uncertainty	17
3.6	Decision trees	18
3.7	Models of decision making.	19
	Module IV	
4.1	Project Management	20

Sl.No	TOPIC	SESSION
	Module I	
4.2	Network construction	21
4.3	Arrow diagram, Redundancy	22
4.4	CPM and PERT Networks	23
4.5	Scheduling computations	24
4.6	PERT time estimates	25
4.7	Probability of completion of project	26
4.8	Introduction to crashing	
	Module V	
5.1	Introduction to functional areas of management,	28
5.2	Operations management	29
5.3	Human resources management ,	30
5.4	Marketing management	31
5.5	Financial management	32
5.6	Entrepreneurship,	33
5.7	Business plans	34
5.8	Corporate social responsibility, Patents and Intellectual property rights	35

SEMESTER VII

CDT 401	CONCEPTS IN CLOUD COMPUTING	CATEGORY	L	T	P	CREDIT
		PCC	2	1	0	3

Preamble:
This course helps the learners to understand cloud computing concepts. This course includes basic understanding of virtualization, fundamentals of cloud security, cloud computing based programming techniques and different industry popular cloud computing platforms. This course enables the student to suggest cloud based solutions to real world problems.

Prerequisite: Basic understanding of computer networks, operating systems and big data processing.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Explain the various cloud computing and service models. **(Cognitive Knowledge Level: Understand)**
CO 2	Demonstrate the significance of implementing virtualization techniques. **(Cognitive Knowledge Level: Understand)**
CO 3	Explain different cloud enabling technologies and compare private cloud platforms. **(Cognitive Knowledge Level: Understand)**
CO 4	Apply appropriate cloud programming methods to solve big data problems. **(Cognitive Knowledge Level: Apply)**
CO 5	Describe the need for security mechanisms in cloud. **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											✓
CO2	✓	✓	✓									✓
CO3	✓											✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓			✓							✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (percentage)	Test2 (percentage)	
Remember	20	20	20
Understand	60	60	60
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance: 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module -1 INTRODUCTION TO CLOUD COMPUTING

Traditional computing- Limitations. System Models for Distributed and Cloud Computing – Software Environments for Distributed Systems and Clouds – Cloud Computing and Service Models – Public – Private – Hybrid Clouds – Infrastructure-as-a-Service (IaaS) – Platform-as-a-Service (PaaS) - Software-as-a-Service (SaaS)-Different Service Providers.

Module -2 INTRODUCTION TO VIRTUALIZATION

Virtual Machines and Virtualization Middleware – Data Center Virtualization for Cloud Computing – Implementation Levels of Virtualization – Virtualization Structures/Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices

Module -3 CLOUD ARCHITECTURE AND RESOURCE MANAGEMENT

Architectural Design of Compute and Storage Clouds – Public Cloud Platforms: GAE – AWS – Azure-Emerging Cloud Software Environments – Eucalyptus- Nimbus – Open Stack – Extended Cloud Computing Services – Resource Provisioning and Platform Deployment – Virtual Machine Creation and Management

Module -4 CLOUD PROGRAMMING AND CLOUD SERVICES

Parallel Computing and Programming Paradigms – Map Reduce – Twister –Hadoop Library from Apache – Pig Latin High Level Languages– Programming the Google App Engine – Google File System (GFS) – Big Table – Google's NOSQL System

Email Communications – Cloud Computing for the Community - Collaborating on Calendars – Schedules and Task Management – Exploring Online Scheduling Applications – Exploring Online Planning and Task Management – Collaborating on Event Management -Word Processing – Databases.

Module -5 **SECURITY IN THE CLOUD**

Security Overview – Cloud Security Challenges – Security -as-a Service – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security

Cloud Forensics - Introduction to cloud forensics - Framework -Evidence Source Identification and preservation - Collection of Evidence - Examination and analysis of collected data.

Text Book

Kai Hwang , Geoffrey C Fox, Jack J Dongarra : "Distributed and Cloud Computing – From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers – 2012.

Reference Books

1.Alex Amies, Harm Sluiman, Qiang Guo Tong and Guo Ning Liu: Developing and Hosting Applications on the cloud, IBM Press, 2012.

2.George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud (Theory in Practice)", O'Reilly Publications, 2009**.**

3. Haley Beard, "Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing – applications and Data Centers in the Cloud with SLAs",Emereo Pty Limited, July 2008

4. James E. Smith and Ravi Nair: Virtual Machines: Versatile Platforms for Systems and Processes, Morgan Kaufmann, ELSEVIER Publication, 2006.

5. John W Rittinghouse and James F Ransome , "Cloud Computing: Implementation – Management – and Security", CRC Press, 2010.

6. Michael Miller, "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online", Pearson Education, 2009.

7. Richard N. Katz, "The Tower and The Cloud", Higher Education in the Age of Cloud Computing, 2008.

8. Toby Velte, Anthony Velte and Robert Elsenpeter: “Cloud Computing – A Practical Approach”, TMH, 2009.

9. Lei Chen, Hassan Takabi and Nhien-An Le-Khac, “Security, Privacy, and Digital Forensics in the Cloud”, Wiley 2019. Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. “A hybrid cloud is a combination of two or more other cloud deployment models”. Justify the statement with an example.
2. What are the main characteristics of a Platform-as-a-Service solution?
3. How does cloud computing help to reduce the time to market for applications and to cut down capital expenses?
4. Differentiate public and private clouds in terms of flexibility

Course Outcome 2 (CO2):

1. Define virtualization. What is the role of VMM in virtualization?
2. Explain various implementation levels of Virtualization.
3. State the differences between a traditional computer and a virtual machine

Course Outcome 3(CO3):

1. Differentiate between on-premise and cloud-based internetworking.
2. What are the benefits of Data Center Technologies?
3. What are the characteristics of Multi-tenant technology?
4. How can virtualization be implemented at the hardware level?

Course Outcome 4 (CO4):

1. Write a Hadoop MapReduce program that counts the number of occurrences of each character in a file.
2. Write a Hadoop MapReduce program to find the maximum temperature in the weather dataset

Course Outcome 5 (CO5):

1. Why is it harder to establish security in the cloud?
2. Explain in detail about the security issues one should discuss with a cloud-computing vendor.
3. List and Explain major cloud security challenges.
4. Explain the cloud-based databases.
5. Explain the framework for cloud forensic.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CDT401

Course Name: Concepts in Cloud Computing

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Is the IT outsourcing model of traditional computing similar to cloud computing? Justify.
2. Why is grid computing considered as the predecessor of cloud computing? Explain.
3. What is virtualization and what are its benefits?
4. Explain why a hypervisor is also called a virtual machine monitor?
5. Differentiate between multi-tenancy and virtualization.
6. "The field of service technology is a keystone foundation of cloud computing". Explain.
7. Discuss any two identity management techniques used in cloud computing
8. Differentiate between mandatory access control (MAC) and discretionary Access Control (DAC).

9. Differentiate between Amazon S3 and Amazon EBS.

10. Explain the database service offered by google cloud.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Discuss the cloud computing reference model. **(8)**

(b) Which are the basic components of an IaaS-based solution for cloud computing? Also provide some examples of IaaS implementations. **(6)**

OR

12. (a) List down the characteristics and challenges of cloud computing **(8)**

(b) Classify the various types of clouds. **(6)**

13. (a) List and discuss various types of virtualizations **(8)**

(b) Differentiate between full virtualization and paravirtualization **(6)**

OR

14. (a) What is Xen? Discuss its elements for virtualization **(8)**

(b) Explain the design requirements for Virtual Machine Monitor (VMM). **(6)**

15. (a) Explain the broadband networks and internet architecture. **(8)**

(b) List and explain the technologies and components of data centres. **(6)**

OR

16. (a) Explain any twocloud software environment. **(8)**

(b) Explain different types of resource provisioning in cloud **(6)**

17. (a) Imagine you are conducting an Arts Festival at your college. Explain the different steps that you will take to make the event successful using the cloud. **(10)**

(b) Explain thelogical data flow of MapReduce function using a suitable example . **(4)**

OR

18. (a) If 2 teams from US and India are collaboratively working on a project, discuss a means by which they can access data. Explain with 2 examples. **(6)**

(b) Write a Hadoop MapReduce program that counts the number of occurrences of each word in a file **(8)**

19. (a) Explain the life cycle of Secure software Development (SecSDLC) **(7)**

(b) Discuss how collaboration on Schedules is made easy with Cloud Computing. **(7)**

OR

20. (a) Explain Security Architecture Design in cloud. **(7)**

(b) Explain cloud forensics **(7)**

Teaching Plan		
No	**Contents**	**No. of Lecture Hours (36 hrs)**
Module -1 (INTRODUCTION TO CLOUD COMPUTING)		**(6 hours)**
1.1	Traditional computing- Limitations	1 hour
1.2	System Models for Distributed and Cloud Computing	1 hour
1.3	Software Environments for Distributed Systems and Clouds	1 hour
1.4	Cloud Computing and Service Models –Infrastructure-as-a-Service (IaaS) – Platform-as-a Service (PaaS) - Software-as-a-Service (SaaS)	1 hour

1.5	Public – Private – Hybrid Clouds	1 hour
1.6	Different Service Providers	1 hour
Module -2(INTRODUCTION TO VIRTUALIZATION		**(8 hours)**
2.1	Virtual Machines	1 hour
2.2	Virtualization Middleware	1 hour
2.3	Data Center Virtualization for Cloud Computing	1 hour
2.4	Implementation Levels of Virtualization	1 hour
2.5	Virtualization Structures/Tools and Mechanisms-Xen Architecture	1 hour
2.6	Full Virtualization	1 hour
2.7	Para Virtualization	1 hour
2.8	Virtualization of CPU – Memory – I/O Devices	1 hour
Module -3 (CLOUD ARCHITECTURE AND RESOURCE MANAGEMENT		(8 hours)
3.1	Architectural Design of Compute and Storage Clouds	1 hour
3.2	Public Cloud Platforms: GAE	1 hour
3.3	AWS,Azure	1 hour
3.4	Emerging Cloud Software Environments – Eucalyptus	1 hour
3.5	Nimbus – Open Stack	1 hour
3.6	Extended Cloud Computing Services	1 hour
3.7	Resource Provisioning and Platform Deployment	1 hour
3.8	Virtual Machine Creation and Management	1 hour
Module -4(CLOUD PROGRAMMING)		**(7 hours)**
4.1	Parallel Computing and Programming Paradigms- Map Reduce - Twister	1 hour
4.2	Hadoop Library from Apache- Pig Latin High Level Languages - Programming the Google App Engine	1 hour
4.3	Google File System (GFS)- Big Table- Google's NOSQL System	1 hour
4.4	Email Communications – Cloud Computing for the Community - Collaborating on Calendars.	1 hour
4.5	Schedules and Task Management – Exploring Online Scheduling Applications –	1 hour
4.6	Exploring Online Planning and Task Management	1 hour
4.7	Collaborating on Event Management -Word Processing – Databases	1 hour

Module -5 (SECURITY IN THE CLOUD)		(7 hours)
5.1	Security Overview – Cloud Security Challenges	1 hour
5.2	Security -as-a Service – Security Governance	1 hour
5.3	Risk Management – Security Monitoring	1 hour
5.4	Security Architecture Design	1 hour
5.5	Data Security – Application Security – Virtual Machine Security	1 hour
5.6	Cloud Forensics - Introduction to cloud forensics - Framework -	1 hour
5.7	Evidence Source Identification and preservation - Collection of Evidence-Examination and analysis of collected data.	1 hour

CDL 411	CLOUD COMPUTING LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3	3	2019

Preamble:

The course enables the learners to get hands-on experience in network programming and various features offered by cloud computing. It covers the implementation of basic networking protocols, virtual machine installation, Google App Engine and various cloud tools. This course helps the learners to understand the basics of virtual machines and cloud application development.

Prerequisite:

Sound knowledge in Programming in Python, Data Structures and Computer Networks

Course Outcomes: At the end of the course, the student should be able to:

CO1	Develop network application programs and protocols. **(Cognitive Knowledge Level: Apply)**
CO2	Analyze network traffic **(Cognitive Knowledge Level: Apply)**
CO3	Implement Infrastructure as a service (**Cognitive knowledge: Apply)**
CO4	Implement platform as a service.**(Cognitive knowledge: Apply)**
CO5	Implement Software as a service **(Cognitive knowledge:Apply)**

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓					✓		✓		✓
CO2	✓	✓	✓	✓				✓		✓		✓
CO3	✓	✓	✓	✓	✓			✓		✓		✓
CO4	✓	✓	✓	✓	✓	✓		✓		✓		✓
CO5	✓	✓	✓	✓	✓			✓		✓		✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and teamwork
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern:

Bloom's Category	**Continuous Assessment Test(Internal Exam) Marks in percentage**	**End Semester Examination Marks in percentage**
Remember	20	20
Understand	20	20
Apply	60	60
Analyse		
Evaluate		
Create		

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	**75**	**75**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : 15 marks
Continuous Evaluation in Lab : 30 marks

Continuous Assessment Test : 15 marks
Viva Voce : 15 marks

Internal Examination Pattern:
The marks will be distributed as Algorithm30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

End Semester Examination Pattern:

The percentage of marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva30 marks. Total 75 marks.

Operating System to Use in Lab : Linux
Programming Language to Use in Lab : Python

Fair Lab Record:
All Students attending the cloud computing lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record, the right-hand page should contain Experiment Heading, Experiment Number, Date of experiment, Aim of the Experiment and the operations performed on them, Details of experiment including algorithm and result of Experiment. The left-hand page should contain a print out of the code used for experiment and sample output obtained for a set of input.

SYLLABUS

CLOUD COMPUTING LAB

*Mandatory

1. Implement Client-Server communication using Socket Programming and TCP as transport layer protocol.*
2. Implement Client-Server communication using Socket Programming and UDP as transport layer protocol.*
3. Implement a multi user chat server using TCP as transport layer protocol.*
4. Implement and simulate algorithm for Distance vector routing protocol.*
5. Develop a packet capturing and filtering application using raw sockets.
6. Design and configure a network with multiple subnets with wired and wireless LANs using required network devices. Configure the following services in the network- TELNET, SSH, FTP server, Web server, File server, DHCP server and DNS server.
7. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)

8. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS *
9. Install a compiler in the virtual machine created using virtual box and execute Simple Programs*
10. Install spark and run simple applications like wordcount.*
11. Install Google App Engine. Create hello world app and other simple web applications using python/java.*
12. Use GAE launcher to launch the web applications.
13. Simulate a cloud scenario using CloudSim and run a scheduling algorithm.
14. Find a procedure to transfer the files from one virtual machine to another virtual machine.*
15. Implement a hello world web application and deploy using docker.*
16. Familiarization of AWS Webhosting, VPC, ELB

CLOUD COMPUTING LAB - PRACTICE QUESTIONS

1. Implement a multi-user chat server using TCP as transport layer protocol.
2. Implement a simple web proxy server that accepts HTTP requests and forwarding to remote servers and returning data to the client using TCP
3. Implement a Concurrent Time Server application using UDP to execute the program at a remote server. Client sends a time request to the server, server sends its system time back to the client. Client displays the result.
4. Implement Distance Vector Routing algorithm or Link State Routing algorithm
5. Develop packet capturing and filtering application using raw sockets.
6. Install and use identity management feature of OpenStack (https://www.openstack.org/)
7. Explore box(https://www.box.com/home), Sync(https://www.sync.com/), JustCloud, Amazon Drive and NordLocker file storage and sharing solutions. Use only their trail versions.
8. Work with Youtube, a cloud service to upload your own educational video(s) and use appropriate settings to make it public.
9. Work with SlideShare (http://www.slideshare.net/) which is a cloud service for slide sharing owned and controlled by LinkedIn.
10. *Virtualization:* Install Oracle Virtual box and create two VMs on your laptop.
11. Install a C++ compiler in the virtual machine and execute a sample program
12. Establish an Google Cloud Platform (https://cloud.google.com) account (use trail version). Explore the following:

(i) IAM & Admin
(ii) Billing
(iii) Marketplace (Creating Virtual Machines)
(iv) Compute Engine
(v) Cloud Storage
(vi) SQL
(vii) Security

13. Use Google App Engine to

    (a) Write a Google app engine program to generate n even numbers and deploy it to Google cloud.

    (b) Write a Google app engine program to multiply two matrices.

    (c) Google app engine program to validate user; create a database login(username, password)in mysql and deploy to cloud.

    (d) Write a Google app engine program to display nth largest no from the given list of numbers and deploy it in Google cloud

14. Establish an AWS account(use trail version). Use the AWS Management Console to launch an Elastic Compute Cloud (EC2) instance and connect to it.
15. Implement a hello world web application and deploy using docker.

CDQ413	SEMINAR	CATEGORY	L	T	P	CREDIT
		PWS	0	0	3	2

Preamble: The course ‘Seminar’ is intended to enable a B.Tech graduate to read, understand, present and prepare report about an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his seminar guide. This course can help the learner to experience how a presentation can be made about a selected academic document and also empower her/him to prepare a technical report.

Course Objectives:

- To do literature survey in a selected area ofstudy.
- To understand an academic document from the literate and to give a presentation about it.
- To prepare a technical report.

Course Outcomes [COs] : After successful completion of the course, the students will be able to:

CO1	Identify academic documents from the literature which are related to her/his areas of interest (Cognitive knowledge level: **Apply**).
CO2	Read and apprehend an academic document from the literature which is related to her/ his areas of interest (Cognitive knowledge level: **Analyze**).
CO3	Prepare a presentation about an academic document (Cognitive knowledge level: **Create**).
CO4	Give a presentation about an academic document (Cognitive knowledge level: **Apply**).
CO5	Prepare a technical report (Cognitive knowledge level: **Create**).

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1		2	1					3
CO2	3	3	2	3		2	1					3
CO3	3	2			3			1		2		3
CO4	3				2			1		3		3
CO5	3	3	3	3	2	2		2		3		3

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

General Guidelines

- The Department shall form an Internal Evaluation Committee (IEC) for the seminar with academic coordinator for that program as the Chairperson/Chairman and seminar coordinator & seminar guide as members. During the seminar presentation of a student, all members of IEC shall be present.
- Formation of IEC and guide allotment shall be completed within a week after the University examination (or last working day) of the previous semester.
- Guide shall provide required input to their students regarding the selection of topic/ paper.
- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than a very specific research work. It's advisable to choose a topic for the Seminar to be closely linked to the final year project area. Every member of the project team could choose or be assigned Seminar topics that covers various aspects linked to the Project area.
- A topic/paper relevant to the discipline shall be selected by the student during the semester break.
- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IEC.
- The IEC shall approve the selected topic/paper by the second week of the semester.
- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

Evaluation pattern

Total marks: 100, only CIE, minimum required to pass 50

Seminar Guide: 20 marks (Background Knowledge – 10 (The guide shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 10).

Seminar Coordinator: 20 marks (Seminar Diary – 10 (Each student shall maintain a seminar diary and the guide shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10).

Presentation: 40 marks to be awarded by the IEC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10).

Report: 20 marks to be awarded by the IEC (check for technical content, overall quality, templates followed, adequacy of references etc.).

CDD415	PROJECT PHASE I	CATEGORY	L	T	P	CREDIT
		PWS	0	0	6	2

Preamble: The course 'Project Work' is mainly intended to evoke the innovation and invention skills in a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation. The project extends to 2 semesters and will be evaluated in the 7^{th} and 8^{th} semester separately, based on the achieved objectives. One third of the project credits shall be completed in 7^{th} semester and two third in 8^{th} semester. It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

Course Objectives

- To apply engineering knowledge in practical problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to engineering problems.

Course Outcomes [COs] : After successful completion of the course, the students will be able to:

CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: **Apply**).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: **Apply**).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: **Apply**).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: **Apply**).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: **Analyze**).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: **Apply**).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	2	2	1	1	1	1	2
CO2	2	2	2		1	3	3	1	1		1	1
CO3									3	2	2	1
CO4					2			3	2	2	3	2
CO5	2	3	3	1	2							1
CO6					2			2	2	3	1	1

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
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PROJECT PHASE I

Phase 1 Target

- Literature study/survey of published literature on the assigned topic
- Formulation of objectives
- Formulation of hypothesis/ design/ methodology
- Formulation of work plan and task allocation.
- Block level design documentation
- Seeking project funds from various agencies
- Preliminary Analysis/Modeling/Simulation/Experiment/Design/Feasibility study
- Preparation of Phase 1 report

Evaluation Guidelines & Rubrics

Total: 100 marks (Minimum required to pass: 50 marks).

- Project progress evaluation by guide: 30 Marks.
- Interim evaluation by the Evaluation Committee: 20 Marks.
- Final Evaluation by the Evaluation Committee: 30 Marks.
- Project Phase - I Report (By Evaluation Committee): 20 Marks.

(The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor).

Evaluation by the Guide

The guide/supervisor shall monitor the progress being carried out by the project groups on a regular basis. In case it is found that progress is unsatisfactory it shall be reported to the Department Evaluation Committee for necessary action. The presence of each student in the group and their involvement in all stages of execution of the project shall be ensured by the guide. Project evaluation by the guide: 30 Marks. This mark shall be awarded to the students in his/her group by considering the following aspects:

Topic Selection: innovativeness, social relevance etc. (2)

Problem definition: Identification of the social, environmental and ethical issues of the project problem. (2)

Purpose and need of the project: Detailed and extensive explanation of the purpose and need of the project. (3)

Project Objectives: All objectives of the proposed work are well defined; Steps to be followed to solve the defined problem are clearly specified. (2)

Project Scheduling & Distribution of Work among Team members: Detailed and extensive Scheduling with timelines provided for each phase of project. Work breakdown structure well defined. (3)

Literature survey: Outstanding investigation in all aspects. (4)

Student's Diary/ Daily Log: The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily/weekly activity diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily/weekly activity diary shall be signed after every day/week by the guide. (7)

Individual Contribution: The contribution of each student at various stages. (7)

EVALUATION RUBRICS for PROJECT Phase I: Interim Evaluation						
No.	**Parameters**	**Marks**	**Poor**	**Fair**	**Very Good**	**Outstanding**
1-a	Topic identification, selection, formulation of objectives and/or literature survey. (Group assessment) [CO1]	10	The team has failed to come with a relevant topic in time. Needed full assistance to finda topic from the guide. They do not respond to suggestions from the evaluation committee and/or the guide. No literature review was conducted. The team tried to gather easy information without verifying the authenticity. No objectives formed yet.	The team has identified a topic. The originally selected topic lacks substance and needs to be revised. There were suggestions given to improve the relevance and quality of the project topic. Only a few relevant references were consulted/ studied and there is no clear evidence to show the team's understanding on the same. Some objectives identified, but not clear enough.	Good evidence of the group thinking and brainstorming on what they are going to build. The results of the brainstorming are documented and the selection of topic is relevant. The review of related references was good, but there is scope of improvement. Objectives formed with good clarity, however some objectives are not realistic enough.	The group has brainstormed in an excellent manner on what they were going to build. The topic selected is highly relevant, real world problem and is potentially innovative. The group shows extreme interest in the topic and has conducted extensive literature survey in connection with the topic. The team has come up with clear objectives which are feasible.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
1-b	Project Planning, Scheduling and Resource/ Tasks Identification and allocation. (Group assessment) [CO4]	10	No evidence of planning or scheduling of the project. The students did not plan what they were going to build or plan on what materials / resources to use in the project. The students do not have any idea on the budget required. The team has not yet decided on who does what. No project journal kept.	Some evidence of a primary plan. There were some ideas on the materials /resources required, but not really thought out. The students have some idea on the finances required, but they have not formalized a budget plan. Schedules were not prepared. The project journal has no details. Some evidence on task allocation among the team members.	Good evidence of planning done. Materials were listed and thought out, but the planwasn't quite complete. Schedules were prepared, but not detailed, and needs improvement. Project journal is presented but it is not complete in all respect / detailed. There is better task allocation and individual members understand about their tasks. There is room for improvement.	Excellent evidence of enterprising and extensive project planning.Gantt charts were used to depict detailed project scheduling. A project management/version control tool is used to track the project, which shows familiarity with modern tools. All materials / resources were identified and listed and anticipation of procuring time is done. Detailed budgeting is done. All tasks were identified and incorporated in the schedule. A well-kept project journal shows evidence for all the above, in addition to the interaction with the project guide. Each member knows well about their individual tasks.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
Phase 1 Interim Evaluation Total Marks: 20						

EVALUATION RUBRICS for PROJECT Phase I: Final Evaluation

Sl. No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
1-c	Formulation of Design and/or Methodology and Progress. (Group assessment) [CO1]	5	None of the team members show any evidence of knowledge about the design and the methodology adopted till now/ to be adopted in the later stages. The team has not progressed from the previous stage of evaluation.	The students have some knowledge on the design procedure to be adopted, and the methodologies. However, the team has not made much progress in the design, and yet to catch up with the project plan.	The students are comfortable with design methods adopted, and they have made some progress as per the plan. The methodologies are understood to a large extent.	Shows clear evidence of having a well- defined design methodology and adherence to it. Excellent knowledge in design procedure and its adaptation. Adherence to project plan is commendable.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
1-d	Individual and Teamwork Leadership (Individual assessment) [CO3]	10	The student does not show any interest in the project activities, and is a passive member.	The student shows some interest and participates in some of the activities. However, the activities are mostly easy and superficial in nature.	The student shows very good interest in project, and takes up tasks and attempts to complete them. Shows excellent responsibility and team skills. Supports the other members well.	The student takes a leadership position and supports the other team members and leads the project. Shows clear evidence of leadership.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
1-e	Preliminary Analysis/ Modeling / Simulation/ Experiment / Design/ Feasibility study [CO1]	10	The team has not done any preliminary work with respect to the analysis/modeling/ simulation/experiment/design/feasibility study/ algorithm development.	The team has started doing some preliminary work with respect to the project. The students however are not prepared enough for the work and they need to improve a lot.	There is some evidence to show that the team has done good amount of preliminary investigation and design/ analysis/ modeling etc. They can improve further.	Strong evidence for excellent progress in the project. The team has completed the required preliminary work already and are poised to finish the phase I in an excellent manner. They have shown results to prove their progress.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)

1-f	Documentation and presentation. (Individual & group assessment). [CO6]	5	The team did not document the work at all. The project journal/diary is not presented. The presentation was shallow in content and dull in appearance. The individual student has no idea on the presentation of his/her part.	Some documentation is done, but not extensive. Interaction with the guide is minimal. Presentation include some points of interest, but overall quality needs to be improved. Individual performance to be improved.	Most of the project details were documented well enough. There is scope for improvement. The presentation is satisfactory. Individual performance is good.	The project stages are extensively documented in the report. Professional documentation tools like LaTeX were used to document the progress of the project along with the project journal. The documentation structure is well-planned and can easily grow into the project report. The presentation is done professionally and with great clarity. The individual's performance is excellent.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
Total		**30**	**Phase - I Final Evaluation Marks: 30**			

EVALUATION RUBRICS for PROJECT Phase I: Report Evaluation						
Sl. No.	**Parameters**	**Marks**	**Poor**	**Fair**	**Very Good**	**Outstanding**
1-g	Report [CO6]	20	The prepared report is shallow and not as per standard format. It does not follow proper organization. Contains mostly Unacknowledged content. Lack of effort in preparation is evident.	Project report follows the standard format to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly in the report.	Project report shows evidence of systematic documentation. Report is following the standard format and there are only a few issues. Organization of the report is good. Most of references are cited properly.	The report is exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and listed and clearly shown. Language is excellent and follows standard styles.
			(0 - 7 Marks)	(8 - 12 Marks)	(13 - 19 Marks)	(20 Marks)
Phase - I Project Report Marks: 20						

SEMESTER VII

PROGRAM ELECTIVE II

AMT 413	**ADVANCED CONCEPTS OF MICROPROCESSOR AND MICRO CONTROLLER**	**Category**	**L**	**T**	**P**	**Credit**
		PCC	**2**	**1**	**0**	**3**

Preamble: The course enables the learners capable of understanding the fundamental architecture of microprocessors and micro controllers. This course focuses on the architecture, assembly language programming, interrupts, interfacing of microprocessors with peripheral devices and microcontrollers and its programming. It helps the learners to extend the study of latest advanced microprocessors and develop hardware-based solutions.

Prerequisite: Sound knowledge in Logic System Design and Computer organization & architecture.

CO#	**Course Outcomes**
CO1	Illustrate the **architecture**, modes of operation and addressing modes of microprocessors **(Cognitive knowledge: Understand)**
CO2	Develop 8086 **assembly** language programs. Demonstrate interrupts, its **handling** in 8086 (**Cognitive Knowledge Level: Apply**)
CO3	Illustrate how different peripherals are interfaced with 8086 microprocessors (8259,8255,8254,8257) (**Cognitive Knowledge Level: Understand**)
CO4	Illustrate the architecture and features of advanced microprocessors (**Cognitive knowledge: Understand)**
CO5	Outline features of **microcontrollers** and develop low level programs. **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓									✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓									✓
CO5	✓	✓	✓									✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks (%)**
	Test1 (%)	**Test2 (%)**	
Remember	**20**	**20**	**20**
Understand	**40**	**40**	**40**
Apply	**40**	**40**	**40**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment Tests : **25 marks**

Continuous Assessment Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations must be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1(Evolution of microprocessors):

8086 microprocessor – Architecture and signals,Stack structure of 8086, Physical Memory organization, Minimum and maximum mode of 8086 system and timings. Comparison of 8086 and 8088.

Module-2 (Addressing modes and instructions):

Addressing Modes of 8086. Instruction set – data copy /transfer instructions, arithmetic instructions, logical instructions, string manipulation instructions, branch instructions, unconditional and conditional branch instruction, flag manipulation and processor control instructions. Assembler Directives and operators. Basic Assembly Language Programming with 8086.Interrupts - Types of Interrupts and Interrupt Service Routine- Handling Interrupts in 8086

Module- 3 (Interfacing chips):

Programmable Interrupt Controller - 8259, Architecture (Just mention the control word, no need to memorize the control word). Programmable Peripheral Input/output port 8255 - Architecture and modes of operation- Programmable interval timer 8254- Architecture and modes of operation- DMA controller 8257 Architecture (Just mention the control word, no need to memorize the control word of 8254 and 8257).

Module- 4 (Advanced Microprocessors):

Introduction to 32-bit advanced microprocessors- Salient Features and comparison of 80286, 80386 and 80486. Introduction to Pentium Microprocessors-Salient features of 80586-System Architecture-Brach predication-Enhanced Instruction set of Pentium-Journey to Pentium -Pro and Pentium-II.

Module- 5 (Microcontrollers):

8051 Architecture- Register Organization- Memory and I/O addressing- Interrupts and Stack- 8051 Addressing Modes- Instruction Set- data transfer instructions, arithmetic instructions, logical instructions, Boolean instructions, control transfer instructions- Simple programs.

Text Books

1. Bhurchandi and Ray, Advanced Microprocessors and Peripherals, Third Edition McGraw Hill.
2. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, Pearson Education.
3. Ramesh Gaonkar, Microprocessor Architecture, Programming, and Applications with the 8085, Penram International Publishing Pvt. Ltd.

Reference Books

1. Barry B. Brey, The Intel Microprocessors – Architecture, Programming and Interfacing, Eighth Edition, Pearson Education.
2. A. NagoorKani, Microprocessors and Microcontrollers, Second Edition, Tata McGraw Hill
3. Douglas V. Hall, SSSP Rao, Microprocessors and Interfacing, Third Edition, McGrawHill Education.

Sample Course Level Assessment Questions

Course Outcome1 (CO1):

1) Describe how pipelining is implemented in 8086 microprocessors
2) Illustrate maximum mode signals in 8086.

Course Outcome 2(CO2):

1) Write an 8086-assembly language program for sorting a sequence of N, 8-bit numbers. Describe the modifications that can be done on the above program so that it will sort N, 16-bit numbers. Rewrite the program with those modifications also.

Course Outcome 3 (CO3):

1) Give the sequence of instructions for setting the IVT for interrupt type 23H. Assume the Interrupt Service Routine, is present in the code segment named CODE.
2) Describe the role of Interrupt Request register and In service register in 8259.
3) Specify the importance of the DMA address register and Terminal count register in 8257

Course Outcome 4(CO4):

1) What are the four major architectural advancement in 80486 over 80386? What are the data types supported by 80486?
2) Classify the instruction set of Pentium processor?
3) Explain branch prediction mechanism for Pentium processor.

Course Outcome 5(CO5):

1) Write an 8051-assembly language program to count the number of 1's and 0's in each8-bit number
2) Write an 8051-assembly language program for computing the square root of an 8-bit number.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES: 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH. DEGREE EXAMINATION, MONTH & YEAR

Course Code: AMT413

Course Name: ADVANCED CONCEPTS OF MICROPROCESSOR AND MICRO CONTROLLER

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Describe the functions of following signals in 8086
   a) NMI b) ALE

2. The value of Code Segment (CS) Register is 4042H and the value of different offsets is as follows:
   BX:2025H,
   IP:0580H,
   DI:4247H
   Calculate the effective address of the memory location pointed by the CS register.

3. Explain the following instructions with example.
   AAD b. AAS c. AAA

4. Specify the use of following assembler directives - EQU, EVEN

5. Differentiate between maskable and non-maskable interrupts?

6. What are the three different I/O modes supported by 8255?

7. Explain the branch prediction in Pentium processors.

8. Compare the features of 80286,80386 and 80486?

9. Differentiate between indirect and indexed addressing modes in 8051.

10. Write the sequence of 8051 instructions to store any two numbers at two consecutive locations 70H and 71H, multiply them and store the result in location 72H. **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Specify the significance of segmentation and how it is implemented in 8086 **(5)**

(b) Explain the maximum mode signals in 8086. **(9)**

OR

12. (a) Explain the physical address calculation in 8086 with example. **(4)**

(b) Explain the physical memory organization of 8086 with a neat diagram. How does the 8086 processor access a word from an odd memory location? How many memory cycles does it take? **(10)**

13. (a) Write an 8086-assembly language program for finding the sum of the squares of first N natural numbers. Calculate the squares of each number using a subroutine SQUARE. **(10)**

(b) Describe any four control transfer instructions in 8086. **(4)**

OR

14. (a) Write an 8086-assembly language program for printing the reverse of a given input string. **(5)**

(b) Explain the addressing modes for sequential control flow instructions in 8086. **(9)**

15. (a) Discuss the following control words of 8259 **(5)**

a) Initialization command word
b) Operating Command word

(b) Explain the architecture of 8259 with diagram **(9)**

OR

16. (a) Describe the internal architecture of 8255 with block diagram. **(10)**

	(b)	Identify the mode and I/O configuration for ports A, B and C of an 8255 after its control register is loaded with 86 H?	**(4)**
17.	(a)	Explain the architecture of Pentium processors with a neat diagram	**(10)**
	(b)	Explain the features of Pentium-Pro and Pentium -II.	**(4)**

OR

18.	(a)	Explain the enhanced instruction sets of Pentium processors in detail	**(8)**
	(b)	Explain the super scalar execution of Pentium processors.	**(6)**
19.	(a)	Explain the architecture of 8051 microcontroller.	**(9)**
	(b)	Write an 8051-assembly language program for adding two matrices whose elements are stored sequentially in some memory location. Assume suitable locations.	**(5)**

OR

20.	(a)	Explain the internal data memory organization of 8051.	**(9)**
	(b)	Describe the control transfer instructions of 8051microcontroller.	**(5)**

Teaching Plan

No	Contents	No of Lecture Hrs
Module 1: (Evolution of microprocessors) (7hours)		
1.1	Architecture of 8086	1hour
1.2	Signals in 8086	1hour
1.3	Memory Segmentation	1hour
1.4	Physical Memory organization	1hour
1.5	Minimum and maximum mode 8086 system and timings (Lecture 1)	1hour
1.6	Minimum and maximum mode 8086 system and timings (Lecture 2)	1hour

1.7	Comparison of 8086 and 8088	1hour
Module 2 :(programming of 8086) (8 hours)		
2.1	Addressing Modes of 8086	1 hour
2.2	Instruction set – data copy/transfer instructions	1hour
2.3	arithmetic instructions, logical instructions	1hour
2.4	unconditional and conditional branch instruction	1hour
2.5	flag manipulation and processor control instructions	1hour
2.6	Assembler Directives and operators	1hour
2.7	Assembly Language Programming with 8086(Lecture 1)	1hour
2.8	Types of interrupts, ISR and handling interrupts in 8086	1hour
Module 3: (Interfacing chips) (7 hours)		
3.1	Programmable Interrupt Controller -8259 (Lecture 1)	1hour
3.2	Programmable Peripheral Input/output port- 8255 (Lecture 1)	1hour
3.3	Programmable Peripheral Input/output port- 8255 (Lecture 2)	1hour
3.4	Programmable interval timer 8254 (Lecture 1)	1hour
3.5	Programmable interval timer 8254 (Lecture 2)	1hour
3.6	DMA controller 8257 Architecture (Lecture 1)	1hour
3.7	DMA controller 8257 Architecture (Lecture 2)	1hour
Module 4 :(Advanced Microprocessors) (7 hours)		
4.1	Introduction to 32-bit microprocessors	1hour
4.2	Salient features of 808286, 80386 and 80486 and comparison (Lecturer 1)	1hour
4.3	Salient features of 808286,80386 and 80486 and comparison (Lecturer 2)	1hour
4.4	80586 -Pentium System Architecture	1hour
4.5	Branch prediction and Enhanced instruction sets	1hour
4.6	MMX architecture, Data types and instruction sets.	1hour
4.7	Journey to Pentium -pro and Pentium -II	1hour
Module 5: (Microcontrollers) (7 hours)		
5.1	8051 Architecture (Lecture 1)	1hour
5.2	8051 Architecture (Lecture 2)	1hour
5.3	Register Organization, Memory and I/O addressing	1hour

5.4	Interrupts and Stack,Addressing Modes	1hour
5.5	Data transfer instructions, Arithmetic instructions, Logical instructions,	1hour
5.6	Boolean instructions, Control transfer instructions	1hour
5.7	Programming of 8051 (Lecture 1)	1hour

CDT 423	CONCEPTS IN ARTIFICIAL INTELLIGENCE	CATEGORY	L	T	P	Credit
		PEC	2	1	0	3

Preamble:

The course introduces the fundamental concept of intelligent systems to students. This involves the basic concept of artificial intelligence, its various characteristics, different problem solving methods, to learn the knowledge representation in solving AI problems and various applications of AI.

Prerequisite: Basic knowledge in Computational Problem Solving, programming languages, and in data analysis.

Mapping of course outcomes with program outcomes

CO1	Illustrate the fundamental concept of intelligent systems and their architecture. **(Cognitive Knowledge level: Understand)**
CO2	Use appropriate search algorithms for problem solving in an intelligent system. **(Cognitive knowledge level: Apply)**
CO3	Solve complex problems using search techniques.**(Cognitive Knowledge level: Apply)**
CO4	Represent AI domain knowledge using logic systems and use inference techniques for reasoning in intelligent systems. **(Cognitive Knowledge level: Apply)**
CO5	Apply of supervised machine learning algorithms for real world applications **(Cognitive Knowledge level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								
CO2	✓	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓								✓
CO4	✓	✓	✓	✓								✓

CO5	✔	✔	✔	✔	✔							✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember	**20**	**20**	**20**
Understand	**40**	**40**	**40**
Apply	**40**	**40**	**40**
Analyze			
Evaluate			
Create			

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Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests(Average of Internal Tests1&2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1**(Introduction)**

Introduction to AI, Foundations of AI, History of AI, Applications of AI. Intelligent Agents-Agents and Environment, Nature of Environments, Rational Agent, Structure of Agents.

Module - 2**(Problem Solving)**

Problem Solving-Problem solving Agents, Example problems, Searching for solutions, Search Strategies-Uninformed Search strategies, Searching with partial Information, Informed search strategies, Heuristic Function. Local search and optimization problems.

Module - 3 **(Searching in Complex environments**)

Adversarial search-Games, Optimal decision in games, The Minimax algorithm, Alpha -Beta pruning.

Constraint Satisfaction Problems-Defining CSP, Constraint Propagation, inference in CSP-AC-3 algorithm, Backtracking search for CSP's, Structure of CSP problems, Examples - Crypt-Arithmetic problems.

Module - 4 (**Knowledge Representation and Reasoning**)

Logical Agents-Knowledge based agents, Logic, Propositional Logic, Propositional Theorem proving, Agents based on Propositional Logic. First Order Predicate Logic-Syntax and semantics of First order Logic, Knowledge representation in First Order Logic. Inference in First Order Logic-Propositional Vs First order inference, Unification and Lifting, Forward Chaining, Backward chaining, Resolution.

Module - 5 (**Machine Learning**)

Forms of Learning-Supervised Learning-le Linear Regression, Learning decision trees. Evaluating and choosing best hypothesis, Regression and classification with linear models

Text Books

1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, 3rd Edition. Prentice Hall

ReferenceBooks

1. Nilsson N.J., Artificial Intelligence - A New Synthesis, Harcourt Asia Pvt. Ltd.
2. Patrick Henry Winston, Artificial Intelligence, Pearson Education, 2003.
3. G. Luger, W. A. Stubblefield, Artificial Intelligence, Third Edition, Addison- Wesley.
4. Elaine Rich & Kevin Knight, Artificial Intelligence, 3rd Edition, Tata McGraw Hill Edition, Reprint, 2008.
5. Russel and Norvig, Artificial Intelligence, Pearson Education, PHI, 2009

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Explain about the basic types of agent programs in intelligent systems.
2. For the following activities, give a PEAS description of the task environment and characterize it in terms of the task environment properties.
   a) Interactive English Tutor.
   b) Bidding on an item at an auction.

Course Outcome 2(CO2):

1. Differentiate between uninformed and informed search strategies in intelligent systems.
2. Illustrate the working of A* search procedure with an Example.

Course Outcome 3(CO3):

1. Solve the following crypt arithmetic problem by hand, using the strategy backtracking with forward checking and the MRV & least-constraining-valueheuristics.

$$\begin{array}{r} \text{T W O} + \\ \text{T W O} \\ \hline \text{F O U R} \end{array}$$

Course Outcome 4(CO4):

1. Prove, or find a counter example to, the following assertion: If $\alpha \models \gamma$ or $\beta \models \gamma$ (or both) then $(\alpha \wedge \beta) \models \gamma$.
2. For each pair of atomic sentences, find the most general unifier if it exists:
   a) P (A, B, B), P (x, y, z).
   b) Q (y, G(A, B)), Q(G(x, x), y).

Course Outcome 5(CO5):

1. Discuss Supervised learning with an example.
2. Explain Linear classification with logistic regression.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CDT 423

Course Name: Concept in Artificial Intelligence

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. What is Rational Agent? Explain.
2. Describe any two ways to represent states and transition between them in agent programs.
3. Differentiate between informed search and uninformed search.
4. Define heuristic function? Give two examples.
5. What are the components of a Constraint Satisfaction Problem? Illustrate with an example.
6. Formulate the following problem as a CSP. Class scheduling: There is a fixednumber of professors and classrooms, a list of classes to be offered, and a list of possible time slots for classes. Each professor has a set of classes that he or she can teach.
7. What is aknowledgebased agent? How does it work?
8. Represent the following assertion in propositional logic: "A person who is radical (R) is electable (E) if he/she is conservative (C), but otherwise is not electable."
9. Describe the various forms of learning.
10. State and explain Ockham's razor principle.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain the structure Goal-based agents and Utility-based agents with the help ofdiagrams. **(8)**

    (b) For the following activities, give a PEAS description of the task environment and characterize it in terms of the task environment properties. **(6)**
    a) Playing soccer
    b) Bidding on an item at an auction.

OR

12. (a) Explain the structure of Simplex- reflex agents and Model-based reflex agents with the help of diagrams. **(8)**

(b) Discuss about any five applications of AI. **(6)**

13. (a) Explain Best First Search algorithm. How does it implement heuristic search? **(6)**

(b)Describe any four uninformed search strategies. **(8)**

OR

14. (a) Write and explain A* search algorithm. **(6)**

(b) Explain the components of a welldefined AI problem? Write the standard formulation of 8-puzzle problem. **(8)**

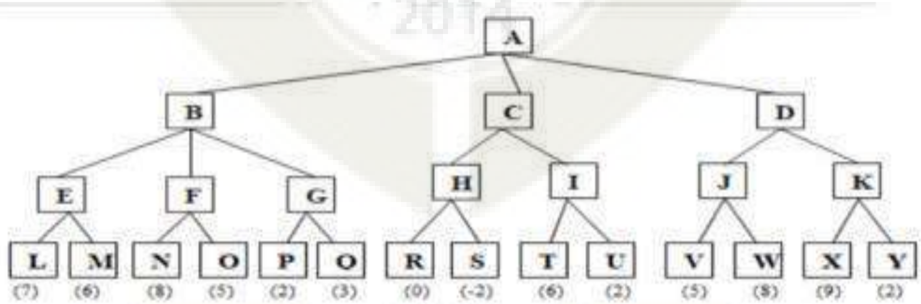
15. (a) Solve the following crypt arithmetic problem by hand, using the strategy ofbacktracking with forward checking and the MRV and least-constraining valueheuristics. **(8)**

(b) What is local consistency in CSP constraint propagation? Explain differenttypes local consistencies. **(6)**

OR

16. (a) Illustrate the use of alpha-beta pruning in games **(6)**

(b) Consider the following game tree in which static evaluation score are all from the players point of view: static evaluation score range is (+10 to -10). **(8)**



17. (a) Convert the following sentence into First order Logic: **(6)**

Everyone who loves all animals is loved by someone.
Anyone who kills an animal is loved by no one.
Jack loves all animals.

Either Jack or Curiosity killed the cat, who is named Tuna.

Did Curiosity kill the cat?

(b) Give a resolution proof to answer the question "Did Curiosity kill the cat? **(8)**

OR

18. (a) Prove or find a counter example to the following assertion in propositional logic: **(6)**

If $\alpha \models (\beta \wedge \gamma)$ then $\alpha \models \beta$ and $\alpha \models \gamma$.

(b) For each pair of atomic sentences, give the most general unifier if it exists: **(8)**

Older (Father (y), y), Older (Father (x), John).

19. (a) How is the best hypothesis selected from alternatives? **(8)**

(b) Explain Univariate Linear Regression. **(6)**

OR

20. (a) Consider the following data set comprised of two binary input attributes (A1 and A2) and one binary output. **(8)**

Example	A_1	A_2	Output y
x_1	1	1	1
x_2	1	1	1
x_3	1	0	0
x_4	0	0	1
x_5	0	1	0
x_6	0	1	0

Use the DECISION-TREE-LEARNING algorithm to learn a decision tree for these data. Show the computations made to determine the attribute to split at each node.

(b) Explain Linear classification with logistic regression. **(6)**

Teaching Plan

No	Contents	No. of Lecture Hours (38 hrs)
	Module-1(Introduction) (6 hours)	
1.1	Introduction to AI, Foundations of AI	1 hour
1.2	History of AI, Applications of AI	1 hour
1.3	Intelligent Agents- Agents and Environment	1 hour
1.4	Nature of Environments	1 hour
1.5	Rational Agent	1 hour
1.6	Structure of Agents	1 hour
	Module-2 (Problem Solving) (8hours)	
2.1	Problem solving Agents-Problem solving Agents	1 hour
2.2	Illustration of the problem solving process by agents	1 hour
2.3	Searching for solutions	1 hour
2.4	Search Strategies-Uninformed Search strategies	1 hour
2.5	BFS, DFS, Uniform cost, Depth-limited search, Iterative depth first search.	1 hour
2.6	Informed search strategies-Best First Search	1 hour
2.7	Informed search strategies-A* Search	1 hour
2.8	Heuristic Function	1 hour
	Module-3 (Searching in Complex Environments) (9 hours)	

3.1	Adversarial search-Games	1 hour
3.2	Optimal decision in games, The Minimax algorithm	1 hour
3.3	Alpha-Beta pruning	1 hour
3.4	Constraint Satisfaction Problems, Defining CSP	1 hour
3.5	Constraint Propagation, inference in CSP	1 hour
3.6	AC-3 algorithm	1 hour
3.7	Backtracking search for CSP	1 hour
3.8	Structure of CSP problems,	1 hour
3.9	Examples - Crypt-Arithmetic problems.	1 hour
Module-4 (Knowledge Representation and Reasoning) (9 hours)		
4.1	Logical Agents – Knowledge based agents and logic	1 hour
4.2	Propositional Logic	1 hour
4.3	Propositional Theorem proving	1 hour
4.4	Agents based on Propositional Logic	1 hour
4.5	First Order Predicate Logic – Syntax and Semantics of First Order Logic	1 hour
4.6	Using First Order Logic, Knowledge representation in First Order Logic	1 hour
4.7	Inference in First Order Logic – Propositional Vs First Order inference, Unification and Lifting	1 hour
4.8	Forward chaining, Backward chaining	1 hour
4.9	Resolution	1 hour
Module-5 (Machine Learning) (6 hours)		
5.1	Learning from Examples – Forms of Learning	1 hour
5.2	Supervised Learning	1 hour
5.3	Learning Decision Trees	1 hour
5.4	Generalization and overfitting	1 hour
5.5	Evaluating and choosing the best hypothesis	1 hour
5.6	Regression and classification with Linear models	1 hour

CDT 453	WEB MINING	Category	L	T	P	Credit
		PEC	2	1	0	3

Preamble:

This course introduces the web mining backgrounds, the concepts of Information retrieval, Structured Data Extraction in web structure and usage mining and Web search with special emphasis on Web Crawling. This course helps the learner to use various aspects of web usage mining.

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain data mining process and techniques, specifically those that are relevant to Web mining. **(Cognitive Knowledge Level: Understand)**
CO2	Identify the use of Social Networks Analysis in Web Mining. (**Cognitive Knowledge Level: Apply)**
CO3	Describe the basics of Information retrieval and Web search with special emphasis on Web Crawling. **(Cognitive Knowledge Level: Understand)**
CO4	Develop the role of Structured Data Extraction in web structure mining **(Cognitive Knowledge Level: Apply)**
CO5	Illustratethe various aspects of web usage mining **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓	✓									
CO3	✓	✓		✓								✓
CO4	✓	✓	✓	✓								✓

CO5	✓	✓										✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember	20	20	20
Understand	60	60	60
Apply	20	20	20
Analyze			
Evaluate			
Create			

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Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests(Average of Internal Tests 1&2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have a maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Introduction)

Introduction – Web Mining – Theoretical background – Association rule mining – Sequential Pattern Mining -Information retrieval and Web search – Information retrieval Models-Relevance Feedback- Text and Web page Pre-processing – Inverted Index – Latent Semantic Indexing – Web Search – Meta-Search – Web Spamming.

Module – 2 (Social Networks Analysis)

Introduction -Social Networks Analysis- Co-Citation and Bibliographic Coupling- Page Rank: PageRank Algorithm, Link-Based Similarity Search, Enhanced Techniques for Page Ranking - HITS: HITS Algorithm, Finding Other Eigenvectors-Community Discovery: Problem Definition, Bipartite Core Communities.

Module - 3 (Web Crawling)

Web Crawling -A Basic Crawler Algorithm: Breadth-First Crawlers, Preferential Crawlers - Implementation Issues- Universal Crawlers- Focused Crawlers- Topical Crawlers -Evaluation - Crawler Ethics and Conflicts - New Developments.

Module - 4 (Structured Data Extraction)

Structured Data Extraction: Wrapper Generation – Preliminaries- Wrapper Induction- Instance Based Wrapper Learning - Automatic Wrapper Generation: Problems - String Matching and Tree Matching -Multiple Alignment - Building DOM Trees - Extraction Based on a Single List Page and Multiple pages- Introduction to Schema Matching – Schema Level Match -Domain and Instance Level Matching – Extracting and Analysing Web Social Networks.

Module - 5 (Web Usage Mining)

Web Usage Mining - Data Collection and Pre-Processing: Sources and Types of Data, Key Elements of Web Usage Data - Data Modelling for Web Usage Mining - Discovery and Analysis of Web Usage Patterns – Applications- Recommender Systems and Collaborative Filtering – Query Log Mining

Text Books

1. Bing Liu, “Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-Centric Systems and Applications)”, Springer; 2nd Edition 2009

Reference Books

1. Zdravko Markov, Daniel T. Larose, “Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage”, John Wiley & Sons, Inc., 2007
2. Guandong Xu, Yanchun Zhang, Lin Li, “Web Mining and Social Networking: Techniques and Applications”, Springer; 1st Edition.2010
3. Soumen Chakrabarti, “Mining the Web: Discovering Knowledge from Hypertext Data”, Morgan Kaufmann; edition 2002
4. Adam Schenker, “Graph-Theoretic Techniques for Web Content Mining”, World Scientific Pub Co Inc, 2005

5. Min Song, Yi Fang and Brook Wu, Handbook of research on Text and Web mining technologies, IGI global, information Science Reference – imprint of: IGI publishing,2008

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Course Level Assessment Questions

Course Outcome1 (CO1):

1. Explain Web Mining.
2. Summarize Association rule mining with an example.
3. Illustrate Latent Semantic Indexing

Course Outcome 2(CO2):

1. Explain Naïve Bayesian Text Classification
2. Explain Partially Supervised Learning.
3. Describe Markov Models

Course Outcome 3(CO3):

1. Make use of an example explain working principle of Hyperlink based Ranking
2. Describe Link-Based Similarity Search in page ranking?
3. Explain the Implementation Issues of Crawler

Course Outcome 4(CO4):

1. Describe Based Wrapper Learning
2. Explain DOM Trees with an example using HTML page
3. Discuss Extracting and Analyzing Web Social Networks.

Course Outcome 5(CO5):

1. Compare Data Collection and Pre-processing.
2. Illustrate query Log Feature Extraction with an example.
3. Explain Probabilistic Latent Semantic Analysis.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CDT 453

Course Name: Web Mining

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Differentiate between Information retrieval and Web search in web mining
2. Explain Boolean model for Information Retrieval System.
3. Describe the role of link analysis and random walks in the PageRank algorithm.
4. Discuss the differences between co-citation and bibliographic coupling as network analysis techniques.
5. Compare breadth-first crawlers and preferential crawlers in terms of their crawling strategies and efficiency.
6. Explain the concept of focused crawling based on social networks or user behaviour.
7. List out the techniques used in string matching and tree matching for automatic wrapper generation.

8. Summarize the process of analysing web social networks.

9. Explain Web Recommender systems based on User and Item.

10. Describe Data Modelling for Web Usage Miningand its role in representing and analysing user behaviour. **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain the characteristics of Web search. **(6)**

(b) Use Latent Semantic Indexing (LSI) to rank these documents for the query gold silver truck for the following "documents": **(8)**

d1: Shipment of gold damaged in a fire.

d2: Delivery of silver arrived in a silver truck

. d3: Shipment of gold arrived in a truck.

OR

12. Trace the results of using the Apriori algorithm on the grocery store example with support threshold s=33.34% and confidence threshold c=60%. Show the candidate and frequent itemsets for each database scan. Enumerate all the final frequent itemsets. Also indicate the association rules that are generated and highlight the strong ones, sort them by confidence **(14)**

Transaction ID	Items
T1	HotDogs, Buns, Ketchup
T2	HotDogs, Buns
T3	HotDogs, Coke, Chips
T4	Chips, Coke
T5	Chips, Ketchup
T6	HotDogs, Coke, Chips

13.	(a)	Illustrate the concept of Link-Based Similarity Search in Page Ranking.	**(6)**
	(b)	Describe how the HITS algorithm can be extended to find other eigenvectors beyond the top-ranked ones.	**(8)**

OR

14.	(a)	Differentiate Schema Level Match-Domain and Instance Level Matching in Web mining.	**(8)**
	(b)	Describe the problem of community discovery in social networks and explain its significance.	**(6)**
15.	(a)	Discuss potential techniques to improve the performance and effectiveness of basic crawler algorithms.	**(8)**
	(b)	Illustrate the evaluation methods used to assess the performance and quality of topical crawlers.	**(6)**

OR

16.		Describe the approaches and techniques used to address ethical and conflict-related challenges in web crawling	**(14)**
17.		Prepare Document Object Model tree from the following HTML page	**(14)**

```
<html>
  <head>
    <title>Here comes the DOM</title>
  </head>
  <body>
    <h2>Document Object Model</h2>
    <img align="right" alt="dom pict" src="dom.png">
    <p>
      This is a simple
      <code>HTML</code>
      page to illustrate the
      <a href="http://www.w3.org/DOM/">DOM</a>
    </p>
  </body>
</html>
```

OR

18. (a) Discuss how structured data extraction can be performed across multiple pages, such as following links and maintaining state during the extraction process. **(8)**

(b) Describe the concept of multiple alignment and how it can be applied to handle variations in web page structures during wrapper generation. **(6)**

19. (a) Explain the challenges and considerations in collecting and pre-processing web usage data, such as privacy concerns and data quality issues. **(8)**

(b) Identify the techniques used in query log mining, such as query clustering, query categorization, and query intent analysis. **(6)**

OR

20. (a) Make use of web usage mining how it can be applied to improve website recommendation systems and collaborative filtering. **(8)**

(b) Describe Click stream Analysis and Web Server Log Files. **(6)**

Teaching Plan

No	Contents	No. of Lecture Hours (36 hrs)
Module-1(Introduction) (7 hours)		
1.1	Introduction – Web Mining, Theoretical background	1 hour
1.2	Association rule mining	1 hour
1.3	Sequential Pattern Mining -Information retrieval and Web search	1 hour
1.4	Information retrieval Models-Relevance Feedback	1 hour
1.5	Text and Web page Pre-processing	1 hour
1.6	Inverted Index – Latent Semantic Indexing	1 hour
1.7	Web Search – Meta-Search – Web Spamming	1 hour
Module-2 (Social Networks Analysis) (7 hours)		
2.1	Introduction -Social Networks Analysis	1 hour
2.2	Co-Citation and Bibliographic Coupling	1 hour
2.3	Page Rank: PageRank Algorithm	1 hour
2.4	Link-Based Similarity Search	1 hour
2.5	Enhanced Techniques for Page Ranking	1 hour
2.6	HITS: HITS Algorithm, Finding Other Eigenvectors	1 hour
2.7	Community Discovery, Problem Definition, Bipartite Core Communities	1 hour
Module-3 (Web Crawling) (7 hours)		
3.1	Web Crawling	1 hour
3.2	A Basic Crawler Algorithm: Breadth-First Crawlers	1 hour
3.3	Preferential Crawlers	1 hour
3.4	Implementation Issues- Universal Crawlers	1 hour

3.5	Focused Crawlers- Topical Crawlers	1 hour
3.6	Evaluation - Crawler Ethics and Conflicts maxima	1 hour
3.7	New Developments	1 hour
Module-4 (Structured Data Extraction) (8 hours)		
4.1	Structured Data Extraction: Wrapper Generation	1 hour
4.2	Preliminaries- Wrapper Induction	1 hour
4.3	Instance Based Wrapper Learning - Automatic Wrapper Generation	1 hour
4.4	Problems - String Matching and Tree Matching -Multiple Alignment	1 hour
4.5	Building DOM Trees	1 hour
4.6	Extraction Based on a Single List Page and Multiple pages- Introduction to Schema Matching	1 hour
4.7	Schema Level Match -Domain and Instance Level Matching	1 hour
4.8	Extracting and Analysing Web Social Networks	1 hour
Module-5 (Web Usage Mining) (7 hours)		
5.1	Web Usage Mining - Data Collection and Pre-Processing	1 hour
5.2	Sources and Types of Data, Key Elements of Web Usage Data	1 hour
5.3	Data Modelling for Web Usage Mining	1 hour
5.4	Discovery and Analysis of Web Usage Patterns	1 hour
5.5	Application of web usage mining	1 hour
5.6	Recommender Systems and Collaborative Filtering	1 hour
5.7	Query Log Mining	1 hour

CST433	SECURITY IN COMPUTING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course helps the learners to explore various algorithms to offer confidentiality, integrity, authentication &non-repudiation services and different attacks on system security with their countermeasures. It covers classical encryption techniques, symmetric and public key crypto-system, key distribution techniques, authentication functions, intruders, malicious software, and DDoS attacks. The concepts covered in this course enable the learners in effective use of cryptographic algorithms and appropriate countermeasures for securing real life applications.

Prerequisite: A fundamental knowledge in mathematical foundations of security.

Course Outcomes: After the completion of the course, the student will be able to

CO1	Identify the security services provided against different types of security attacks. **(Cognitive Knowledge Level: Understand)**
CO2	Illustrate classical encryption techniques for information hiding. **(Cognitive Knowledge Level: Apply)**
CO3	Illustrate symmetric/asymmetric key cryptosystems for secure communication. **(Cognitive Knowledge Level: Apply)**
CO4	Explain message integrity and authentication methods in a secure communication scenario. **(Cognitive Knowledge Level: Understand)**
CO5	Interpret public/secret key distribution techniques for secure communication. **(Cognitive Knowledge Level: Understand)**
CO6	Identify the effects of intruders, malicious software and distributed denial of service attacks on system security. **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓	✓	✓									✓
CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓			✓						✓
CO5	✓	✓	✓									✓
CO6	✓	✓	✓			✓		✓				✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom’s Category	Test 1 (%)	Test 2 (%)	End Semester Examination (%)
Remember	30	30	30
Understand	40	40	40

Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment Test : **25 marks**

Continuous Assessment Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1 (Basics of Security and Traditional Cryptosystems)
OSI security architecture – Security attacks, Services, Mechanisms. Cryptography vs Cryptanalysis. Classical encryption techniques – Symmetric cipher model. Substitution ciphers – Monoalphabetic vs Polyalphabetic ciphers, Caesar cipher, Affine cipher, Playfair cipher, Vigenere cipher, Hill cipher. Transposition ciphers – Keyless, Keyed, Double transposition.

Module-2 (Modern Symmetric Key Cryptosystems)
Symmetric key ciphers – Block vs Stream ciphers, Block cipher components, Product ciphers, Feistel and Non-Feistel ciphers. Data Encryption Standard (DES) – Structure, Key generation, Design criteria, Weaknesses, Double DES, Triple DES. Advanced Encryption Standard (AES) – Structure, Key expansion. Block cipher modes of operation – Electronic Codebook Mode (ECB), Cipher Block Chaining Mode (CBC), Cipher Feedback Mode (CFB), Output Feedback Mode (OFB), Counter Mode (CTR). Stream ciphers – Structure, RC4.

Module-3 (Public Key Cryptosystems)
Introduction to public key cryptosystems – Principles, Applications, Requirements, Conventional vs Public key cryptosystems. RSA cryptosystem – Algorithm, Security, Attacks. ElGamal cryptosystem – Algorithm. Diffie-Hellman key exchange – Algorithm, Man-in-the-middle attack. Elliptic Curve Cryptography (ECC) – ElGamal ECC, Key exchange using ECC.

Module-4 (Message Integrity and Authentication)
Hash functions – Security requirements, Secure Hash Algorithm (SHA-512). Message Authentication Code (MAC) – Requirements, Uses, Hash-based MAC (HMAC), Cipher-based MAC (CMAC). Digital signatures – Attacks, Forgeries, Requirements, Direct vs Arbitrated digital signatures, RSA digital signature, ElGamal digital signature, Digital Signature Standard (DSS).

Module-5 (Key Distribution and System Security)
Key management – Distribution of secret keys using symmetric and asymmetric encryption, Distribution of public keys. System security – Intruders, Intrusion detection techniques, Password management. Malicious software – Viruses, Related threats, Countermeasures. Distributed Denial of Service (DDoS) attacks – Types, Countermeasures.

Text Books
1. William Stallings, Cryptography and Network Security Principles and Practice, 4/e, Pearson Ed.
2. Behrouz A Forouzan, Cryptography and Network Security, 3/e, Tata McGraw-Hill.

References

1. Charles P Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, Security in Computing, 5/e, Prentice Hall.
2. G.A. Jones & J.M. Jones, Elementary Number Theory, Springer UTM, 2007.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Define the type of security attack in the following case: A student breaks into a teacher's office to obtain a copy of the next day's exam question paper.
2. Which security mechanism is provided in the following case: A bank requires the customer's signature for a withdrawal.

Course Outcome 2 (CO2):

1. Alice wishes to send the message "COME BACK EARLY" to Bob, using Playfair cipher. The key to be used is "SAFFRON". Show the process of encryption.
2. Using Affine cipher, encrypt "HOT" and decrypt "JDG". Key is (7, 3).
3. Implement the Vigenere cipher method in a suitable programming language. (Assignment)

Course Outcome 3 (CO3):

1. If the DES key with parity bit is 0123 ABCD 2562 1456, find the first round key.
2. In RSA, given p=19, q=23, public key(e)=3, find n, $\phi(n)$ and private key(d).
3. Implement any two symmetric/asymmetric encryption techniques in a suitable programming language. (Assignment)

Course Outcome 4 (CO4):

1. Describe the steps involved in generating a Hash-based MAC.
2. Using ElGamal scheme, generate the signatures for the message M=400 with p=881, d=700 and r=17.
3. A company wishes to implement a secure authentication mechanism for communication. As a system security admin suggest any two ways of implementing such a mechanism. (Assignment)

Course Outcome 5 (CO5):

1. List any two ways in which secret keys can be distributed to two communicating parties.
2. Explain the significance of a public-key authority in the distribution of public keys.

Course Outcome 6 (CO6):

1. What are false positives and negatives in the context of Intrusion Detection Systems? How can we reduce these two?
2. Distinguish between a direct DDoS attack and a reflector DDoS attack.
3. Bob works as a network administrator in ABC & Co. On a day of his absence, he shared his admin password with one of his colleagues, John, to manage a network issue. Later John started misusing this privilege by launching DoS attacks in the network. Describe the ethical issues in this scenario and how can this be avoided? (Assignment)

Model Question Paper

QP CODE: **PAGES: ___**

Reg No:_______________
Name:_________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST433
Course Name: SECURITY IN COMPUTING

Max Marks: 100 **Duration: 3 Hours**

PART A
(Answer All Questions. Each question carries 3 marks)

1. Differentiate between passive attack and active attack.
2. Use an Affine cipher to encrypt the message “SECURITY” with the key pair(7,2) in modulus 26.
3. Compare stream cipher and Block cipher with example.

4. Differentiate between diffusion and confusion.

5. Define the elliptic curve logarithm problem.

6. Consider an ElGamal scheme with a common prime q = 71 and a primitive root α = 7. If B has a public key Y_B = 3 and A chose the random number k = 2, what is the ciphertext of the message M = 30?

7. Give the requirements of MAC function.

8. Specify the different types of forgery in digital signature.

9. List three different classes of intruders.

10. Mention the phases of operation of a virus.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Illustrate the two approaches to attack a conventional encryption scheme. **(4)**

(b) A Hill cipher is setup with the key matrix $\begin{bmatrix} 9 & 4 \\ 5 & 7 \end{bmatrix}$. **(10)**

Encrypt the text "COMPUTER". Show the calculations for the corresponding decryption of the ciphertext to recover the original text back.

OR

12. (a) Encrypt the text "this is an exercise and complete it" using transposition cipher with the key (3,2,1,4,5). Show decryption of the ciphertext to recover the original text back. **(6)**

(b) Encrypt the message "the house is being sold tonight"using the following ciphers. Ignore the space between words. **(8)**

i) Vigenere cipher with key = "largest".

ii) Autokey system of Vigenere cipher with key ="largest".

13. (a) How is round key generated in DES? **(4)**

(b) Illustrate AES encryption in detail. **(10)**

OR

14. (a) Explain the construction of S-box in AES. **(5)**

(b) Summarize the primitive operations in RC4 algorithm. **(9)**

15. (a) Compare the Cipher Block Chaining Mode (CBC) and Cipher Feedback Mode (CFB) of block ciphers. **(6)**

(b) Explain RSA cryptosystem. In an RSA cryptosystem a participant A uses two prime numbers p=13 and q=17 to generate public key and private key. The public key of A is 35. Find the private key of A. **(8)**

OR

16. (a) Illustrate ElGamal cryptosystem. **(6)**

(b) Consider a Diffie–Hellman scheme with a common prime q=11 and a primitive root α=2. **(8)**

i) Show that 2 is a primitive root of 11.

ii) If User A has public key Y_A= 9, what is A's private key X_A?

iii) If User A has public key Y_B= 3, what is the shared secret key K, shared with A?

17. (a) Describe different types of arbitrated digital signature techniques. **(6)**

(b) Explain Cipher – Based Message Authentication Code. **(8)**

OR

18. (a) Explain the attacks on digital signature. **(5)**

(b) Describe the working of SHA-512 with diagrams. **(9)**

19. (a) Explain four techniques used to avoid guessable passwords. **(6)**

(b) Describe the different techniques for public key distribution. **(8)**

OR

20. (a) Explain different types of Simple DDoS attack and its countermeasures. **(6)**

(b) Differentiate between statistical anomaly detection and rule-based intrusion detection. **(8)**

Teaching Plan

No	Contents	No.of Lecture Hours (35Hrs)
Module-1 (Basics of Security and Traditional Cryptosystems) (6 hrs)		
1.1	OSI security architecture – Security attacks, Services, Mechanisms	1
1.2	Cryptography vs Cryptanalysis. Classical encryption techniques – Symmetric cipher model	1
1.3	Substitution ciphers – Monoalphabetic vs Polyalphabetic ciphers, Caesar cipher, Affine cipher	1
1.4	Playfair cipher, Vigenere cipher	1
1.5	Hill cipher	1
1.6	Transposition ciphers – Keyless, Keyed, Double transposition	1
Module-2 (Modern Symmetric Key Cryptosystems) (9hrs)		
2.1	Symmetric key ciphers – Block vs Stream ciphers, Block cipher components, Product ciphers, Feistel and Non-Feistel ciphers	1
2.2	Data Encryption Standard (DES) – Structure, Key generation	1
2.3	Design criteria, Weaknesses	1
2.4	Double DES, Triple DES	1
2.5	Advanced Encryption Standard (AES) – Overall Structure	1
2.6	Stages of encryption/decryption	1
2.7	Key expansion	1
2.8	Block cipher modes of operation – Electronic Codebook Mode (ECB), Cipher Block Chaining Mode (CBC), Cipher Feedback Mode (CFB), Output Feedback Mode (OFB), Counter Mode (CTR).	1
2.9	Stream ciphers – Structure, RC4	1
Module-3 (Public Key Cryptosystems)(7hrs)		
3.1	Public key cryptosystems – Principles, Applications, Requirements, Conventional vs Public key cryptosystems	1

3.2	RSA cryptosystem – Algorithm	1
3.3	RSA Security, Attacks	1
3.4	ElGamal cryptosystem – Algorithm	1
3.5	Diffie-Hellman key exchange – Algorithm, Man-in-the-middle attack	1
3.6	Elliptic Curve Cryptography (ECC) – ElGamal ECC	1
3.7	Key exchange using ECC	1
Module-4 (Message Integrity and Authentication) (6 hrs)		
4.1	Hash functions – Security requirements, Secure Hash Algorithm (SHA-512)	1
4.2	Message Authentication Code (MAC) – Requirements, Uses	1
4.3	Hash-based MAC (HMAC), Cipher-based MAC (CMAC)	1
4.4	Digital signatures – Attacks, Forgeries, Requirements, Direct Vs Arbitrated digital signatures	1
4.5	RSA digital signature, ElGamal digital signature	1
4.6	Digital Signature Standard (DSS)	1
Module-5 (Key Distribution and System Security) (7hrs)		
5.1	Key management – Distribution of secret keys using symmetric and asymmetric encryption	1
5.2	Distribution of public keys	1
5.3	System security – Intruders, Intrusion detection techniques	1
5.4	Password management	1
5.5	Malicious software – Viruses, Related threats	1
5.6	Virus countermeasures	1
5.7	Distributed Denial of Service (DDoS) attacks – Types, Countermeasures	1

CST443	MODEL BASED SOFTWARE DEVELOPMENT	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: The objective of the course is to familiarize learners about the concepts and advantages of using model based software development. This course covers the methodologies in developing the model of a software, perform analysis on the model and automatic generation of code from the model. The OSATE framework and its plugins using the Architecture Analysis and Design Language(AADL) language is used in the course to demonstrate the end-to-end concept of MBSD which helps the learners to get a hands on experience.

Prerequisite: Software Engineering

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the relevance of model based software development in the software development process. (**Cognitive Knowledge level: Understand**)
CO2	Explain Model Driven Architecture with Computation Independent Model (CIM), Platform Independent Model(PIM), Platform Specific Model (PSM). (**Cognitive Knowledge level: Apply**)
CO3	Illustrate software modeling with Architecture Analysis and Design Language (AADL). (**Cognitive Knowledge level: Apply**)
CO4	Explain error annex using error modelling concepts and illustrate error modelling in AADL. (**Cognitive Knowledge level: Understand**)
CO5	Illustrate the process of code generation from an AADL model. (**Cognitive Knowledge level: Understand**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔									✔
CO2	✔	✔	✔	✔								✔
CO3	✔	✔	✔	✔								✔
CO4	✔	✔	✔									✔
CO5	✔	✔	✔									✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Test 1 (Marks in percentage)	Test 2 (Marks in percentage)	End Semester Examination Marks
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test : 25 marks
Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum of 2 sub-divisions and carries 14 marks.

Syllabus

Module - 1 (Introduction to Model Based Software Development)

Software faults, Introduction to Model checking, Introduction to Automated Testing, Model Based Software Development (MBSD) – Need, MBSD Approach, Learning MBSD from the perspective of Architecture Analysis and Design Language (AADL).

Module - 2 (More on MBSD)

MBSD based software development – Requirements, Analysis, Design and Implementation. Model-Driven Architecture **-** Definitions and Assumptions, Overview of MBSD methodology, The modeling levels-Computation Independent Model (CIM), Platform Independent Model (PIM), Platform Specific Model (PSM). Introduction to AADL, Basic Comparison of AADL with other modeling languages - Comparison with UML.

Module -3 (Modeling using AADL)

Modeling: Developing a Simple Model - Define the components - Explain with example (powerboat autopilot system), Develop a top-level model - Use example Powerboat Autopilot (PBA) system.

AADL: Components - Software, Hardware, Composite, Runtime semantics, Language syntax, AADL declarations, AADL classifiers, AADL system models and specifications

Case Study: Powerboat Autopilot System.

Module - 4 (Model Analysis)

Safety Analysis -Fault tree analysis, Minimal cutsets. Error Modeling in AADL-Error Model Libraries and Subclause Annotations, Error Types and Common Type Ontology, Error Sources and Their Impact, Component Error Behavior, Compositional Abstraction of Error Behavior, Use of Properties in Architecture Fault Models, Error modeling example.

Module - 5 (Code Generation)

Need for code generation, Categorization, Code Generation Techniques, Code Generation in AADL Model – Ocarina.

Text Books

1. Marco, Brambilla, Jordi Cabot, Manuel Wimmer, Model-Driven Software Engineering in Practice, 2/e, Synthesis Lectures on Software Engineering, 2017.
2. Christel Baier and Joost-Pieter Katoen, Principles of model checking, The MIT Press.
3. Thomas Stahl and Markus Volter, Model-Driven Software Development, Wiley, 2006.
4. David P. Gluch, Peter H. Feiler, Model-Based Engineering with AADL: An Introduction to the SAE Architecture Analysis & Design Language, Adison-Wesley, 2015.

References:

1. Automated software testing : http://www2.latech.edu
2. Peter H. Feiler, David P. Gluch, John J. Hudak.The Architecture Analysis & Design Language(AADL): An Introduction.
3. de Niz, Dionisio, Diagrams and Languages for Model-Based Software Engineering of EmbeddedSystems: UML and AADL
4. FAA System Safety Handbook, Chapter 8: Safety Analysis/Hazard Analysis Tasks
5. Enno Ruijters, Marielle Stoelinga, Fault tree analysis: A survey of the state-of-the-art in modeling, analysis and tools.
6. Larson, Brian &Hatcliff, John & Fowler, Kim &Delange, Julien. (2013). Illustrating the AADL error modeling annex (v.2) using a simple safety-critical medical device. ACM SIGAda Ada Letters. 33. 65-84. 10.1145/2527269.2527271.
7. Delange, Julien&Feiler, Peter &Hudak, John &Gluch, Dave. (2016). Architecture Fault Modeling and Analysis with the Error Model Annex, Version 2. 10.13140/RG.2.1.4224.7927.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Justify the need of model based software development?
2. Explain the advantages of model based software development?

Course Outcome 2 (CO2):

1. Explain infrastructure of model driven architecture.
2. Describe about MDA modeling levels.

Course Outcome 3 (CO3):

1. Illustrate the basic components of an AADL Model.

2. Assume we have a system to regulate the fuel valve of a boiler by monitoring the steam flow and steam pressure. Identify the basic components of this system and design its AADL model.

Course Outcome 4 (CO4):

1. Suppose we have an isolette system which ensures the temperature is within a specified temperature range with following components:

   i) temperature sensor - detects air temperature.

   iii) heat source - supply hot air to maintain temperature.

   iv) operator interface - specify target temperature range(lower desired temperature, upper desired temperature.)

   iv) thermostat - takes as input an air temperature value from a temperature sensor and controls a heat source to produce an air temperature within a target range.

   Model the error flows, error propagations, component error behaviour and error properties for the value error in the isolette system.

Course Outcome 5 (CO5):

1. Illustrate code generation from an AADL model.

Model Question Paper

QP CODE:

Reg No: _______________

Name: ___________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST443

Course Name: Model Based Software Development

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. List any three advantages of automated software testing.

2. Specify the steps and their purpose in the model checking process.

3. Compare Analysis And Design Language (AADL) with Unified modeling language (UML).

4. Describe the design phase in the model based software development process.

5. Represent interface component with an out data port and an out event port in AADL.

a) textual b)graphical

6. Give the textual top level model of a powerboat autopilot system in AADL.

7. What is an error type? Mention any two pre-declared timing and value errors in AADL.

8. Define : (i) Fault Tree Analysis (ii) Minimal cutsets

9. Explain templates and filtering code generation technique.

10. How does automated code generation help to deal with faults in a software system?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain model based software development approach. **(12)**

(b) Why is model based software development important? **(2)**

OR

12. (a) What are software faults? Mention any three software faults and its consequences. **(5)**

(b) Explain two approaches for ensuring software reliability? **(9)**

(i) Model Checking

(ii) Automated Testing

13. (a) Illustrate model based software development process. **(8)**

(b) Explain infrastructure of model driven architecture. **(6)**

OR

14. (a) What is AADL? Compare AADL and UML. **(6)**

(b) Explain in detail about MDA modeling levels. **(8)**

15. (a) Illustrate the components of an AADL model. **(12)**

(b) What is the AADL language syntax? **(2)**

OR

16. (a) Explain the following:

i) AADL classifiers

ii) AADL declarations **(2)**

(2)

(b) Design an AADL model which controls the speed of a vehicle. Also describe the basic components of the designed model. **(10)**

17. (a) Illustrate how value error can be modelled using AADL in the isolette system. **(10)**

(b) With a diagram explain error propagation, termination and transformation in AADL models. **(4)**

OR

18. (a) Illustrate error state machines in AADL using proper textual representations. **(8)**

(b) Suppose we have a train door controller system with following components **(6)**

i) door_controller - ensures safe opening of the door.

ii) train_controller - sends train speed and transit status to the door_controller.

iii) alarm - triggered when an emergency occurs in other components.

Model the error flows, error propagations, component error behaviour and error properties for the value error in the component door_controller.

19. (a) Explain templates and meta model type code generation? **(4)**

(b) Illustrate how the code can be generated from an AADL model. **(10)**

OR

20. (a) Describe any four code generation techniques. **(10)**

(b) Explain the advantages of automatic code generation. **(4)**

Teaching Plan

Sl No	Contents	Number of Lecture Hours (35)
	Module 1 (Introduction) (7 Hours)	
1.1	Software faults	1
1.2	Introduction to Model Checking	1
1.3	Introduction to Automated Testing (Lecture 1)	1
1.4	Introduction to Automated Testing (Lecture 2)	1
1.5	Need for MBSD, MBSD Approach	1
1.6	Architecture centric model driven software development	1
1.7	AADL and architecture-centric model-based software systems	1
	Module 2 (Model Based Software Development) (7 Hours)	
2.1	Model based software development process	1
2.2	Overview of MBSD methodology	1
2.3	Model Driven Architecture	1
2.4	MDA Definitions and Assumptions	1
2.5	The modeling levels	1
2.6	Introduction to AADL	1
2.7	Comparison of AADL with other modeling languages	1
	Module 3 (Modeling using AADL) (7 Hours)	
3.1	Modeling in detail: AADL components	1
3.2	Modeling in detail: Developing a simple model	1

3.3	Modeling in detail: Define top level model with an example	1
3.4	AADL in detail: Explain AADL components, Language syntax	1
3.5	AADL declarations and classifiers	1
3.6	AADL system models and specifications	1
3.7	Case study: Power boat auto pilot system	1
	Module 4 (Model Analysis)(7 Hours)	
4.1	Introduction to safety analysis	1
4.2	Fault tree analysis, minimal cutsets	1
4.3	Error modeling with AADL - Error Model Libraries and Subclause Annotations	1
4.4	Error modeling with AADL - Error Types and Common Type Ontology,	1
4.5	Error modeling with AADL - Error Sources and Their Impact, Component Error Behavior	1
4.6	Error modelling with AADL - Compositional Abstraction of Error Behavior, Use of Properties in Architecture Fault Models	1
4.7	Illustrate isolette error model	1
	Module 5 (Code Generation) (7 Hours)	
5.1	Code generation and its advantages	1
5.2	Categorization	1
5.3	Code generation techniques - Templates + filtering, Template + metamodel, Frame processors	1
5.4	Code generation techniques - API-based generators, In-line generation, Code attributes	1
5.5	Code generation techniques - Code weaving Commonalities and Differences Between the Different Code generation Approaches	1
5.6	Code generation in AADL - Ocarina	1
5.7	Illustration of code generation using AADL model	1

CST463	WEB PROGRAMMING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course helps the learners to understand the web programming concepts. It includes the essential frontend and backend technologies needed for the development of web applications. The learners will have an opportunity to gain necessary web development skills such as HTML, CSS, JavaScript, PHP, MySQL integration, JSON and Laravel framework.

Prerequisite: Knowledge of Programming is required.

Course Outcomes: After the completion of the course the student will be able to

CO1	Use HyperText Markup Language (HTML) for authoring web pages and understand the fundamentals of WWW. **(Cognitive Knowledge Level: Understand)**
CO2	Construct and visually format responsive, interactive web pages using CSS and JavaScript (JS) **(Cognitive Knowledge Level: Apply)**
CO3	Construct websites using advanced sever side programming tool PHP **(Cognitive Knowledge Level: Apply)**
CO4	Develop dynamic web applications using PHP and perform MySQL database operations. **(Cognitive Knowledge Level: Apply)**
CO5	Explain the importance of object exchange formats using JSON and the MVC based web application development frameworks (Laravel) **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔				✔							✔
CO2	✔	✔	✔		✔							✔
CO3	✔	✔	✔	✔	✔							✔
CO4	✔	✔	✔	✔	✔							✔

CO5	✔	✔			✔							✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember	**20**	**20**	**20**
Understand	**40**	**40**	**40**
Apply	**40**	**40**	**40**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	**50**	**100**	**3**

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests (Average of Internal Tests 1 & 2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks.

First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

Syllabus

Module – 1 (WWW, HTML)

Introduction to the Internet & WWW: Evolution of Internet & World Wide Web- Web Basics, URI's & URL-MIME.

Introduction to HTML5: Structuring & editing an HTML5 document, Fundamentals of HTML - Headings-Hyper Links- Images - Special Characters & Horizontal Rules-Lists- Tables -Forms - Internal Linking- Meta Elements-HTML5 Form input types -Input and Data List Elements and autocomplete attribute- Page Structure Elements -Multimedia-HTML5 Audio & video elements..

Module -2 (CSS, JavaScript)

Introduction to Stylesheets : Introduction to CSS-Basic syntax and structure-Inline Styles, Embedded Style Sheets, Conflict Resolution, Linking External Style Sheets-Exploring CSS Selectors-Properties, values, Positioning Elements: Absolute Positioning, Relative Positioning -

Backgrounds-List Styles-Element Dimensions- Table Layouts-Box Model and Text Flow-div and span -Basics of Responsive CSS, Media port & Media Queries.

Introduction to JavaScript : Introduction to Scripting- Programming fundamentals of JavaScript -Obtaining User Input with prompt Dialogs-Arithmetic-Decision Making -Control Statements -Functions -Arrays -Objects -Document Object Model (DOM) -Form processing

Module- 3 (PHP Basics)

PHP Language Structure: Introduction- **B**uilding blocks of PHP-Variables, Data Types -simple PHP program-Converting between Data Types- Operators and Expressions -Flow Control functions - Control statements- Working with Functions- Initialising and Manipulating Arrays--Objects- String Comparisons-String processing with Regular Expression

Module -4 (PHP- MySQL, JSON)

Advanced PHP: Form processing and Business Logic-Cookies- Sessions & MySQL Integration-Connecting to MySQL with PHP- Performing CREATE, DELETE, INSERT, SELECT and UPDATE operations on MySQL table -Working with MySQL data-Reading from Database-Dynamic Content.

Module- 5 (JSON, Laravel)

JSON Data Interchange Format: Syntax, Data Types, Object, JSON Schema, Manipulating JSON data with PHP

Web Development Frameworks: Laravel Overview**-**Features of Laravel-Setting up a Laravel Development Environment-Application structure of Laravel-Routing -Middleware-Controllers-Route Model Binding-Views-Redirections-Request and Responses.

Text Books

1 Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, Internet & World Wide Web How to Program 5^{th} Edition **[Module 1,2,3,4]**
2. Lindsay Bassett, Introduction to JavaScript Object Notation: A To-the-Point Guide to JSON 1st Edition, O'Reilly **[Module 5]**
3. Julie C. Meloni, Pearson -PHP, MySQL & JavaScript All in One, Sams Teach Yourself,5th Ed [**Module 4]**
4. Matt Stauffer," LARAVEL up and Running, A framework for building modern PHP apps"1st Edition, O'REILLY **[Module 5]**

Reference Books

1. Robert W Sebesta, Programming the World Wide Web, 7/e, Pearson Education Inc,8th Edition
2. Larry Ullman, Pearson- PHP 6 and MySQL 5 for Dynamic Web Sites: Visual QuickPro Guide
3. Eric van der Vlist, Danny Ayers, Erik Bruchez, Joe Fawcett, Alessandro Vernet",Wrox-Professional Web 2.0 Programming, Wiley-India edition
4. Web Technologies Black Book 2018(As per Mumbai University Syllabus) HTML, CSS3, JavaScript, iQuery, AJAX,PHP,XML,MVC and Laravel DT Editorial Services (ISBN: 9789386052490)

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Construct a valid HTML document for your personal Profile registration page for a Job Site www.123Jobs.com. Add relevant HTML elements in a table, to accept a minimum of 10 different fields which includes your name, address, phone, email address, your picture, your college; your branch, fields for your personal history (Minimum 3 fields), favourite theory and practical subjects (Checkbox), Username, Password(password)

2. What is MIME? Give the expansion of MIME. List four examples for MIME types. State the reason why MIME type specification is necessary in a request-response transaction between a browser and server.

3. What is codec? Recognize the role of controls attribute in <video> & <audio> tag in HTML. Use the COVID vaccination promotional video 'MySafety.mp4' in a web page with suitable HTML code, 'autoplay' option enabled and displayed in a standard dimension 750 X500.

Course Outcome 2 (CO2):

1. Organize a sample web page for the event 'Raagam2021' at your campus and use embedded Style sheets to apply a minimum 5 styles. State the Style Specification format of embedded style sheets.

2. Write CSS style rules to implement the following in a web page:

   a. to display the content of hyperlinks with yellow background color and in italics

   b. to display the contents of unordered lists in bold and in Arial font

   c. to display a background image titled "birds.jpg" with no tiling.

3. Write the code for an HTML document with embedded JavaScript scripts, which initially displays a paragraph with text "Welcome" and a button titled "Click". When the button is clicked, the message "Hello from JavaScript" in bold should replace the paragraph text

Course Outcome 3 (CO3):

1. Write a PHP program to store the name and roll no of 10 students in an Associative Array and Use foreach loop to process the array and Perform asort, rsort and ksort in the array. Illustrate with suitable output data
2. Design an HTML page which enters a given number, write a PHP program to display a message indicating, whether the number is odd or even, when clicking on the submit button.
3. Write a PHP program to compute the sum of the positive integers up to 100 using do while.

Course Outcome 4 (CO4):

1. Write a PHP form handling program to verify the user authentication credentials of a web page using MySQL connection and store the userid value as a Session variable if the userid is valid.
2. Create a valid HTML document for yourself, including your name, address, and email address. Also add your college; your major and the course. Perform form handling in PHP and process the output using POST method.
3. Write an embedded PHP script which displays the factorial of all numbers from 1 to 10 in a table in the web page. The factorial should be calculated and returned from a function. The table headings should be "Number" and "Factorial"

Course Outcome 5 (CO5):

1. What is Route Model Binding in Laravel? Which types of route model binding are supported in Laravel?
2. Explain how laravel performs route handling using routes calling controller methods?
3. List the data types used in JSON? Explain the use of parse () and stringify() functions in JSON with examples.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST463

Course Name: Web Programming

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Define WWW. List any two examples of web server & web browser. Differentiate between URL and a domain?

2. Write the syntax of the URL? Rewrite the default URL of your university website by adding a subdomain named ‘Research’ and a web page named ‘FAQ.html’. Also link this URL through the logo of ‘kturesearch.png’ placed in a web page. The FAQ page should be opened in a new window.

3. Illustrate the implementation of a JavaScript function greeting () using external .js file, to display a welcome message, when you click on a Button in an HTML page.

4. What are different ways of adjusting spacing in a text with suitable example.

5. Discuss the various CSS style sheet levels with suitable examples. How are conflicts resolved when multiple style rules apply to a single web page element?

6. Describe how input from an HTML form is retrieved in a PHP program, with an example

7. Write a PHP program to check whether a number is prime number or not.

8. Discuss the various steps for establishing PHP-MySQL connection with a MySQL

database ?

9. Describe the schema of a document implemented in JSON with suitable examples

10. Explain the role of Resource controllers in Laravel.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Design a webpage that displays the following table. **(6)**

Food Item	Recommended Intake			
	age<15		age>15	
	gm	Kcal	gm	Kcal
Cerials	1000	2000	750	1760
NonCerials	450	800	350	600

(b) What is the difference between radio buttons and checkboxes when implemented using HTML? Write HTML code to implement a form which has the following elements: **(8)**

i. A textbox which can accept a maximum of 25 characters
ii. Three radio buttons with valid Label, Names and values
iii. Three check boxes buttons with valid Label, Names and values
iv. A selection list containing four items, two which are always visible
v. A submit button clicking on which will prompt the browser to send the form data to the server "http://www..mysite.com/reg.php" using "POST" method and reset button to clear its contents. You can use any text of your choice to label the form elements.

OR

12. (a) Write the equivalent HTML code to implement the following in a web page: (i) An image titled "birds.jpg" with a height of 100 pixels and width of 200 pixels. If the image cannot be accessed, a message "No image available" should be displayed (ii) A hyperlink to the URL "www.mysite.com/birds.jpg". The hyperlink should have the label "Click Here". **(6)**

(b) Create a static HTML document for your portfolio, which includes the following contents: your name, address, Mobile Number and email address. Also add the details about your college, university, your major and the batch **(8)** of study. Include a picture of yourself and at least one other image (friend/pet/role model) to the document with a short description about that. Add three paragraphs about your personal history, with links to your social media profile. Also create an ordered list for describing your Skill Set & an unordered list showing your Strengths & Weaknesses.

13. (a) Illustrate the usage of JavaScript DOM in event handling and explain any three methods with example. **(8)**

(b) Write CSS and the corresponding HTML code for the following: **(6)**

i. Set the background color for the hover and active link states to "green"

ii. Set the list style for unordered lists to "square".

iii. Set "Flower.png" as the background image of the page and set 3% margin for the pages

iv. Set dashed border for left and right and double border for top & bottom of a table with 2 rows.

OR

14. (a) List the order of precedence of style levels. Organize a sample web page for providing 'KTU BTech Honours Regulation 19' for KTU and use embedded Style sheet to apply minimum 5 styles for list, tables and pages. **(6)**

(b) Illustrate the different ways of Array declaration in JavaScript. Describe the function of the following JavaScript Array object methods with examples. **(8)**

(i) join (ii) slice

15. (a) Explain any six string handling functions used in PHP with example. **(6)**

(b) How does a PHP array differ from an array in C? List the different ways to create an array in PHP with an example. Explain any 4 functions that deals with PHP array. **(8)**

OR

16. (a) During the process of fetching a web page from a web server to a client browser, at what point does an embedded PHP script get executed. What are the two modes that the PHP processor operates in? Explain **(6)**

(b) Why is PHP considered to be dynamically typed? Distinguish between **(8)** implode and explode function in PHP with suitable examples.

17. (a) Write equivalent PHP statements corresponding to the following: **(8)**

i. Declare an associative array named "ages" to store the key-value pairs ("Alice", 30), ("Bob", 30), ("Harry", 35), ("Mary", 32).
ii. Modify the value associated with the key "Mary" to 28.
iii. Sort the array according to values maintaining the key-value relationships and print the sorted key-value pairs.
iv. The entry identified by the key "Bob"

(b) What are the uses of cookies in web pages? Describe syntax for setting cookies in PHP. How can you access and delete the cookie using setcookie() function? **(6)**

OR

18. (a) Write a PHP form handling program to perform the user registration of any website with a minimum of 5 different fields and insert the data into a MySQL table after establishing necessary connections with the DB, **(8)**

(b) Design the HTML page which enters a given number and embed the PHP code to display a message indicating, whether the number is odd or even, when clicking on the 'CHECK NUMBER' button. **(6)**

19. (a) With a neat diagram, explain about Laravel MVC Framework. **(6)**

(b) Discuss in detail about Laravel's Routing mechanisms. **(8)**

OR

20. (a) Enumerate the data types in JSON. Illustrate the document definition of a 'Student document 'using JSON Schema. **(8)**

(b) Discuss the following in Laravel Views **(6)**

i. Creating & Rendering Views
ii. Passing Data to Views
iii. Sharing Data with All Views

Teaching Plan

No	Contents	No of Lecture Hrs (35 hrs)
Module 1 (7 hours)		
Introduction to Internet and WWW		
1.1	Evolution of Internet &World Wide Web- Web Basics URI's & URL -MIME [Book 1 - Chapter 1]	1
Introduction to HTML5		
1.2	Structuring & editing an HTML5 document- Fundamentals of HTML, Headings-Images [Book 1 - Chapter 2]	1
1.3	Hyper Links, Internal Linking- Lists [Book 1 - Chapter 2]	1
1.4	Special Characters & Horizontal Rules- meta Elements- div and span [Book 1 - Chapter 2]	1
1.5	Tables- Forms [Book 1 - Chapter 2]	1
1.6	HTML5 Form input types, input and data list Elements and autocomplete attributes-Page Structure Elements [Book 1 - Chapter 3]	1
1.7	Multimedia-HTML5 Audio & video elements [Book 1 - Chapter 9]	1
Module 2 (10 hours)		
Introduction to Cascading Style Sheets(CSS)		
2.1	Introduction to CSS3-Basic syntax and structure-Inline Styles [Book 1 - Chapter 4]	1
2.2	Embedded Style Sheets-Linking External Style Sheets [Book 1 - Chapter 4]	1
2.3	Exploring CSS Selectors-Properties-values [Book 1 - Chapter 4]	1
2.4	Positioning Elements: Absolute Positioning- Relative Positioning -Backgrounds-List Styles- Table Layouts [Book 1 - Chapter 4]	1

2.5	Box Model and Text Flow, Basics of Responsive CSS-Media port & Media Queries [Book 1 - Chapter 4]	1
Introduction to JavaScript		
2.6	Introduction to Scripting- Programming fundamentals of JavaScript -Obtaining User Input with prompt Dialogs [Book 1 - Chapter 6]	1
2.7	Arithmetic-Decision Making [Book 1 - Chapter 6]	1
2.8	Control Statements [Book 1 - Chapter 7]- Functions [Book 1 - Chapter 9]	1
2.9	Arrays [Book 1 - Chapter 10] - Objects [Book 1 - Chapter 11]	1
2.10	Document Object Model (DOM)- Form processing [Book 1 - Chapter 12,13]	1
Module 3 (6 hours)		
Introduction to PHP		
3.1	Building blocks of PHP-Variables, Data Types simple PHP program [Book 3- Chapters 4]	1
3.2	Converting between Data Types, Operators and Expressions -Flow Control functions [Book 1- Chapters 19]	1
3.3	Control Statements -Working with Functions [Book 3- Chapters 6]	1
3.4	Initialising and Manipulating Arrays- Objects [Book 1- Chapters 19]	1
3.5	Working with Strings-String processing with Regular expression, Pattern Matching [Book 1- Chapters 19]	1
3.6	Form processing and Business Logic [Book 1- Chapters 19]	1
Module 4 (6 hours)		
PHP -MYSQL		
4.1	Cookies- Sessions [Book 1- Chapters 19]	1
4.2	PHP& MySQL Integration-Connecting to MySQL with PHP . [Book 4- Chapters 18]	1

4.3	Working with MySQL data [Book 4- Chapters 18]	1
4.4	Performing CREATE, DELETE, INSERT operations on MySQL table from PHP Program. [Book 4- Chapters 16]	1
4.5	Performing SELECT and UPDATE operations on MySQL table from PHP Program. [Book 4- Chapters 16]	1
4.6	Building Dynamic Content in PHP application [Book1- Chapter19]	1
Module 5 (6 hours)		
	JSON	
5.1	JSON Data Interchange Format -Syntax, Data Types, Object [Book 2 - Chapters 1-2]	1
5.2	JSON Schema, Manipulating JSON data with PHP [Book 2 - Chapter 3,4]	1
	LARAVEL	
5.3	Laravel Overview**-** Design Pattern- Laravel Features [Book 4- Chapters 1] Setting up a Laravel Development Environment-Application structure of Laravel [Book 4- Chapters 2]	1
5.4	**Laravel Basics** Routing -middleware - Controllers [Book 4- Chapters 3]	1
5.5	Route Model Binding-Views-Redirections [Book 4- Chapters 3]	1
5.6	**Blade Templating-**echoing data, control structures [Book 4- Chapters 4]	1

CST473	NATURAL LANGUAGE PROCESSING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course enables the learners to understand the concepts of Natural Language Processing. The course covers basic pre-processing steps, language models, text classification using machine learning algorithms, information and relation extraction methods, Information Retrieval, Question Answer Systems and Machine Translation models. This course enables the students to apply techniques and methods to solve challenging real-world problems in NLP.

Prerequisite: Nil.

Course Outcomes: After the completion of the course the student will be able to

CO1	Summarize basic concepts and learning methods for NLP **(Cognitive Knowledge Level: Understand)**
CO2	Demonstrate the relevance of pre-processing methods on text data**(Cognitive Knowledge Level: Apply)**
CO3	Compare different language modelling techniques**(Cognitive Knowledge Level: Apply)**
CO4	Make use of NLP techniques in Text Classification and Information Retrieval**(Cognitive Knowledge Level: Apply)**
CO5	Explain Information Extraction, Relation Detection, QA Systems and Machine Translation**(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔											✔
CO2	✔	✔	✔		✔							✔
CO3	✔	✔	✔		✔							✔
CO4	✔	✔	✔									✔
CO5	✔											✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests (Average of Internal Tests 1 & 2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Introduction to NLP)

NLP Tasks and Applications, Language-Building Blocks, Challenges of NLP, Machine Learning for NLP – Naïve Bayes Classifier, Logistic Regression, Support Vector Machines, Approaches to NLP-- Heuristics-Based NLP, Machine Learning-based NLP.

Module – 2 (Pre-processing and Representation Models)

NLP System Pipeline--Steps--Data Acquisition, Text Extraction and Clean-up, Pre-processing, Feature Engineering, Modelling, Evaluation, Post-Modelling Phases

Text Representation--Vector Space Models--Basic Vectorization Approaches--One-Hot Encoding, Bag of Words, Bag of N-Grams TF-IDF; Distributed Representations-- Word Embeddings, Doc2Vec.

Module - 3 (Classification and Information Extraction)

Text Classification--Text classification applications – Pipeline for building text classification systems, Naïve Bayes for Sentiment Classification – Naïve Bayes Classifier Training – Optimizing for Sentiment Analysis, Logistic Regression, Support Vector Machine for Text Classification

Information Extraction(IE)—IE Applications – The General Pipeline for IE - Named Entity Recognition(NER), Ambiguity in Named Entity Recognition – NER as Sequence Labeling – Evaluation of NER.

Module - 4 (Relation Detection and Information Retrieval)

Relation Detection and Classification – Supervised Learning Approaches to Relation Analysis – Lightly Supervised Approaches to Relation Analysis – Evaluation of Relation Analysis systems

Information Retrieval – Term weighting and document scoring – Inverted Index – Evaluation of Information Retrieval Systems.

Module - 5 (QA Systems and Machine Translation)

Question-Answering Systems – Factoid Question Answering – Question Processing – Passage Retrieval – Answer Processing – Evaluation of Factoid Answers

Machine Translation – Why Machine Translation is Hard – Classical Machine Translation – Direct Translation – Transfer – Statistical Machine Translation- The Phrase based Translation model – Alignment in MT – Training Alignment Models – Symmetrizing Alignments for Phrase-based MT – Decoding for Phrase-based Statistical MT

Text Books

1. Daniel Jurafsky, James H. Martin , "Speech and Language Processing"(2nd and 3rd editions), Pearson Prentice Hall
2. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana," Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems " June 2020 Publisher(s): O'Reilly Media, Inc. ISBN: 9781492054054.

Reference Books

1. James Allen, "Natural Language Understanding", Second Edn , Pearson.
2. Christopher Manning and Hinrich Schutze, Statistical Natural Language Processing, MIT Press.

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Explain the fundamental tasks that make up an NLP system.
2. Why is NLP considered a challenging problem domain?
3. The following table shows data about the profile of customers and whether they purchase computers or not. Given this data, use Naïve Bayes Classifier to classify the customer ***X*** (*age = youth, income = medium, student = yes, credit rating = fair*)

RID	age	income	student	credit_rating	Class: buys_computer
1	youth	high	no	fair	no
2	youth	high	no	excellent	no
3	middle_aged	high	no	fair	yes
4	senior	medium	no	fair	yes
5	senior	low	yes	fair	yes
6	senior	low	yes	excellent	no
7	middle_aged	low	yes	excellent	yes
8	youth	medium	no	fair	no
9	youth	low	yes	fair	yes
10	senior	medium	yes	fair	yes
11	youth	medium	yes	excellent	yes
12	middle_aged	medium	no	excellent	yes
13	middle_aged	high	yes	fair	yes
14	senior	medium	no	excellent	no

4. Illustrate how linearly inseparable data can be made linearly separable by suitable mapping using kernel functions.

Course Outcome 2(CO2):

1. Mention two issues associated with sentence segmentation.

2. Show how is lemmatization done using Python Library.

3. Given a dataset of tweets, prepare the data for sentiment analysis by doing the following operations: conversion to lower casing, removal of punctuations, removal of stop-words, stemming, lemmatization, removal of emojis and removal of URLs. (Assignment Question)

Course Outcome 3(CO3):

1. Compare Bag-of-Words model and Bag-of-n-gram model.
2. Illustrate how TF-IDF model is used to represent text. Mention the advantage of TF-IDF over other models.
3. A corpus of data is given below :

D1	Dog bites man.
D2	Man bites dog.
D3	Dog eats meat.
D4	Man eats food.

Use one hot-encoding and Bag-of-words models to represent “dog bites man”.

Using the toy corpus given above, represent the sentence “Dog and Man eat meat” with TF-IDF model. Use python code for implementation. (Assignment Question)

Course Outcome 4(CO4): .

1. Given the following data about documents and contents, use tf-idf document scoring method to retrieve the document for the query "best game"

Doc 1	The game was so exciting. The players excelled in every department of the game.
Doc 2	It was an excellent game.
Doc 3	The game was not good. The moves were boring

2. A corpus of data is available from a social media platform that represents review of books. How can Naïve Bayes Classifier be used for sentiment analysis of the reviews? What changes can be made to this classifier to make it tuned for sentiment analysis.
3. Use python library to implement sentiment analysis of review of a book, given a toy corpus data set given below. (Assignment Question)

Document	Category
just plain boring	Negative
entirely predictable and lacks energy	Negative
no surprises and very few laughs	Negative
very powerful book	Positive
the best book of the summer	Positive

Course Outcome 5(CO5):

1. Explain lightly supervised approaches to relational analysis.
2. Explain a statistical algorithm for word alignment in Machine Translation.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST473

Course Name: Natural Language Processing

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Differentiate information extraction and information retrieval.

2. State Bayes' Theorem.

3. List three preprocessing steps that are necessary for an HTML file.

4. Differentiate CBOW and Skipgram models

5. Explain the role of support vectors in SVM Classification.

6. Explain challenges in Name Entity Recognition.

7. How is a Relational Analysis System evaluated?

8. Explain the need for an inverted index in an information retrieval system. Are there any more efficient data structures that serve the same purpose.

9. How do you extract answers to DEFINITION questions?

10. What are the components that make up a noisy channel model of statistical Machine Translation?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) How is classification done by SVM on linearly separable data? **(8)**

(b) What is a kernel function? What is the need for a kernel function? Can a kernel function be replaced by an ordinary mapping function? **(4)**

(c) Explain Heuristic-based NLP. **(2)**

OR

12. (a) Illustrate the steps involved in classification in Naïve Bayes Classifier. **(8)**

(b) Explain the fundamental tasks that make up an NLP system. **(6)**

13. (a) Supposing that a set of social media posts' dataset is available to do sentiment analysis. What pre-processing steps need to be done in order to use the data for generating a language model? Illustrate. **(8)**

(b) Illustrate Bag-of-ngrams model with an example. **(6)**

OR

14. (a) Explain the concept of word embeddings as a model for text representation. **(6)**

(b) Compare word embeddings model with vectorization approaches. **(4)**

(c) Explain the concept of feature engineering in NLP Systems. **(4)**

15. (a) 1. Given the following data about movie review and its classification, classify "predictable with no fun" to one of the classes using Naïve Bayes Classifier. **(10)**

Document	Category
just plain boring	Negative
entirely predictable and lacks energy	Negative
no surprises and very few laughs	Negative
very powerful	Positive
the most fun film of the summer	Positive

(b) Explain challenges in Name Entity Recognition. **(4)**

OR

16. (a) Explain Logistic Regression for Text Classification. **(6)**

(b) Explain Name Entity Recognition using Sequence Labeling. **(8)**

17. (a) Explain supervised approach to relation analysis. What are its limitations? **(10)**

(b) How is term selection done for indexing? **(4)**

OR

18. (a) Given the following data about documents and contents, use tf-idf document scoring method to retrieve the document for the query “sweet love”. **(10)**

Doc 1	Sweet sweet nurse! Love
Doc 2	Sweet sorrow
Doc 3	How sweet is love?
Doc 4	Nurse!

(b) Explain the approaches to evaluate a relation analysis system. **(4)**

19. (a) Explain the phases of a factoid question-answering system. **(8)**

(b) Give an algorithm for word alignment in Machine Translation. **(6)**

OR

20. (a) How is decoding done in a Phrase-based Statistical Machine Translation System? **(10)**

(b) Explain the concept of Mean Reciprocal Rank. **(4)**

Teaching Plan

No	Contents	No of Lecture Hrs: 35
Module 1 : Introduction to NLP (7 hours)		
1.1	Introduction to NLP – Tasks and Applications	1
1.2	Language – Building Blocks, Challenges of NLP	1
1.3	Approaches to NLP - Heuristics-Based NLP, Machine Learning for NLP	1
1.4	Machine Learning for NLP – Naïve Bayes Classifier	1
1.5	Logistic Regression	1
1.6	Support Vector Machines – Linearly Separable Data	1
1.7	Support Vector Machines – Linearly Inseparable Data	1
Module 2 : Pre-processing and Representation Models(7 hours)		
2.1	NLP System Pipeline – Stages – Overview, Data Acquisition	1
2.2	NLP System Pipeline – Text Extraction and Cleanup	1
2.3	NLP System Pipeline – Preprocessing - Sentence segmentation, Word tokenization, Stemming and lemmatization	1
2.4	Feature Engineering, Model Building, Evaluation – Metrices, Post-modeling phase	1
2.5	Text Representation – Vector Space Model, Vectorization Approaches – One hot encoding, Bag of words	1
2.6	Bag of n-grams, TF-IDF	1
2.7	Word Embeddings – Word2Vec- CBOW, SkipGram models	1
Module 3: Classification and Information Extraction(7 hours)		
3.1	Text Classification--Text classification applications – Pipeline for building text classification systems	1
3.2	Sentiment Analysis using Naïve Bayes Classifier	1
3.3	Case Studies for Text Classification using Logistic Regression and	1

	Support Vector Machines	
3.4	Information Extraction (IE) and Applications, IE Tasks and the IE Pipeline	1
3.5	Named Entity Recognition (NER) – Ambiguity in NER	1
3.6	NER as Sequence Labeling	1
3.7	Evaluation of NER, Practical NER Systems	1
Module 4 : Relation Detection and Information Retrieval(5 hours)		
4.1	Relation Detection and Classification – Supervised Learning Approaches to Relation Analysis	1
4.2	Relation Detection and Classification – Lightly Supervised Approaches to Relation Analysis	1
4.3	Relation Detection and Classification -Evaluation of Relation Analysis systems	1
4.4	Information Retrieval – Term weighting and document scoring	1
4.5	Inverted Index, Evaluation of Information-Retrieval Systems	1
Module 5 : QA Systems and Machine Translation (9 hours)		
5.1	Question-Answering Systems – Factoid Question Answering, Question Processing	1
5.2	Passage Retrieval	1
5.3	Answer Processing, Evaluation of Factoid Answers	1
5.4	Machine Translation – Why Machine Translation is Hard	1
5.5	Classical Machine Translation	1
5.6	Statistical Machine Translation	1
5.7	The Phrase based Translation model	1
5.8	Alignment in Machine Translation	1
5.9	Decoding for Phrase-based Statistical MT	1

SEMESTER VII

OPEN ELECTIVE

CST415	INTRODUCTION TO MOBILE COMPUTING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0	3	2019

Preamble: The purpose of this course is to prepare learners to understand the functionalities and design considerations of mobile computing. The course content is designed to cover the mobile computing architecture, features of different communication systems and major elements of mobile security and next generation computer systems. This course enables the learners to acquire advanced concepts on mobile and ad-hoc networks.

Prerequisite: A good knowledge of data communication and computer networks.

Course Outcomes: After the completion of the course the student will be able to

CO#	Course Outcomes
CO1	Describe the mobile computing applications, services, design considerations and architectures(**Cognitive knowledge: Understand**)
CO2	Identify the technology trends for cellular wireless networks**(Cognitive knowledge:Understand)**
CO3	Summarize the Short Messaging Service and General Packet Radio Service **(Cognitive knowledge: Understand)**
CO4	Outline the LAN technologies used in mobile communication **(Cognitive knowledge: Understand)**
CO5	Describe the security protocols and apply suitable security algorithm to secure the communication **(Cognitive knowledge: Apply)**
CO6	Explain the fundamental concepts of next generation mobile networks**(Cognitive knowledge: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔										✔
CO2	✔	✔	✔									✔
CO3	✔	✔	✔									✔
CO4	✔	✔	✔									✔
CO5	✔	✔	✔									✔
CO6	✔	✔	✔									✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyse			
Evaluate			

Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment Test : **25 marks**

Continuous Assessment Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations shall be conducted for 50 marks. First series test shall be conducted preferably after completing the first half of the syllabus and the second series test shall be conducted preferably after completing the remaining part of the syllabus. There shall be two parts for the question paper: Part A and Part B. Part A shall contain five questions (preferably, two questions each from the fully completed modules and one question from the partly covered module), having three marks for each question adding up to 15 marks for part A. A student is expected to answer all questions from Part A. Part B shall contain seven questions (preferably, three questions each from the fully completed modules and one question from the partially completed module), each having seven marks. Out of the seven questions, a student is expected to answer any five.

End Semester Examination Pattern:

There shall be two parts; Part A and Part B. Part A shall contain 10 questions with 2 questions from each module, having 3 marks for each question. A student is expected to answer all questions from Part A. Part B shall contain 2 questions from each module, out of which a student is expected to answer any one. Each question shall have a maximum of two sub-divisions and shall carry 14 marks.

Syllabus

Module-1 (Mobile Computing Architecture)

Introduction to mobile computing – Functions, Devices, Middleware and gateways, Applications and services, Limitations. Mobile computing architecture – Internet: The ubiquitous network, Three-tier architecture, Design considerations for mobile computing.

Module-2 (Communication Systems)

Mobile computing through telephony - Evolution of telephony, Multiple access procedures - Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Space Division Multiple Access (SDMA). Satellite communication systems – Basics, Applications, Geostationary Earth Orbit (GEO), Low Earth Orbit (LEO), Medium Earth Orbit (MEO), Satellite phones. Mobile computing through telephone – Interactive Voice Response (IVR) architecture, Overview of voice software, Developing an IVR application. Global System for Mobile Communication (GSM) - Introduction, Architecture, Entities, Call routing, Mobility management, Frequency allocation, Authentication and security.

Module-3 (Short Messaging Service and General Packet Radio Service)

Short Message Service (SMS) – Strengths, Architecture, Value added services, Accessing the SMS bearer. General Packet Radio Service (GPRS) – Architecture, Network operations, Data services, Applications, Limitations, Billing and charging.

Module-4 (Wireless Local Area Networks)

Wireless Local Area Network (WLAN) - Advantages, Evolution, Applications, Architecture, Mobility, Security, Deploying WLAN. Wireless Local Loop (WLL) – Architecture. High Performance Radio Local Area Network (HIPERLAN). WiFi Vs 3G.

Module-5 (Mobile Security and Next Generation Networks)

Security issues in mobile computing - Information security, Security techniques and algorithms, Security protocols. Next generation networks – The Converged Scenario, Narrowband to broadband, Orthogonal Frequency Division Multiplexing (OFDM), Multi Protocol Label Switching (MPLS), Wireless Asynchronous Transfer Mode (WATM), Multimedia broadcast services.

Text Books

1. Asoke K. Talukder, Hasan Ahmad, Roopa R Yavagal, Mobile Computing Technology- Application and Service Creation, 2nd Edition, McGraw Hill Education.
2. Schiller J., Mobile Communications, 2/e, Pearson Education, 2009.

Reference Books

1. Andrew S. Tanenbaum, Computer Networks, 6/e, PHI.
2. Theodore S. Rappaport, Wireless Communications Principles and Practice, 2/e, PHI, New Delhi, 2004.
3. Curt M. White, Fundamentals of Networking and Communication 7/e, Cengage learning.

Course Level Assessment Questions

Course Outcome 1 CO1):

1. Describe the design considerations in mobile computing.
2. Give five examples of mobile computing applications.

Course Outcome 2 (CO2):

1. Draw a call flow diagram for a theatre ticket booking system.
2. Illustrate the GSM architecture with figure.

Course Outcome 3 (CO3):

1. Illustrate the billing and charging services in GPRS.
2. Describe the SMS architecture.

Course Outcome 4 (CO4):

1. Compare IEEE 802.11, HIPERLAN with respect to their ad-hoc capabilities.
2. Discuss the security mechanism used in WLAN.

Course Outcome 5 (CO5):

1. With the help of a suitable example, show the working of Diffie-Hellman key exchange algorithm.
2. Bob chooses 7 and 11 as two prime numbers and chooses e as 13. Find an appropriate value for d and decrypt the plaintext 5 send by Alice to Bob.
3. Describe the security issues in mobile computing.

Course Outcome 6 (CO6):

1. Describe WATM and Multimedia broadcast services.
2. Describe the significance of Orthogonal Frequency Division Multiplexing (OFDM) in next generation networks.

Model Question Paper

QP CODE: **PAGES: 3**

Reg No:_______________
Name:_________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST415

Course Name : INTRODUCTION TO MOBILE COMPUTING

Max Marks: 100 **Duration: 3 Hours**

PART-A

(Answer All Questions. Each question carries 3 marks)

1. Explain the different types of middleware and gateways required in mobile computing.
2. List any six limitations of mobile computing.
3. Compare and contrast the satellite systems – GEO, LEO and MEO.
4. How is frequency allocation done in GSM?
5. What are the various strengths of SMS?
6. How is billing and charging done in GPRS?
7. What are the different types of Wireless LANs?
8. Describe the architecture of a Wireless Local Loop.
9. Explain the key features of TLS protocol.
10. How are attacks classified?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Describe any four mobile computing functions. **(4)**

    (b) Explain the three-tier architecture of mobile computing with figure. **(10)**

OR

12. (a) Describe the significance and functions of core, edge and access network. **(6)**

(b) Explain the terms (i) Client Context Manager (ii) Policy Manager (iii) Security Manager (iv) Adaptability Manager **(8)**

13. (a) Why is multiple access important? With the help of suitable examples, explain the various multiple access techniques. **(7)**

(b) Describe the different algorithms used for security and authentication in GSM. **(7)**

OR

14. (a) Show how call routing is done in GSM. Give an example. **(7)**

(b) Explain the process of handover. How does handover differ from roaming? **(7)**

15. (a) With the help of neat sketches, explain the difference between Short Message Mobile Terminated (SM MT) and Short Message Mobile Originated (SM MO) messages. **(6)**

(b) Explain the network operations in GPRS. **(8)**

OR

16. (a) How does operator-centric pull differ from operator-independent push and pull? **(7)**

(b) Describe the data services and applications of GPRS. **(7)**

17. (a) Compare the HIPERLAN and OSI layered architecture. **(4)**

(b) Explain the 802.11 architecture. **(10)**

OR

18. (a) Compare 3G and WiFi. **(7)**

(b) Explain the HIPERLAN communication models with suitable diagrams. **(7)**

19. (a) Given p = 7, q = 17 and e = 5. Find the value of d and also encrypt the message P = 65 using RSA. **(7)**

(b) Explain the role of MPLS in service provisioning. **(7)**

OR

20. (a) With the help of a suitable example, show the working of Diffie-Hellman key exchange algorithm. **(7)**

(b) Explain the features of any three multimedia broadcast services. **(7)**

TEACHING PLAN

No	Contents	No.of Lecture Hrs (35 hrs)
Module-1 (Mobile Computing Architecture) (6 hrs)		
1.1	Introduction to mobile computing – Functions, Devices, Middleware and gateways	1
1.2	Applications, services, limitations, Internet: The ubiquitous network	1
1.3	Three-tier architecture (Lecture 1)	1
1.4	Three-tier architecture (Lecture 2)	1
1.5	Design considerations for mobile computing (Lecture 1)	1
1.6	Design considerations for mobile computing (Lecture 2)	1
Module-2 (Communication Systems) (7hrs)		
2.1	Evolution of telephony, Multiple access procedures – FDMA, TDMA, CDMA, SDMA	1
2.2	Satellite communication systems – GEO, MEO, LEO, Satellite phones	1
2.3	Interactive Voice Response (IVR) architecture, Overview of voice software, Developing an IVR application (Call flow diagram)	1
2.4	Introduction to GSM,Architecture	1
2.5	GSM entities, Call routing	1
2.6	Mobility management	1
2.7	Frequency allocation, Authentication and security	1
Module-3 (Short Messaging Service and General Packet Radio Service) (8hrs)		
3.1	SMS Strengths, Architecture, Short Message Mobile Terminated (SM MT) and Short Message Mobile Originated (SM MO) messages	1
3.2	SMS Architecture - Operator-centric pull, operator-	1

	independent push/pull, Value added services	
3.3	Accessing the SMS bearer (Lecture 1)	1
3.4	Accessing the SMS bearer (Lecture 2)	1
3.5	GPRS architecture	1
3.6	Network operations	1
3.7	Data services, Applications	1
3.8	Limitations, Billing and charging	1
Module-4 (Wireless Local Area Networks) (7 hrs)		
4.1	WLAN Advantages, Evolution, Applications	1
4.2	WLAN Architecture (Lecture 1)	1
4.3	WLAN Architecture (Lecture 2)	1
4.4	Mobility, Security	1
4.5	Deploying WLAN	1
4.6	WLL Architecture, HIPERLAN	1
4.7	WiFi Vs 3G	1
Module-5 (Mobile Security and Next Generation Networks) (7hrs)		
5.1	Information security – Attacks, Components	1
5.2	Security techniques and algorithms – Stream Vs Block cipher, Symmetric Vs Asymmetric cryptography	1
5.3	Security techniques and algorithms – RSA, Diffie Hellman Key exchange	1
5.4	Security protocols – Secure Socket Layer, Transport Layer Security, Wireless Transport Layer Security	1
5.5	The Converged Scenario, Narrowband to broadband	1
5.6	Orthogonal Frequency Division Multiplexing (OFDM) and Multi Protocol Label Switching (MPLS)	1
5.7	Wireless Asynchronous Transfer Mode (WATM) and Multimedia broadcast services	1

CST425	INTRODUCTION TO DEEP LEARNING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0	3	2019

Preamble: This course aims to introduce the learner to an overview of the concepts and algorithms involved in deep learning. Basic concepts and application areas of machine learning, deep networks, convolutional neural network and recurrent neural network are covered in this course. This is a foundational program that will help students understand the capabilities, challenges, and consequences of deep learning and prepare them to participate in the development of leading-edge AI technology. They will be able to gain the knowledge needed to take a definitive step in the world of AI.

Prerequisite: Basics of linear algebra and probability.

Course Outcomes: After the completion of the course the student will be able to

CO1	Demonstrate basic concepts in machine learning.**(Cognitive Knowledge Level: Understand)**
CO2	Illustrate the validation process of machine learning models using hyper-parameters and validation sets. **(Cognitive Knowledge Level: Understand)**
CO3	Demonstrate the concept of the feed forward neural network and its training process. **(Cognitive Knowledge Level: Apply)**
CO4	Build CNN and Recurrent Neural Network (RNN) models for different use cases. **(Cognitive Knowledge Level: Apply)**
CO5	Use different neural network/deep learning models for practical applications. **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓										✓
CO3	✓	✓	✓	✓								✓
CO4	✓	✓	✓	✓								✓
CO5	✓	✓	✓	✓								✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		End Semester Examination Marks (%)
	Test 1 (%)	**Test 2 (%)**	
Remember	**30**	**30**	**30**
Understand	**30**	**30**	**30**
Apply	**40**	**40**	**40**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module-1 (Introduction)

Key components - Data, models, objective functions, optimization algorithms, Learning algorithms. Supervised learning- regression, classification, tagging, web search, page ranking, recommender systems, sequence learning, Unsupervised learning, Reinforcement learning, Historical Trends in Deep Learning. Other Concepts - overfitting, underfitting , hyperparameters and validation sets, estimators, bias and variance.

Module- 2 (Optimization and Neural Networks)

Neural Networks –Perceptron, Gradient Descent solution for Perceptron, Multilayer perceptron, activation functions, architecture design, chain rule, back propagation, gradient based learning. Introduction to optimization– Gradient based optimization, linear least squares. Stochastic gradient descent, Building ML algorithms and challenges.

Module -3 (Convolutional Neural Network)

Convolutional Neural Networks – convolution operation, motivation, pooling, Convolution and Pooling as an infinitely strong prior, variants of convolution functions, structured outputs, data types, efficient convolution algorithms.

Module- 4 (Recurrent Neural Network)

Recurrent neural networks – Computational graphs, RNN design, encoder – decoder sequence to sequence architectures, deep recurrent networks, recursive neural networks, modern RNNs LSTM and GRU, Practical use cases for RNNs.

Module-5 (Application Areas)

Applications – computer vision, speech recognition, natural language processing. Research Areas – Autoencoders, Representation learning, Boltzmann Machines, Deep belief networks.

Text Book

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press 2015 ed.
2. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Dive into Deep Learning, August 2019.
3. Neural Networks and Deep Learning: A Textbook by Charu C. Aggarwal. Springer.1st edition, 2018.

Reference Books

1. Neural Smithing: Supervised Learning in Feed forward Artificial Neural Networks by Russell Reed, Robert J MarksII, 1st edition, 1999, MIT Press.
2. Practical Convolutional Neural Networks by Mohit Sewak, Md. Rezaul Karim, Pradeep Pujari, 1st edition, 2018, Packt Publishing Ltd.
3. Hands-On Deep Learning Algorithms with Python by Sudharsan Ravichandran, 1st edition, 2019, Packt Publishing Ltd.
4. Deep Learning with Python by Francois Chollet, 2nd edition, 2018, Manning Publications Co.

Sample Course Level Assessment Questions

Course Outcome1(CO1):

1. Compare regression and classification.
2. Define supervised learning? Distinguish between regression and classification.
3. Discuss the different learning approaches used in machine learning.
4. You train an initial model that achieves a 90% accuracy on the training dataset. What kind of problems your model is experiencing, and suggest a possible solution.
5. How does splitting a dataset into train, validation and test sets help identify overfitting?
6. Consider solving a classification task. You first train your network on 20 samples. Training converges, but the training loss is very high. You then decide to train this network on 10,000 examples. Is your approach to fixing the problem correct? If yes, explain the most likely results of training with 10,000 examples. If not, give a solution to this problem.

7. Describe one advantage of using mini-batch gradient descent instead of full-batch gradient descent.
8. Sketch the typical learning curves for the training and validation sets, for a setting where overfitting occurs at some point. Assume that the training set and the validation set are of the same size

Course Outcome 2(CO2):

1. What are hyperparameters? Why are they needed?
2. What issues are to be considered while selecting a model for applying machine learning in a given problem?
3. Update the parameters V11 in the given MLP using back propagation with learning rate as 0.5 and activation function as sigmoid. Initial weights are given as V11= 0.2, V12=0.1, V21=0.1, V22=0.3, V11=0.2, W11=0.5, W21=0.2
4. Draw the architecture of a multi-layer perceptron.
5. Derive update rules for parameters in the multi-layer neural network through the gradient descent.
6. Why is it important to place non-linearities between the layers of neural networks?
7. You design a fully connected neural network architecture where all activations are sigmoids. You initialize the weights with large positive numbers. Is this a good idea? Explain your answer.
8. You are doing full batch gradient descent using the entire training set (not stochastic gradient descent). Is it necessary to shuffle the training data? Explain your answer.
9. Consider training a fully-connected neural network with 5 hidden layers, each with 10 hidden units. The input is 20-dimensional and the output is a scalar. What is the total number of trainable parameters in your network?
10. Consider building a 10-class neural network classifier. Given a cat image, you want to classify which of the 10 cat breeds it belongs to. What loss function do you use? Introduce the appropriate notation and write down the formula of the loss function.
11. Why is the sigmoid activation function susceptible to the vanishing gradient problem?

Course Outcome 3 (CO3):

1. Give two benefits of using convolutional layers instead of fully connected ones for visual tasks.
2. Suppose that a CNN was trained to classify images into different categories. It performed well on a validation set that was taken from the same source as the training set but not on a testing set. What could be the problem with the training of such a CNN? How will you ascertain the problem? How can those problems be solved?
3. You are given a dataset of 10 x 10 grayscale images. Your goal is to build a 5-class classifier. You have to adopt one of the following two options: a) the input is flattened into a 100-dimensional vector, followed by a fully-connected layer with 5

neurons, b) the input is directly given to a convolutional layer with five 10 x 10 filters. Explain which one you would choose and why.

4. Weight sharing allows CNNs to deal with image data without using too many parameters. Does weight sharing increase the bias or the variance of a model?
5. Why do the layers in a deep architecture need to be non-linear?
6. A convolutional neural network has 4 consecutive layers as follows:
   3 x 3 conv (stride 2) - 2 x 2 Pool - 3 x 3 conv (stride 2) - 2 x 2 Pool
   How large is the set of image pixels which activate a neuron in the 4th non-image layer of this network?
7. Consider a convolution layer. The input consists of 6 feature maps of size 20 x 20. The output consists of 8 feature maps, and the filters are of size 5 x 5. The convolution is done with a stride of 2 and zero padding, so the output feature maps are of size 10 x 10. Determine the number of weights in this convolution layer

Course Outcome 4(CO4):

1. Explain how the cell state is updated in the LSTM model from Ct-1 to Ct
2. Show the steps involved in an LSTM to predict stock prices.
3. Illustrate the workings of the RNN with an example of a single sequence defined on a vocabulary of four words.
4. If we have a recurrent neural network (RNN), we can view it as a different type of network by "unrolling it through time". Briefly explain what that means.
5. Briefly explain how “unrolling through time” is related to “weight sharing” in convolutional networks.
6. Explain how the cell state is updated in the LSTM model from Ct-1 to Ct
7. Show the steps involved in an LSTM to predict stock prices.Give one advantage of using an RNN rather than a convolutional network.

Course Outcome 5 (CO5):

1. Development a deep learning solution for problems in the domain i) natural language processing or ii Computer vision (Assignment)
2. Is an autoencoder for supervised learning or for unsupervised learning? Explain briefly.
3. Sketch the architecture of an autoencoder network.
4. Describe how to train an autoencoder network.
5. Write down the formula for the energy function (E) of a Restricted Boltzmann Machine (RBM).

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST425

Course Name: Introduction To Deep Learning

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Distinguish between supervised learning and Reinforcement learning. Illustrate with an example.
2. Differentiate classification and regression.
3. Compare overfitting and underfitting. How it can affect model generalization.
4. Why does a single perceptron cannot simulate simple XOR function? Explain how this limitation is overcome?
5. Illustrate the strengths and weaknesses of convolutional neural networks.
6. Illustrate convolution and pooling operation with an example
7. How many parameters are there in AlexNet? Why the dataset size (1.2 million) is important for the success of AlexNet?
8. Explain your understanding of unfolding a recursive or recurrent computation into a computational graph.
9. Illustrate the use of deep learning concepts in Speech Recognition.
10. What is an autoencoder? Give one application of an autoencoder

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) "A computer program is said to learn from experience E with respect to some class oftasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E." What is your understanding of the terms task, performance and experience. Explain with two example **(10)**

(b) "How does bias and variance trade-off affect machine learning algorithms? **(4)**

OR

12. (a) Illustrate the concepts of Web search, Page Ranking, Recommender systems with suitable examples. **(10)**

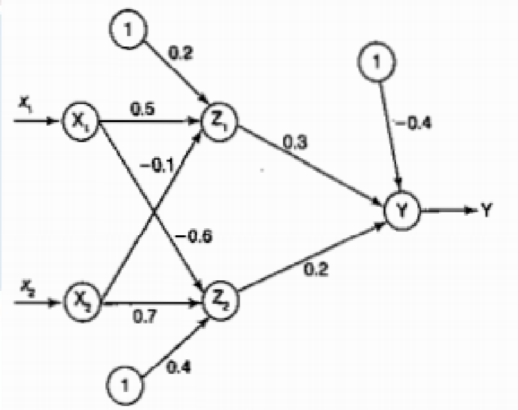
(b) List and discuss the different hyper parameters used in fine tuning the traditional machine learning models **(4)**

13. (a) How multilayer neural networks learn and encode higher level features from input features. **(7)**

(b) Explain gradient decent and delta rule? Why stochastic approximation to gradient descent is needed? **(7)**

OR

14. (a) Find the new weights for the network using backpropogation algorithm, the network is given with a input pattern[-1,1] and target output as +1, Use learning rate of alpha=0.3 and bipolar sigmoid function. **(7)**



(b) Write an algorithm for backpropagation which uses stochastic gradient descent method. Comment on the effect of adding momentum to the network. **(7)**

15. (a) Input to CNN architecture is a color image of size 112x112x3. The first convolution layer comprises of 64 kernels of size 5x5 applied with a stride of 2 and padding 0. What will be the number of parameters? **(5)**

(b) Let X=[-1, 0, 3, 5] W=[.3 ,.5 .2,.1] be the the input of i^{th} layer of a neural network and to apply softmax function. What should be the output of it? **(4)**

(c) Draw and explain the architecture of convolutional network **(5)**

OR

16. (a) Explain the concept behind i) Early stopping ii) dropout iii) weight decay **(9)**

(b) How backpropagation is used to learn higher-order features in a convolutional Network? **(5)**

17. (a) Explain the working of RNN and discuss how backpropagation through time is used in recurrent networks. **(8)**

(b) Describe the working of a long short term memory in RNNs. **(6)**

OR

18. (a) What is the vanishing gradient problem and exploding gradient problem? **(8)**

(b) Why do RNNs have a tendency to suffer from exploding/vanishing gradient? How to overcome this challenge? **(6)**

19. (a) Explain any two word embedding techniques **(8)**

(b) Explain the merits and demerits of using Auto encoders in Computer Vision. **(6)**

OR

20. (a) Illustrate the use of representation learning in object classification. **(7)**

(b) Compare Boltzmann Machine with Deep Belief Network. **(7)**

Teaching Plan

No	Contents	No. of Lecture Hours (37 hrs)
Module 1 : Introduction (8 hours)		
1.1	Key components - Data, models, objective functions, optimization algorithms. (TB2: Section 1.1-1.2)	1
1.2	Learning algorithm (TB1: Section 5.1), Supervised learning- regression, classification, tagging, web search, page ranking (TB2: Section 1.3.1)	1
1.3	Recommender systems, Sequence learning, Unsupervised learning, Reinforcement learning(TB2: Section 1.3.2-1.3.4)	1
1.4	Historical Trends in Deep Learning (TB1: Section 1.2).	1
1.5	Concepts: overfit, underfit, hyperparameters and validation sets. (TB1: Section 5.2-5.3)	1
1.6	Concepts: Estimators, bias and variance. (TB1: Section 5.4)	1
1.7	Demonstrate the concepts of supervised learning algorithms using a suitable platform.	1
1.8	Demonstrate the concepts of unsupervised using a suitable platform.	1
Module 2 : Optimization and Neural Networks (9 hours)		
2.1	Perceptron, Stochastic Gradient descent, Gradient descent solution for perceptron (TB3: Section 1.1 - 1.2.1)	1
2.2	Multilayer perceptron (TB3: Section 1.2.2), (TB1: Section 6.1,6.3)	1
2.3	Activation functions- Sigmoid, tanh, Softmax, ReLU, leaky ReLU (TB3: Section 1.2.1.3 - 1.2.1.5)	1
2.4	Architecture design (TB1: Section 6.4, TB3: Section 1.6)	1
2.5	Chain rule, back propagation (TB3: Section 1.3)	1
2.6	Gradient based learning (TB1: Section 6.2)	1
2.7	Gradient based optimization (TB1: Section 4.3)	1
2.8	Linear least squares using a suitable platform. (TB1: Section 4.5)	1
2.9	Building ML Algorithms and Challenges (TB3: 1.4, TB1: 5.10-5.11)	1
Module 3 :Convolution Neural Network (8 hours)		
3.1	Convolution operation (TB1:Section 9.1)	1
3.2	Motivation, pooling (TB1:Section 9.2-9.3)	1

3.3	Convolution and Pooling as an infinitely strong prior (TB1: Section 9.4)	1
3.4	Variants of convolution functions – multilayer convolutional network, tensors, kernel flipping, downsampling, strides and zero padding. (TB1: Section 9.5)	1
3.5	Variants of convolution functions - unshared convolutions, tiled convolution, training different networks. (TB1: Section 9.5)	1
3.6	Structured outputs, data types (TB1: Section 9.6-9.7)	1
3.7	Efficient convolution algorithms. (TB1: Section 9.8,9.10)	1
3.8	Case Study: AlexNet, VGG, ResNet. (TB3: Section 8.4.1, 8.4.3, 8.4.5)	1
Module 4 :Recurrent Neural Network (7 hours)		
4.1	Computational graphs (TB1: Section 10.1)	1
4.2	RNN (TB1: Section 10.2-10.3)	1
4.3	Encoder – decoder sequence to sequence architectures. (TB1: Section 10.4)	1
4.4	Deep recurrent networks (TB1: Section 10.5)	1
4.5	Recursive neural networks , Modern RNNs, LSTM and GRU (TB1: Section 10.6, 10.10)	1
4.6	Practical use cases for RNNs. (TB1: Section 11.1-11.4)	1
4.7	Demonstrate the concepts of RNN using a suitable platform.	1
Module 5 : Applications and Research (5 hours)		
5.1	Computer vision. (TB1: Section 12.2)	1
5.2	Speech recognition. (TB1: Section 12.3)	1
5.3	Natural language processing. (TB1: Section 12.4)	1
5.4	Brief introduction on current research areas- Autoencoders, Representation learning. (TB1: Section 14.1-14.2, TB3: 9.3)	1
5.5	Brief introduction on current research areas- Boltzmann Machines, Deep belief networks. (TB1: Section 20.1, 20.3)	1

CST435	COMPUTER GRAPHICS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0	3	2019

Preamble: This course helps the learners to make awareness about strong theoretical concept in computer graphics. It covers the three-dimensional environment representation in a computer, transformation of 2D/3D objects and basic mathematical techniques and algorithms used to build applications. This course enables the learners to develop the ability to create image processing frameworks for different domains and develop algorithms for emerging display technologies.

Prerequisite: A sound knowledge of Mathematics and concepts of any programming language.

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Describe the working principles of graphics devices**(Cognitive Knowledge level: Understand)**
CO2	Illustrate line drawing, circle drawing and polygon filling algorithms**(Cognitive Knowledge level: Apply)**
CO3	Demonstrate geometric representations and transformations on 2D & 3D objects **(Cognitive Knowledge level: Apply)**
CO4	Demonstrate the working of line and polygon clipping algorithms**(Cognitive Knowledge level: Apply)**
CO5	Summarize visible surface detection methods and illustrate projection algorithms. **(Cognitive Knowledge level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓										✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests (Average of SeriesTests1& 2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one full question. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1(Basics of Computer graphics)

Basics of Computer Graphics and its applications. Video Display devices- Refresh Cathode Ray Tubes(CRT), Random Scan Displays and systems, Raster scan displays and systems, Color CRT displays, Flat panel display and its categories.

Module – 2 (Line drawing, Circle drawing and Filled Area Primitives)

Line drawing algorithms- DDA, Bresenham's algorithm. Circle drawing algorithms- Midpoint Circle generation algorithm, Bresenham's algorithm. Filled Area Primitives- Scan line polygon filling, Boundary filling and flood filling.

Module - 3 (Geometric transformations)

Two dimensional transformations-Translation, Rotation, Scaling, Reflection and Shearing, Composite transformations, Matrix representations and homogeneous coordinates. Basic 3D transformations.

Module - 4 (Clipping)

Window to viewport transformation. Cohen Sutherland and Midpoint subdivision line clipping algorithms, Sutherland Hodgeman and Weiler Atherton Polygon clipping algorithms.

Module - 5 (Three dimensional graphics)

Three dimensional viewing pipeline. Projections- Parallel and Perspective projections. Visible surface detection algorithms- Back face detection, Depth buffer algorithm, Scan line algorithm, A buffer algorithm

Text Book

1. Zhigang Xiang and Roy Plastock, Computer Graphics (Schaum's outline Series), McGraw Hill, 2019.
2. Donald Hearn and M. Pauline Baker, Computer Graphics, PHI, 2e, 1996

References

1. William M. Newman and Robert F. Sproull, Principles of Interactive Computer Graphics. McGraw Hill, 2001
2. David F. Rogers , Procedural Elements for Computer Graphics, Tata McGraw Hill,2001.
3. Donald Hearn, M. Pauline Baker and Warren Carithers, Computer Graphics with OpenGL, PHI, 4e, 2013

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Compare the working principle of raster scan systems and random scan systems.
2. How much time is spent scanning across each row of pixels during screen refresh on a raster system with resolution of 1280*1024 and a refresh rate of 60 frames per second?

Course Outcome 2 (CO2):

1. Rasterize the line using Bresenham's line drawing algorithm with end points (2,3) and (5,8) accepted from the user and implement it using any appropriate programming language. (Assignment)
2. Illustrate how the 4-connected boundary filling approach differs from 8-connected boundary filling and implement it using any appropriate programming language. (Assignment)

Course Outcome 3 (CO3):

1. Rotate a triangle ABC 45 degree counter clockwise about the pivot point (10,3) , where the position vector of the coordinates is given as A(4,1), B(5,2) and C(4,3).
2. Implement the above transformation using any appropriate programming language with user inputs. (Assignment)
3. Illustrate the steps required for a general 3D rotation if the rotation axis is not parallel to any one of the principal axis. The rotation axis is defined by the points P1(x1,y1,z1) and P2(x2,y2,z2). Give its composite matrix representation.

Course Outcome 4 (CO4):

1. Given a clipping window A(20,20), B(60,20), C(60,40) and D(20,40). Using Cohen Sutherland algorithm, find the visible portion of the line segment joining the points P(40,80) and Q(120,30).

2. Implement Cohen Sutherland clipping algorithm using any appropriate programming language with user inputs. (Assignment)

Course Outcome 5 (CO5):

1. Explain scan line algorithm for detecting visible surfaces in an object.
2. Derive the matrix for performing perspective projection and parallel projection.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 3**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST435

Course Name: Computer Graphics

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Describe Flat Panel display and its categories.

2. Consider a raster system with a resolution of 1024*1024. Compute the size of the raster needed to store 4 bits per pixel? How much storage is needed if 8 bits per pixel are to be stored?

3. Justify the usage of integer arithmetic in Bresenham's line drawing algorithm.

4. How 8-way symmetry of circle can be used for developing circle drawing algorithms?

5. Show that two successive reflections about either of the coordinate axes is equivalent to a single rotation about the coordinate origin.

6. Determine a sequence of basic transformations that is equivalent to x-direction shearing.

7. Find the window to viewport normalization transformation with window lower left corner at (1,1) and upper right corner at (2,6).

8. How does Cohen Sutherland algorithm determine whether a line is visible, invisible or a candidate for clipping based on the region codes assigned to the end points of the line?

9. Define the terms (i) Centre of projection (ii) Principal vanishing point

10. Differentiate between the object space and image space method for the hidden surface removal of an image. **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain the working principle of beam penetration method and shadow mask method with suitable illustrations. **(8)**

(b) Draw the architecture of raster scan display systems and explain its working principle. **(6)**

OR

12. (a) Explain the working principle of a Refresh CRT monitor with suitable diagrams. **(8)**

(b) Describe random graphics system with suitable illustrations. **(6)**

13. (a) Differentiate between boundary fill and flood fill algorithms. **(5)**

(b) Derive the initial decision parameter of Bresenham's line drawing algorithm and rasterize a line with endpoints (2,2) and (10,10). **(9)**

OR

14. (a) Write Midpoint circle drawing algorithm and identify the points in the circle with radius as 20 and center at (50,30) using the algorithm. **(8)**

(b) Illustrate the working principle of scan line polygon filling algorithm. **(6)**

15. (a) Reflect a triangle ABC about the line 3x-4y+8=0, where the coordinates of the triangle are given as A(4,1), B(5,2) and C(4,3). **(8)**

(b) A diamond shaped polygon is located at P(-1,0), Q(0,-2), R(1,0) and S(0,2). Find the transformation matrix which would rotate the triangle by 90 degree counter clockwise about the point Q. Using the transformation matrix, find the coordinates of the rotated polygon. **(6)**

OR

16. (a) Describe the steps required for a general 3D rotation if the rotation axis is not parallel to any one of the principal axis. The rotation axis is defined by the points P1(x1,y1,z1) and P2(x2,y2,z2). Give its composite matrix representation. **(8)**

(b) Consider a triangle at (2,2), (10,2), (2,10). Perform the following 2D transformations in succession and find the resultant vertices. **(6)**

i) Scale with respect to (2,2) by scaling factors (2,2) along x and y directions.

ii) Rotate by 90 degree counter clockwise direction.

iii) Reflection based on y=x

17. (a) Illustrate Weiler – Atherton polygon clipping algorithm. **(6)**

(b) Explain Cohen-Sutherland line clipping algorithm. Use the algorithm to clip line with end points P1 (70, 20) and P2(100,10) against a window with lower left hand corner (50,10) and upper right hand corner (80,40). **(8)**

OR

18. (a) Describe Sutherland Hodgeman polygon clipping algorithm and list out its limitations. **(7)**

(b) Explain the steps involved in clipping a line using Mid point Subdivision algorithm. **(7)**

19. (a) Explain how visible surfaces can be detected using depth buffer algorithm. **(7)**

(b) Define parallel projection. Describe orthographic and oblique parallel projection. **(7)**

OR

20. (a) Illustrate the scan line method used in visible surface detection. **(7)**

(b) Derive the matrix needed for performing perspective projections. **(7)**

TEACHING PLAN

No	Contents	No of Lecture Hrs (35 hrs)
Module – 1 (Basics of Computer Graphics) (6 hrs)		
1.1	Basics of Computer Graphics and applications	1
1.2	Refresh Cathode Ray Tubes	1
1.3	Random Scan Displays and systems	1
1.4	Raster scan displays and systems	1
1.5	Color CRT displays	1
1.6	Flat panel display and its categories.	1
Module - 2 (Line drawing, Circle drawing and Filled Area Primitives) (7 hrs)		
2.1	DDA Line drawing Algorithm	1
2.2	Bresenham's line drawing algorithm	1
2.3	Midpoint Circle generation algorithm	1
2.4	Bresenham's Circle generation algorithm	1
2.5	Illustration of line drawing and circle drawing algorithms	1
2.6	Scan line polygon filling	1
2.7	Boundary filling and flood filling	1
Module - 3 (Geometric transformations) (8 hrs)		
3.1	Basic 2D transformations-Translation and Rotation	1
3.2	Basic 2D transformations- Scaling	1
3.3	Reflection and Shearing	1
3.4	Illustration of 2D Transformations	1
3.5	Composite transformations	1
3.6	Matrix representations and homogeneous coordinates	1
3.7	Basic 3D transformations	1
3.8	Illustration of basic 3D transformations	1
Module - 4 (2D Clipping) (6 hrs)		
4.1	Window to viewport transformation	1
4.2	Cohen Sutherland Line clipping algorithm	1
4.3	Midpoint subdivision Line clipping algorithm	1
4.4	Sutherland Hodgeman Polygon clipping algorithm	1
4.5	Weiler Atherton Polygon clipping algorithm	1
4.6	Practice problems on Clipping algorithms	1
Module - 5 (Three dimensional graphics)(8 hrs)		
5.1	Three dimensional viewing pipeline, Projections-Parallel projections	1

5.2	Projections- Perspective projections	1
5.3	Visible surface detection algorithms- Back face detection.	1
5.4	Depth buffer algorithm	1
5.5	Depth buffer algorithm	1
5.6	Scan line visible surface detection algorithm	1
5.7	Scan line visible surface detection algorithm	1
5.8	A buffer algorithm	1

CST445	PYTHON FOR ENGINEERS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0	3	2019

Preamble: The objective of the course is to provide learners an insight into Python programming in a scientific computation context and develop programming skills to solve engineering problems. It covers programming environment, important instructions, data representations, intermediate level features, Object Oriented Programming and file data processing of Python. This course lays the foundation to scientific computing, develop web applications, Machine Learning, and Artificial Intelligence-based applications and tools, Data Science and Data Visualization applications.

Prerequisite: NIL

Note : ***Students who have successfully completed CST 283 - Python for Machine Learning (Minor) are not eligible to opt this course.***

Course Outcomes: After the completion of the course the student will be able to

CO1	Write, test and debug Python programs **(Cognitive Knowledge level: Apply)**
CO2	Illustrate uses of conditional (if, if-else, if-elif-else and switch-case) and iterative (while and for) statements in Python programs **(Cognitive Knowledge level: Apply)**
CO3	Develop programs by utilizing the modules Lists, Tuples, Sets and Dictionaries in Python **(Cognitive Knowledge level: Apply)**
CO4	Implement Object Oriented programs with exception handling **(Cognitive Knowledge level: Apply)**
CO5	Analyze, Interpret, and Visualize data according to the target application (**Cognitive Knowledge level: Apply**)
CO6	Develop programs in Python to process data stored in files by utilizing the modules Numpy, Matplotlib, and Pandas **(Cognitive Knowledge level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓										✓
CO3	✓	✓										✓
CO4	✓	✓	✓		✓							✓
CO5	✓	✓	✓		✓							✓
CO6	✓	✓	✓		✓							✓

Abstract POs defined by National Board of Accreditation

#PO	Broad PO	#PO	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Test 1 (*Marks in percentage*)	Test 2 (*Marks in percentage*)	End Semester Examination Marks
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test	: 25 marks
Continuous Assessment Assignment	: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum of 2 sub-divisions and carries 14 marks.

Syllabus

Module 1 (Basics of Python)

Getting Started with Python Programming - Running code in the interactive shell, Editing, Saving, and Running a script. Using editors - IDLE, Jupyter. Basic coding skills - Working with data types, Numeric data types and Character sets, Keywords, Variables and Assignment statement, Operators, Expressions, Working with numeric data, Type conversions, Comments in the program, Input Processing, and Output, Formatting output. How Python works. Detecting and correcting syntax errors. Using built in functions and modules in math module. Control statements - Selection structure - if-else, if-elif-else. Iteration structure - for, while. Testing the control statements. Lazy evaluation.

Module 2 (Functions and Python Data Structures)

Functions - Hiding redundancy and complexity, Arguments and return values, Variable scopes and parameter passing, Named arguments, Main function, Working with recursion, Lambda functions. Strings - String function. Lists - Basic list Operations and functions, List of lists, Slicing, Searching and sorting list, List comprehension. Work with tuples. Sets. Dictionaries - Dictionary functions, dictionary literals, adding and removing keys, accessing and replacing values, traversing dictionaries, reverse lookup.

Module 3 (Object Oriented Programming)

Design with classes - Objects and Classes, Methods, Instance Variables, Constructor, Accessors and Mutators. Structuring classes with Inheritance and Polymorphism. Abstract Classes. Exceptions - Handle a single exception, Handle multiple exceptions.

Module 4 (Visualization and File handling)

Plotting - An Interactive Session with PyPlot, Basic Plotting, Logarithmic Plots, More Advanced Graphical Output, Plots with multiple axes, Mathematics and Greek symbols, The Structure of matplotlib, Contour and Vector Field Plots. File Processing - The os and sys modules, Introduction to file I/O, Reading and writing text files, Working with CSV files.

Module 5 (Scientific Computing)

Numerical Routines. SciPy and NumPy - Basics, Creating arrays, Arithmetic, Slicing, Matrix Operations, Special Functions, Random Numbers, Linear Algebra, Solving Nonlinear Equations, Numerical Integration, Solving ODEs. Data Manipulation and Analysis – Pandas : Reading Data from Files Using Pandas, Data Structures: Series and DataFrame, Extracting Information from a DataFrame, Grouping and Aggregation.

Text Books:

1. Kenneth A Lambert., Fundamentals of Python : First Programs, 2/e, Cengage Publishing, 2016
2. David J. Pine, Introduction to Python for Science and Engineering, CRC Press, 2021

Reference Books:

1. Wes McKinney, Python for Data Analysis, 2/e, Shroff / O'Reilly Publishers, 2017
2. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2/e, Schroff, 2016
3. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016
4. David M.Baezly, Python Essential Reference. Addison-Wesley Professional; 4/e, 2009.
5. Charles Severance. Python for Informatics: Exploring Information,
6. http://swcarpentry.github.io/python-novice-gapminder/

Sample Course Level Assessment Questions

Course Outcome1(CO1):

1. What is type conversion? How is it done in Python?

Course Outcome 2(CO2):

1. Given is a list of of words, *wordlist*, and a string, *name.* Write a Python function which takes *wordlist* and *name* as input and returns a tuple. The first element of the output tuple is the number of words in the *wordlist* which have *name* as a substring in it. The second element of the tuple is a list showing the index at which the *name* occurs in each of the words of the *wordlist* and a 0 if it doesn't occur.

Course Outcome 3(CO3):

1. Write a Python program to implement the addition, subtraction, and multiplication of complex numbers using classes. Use constructors to create objects. The input to the program consist of real and imaginary parts of the complex numbers.

Course Outcome 4(CO4):

1. Plot the function $y = 3x^2$ for $-1 \leq x \leq 3$ as a continuous line. Include enough points so that the curve you plot appears smooth. Label the axes x and y

Course Outcome 5(CO5):

1. Given a file "auto.csv" of automobile data with the fields *index, company, body-style, wheel-base, length, engine-type, num-of-cylinders, horsepower, average-mileage,* and *price***,** write python code to
   i. Clean and Update the CSV file
   ii. Print total cars of all companies
   iii. Find the average mileage of all companies
   iv. Find the highest priced car of all companies.

Model Question Paper

QP CODE: PAGES:

Reg No:________________
Name:__________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR
Course Code: CST445

Course name : PYTHON FOR ENGINEERS

Max Marks: 100 **Duration: 3 Hours**

PART-A

(Answer All Questions. Each question carries 3 marks)

1. Explain the basic data types available in Python, with examples.
2. Write a Python program to reverse a number and also find the sum of digits of the number. Prompt the user for input.
3. Compare tuples, lists, and dictionaries.
4. Explain the concept of scope and lifetime of variables in Python programming language, with a suitable example.
5. What is polymorphism? Give an example in the context of OOP in Python.
6. How is exception handling accomplished in Python programs?
7. Describe the characteristics of the CSV format.

8. Plot the function $y = 3x^2$ for $-1 \le x \le 3$ as a continuous line. Include enough points so that the curve you plot appears smooth. Label the axes x and y

9. Describe random number generation using Python

10. How can a generalized eigen value problem can be solved using Python?

PART-B

(Answer any one full question from each module)

Module -1

11. (a) Compare and contrast interpreted languages and compiled languages. How does it affect the quality of program development and execution of the program? (6)

(b) What are the possible errors in a Python program. Write a Python program to print the value of $2^{2n}+n+5$ for *n* provided by the user. (8)

OR

12. (a) Describe Arithmetic operators, Assignment operators, Comparison operators, Logical operators, and Bitwise operators in detail with examples. (6)

(b) Input 4 integers (+ve and −ve). Write a Python code to find the sum of negative numbers, positive numbers, and print them. Also, find the averages of these two groups of numbers and print (8)

Module -2

13. (a) Write a Python code to create a function called *list_of_frequency* that takes a string and prints the letters in non-increasing order of the frequency of their occurrences. Use dictionaries. (5)

(b) Write a Python program to read a list of numbers and sort the list in a non-decreasing order without using any built in functions. Separate function should be written to sort the list wherein the name of the list is passed as the parameter. (9)

OR

14. (a) Illustrate the following Set methods with an example. (8)

i. *intersection( )* ii. *Union( )* iii. *Issubset( )* iv. *Difference( )* v. *update( )* vi. *discard( )*

(b) Write a Python program to check the validity of a password given by the user. (6)

The Password should satisfy the following criteria:

1. Contains at least one letter between a and z

2. Contains at least one number between 0 and 9

3. Contains at least one letter between A and Z

4. Contains at least one special character from $, #, @
5. Minimum length of password: 6

Module -3

15. (a) How can a class be instantiated in Python? Write a Python program to express the instances as return values to define a class RECTANGLE with parameters *height, width, corner_x,* and *corner_y* and member functions to find center, area, and perimeter of an instance. (5)

(b) Explain inheritance in Python. Give examples for each type of inheritance. (9)

OR

16. (a) Write a Python class named Circle constructed by a radius and two methods which will compute the area and the perimeter of a given circle (6)

(b) Define a class in Python to store the details of a ship (name, source,destination) with the following methods: (8)

i) *get_details( )* - to assign values to class attributes

ii) *print_details( )* - to display the attribute values

Create an object of the class and invoke the methods

Module -4

17. (a) Plot the functions *sin x* and *cos x* vs *x* on the same plot with x going from −π to π. Make sure the limits of the *x*-axis do not extend beyond the limits of the data. Plot *sin x* in the color orange and *cos x* in the color green and include a legend to label the two curves. Place the legend within the plot, but such that it does not cover either of the sine or cosine traces. Draw thin gray lines behind the curves, one horizontal at $y = 0$ and the other vertical at $x = 0$. (10)

(b) Explain semi-log plots and log-log plots along with the functions used in creating such plots. (4)

OR

18. (a) Explain how *matplotlib* can be used to create dimensional contour plots and vector field plots. (6)

(b) Given a file "*auto.csv*" of automobile data with the fields *index, company, body-style, wheel-base, length, engine-type, num-of-cylinders, horsepower, average-mileage,* and *price,* write Python codes using Pandas to (8)

1) Clean and Update the CSV file
2) Print total cars of all companies
3) Find the average mileage of all companies
4) Find the highest priced car of all companies.

Module -5

19. (a) Write python program to solve the following system of equations (4)

$x_1 - 2x_2 + 9x_3 + 13x_4 = 1$

$-5x_1 + x_2 + 6x_3 - 7x_4 = -3$

$4x_1 + 8x_2 - 4x_3 - 2x_4 = -2$

$8x_1 + 5x_2 - 7x_3 + x_4 = 5$

(b) Given the sales information of a company as CSV file with the following fields *month_number, facecream, facewash, toothpaste, bathingsoap, shampoo, moisturizer, total_units, total_profit*. Write Python codes to visualize the data as follows (10)

1) Toothpaste sales data of each month and show it using a scatter plot
2) Face cream and face wash product sales data and show it using the bar chart

Calculate total sale data for last year for each product and show it using a Pie chart.

OR

20. (a) Write Python program to write the data given below to a CSV file. (9)

SN	Name	Country	Contribution	Year
1	Linus Torvalds	Finland	Linux Kernel	1991
2	Tim Berners-Lee	England	World Wide Web	1990
3	Guido van Rossum	Netherlands	Python	1991

(b) Explain how integration is performed with SciPy. Illustrate the same with the two sample integrals using SciPy function. (5)

Teaching Plan

Sl No	Contents	Number of Hours (35 Hrs)
Module 1: Basics of Python (8 hours)		
1.1	Getting Started with Python Programming: Running code in the interactive shell Editing, Saving, and Running a script	1 hour
1.2	Using editors: IDLE, Jupyter	1 hour
1.3	Basic coding skills: Working with data types, Numeric data types and Character sets, Keywords, Variables and Assignment statement, Operators, Expressions,	1 hour
1.4	Working with numeric data, Type conversions, Comments in the program, Input Processing, and Output. Formatting output	1 hour
1.5	How Python works. Detecting and correcting syntax errors. Using built in functions and modules in math module.	1 hour
1.6	Control statements : Selection structure, if-else, if ~~elif~~else	1 hour
1.7	Iteration structure - for, while	1 hour
1.8	Testing the control statements, Lazy evaluation.	1 hour
Module 2: Functions and Python Data Structures (8 hours)		
2.1	Functions: Hiding redundancy and complexity, Arguments and return values	1 hour
2.2	Variable scopes and parameter passing	1 hour
2.3	Named arguments, Main function,	1 hour
2.4	Working with recursion, Lambda functions	1 hour
2.5	Strings - String function	1 hour
2.6	Lists - Basic list Operations and functions, List of lists, Slicing, Searching and sorting list, List comprehension.	1 hour
2.7	Work with tuples. Sets.	1 hour
2.8	Dictionaries - Dictionary functions, dictionary literals, adding and removing keys, Accessing and replacing values, traversing dictionaries, reverse lookup	1 hour
Module 3: Object Oriented Programming (6 hours)		
3.1	Design with classes : Objects and Classes, Methods, Instance Variables	1 hour
3.2	Constructor, Accessors, and Mutators	1 hour
3.3	Structuring classes with Inheritance	1 hour
3.4	Polymorphism	1 hour
3.5	Abstract Classes	1 hour
3.6	Exceptions: Handle a single exception, Handle multiple exception	1 hour
Module 4: Visualization and File handling (6 hours)		

4.1	Plotting - An Interactive Session with PyPlot, Basic Plotting,	1 hour
4.2	Logarithmic Plots, More Advanced Graphical Output	1 hour
4.3	Plots with multiple axes, Mathematics and Greek symbols	1 hour
4.4	The Structure of matplotlib, Contour and Vector Field Plots	1 hour
4.5	File Processing -The *os* and *sys* modules, Introduction to file I/O, Reading and writing text files	1 hour
4.6	Working with CSV files	1 hour
Module 5: Scientific Computing (7 hours)		
5.1	Numerical Routines: SciPy and NumPy - Basics, Creating arrays, Arithmetic, Slicing	1 hour
5.2	Matrix Operations, Special Functions, Random Numbers	1 hour
5.3	Linear Algebra, Solving Nonlinear Equations	1 hour
5.4	Numerical Integration, Solving ODEs	1 hour
5.5	Data Manipulation and Analysis: Pandas - Reading Data from Files Using Pandas	1 hour
5.6	Data Structures - Series and DataFrame	1 hour
5.7	Extracting Information from a DataFrame, Grouping and Aggregation	1 hour

CST455	OBJECT ORIENTED CONCEPTS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0	3	2019

Preamble: The purpose of this course is to enable learners to solve problems by breaking it down to object level while designing software and to implement it using Java. This course covers Object Oriented Principles, Object Oriented Programming in Java, Exception handling, Event handling, multithreaded programming and working with window-based graphics. This course provides learners the basics to develop Mobile applications, Enterprise Applications, Scientific Applications and Web based Applications.

Prerequisite: A sound background in any of the programming languages like C, C++, Python etc is mandatory. Students who completed the minor stream course CST 281 Object Oriented Programming are not allowed to choose this Open Elective Course.

Course Outcomes: After the completion of the course the student will be able to

CO1	Develop Java programs using the object-oriented concepts - classes, objects, constructors, data hiding, inheritance and polymorphism **(Cognitive Knowledge Level: Apply)**
CO2	Utilise data types, operators, control statements, built in packages & interfaces, Input/Output Streams and Files in Java to develop programs **(Cognitive Knowledge Level: Apply)**
CO3	Illustrate how robust programs can be written in Java using exception handling mechanism **(Cognitive Knowledge Level: Apply)**
CO4	Develop application programs in Java using multithreading **(Cognitive Knowledge Level: Apply)**
CO5	Develop Graphical User Interface based application programs by utilising event handling features and Swing in Java **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔									✔
CO2	✔	✔	✔									✔
CO3	✔	✔	✔									✔
CO4	✔	✔	✔									✔
CO5	✔	✔	✔									✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests(Average of Internal Tests1&2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Object Orientation and Java basics)

Object Orientation Principles – Object and Class, Data abstraction and Encapsulation, Inheritance, Polymorphism, Dynamic binding, Message communication, Benefits of using Object orientation.

Introduction to Java - Java programming Environment and Runtime Environment, Development Platforms -Standard, Enterprise. Java Virtual Machine (JVM), Java compiler, Bytecode, Java applet, Java Buzzwords, Java program structure, Comments, Garbage Collection, Lexical Issues.

Primitive Data types - Integers, Floating Point Types, Characters, Boolean. Literals, Type Conversion and Casting, Variables, Arrays, Strings, Vector class.

Module – 2 (Core Java Fundamentals)

Operators - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence.

Control Statements - Selection Statements, Iteration Statements and Jump Statements.

Object Oriented Programming in Java - Class Fundamentals, Declaring Objects, Object Reference, Introduction to Methods, Constructors, ***this*** Keyword, Method Overloading, Using Objects as Parameters, Returning Objects, Recursion, Access Control, Static Members, Command-Line Arguments, Variable Length Arguments.

Module - 3 (More features of Java)

Inheritance - Super Class, Sub Class, The Keyword ***super***, protected Members, Calling Order of Constructors, Method Overriding, the Object class, Abstract Classes and Methods, Using ***final*** with Inheritance.

Packages and Interfaces - Defining Package, CLASSPATH, Access Protection, Importing Packages, Interfaces.

Exception Handling **-** Checked Exceptions, Unchecked Exceptions, ***try*** Block and ***catch*** Clause, Multiple ***catch*** Clauses, Nested ***try*** Statements, ***throw***, ***throws*** and ***finally***.

Module - 4 (Advanced features of Java)

Input/Output - I/O Basics, Reading Console Input, Writing Console Output, PrintWriter Class, Reading and Writing Files.

Java Library - String Handling – String Constructors, String Length, Special String Operations - Character Extraction, String Comparison, Searching Strings, Modifying Strings, Using valueOf(), Comparison of String Buffer and String.

Module - 5 (GUI Programming, Event Handling and Multithreaded Programming)

Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread, Creating Multiple Threads, Suspending, Resuming and Stopping Threads.

Event Handling **-** Event Handling Mechanisms, Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Using the Delegation Model.

Swing Fundamentals - Swing Key Features, Model View Controller (MVC), Swing Controls, Components and Containers, Exploring Swing - JFrame, JLabel, JButton, JTextField.

Text Books

1. Herbert Schildt, Java: The Complete Reference, 8/e, Tata McGraw Hill, 2011.
2. Balagurusamy E., Programming JAVA a Primer, 5/e, McGraw Hill, 2014.

Reference Books

1. Paul Deitel, Harvey Deitel, Java How to Program, Early Objects 11/e, Pearson, 2018.
2. Y. Daniel Liang, Introduction to Java Programming, 7/e, Pearson, 2013.
3. Nageswararao R., Core Java: An Integrated Approach, Dreamtech Press, 2008.
4. Flanagan D., Java in A Nutshell, 5/e, O'Reilly, 2005.
5. Sierra K., Head First Java, 2/e, O'Reilly, 2005.

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Three types of employees work in an organization: Regular, Contract and Hourly. Regular employees are permanent workers of the organization. Their salary is computed as the sum of basic pay, DA (50% of basic pay) and HRA. Contract employees work for the organization only for the contract period and earn a fixed salary. Hourly employees work for a fixed number of hours each day. Their salary is computed based on the total number of hours worked.

   Using object oriented principles, write a Java program to prepare pay roll of the organization.

2. Write a java program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Square, Triangle and Circle with proper class hierarchy. Each one of the classes contain only the method printArea( ) that prints the area of the given shape.

Course Outcome 2(CO2):

1. Write a Java program that reads a file and displays the file on the screen, with a line number before each line.
2. Write a Java program to prepare the rank list of computer science students based on their performance in the first Semester B.Tech. Degree examination at APJ Abdul Kalam Technological University. The output should be stored in a file.

Course Outcome 3(CO3):

1. Write a program to demonstrate the use of *throws* clause to handle an exception occurred within a method.
2. Write a program to demonstrate how exception handling is supported in Java.

Course Outcome 4(CO4):

1. Write a program to compute the sum of elements in an array using two threads in a parallel way. The first thread sums up the first half of the array and the second thread sums up the second half of the array. Finally, the main thread adds these partial sums and prints the result.
2. Write a java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and ifthe value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.

Course Outcome 5(CO5):

1. Write a GUI based program to convert temperature from degree Celsius to Fahrenheit.
2. Write a java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green with buttons. On selecting a button, an appropriate message with “stop” or “ready” or “go” should appear above the buttons in a selected color. Initially there is no message shown.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES :4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST455

Course Name: Object Oriented Concepts

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Java is considered to be secure and portable. Justify this statement.
2. Describe the concept of dynamic binding.
3. Explain the different arithmetic operators in Java.
4. What does the following Java function compute? Justify your answer.

```
intgreater(int a, int b)
{
while(a!=b)
{
```

```
    if(a>b)
a=a-b;
    else
b=b-a;
}
return a;
}
```

5. Explain the use of CLASSPATH with an example.

6. What are the different types of exceptions?

7. Explain file handling features available in Java.

8. Write a simple program to read an integer value from console and print it.

9. Explain the concept of *main thread* in multi-threading.

10. Explain any two Event classes in Java. **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Describe in detail polymorphism, abstraction and inheritance with suitable examples. **(9)**

    (b) What is Java Virtual Machine? **(5)**

OR

12. (a) Explain the salient features of Java language. How does Java Enterprise Edition (J2EE) differ from Java Standard Edition (Java SE)? **(9)**

    (b) Explain the declaration and use of multi-dimensional array variables in Java, with example. **(5)**

13. (a) Explain iteration control statements in Java. Give examples. **(8)**

(b) Write a recursive program to compute the factorial of a number. **(6)**

OR

14. (a) Using a suitable Java program, explain the concept of methods and constructors. **(6)**

(b) Write a Java program that prompts the user for an integer and then prints out all the prime numbers up to that number. **(8)**

15. (a) In a table format, show the effect of access specifiers within and outside packages in Java. **(6)**

(b) Describe exception handling using **try** block and **catch** clause in Java with the help of a suitable Java program. **(8)**

OR

16. (a) What is an interface in Java? Explain with a suitable example. **(6)**

(b) Write a program that perform integer divisions. The user enters two input data (any data type) through console into variables Num1 and Num2. If Num1 or Num2 were not an integer, the program would throw a Number Format Exception. If Num2 were Zero, the program would throw an Arithmetic Exception. Display the appropriate exception or result. **(8)**

17. (a) Write a Java program that displays the number of characters, lines and words in a text file. **(8)**

(b) Explain any three String constructors with the help of sample code for each. **(6)**

OR

18. (a) Write a program to demonstrate the usage of the *PrintWriter* class. **(7)**

(b) Write a Java program for sorting a given list of names in ascending order. **(7)**

19. (a) Explain Delegation Event model for event handling in Java. **(7)**

(b) Write a program to compute the sum of elements in an array using two **(7)** threads in a parallel way. The first thread sums up the first half of the array and the second thread sums up the second half of the array. Finally, the main thread adds these partial sums and prints the result.Use Runnable interfacefor the creation of a thread.

OR

20. (a) What are the differences between a process and a thread? **(4)**

(b) Write a Graphical User Interface (GUI) based Java program to implement a simple calculator supporting the operations addition, subtraction, multiplication and division. Use Swing controls to implement GUI. There may be three text boxes, the first two for accepting the operands and the last for displaying the result. Add four buttons for the above operations. Write neat comments in your program to show how you handle events. **(10)**

Teaching Plan

No	**Contents**	**No. of Lecture Hours (36hrs)**
	Module – 1 (Object Orientation and Java basics) (7 hrs)	
1.1	Object Orientation Principles – Object and Class, Data abstraction and Encapsulation	1 hour
1.2	Inheritance, Polymorphism	1 hour
1.3	Dynamic binding, Message communication, Benefits of using Object orientation.	1 hour
1.4	Java programming Environment and Runtime Environment, Development Platforms -Standard, Enterprise. JVM, Java compiler, Bytecode	1 hour
1.5	Java applet, Java Buzzwords, Java program structure, Comments, Garbage Collection, Lexical Issues	1 hour
1.6	Primitive Data types - Integers, Floating Point Types, Characters, Boolean	1 hour
1.7	Literals, Type Conversion and Casting, Variables, Arrays, Strings, Vector	1 hour

	class.	
Module - 2 (Core Java Fundamentals) (7 hrs)		
2.1	Operators - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence.	1 hour
2.2	Control Statements - Selection Statements, Iteration Statements and Jump Statements.	1 hour
2.3	Object Oriented Programming in Java - Class Fundamentals, Declaring Objects	1 hour
2.4	Object Reference, Introduction to Methods, Constructors, ***this*** Keyword	1 hour
2.5	Method Overloading, Using Objects as Parameters, Returning Objects	1 hour
2.6	Recursion, Access Control, static Members	1 hour
2.7	Command-Line Arguments, Variable Length Arguments	1 hour
Module - 3 (More features of Java) (8 hrs)		
3.1	Inheritance - Super class, Sub class, the keyword super, protected Members	1 hour
3.2	Calling Order of Constructors, Method Overriding, the Object class	1 hour
3.3	Abstract Classes and Methods, Using final with Inheritance	1 hour
3.4	Packages and Interfaces - Defining Package, CLASSPATH, Access Protection	1 hour
3.5	Importing Packages, Interfaces	1 hour
3.6	Exception Handling - Checked Exceptions, Unchecked Exceptions, ***try*** Block and ***catch*** Clause	1 hour
3.7	Multiple ***catch*** Clauses, Nested ***try*** Statements	1 hour
3.8	***throw***, ***throws*** and ***finally***	1 hour
Module - 4 (Advanced features of Java) (6 hrs)		
4.1	Input/Output - I/O Basics, Reading Console Input	1 hour
4.2	Writing Console Output, PrintWriter Class	1 hour
4.3	Working with Files (Lecture-1)	1 hour

4.4	Working with Files (Lecture-2)	1 hour
4.5	Java Library - String Handling – String Constructors, String Length	1 hour
4.6	Special String Operations - Character Extraction, String Comparison, Searching Strings, Modifying Strings, Using valueOf( ), Comparison of StringBuffer and String.	1 hour
	Module - 5 (GUI Programming, Event Handling and Multithreaded Programming) (8hrs)	
5.1	Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread	1 hour
5.2	Creating Multiple Threads	1 hour
5.3	Suspending, Resuming and Stopping Threads.	1 hour
5.4	Event handling **-** Event Handling Mechanisms, Delegation Event Model	1 hour
5.5	Event Classes,Sources of Events, Event Listener Interfaces	1 hour
5.6	Using the Delegation Model, Swing fundamentals, Swing Key Features	1 hour
5.7	Model View Controller (MVC), Swing Controls, Components and Containers	1 hour
5.8	Exploring Swing –JFrame, JLabel, JButton, JTextField	1 hour

SEMESTER VII

MINOR

CSD481	MINI PROJECT	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PWS	0	0	3	4	2019

Preamble: The objective of this course is to apply the fundamental concepts of different courses learned in respective Minor Streams: Software Engineering, Machine Learning and Networking. This course helps the learners to get an exposure to the development of application software/hardware solutions/ software simulations in the field of Computer Science and Engineering. It enables the learners to understand the different steps to be followed such as literature review and problem identification, preparation of requirement specification &design document, testing, development and deployment. Mini project enables the students to boost their skills, widen the horizon of thinking and their ability to resolve real life problems.

Prerequisite:

A sound knowledge in courses studied in respective minor stream.

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Identify technically and economically feasible problems **(Cognitive Knowledge Level: Apply)**
CO2	Identify and survey the relevant literature for getting exposed to related solutions. **(Cognitive Knowledge Level: Apply)**
CO3	Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions of minimal complexity by using modern tools & advanced programming techniques (**Cognitive Knowledge Level: Apply)**
CO4	Prepare technical report and deliver presentation **(Cognitive Knowledge Level: Apply)**
CO5	Apply engineering and management principles to achieve the goal of the project **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO2	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔
CO3	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CO4	✔	✔	✔	✔	✔			✔	✔	✔	✔	✔
CO5	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Mark Distribution

Total Marks	CIE Marks	ESE Marks
150	**75**	**75**

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Project Guide **15 marks**

Project Report **10 marks**

Evaluation by the Committee (will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement) : **40 marks**

Student Groups with 4 or 5 members should identify a topic of interest in consultation with a Faculty Advisor/Project Coordinator/Guide. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives by strictly following steps specified in the teaching plan. Innovative design concepts, performance, scalability, reliability considerations, aesthetics/ergonomic, user experience and security aspects taken care of in the project shall be given due weight.

The progress of the mini project is evaluated based on a minimum of two reviews. The review committee may be constituted by a senior faculty member, Mini Project coordinator and project guide. The internal evaluation shall be made based on the progress/outcome of the project, reports and a viva-voce examination, conducted internally by a 3-member committee. A project report is required at the end of the semester. The project has to be demonstrated for its full design specifications.

End Semester Examination Pattern:

The marks will be distributed as

Presentation	: **30 marks**
Demo	: **20 marks**
Viva	: **25 marks.**
Total	: **75 marks**.

TEACHING PLAN

Students are expected to follow the following steps.

1. Review of Literature and Identification of a problem
2. Create an abstract with a problem statement, solution approach, technology stack, team, etc.
3. Create Requirements Specification
4. Create Design Document . This may include designs like,
    a. System Architecture Design
    b. Application Architecture Design
    c. GUI Design
    d. API Design
    e. Database Design
    f. Technology Stack
5. Deployment, Test Run & Get Results
6. Prepare Project Report

Guidelines for the Report preparation

A bonafide report on the mini project shall be submitted within one week after the final presentation. Minimum number of pages should be 40.

- Use Times New Roman font for the entire report – Chapter/Section Title – Times New Roman18, Bold; Heading 2 – Times New Roman16, Bold; Heading 3 – Times New Roman14, Bold; Body- Times New Roman 12, Normal.
- Line Spacing – Between Heading 2 – 3 lines, between lines in paragraph 1.5 lines.
- Alignments – Chapter/Section Title – Center, Heading 2 & 3 should be Left Aligned. Ensure that all body text is paragraph justified.

- Figures & Tables – Ensure that all Figures and Tables are suitably numbered and given proper names/headings. Write figure title under the figure and table title above the table.

- **Suggestive order of documentation:**
  i. Top Cover
  ii. Title page
  iii. Certification page
  iv. Acknowledgement
  v. Abstract
  vi. Table of Contents
  vii. List of Figures and Tables
  viii. Chapters
  ix. Appendices, if any
  x. References/Bibliography

SEMESTER VII

HONOURS

CST495	CYBER FORENSICS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		VAC	3	1	0	4	2019

Preamble: The course on Cyber Forensics aims at exploring the basics of Cyber Forensics and Cyber security, the forensic investigation process and principles and the different types of cybercrimes and threats. This course also focuses on the forensic analysis of File systems, the Network, the Windows and Linux Operating systems. The course gives a basic understanding of the forensics analysis tools and a deep understanding of Anti forensics practices and methods. All the above aspects are dealt with case studies of the respective areas.

Prerequisite: Knowledge in File Systems, Operating systems, Networks and a general awareness on Cyber Technologies.

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain thebasic concepts in Cyber Forensics, Forensics Investigation Process and Cyber security(**Cognitive Knowledge Level: Understand**)
CO2	Infer the basic concepts of File Systems and its associated attribute definitions (**Cognitive Knowledge Level: Understand)**
CO3	Utilize the methodologies used in data analysis and memory analysis for detection of artefacts**(Cognitive Knowledge Level: Apply)**
CO4	Identify web attacks and detect artefacts using OWASP and penetration testing. **(Cognitive Knowledge Level: Apply)**
CO5	Summarize anti-forensics practices and data hiding methods **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓				✓						✓
CO2	✓	✓										✓
CO3	✓	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓			✓							✓

Abstract POs defined by National Board of Accreditation

PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (Percentage)	Test2 (Percentage)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks.

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1(Cyber Forensics and Cyber Security)

Computer Forensics: History of computer forensics, preparing for computer investigations, understanding Public and private investigations- Forensics Investigation Principles - Forensic Protocol for Evidence Acquisition - Digital Forensics -Standards and Guidelines - Digital Evidence – Data Acquisition - storage formats for digital evidence, determining the best acquisition method, contingency planning for image acquisitions, Cyber Forensics tools- Challenges in Cyber Forensics, Skills Required to Become a Cyber Forensic Expert

Cyber Security: Cybercrimes, Types of Cybercrimes - Recent Data Breaches - Recent Cyber security Trends - Case Study: Sim Swapping Fraud, ATM Card Cloning, Hacking email for money, Google Nest Guard, Email Crimes, Phishing, Types of Phishing.

Module-2 (File System Forensics)

File system Analysis: FAT and NTFS concepts and analysis -File system category, Content category, Metadata category, File name category, Application category,Application-level search techniques, Specific file systems, File recovery, Consistency check. FAT data structure-Boot sector, FAT 32 FS info, directory entries, Long file name directory entries

Module-3 (Operating System Forensics)

Windows Forensics: Live Response- Data Collection- Locard's Exchange Principle, Order of Volatility Volatile and Non Volatile Data Live-Response Methodologies: Data Analysis- Agile Analysis, Windows Memory Analysis, Rootkits and Rootkit detection.

Linux Forensics: Live Response Data Collection- Prepare the Target Media, Format the Drive, Gather Volatile Information, Acquiring the Image, Initial Triage, Data Analysis- Log Analysis, Keyword Searches, User Activity, Network Connections, Running Processes, Open File Handlers, The Hacking Top Ten, Reconnaissance Tools

Module-4 (Network Forensics)

The OSI Model, Forensic Footprints, Seizure of Networking Devices, Network Forensic Artifacts, ICMP Attacks, Drive-By Downloads, Network Forensic Analysis Tools, Case Study: Wireshark. Web Attack Forensics: OWASP Top 10, Web Attack Tests, Penetration Testing.

Module-5 (Anti-Forensics)

Anti-forensic Practices - Data Wiping and Shredding- Data Remanence, Degaussing, Case Study: USB Oblivion, Eraser - Trail Obfuscation: Spoofing, Data Modification, Case Study: Timestamp – Encryption, Case Study: VeraCrypt, Data Hiding: Steganography and Cryptography, Case Study: SilentEye, Anti-forensics Detection Techniques, Case Study: Stegdetect

Text Books

1. Bill Nelson, Amelia Phillips and Christopher Steuart, Computer forensics - Guide to Computer Forensics and Investigations, 4/e, Course Technology Inc.
2. Brian Carrier, File System Forensic Analysis, Addison Wesley, 2005.
3. Harlan Carvey, Windows Forensic Analysis DVD Toolkit, 2/e, Syngress.
4. Cory Altheide, Todd Haverkos, Chris Pogue,Unix and Linux Forensic Analysis DVD Toolkit, 1/e, Syngress.
5. William Stallings,Network Security Essentials Applications and Standards, 4/e, Prentice Hall
6. Eric Maiwald, Fundamentals of Network Security, McGraw-Hill, 2004.

References

1. Michael. E. Whitman, Herbert. J. Mattord, Principles of Information Security, Course Technology, 2011.
2. William Stallings, Cryptography and Network Security Principles and Practice, 4/e, Prentice Hall.
3. Niranjan Reddy, Practical Cyber Forensics: An Incident-Based Approach to Forensic Investigations, Apress, 2019.

Sample Course Level Assessment Questions

CourseOutcome1(CO1): Explain the Forensics principles and protocols for evidence acquisition.

Discuss the different cyber forensics tools used for image acquisition.

CourseOutcome2(CO2): Explain the pros and cons of NTFS and FAT File systems. Also give the challenges the investigators would face in extracting evidences from these file systems.

CourseOutcome3 (CO3): Apply any memory forensics methodologies/tools to extract volatile and nonvolatile data from a Windows based system.

CourseOutcome4 (CO4): Use web attacks test tools like netcraft to identify web application vulnerabilities of a particular site say **www.xyz.com**

Course Outcome 5 (CO5): Explain the different anti-forensics practices used to destroy or conceal data in order to prevent others from accessing it.

Model Question Paper

QP CODE:

Reg No: _______________

Name: ___________________ **PAGES : 3**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST495

Course Name: Cyber Forensics

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Distinguish between public and private investigations.

2. What are the three computer forensics data acquisitions formats?

3. List any three features of NTFS which are not in FAT.

4. Define the terms file slack, RAM slack and drive slack.

5. What is Locard's exchange principle? Why is it important in forensic investigations?

6. Why would you conduct a live response on a running system?

7. What are the different tools used in Network Forensics?

8. Explain how Risk Analysis and Penetration Testing are different.

9. Why we are using Steganography?

10. How is data wiping done in hard drive?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Discuss the different types of Cybercrimes. List the tools used for identifying Cyber Crimes. **(8)**

    (b) Differentiate between Static acquisition and Live acquisition with example. **(6)**

OR

12. (a) Explain the principles of Digital Forensic Investigation? Why is it important? Comment. **(8)**

    (b) When you perform an acquisition at a remote location, what should you consider preparing this task? **(6)**

13. (a) Discuss the FAT File Structure. **(8)**

    (b) Does Windows NT use FAT or NTFS? Explain. **(6)**

14. (a) What is Metadata? Discuss the first 16 metadata records you would find in the MFT? **(6)**

(b) Explain the different data categories in a File System. **(8)**

15. (a) What is Agile requirement analysis? **(6)**

(b) Explain the different types of volatile information in a live response system. List any two tools used for obtaining volatile information. **(8)**

16. (a) What are the main live response methodologies? **(6)**

(b) What is Physical Memory Dump? Explain how a physical memory dump is analysed. **(8)**

17. (a) What is OWASP? Also mention the Top 10 web application vulnerabilities in 2021. **(8)**

(b) How would you setup Wireshark to monitor packets passing through aninternet router? **(6)**

18. (a) What are the goals of conducting a pentesting exercise? **(3)**

(b) Discuss the types of penetration testing methodologies. **(5)**

(c) Define OSI Layers. **(6)**

19. (a) How is Steganography done? **(7)**

(b) Why does data need Cryptography? **(4)**

(c) What is the difference between a Cryptographer and a Crypter? **(3)**

OR

20. (a) Explain the different types of Anti-forensics Detection Techniques. **(8)**

(b) What is Spoofing? How to prevent spoofing attack? **(6)**

TEACHING PLAN

Sl.No.	**Contents**	**No of Lecture Hrs (44hrs)**
Module-1 (Cyber Forensics and Cyber Security) (11 Hrs)		
1.1	History of computer forensics, preparing for computer investigations	1 hour
1.2	Understanding Public and private investigations- Forensics Investigation Principles	1 hour
1.3	Forensic Protocol for Evidence Acquisition	1 hour
1.4	Digital Forensics -Standards and Guidelines - Digital Evidence	1 hour
1.5	Data Acquisition - storage formats for digital evidence, determining the best acquisition method	1 hour
1.6	Contingency planning for image acquisitions, Cyber Forensics tools	1 hour
1.7	Challenges in Cyber Forensics, Skills Required to Become a Cyber Forensic Expert	1 hour
1.8	Cybercrimes, Types of Cybercrimes - Recent Data Breaches - Recent Cyber security Trends	1 hour
1.9	Case Study: Sim Swapping Fraud, ATM Card Cloning	1 hour
1.10	Case Study:Hacking email for money, Google Nest Guard	1 hour
1.11	Email Crimes, Phishing, Types of Phishing	1 hour
Module-2 (File System Forensics) (9 Hrs)		

2.1	FAT and NTFS concepts and analysis	1 hour
2.2	File system category, Content category	1 hour
2.3	Metadata category	1 hour
2.4	File name category,Application category	1 hour
2.5	Application-level search techniques	1 hour
2.6	Specific file systems, File recovery, Consistency check	1 hour
2.7	FAT data structure-Boot sector	1 hour
2.8	FAT 32 FS info, directory entries	1 hour
2.9	Long file name directory entries	1 hour
Module-3 (Operating System Forensics) (11 Hrs)		
3.1	Live Response- Data Collection- Locard's Exchange Principle	1 hour
3.2	Order of Volatility, Volatile and Non Volatile Data	1 hour
3.3	Live-Response Methodologies: Data Analysis- Agile Analysis	1 hour
3.4	Windows Memory Analysis	1 hour
3.5	Rootkits and Rootkit detection	1 hour
3.6	Linux Forensics: Live Response Data Collection	1 hour
3.7	Prepare the Target Media, Format the Drive, Gather Volatile Information	1 hour
3.8	Acquiring the Image, Initial Triage	1 hour
3.9	Data Analysis- Log Analysis, Keyword Searches, User Activity	1 hour

3.10	Data Analysis- Network Connections, Running Processes, Open File Handlers	1 hour
3.11	The Hacking Top Ten, Reconnaissance Tools	1 hour
Module-4 (Network Forensics) (7 Hrs)		
4.1	OSI Model	1 hour
4.2	Forensic Footprints, Seizure of Networking Devices, Network Forensic Artifacts	1 hour
4.3	ICMP Attacks, Drive-By Downloads, Network Forensic Analysis Tools	1 hour
4.4	Web Attack Forensics	1 hour
4.5	OWASP Top 10, Web Attack Tests	1 hour
4.6	Penetration Testing-1	1 hour
4.7	Penetration Testing.-2	1 hour
Module – 5 (Anti-Forensics) (6 Hrs)		
5.1	Anti-forensic Practices - Data Wiping and Shredding	1 hour
5.2	Data Remanence, Degaussing	1 hour
5.3	Trail Obfuscation: Spoofing, Data Modification	1 hour
5.4	Role of Encryption in Forensics	1 hour
5.5	Data Hiding: Steganography and Cryptography	1 hour
5.6	Anti-forensics Detection Techniques	1 hour

AIT 497	COMPUTATIONAL HEALTH INFORMATICS	CATEGORY	L	T	P	Credit
		Honors	3	1	0	4

Preamble:

This course helps learners to develop know-how in computational methods, algorithms, and tools commonly used in health informatics. This includes data mining, machine learning, statistical analysis, and visualization techniques. Also, the course helps to gain knowledge of applications of machine learning in healthcare and how to analyze medical images, interpret healthcare data, and understand the role of informatics in disease diagnosis

Prerequisite: Basic background in Programming, Computational Biology and Machine learning

Course Outcomes: After the completion of the course, the student will be able to

CO 1	Describe health informatics, including its principles, concepts, and applications of computational methods and techniques used in health informatics (**Cognitive knowledge level: Understand**)
CO 2	Illustrate latest trends, advancements, and emerging technologies in computational health informatics(**Cognitive knowledge level: Apply)**
CO 3	Demonstrate application of computational methods and techniques to analyze and manipulate medical images for various purposes, such as diagnosis, treatment planning, and research (**Cognitive knowledge level: Apply)**
CO 4	Use the machine learning techniques to health images to aid in various aspects of healthcare, including diagnosis, treatment planning, and disease monitoring (**Cognitive knowledge level: Apply)**
CO 5	Implement deep learning techniques to analyze and interpret medical images (**Cognitive knowledge level: Apply**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓								✓
CO5	✓	✓			✓							✓

PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	Test1 (%)	**Test2 (%)**	
Remember	**30**	**30**	**30**
Understand	**50**	**50**	**50**
Apply	**20**	**20**	**20**
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests (Average of Series Tests 1& 2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS`

Module -01 (Introduction to Health Informatics)

Definition, scope, and objectives of health informatics, Historical development and current trends in health informatics, Health informatics frameworks and models, Health data standards (HL7, SNOMED CT, ICD, etc.), Interoperability challenges and solutions, Data capture, storage, and retrieval in health informatics, Data quality and integrity, Data analytics techniques and applications in healthcare, Data visualization for decision support

Module-02 (Emerging Technologies in Health Informatics)

Artificial intelligence (AI) and machine learning in healthcare, Internet of Things (IoT) and its applications in healthcare, Hybrid IoT-NG-PON system, Blockchain technology in health informatics, Clinical research informatics, Genome sequencing and translational bioinformatics approach to genomics and precision medicine, IoT devices for healthcare, IoT beneficiaries in healthcare, IoT architecture, Data sharing and secondary use of health data

Module-03 (Medical Image Processing)

Overview of medical image processing and its significance in healthcare, Challenges and opportunities in medical image analysis, Principles of X-ray imaging, Magnetic Resonance Imaging (MRI) basics, Computed Tomography (CT) fundamentals, Ultrasound imaging and its characteristics, Image Enhancement Techniques, Contrast enhancement methods for medical images, Noise reduction and image denoising techniques, Image sharpening and edge enhancement,

Module-04 (Machine Learning in Medical Image Analysis)

Image Segmentation, Thresholding techniques for image segmentation, Region-based segmentation algorithms, Edge detection and contour-based segmentation, Feature Extraction and Representation, Supervised and unsupervised learning algorithms, Classification and regression techniques for medical image analysis, Performance evaluation and validation of machine learning models

Module-05 (Deep Learning for Medical Image Processing)

Convolutional Neural Networks (CNNs) for medical image analysis, Segmentation and object detection using deep learning, Transfer learning and pretrained models in medical imaging, Volumetric image analysis and 3D reconstruction, Image-based modeling and simulation, Advanced imaging modalities (functional MRI, diffusion tensor imaging), Artificial intelligence in medical image processing

Books

1. Translational Bioinformatics in Healthcare anMedicine. (2021). Netherlands: Elsevier Science.
2. Computational Analysis and Deep Learning for Medical Care: Principles, Methods, and Applications. (2021). United Kingdom: Wiley.

References

1. Introduction to Computational Health Informatics. United States (2020) CRC Press.
2. Signal Processing Techniques for Computational HealthInformatics. (2020). Germany: Springer International Publishing.
3. Computational Intelligence and Healthcare Informatics. (2021). UnitedKingdom: Wiley.
4. Computational Intelligence for Machine Learning and Healthcare Informatics. (2020). Germany: De Gruyter.
5. Smart Computational Intelligence in Biomedical and Health Informatics. (2021). United States: CRC Press.
6. Healthcare Systems and Health Informatics: Using Internet of Things. (2022). United States: CRC Press.
7. Deep Learning Techniques for Biomedical and Health Informatics. (2020). United Kingdom: Elsevier Science.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Summarize Health informatics frameworks and models
2. Explain Health data standards HL7, SNOMED CT and ICD
3. Illustrate data analytics techniques and applications in healthcare

Course Outcome 2 (CO2):

1. Explain Blockchain technology in health informatics.
2. Illustrate Internet of Things (IoT) and its applications in healthcare with examples
3. How can translational bioinformatics facilitate the identification of disease-associated genetic variants and the development of targeted therapies?

Course Outcome 3 (CO3):

1. Differentiate principles and fundamentals of X-ray imaging, MRI, and CT
2. Explain the importance of image enhancement techniques in medical imaging and how they contribute to improved diagnosis and treatment
3. Explain the concept of edge detection in medical imaging and its role in image sharpening and feature extraction.

Course Outcome 4 (CO4):

1. Explain the concept of image segmentation and its significance in medical image analysis and diagnosis.
2. Compare and contrast different supervised learning algorithms used in medical image analysis

Course Outcome 5 (CO5):

1. Explain the process of training a CNN for medical image analysis, including data preprocessing, feature extraction, and backpropagation.
2. Discuss the potential benefits of applying AI in medical image processing, including improved accuracy, efficiency, and diagnostic outcomes.

TEACHING PLAN

No	Contents	No of Lecture (45Hrs)
Module -01 (Introduction to Health Informatics) (9hrs)		
1.1	Definition, scope, and objectives of health informatics	1
1.2	Historical development and current trends in health informatics	1
1.3	Health informatics frameworks and models,	1
1.4	Health data standards (HL7, SNOMED CT, ICD)	1
1.5	Interoperability challenges and solutions	1
1.6	Data capture, storage, and retrieval in health informatics	1
1.7	Data quality and integrity	1
1.8	Data analytics techniques and applications in healthcare	1
1.9	Data visualization for decision support	1
Module-02 (Emerging Technologies in Health Informatics)(9hrs)		
2.1	Artificial intelligence (AI) and machine learning in healthcare	1
2.2	Internet of Things (IoT) and its applications in healthcare	1
2.3	Hybrid IoT-NG-PON system	1
2.4	IoT devices for healthcare	1
2.5	IoT beneficiaries in healthcare, IoT architecture	1
2.6	Blockchain technology in health informatics	1
2.7	Clinical research informatics	1
2.8	Translational bioinformatics	1
2.9	Data sharing and secondary use of health data	1
Module-03 (Medical Image Processing) (10hrs)		
3.1	Overview of medical image processing and its significance in healthcare	1
3.2	Challenges and opportunities in medical image analysis	1
3.3	Principles of X-ray imaging	1
3.4	Magnetic Resonance Imaging (MRI) basics	1
3.5	Computed Tomography (CT) fundamentals	1
3.6	Ultrasound imaging and its characteristics	1
3.7	Image Enhancement Techniques	1
3.8	Contrast enhancement methods for medical images	1
3.9	Noise reduction and image denoising techniques	1
3.10	Image sharpening and edge enhancement	1

Module-04 (Machine Learning in Medical Image Analysis) (8hrs)		
4.1	Image Segmentation, Thresholding techniques for image segmentation	1
4.2	Region-based segmentation algorithms	1
4.3	Edge detection and contour-based segmentation	1
4.4	Feature Extraction and Representation	1
4.5	Supervised and unsupervised learning algorithms for medical	1

	image analysis	
4.6	Classification techniques for medical image analysis	1
4.7	Regression techniques for medical image analysis	1
4.8	Performance evaluation and validation of machine learning models	1
	Module-05 (Deep Learning for Medical Image Processing)(9hrs)	
5.1	Convolutional Neural Networks (CNNs) for medical image analysis	1
5.2	Segmentation and object detection using deep learning	1
5.3	Transfer learning and pretrained models in medical imaging	1
5.4	Volumetric image analysis and 3D reconstruction	1
5.5	Image-based modeling and simulation	1
5.6	Advanced imaging modalities (functional MRI)	1
5.7	Advanced imaging modalities (diffusion tensor imaging)	1
5.8	Artificial intelligence in medical image processing	1
5.9	Artificial intelligence in medical image processing Challenges	1

Model Question Paper		
QP CODE:		
Reg No: _______________		
Name: _________________		**PAGES: 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AIT 497

Course Name: COMPUTATIONAL HEALTH INFORMATICS

Max. Marks: 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1.	Compare and contrast the techniques, SNOMED CT and ICD	**3**
2.	List any three tools commonly used for data visualization in healthcare decision support within the field of Health Informatics with their use.	**3**
3.	Give examples of specific use cases where blockchain can improve healthcare systems.	**3**
4.	List any three IoT devices for healthcare with application.	**3**
5.	Explain the basic principles of Magnetic Resonance Imaging?	**3**
6.	Specify the different categories of image enhancement techniques used in health informatics.	**3**
7.	Give examples of different types of medical image segmentation techniques and applications.	**3**
8.	List of any three commonly used supervised and unsupervised learning algorithms for medical image analysis.	**3**
9.	Draw the architecture of a typical CNN.	**3**
10.	Give the concept of functional MRI and its applications.	**3** **(10x3=30)**

Part B
(Answer any one question from each module. Each question carries 14 Marks)

11.	(a)	Explain the purpose and role of HL7 standards in healthcare data interoperability. Provide examples of HL7 standards commonly used in clinical settings.	**(7)**

	(b)	Discuss the privacy and security concerns related to data capture, storage, and retrieval in health informatics. What are some strategies and best practices to mitigate these concerns and protect patient information?	**(7)**
		OR	
12.	(a)	Explain the importance of standardizing health data using controlled vocabularies and classifications like SNOMED CT and ICD. What are the benefits of using standardized codes?	**(7)**
	(b)	Discuss the importance of data capture in health informatics. Explain the different methods of data capture used in healthcare settings.	**(7)**
13.	(a)	Discuss the impact of emerging technologies on health informatics, highlighting their potential benefits and challenges in the healthcare industry.	**(7)**
	(b)	Explain the concept of precision medicine and its relationship with translational bioinformatics. How can bioinformatics tools and techniques contribute to the development of personalized treatment approaches?	**(7)**
		OR	
14.	(a)	Describe the potential uses of IoT devices in healthcare and discuss their impact on patient care and health monitoring.	**(7)**
	(b)	Discuss the types of machine learning algorithms commonly used in healthcare. Provide examples of supervised, unsupervised, and reinforcement learning algorithms and describe their specific applications in healthcare settings.	**(7)**
15.	(a)	Describe the characteristics of ultrasound waves used in imaging. How does ultrasound utilize sound waves to create images of internal body structures?	**(7)**
	(b)	Explain the concept of contrast enhancement in medical image processing. Why is contrast enhancement important in improving the visual quality and diagnostic utility of medical images?	**(7)**
		OR	
16.	(a)	Discuss the challenges in medical image analysis posed by the complexity and variability of anatomical structures and diseases. How can these challenges be addressed to improve the accuracy and reliability of image analysis?	**(7)**
	(b)	Describe the different types of noise commonly encountered in medical images. Why is it necessary to remove or reduce noise to improve medical images' visual quality and interpretability?	**(7)**
17.	(a)	Describe the basic principles of supervised learning for classification in medical image analysis. Discuss the steps involved, including data preparation, feature extraction, model training, and model evaluation.	**(7)**
	(b)	Discuss the concept of training, validation, and testing datasets in machine learning. Discuss the purpose of each dataset and their roles in evaluating	**(7)**

		model performance and generalization.	
		OR	
18.	(a)	How do regression techniques contribute to tasks such as disease prognosis, treatment response prediction, and quantitative analysis in healthcare?	**(7)**
	(b)	Discuss the application of edge detection and edge-based features in medical image analysis. List any two edge detection algorithms which can be used to extract edge-based features with their pros and cons	**(7)**
19.	(a)	Evaluate the future prospects and advancements in volumetric image analysis and 3D reconstruction in health. Discuss emerging technologies and trends in healthcare.	**(7)**
	(b)	Discuss the challenges and considerations in object detection and segmentation using deep learning.	**(7)**
		OR	
20.	(a)	Explain the concept of diffusion tensor imaging and its significance in medical imaging. Discuss how diffusion tensor imaging captures and measures the diffusion of water molecules in biological tissues.	**(7)**
	(b)	Explain the challenges associated with variability in medical images. Also, explain the challenges of model interpretability and explainability in AI-based medical image processing	**(7)**

AIT 499	SURVEILLANCE VIDEO ANALYTICS	**Category**	**L**	**T**	**P**	**Credit**
		Honors	**3**	**1**	**0**	**4**

Preamble:

This course provide a comprehensive understanding of the principles, techniques, and applications of video analytics in the field of surveillance. The ability to extract meaningful insights and actionable intelligence from surveillance videos is crucial for enhancing situational awareness, detecting anomalies, and making informed decisions. **Prerequisite:** Basic knowledge in set theory.

Prerequisite: Basic concepts in Basic Image Processing and video analytics

Mapping of course outcomes with program outcomes

CO1	Use the probability concepts, statistical pattern recognition to analyze image and video **(Cognitive Knowledge level: Apply)**
CO2	Demonstrate knowledge and skills to effectively preprocess and post-process data **(Cognitive knowledge level: Apply)**
CO3	Explain the video analytic architectures, hardware devices, classification trees, and various algorithms for attribute classification **(Cognitive Knowledge level: Understand)**
CO4	Describe the techniques and algorithms in video processing and motion estimation **(Cognitive Knowledge level: Understand)**
CO5	Demonstrate the concepts of video coding **(Cognitive Knowledge level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓											✓
CO2	✓	✓	✓									✓
CO3	✓	✓										✓
CO4	✓	✓										✓
CO5	✓	✓	✓	✓	✓							✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	**20**	**20**	**20**
Understand	**50**	**50**	**50**
Apply	**30**	**30**	**30**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests(Average of Internal Tests1&2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Fundamentals and Requirements)

Probability concepts, Sampling Concepts, Generating Random Variables, Exploratory Data Analysis, Monte Carlo Methods for Inferential Statistics, Data Partitioning, Probability Density Estimation, Statistical Pattern Recognition, and Nonparametric Regression.
Basic image analysis, and the four core analytics categories used in video surveillance; VMD, Heuristics, Conventional Object Detection, and Deep Learning Object Detection(Basics) deep learning neural networks for video analytics, datasets for neural network training (e.g. COCO, ImageNet, Pascal2, Wider, Government datasets)

Module - 2(Pre-processing and Feature Extraction)

Preprocessing and Post processing in data mining – Steps in Preprocessing, Discretization, Manual Approach, Binning, Entropy- based Discretization, Gaussian Approximation, K-tile method, Chi Merge, Feature extraction, selection and construction, Feature extraction Algorithms, Feature selection, Feature construction, Missing Data, Post processing

Module - 3 (**Video analytic architecture**)

Video analytic architectures, video analytic hardware devices, Classification trees, Algorithms for Normal Attributes, Information Theory and Information. Entropy, Building tree, Highly-Branching Attributes, ID3 to c4.5, CHAID, CART, Regression Trees, Model Trees, Pruning.

Module - 4 (**Steps of Video Processing**)

Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations 2-D Motion Estimation: Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm

Module - 5 (**Motion Estimation**)

Motion estimation: Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Coding: Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.

Text Books

1. Richard Szeliski , Computer Vision: Algorithms and Applications, A free electronic copy is available online.
2. Emanuele Trucco and Alessandro Verri, Introductory techniques for 3-D Computer Vision,

Reference Books

1. Multiple View Geometry in Computer Vision (2nd edition) by Richard hartley and Andrew Zisserman
2. Computer Vision: A Modern Approach by David Forsyth and Jean Ponce.
3. Digital Image Processing (Rafael Gonzalez and Richard Woods)
4. Yao wang, Joem Ostarmann and Ya – quin Zhang, Video processing and communication ,1st edition , PHI.
5. M. Tekalp , Digital video Processing, Prentice Hall International

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Explain Monte Carlo Simulation.
2. Discuss the importance of data partitioning in data mining and statistical analysis
3. Explain the concept of deep learning object detection and its significance in computer vision applications.

Course Outcome 2(CO2):

1. Explain the concept of entropy-based discretization in data mining and its role in feature transformation

2. Discuss the challenges and techniques associated with handling missing data in Video analysis.
3. Explain the concept of binning in data preprocessing and its significance in handling continuous variables. Discuss the steps involved in the binning process, including defining bin boundaries, assigning data points to bins, and aggregating data within each bin.

Course Outcome 3 (CO3):

1. Describe the components and architecture of video analytics systems. Explain the key elements involved in video analytic architectures, including hardware devices, software algorithms, and network infrastructure.
2. Discuss the different discretization techniques, such as equal-width binning, equal-frequency binning, and entropy-based discretization.
3. Describe the concept of feature construction in machine learning and its role in enhancing the predictive power of models

Course Outcome 4(CO4): .

1. Explain the concept of geometric image formation in computer vision and its role in understanding the relationship between the 3D world and 2D image observations
2. Discuss the concept of filtering operations in video processing and their significance in enhancing visual quality and extracting relevant information.
3. Explain the concept of the block matching algorithm in motion estimation and its significance in video analysis

Course Outcome 5(CO5):

1. Describe the concept of mesh-based motion estimation in video analysis and its role in accurately tracking object motion
2. Explain the concept of multi-resolution motion estimation in video analysis and its significance in capturing motion information at different levels of detail.

COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AIT 499

Course Name SURVEILLANCE VIDEO ANALYTICS

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. List the pre and post processing techniques used in data mining.
2. Discuss the importance of data partitioning in data mining and statistical analysis.
3. List the data compression technique used in decision tree and types of pruning.
4. Derive the optical flow constraint equation.
5. Explain Gaussian Approximation and its relevance in data analysis.
6. Give the different video analytic architectures available, and specify how they contribute to video analytics.
7. How can 3D motion models be applied in the field of augmented reality (AR)?
8. List any three potential applications of optical flow in computer vision and video analysis?
9. Derive the equation for mesh-based motion estimation technique.

10. How does block-based transform coding contribute to video compression by exploiting spatial and temporal redundancies?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11.	(a)	Describe the Monte Carlo method for inferential statistics, steps involved and its significance in addressing complex statistical problems.	**(7)**
	(b)	Explain the concept of conventional object detection in computer vision and its key components.	**(7)**

OR

12.	(a)	Define random variables in probability theory and explain their significance in statistical analysis	**(7)**
	(b)	Define the four core analytics categories used in video surveillance	**(7)**
13.	(a)	Explain the importance of preprocessing and postprocessing in data mining and their respective roles in the overall Video analysis process	**(14)**

OR

14.	(a)	Explain the k-tile method in inferential statistics, its steps, purpose, and significance.	**(7)**
	(b)	Explain the Chi-Merge algorithm used in statistical analysis for merging adjacent intervals in a discretized dataset	**(7)**
15.	(a)	Discuss how entropy is calculated and interpreted for various video analysis tasks.	**(7)**
	(b)	Explain Regression Trees (CART) algorithm in machine learning, the key steps involved in building CART models.	**(7)**

OR

16.	(a)	Describe the algorithm for handling normal attributes in statistical analysis.	**(7)**

	(b)	Explain the concepts of regression trees and pruning in decision tree-based modeling.	**(7)**
17.	(a)	Explain in detail the steps involved in structure from motion (SSM) method for 3D reconstruction.	**(14)**
		OR	
18.	**(a)**	Describe the pixel-based motion estimation in video analysis, its principles, methodologies, and applications.	**(7)**
	(b)	Describe the concept of mesh-based motion estimation in video analysis and its role in accurately tracking object motion	**(7)**
19.	(a)	Explain the concept of multi-resolution motion estimation in video analysis and its significance in capturing motion information at different levels.	**(14)**
		OR	
20.	(a)	Discuss the various applications of motion estimation in video coding.	**(14)**

Teaching Plan

Module - 1 (Fundamentals and Requirements)		(10 hours)
1.1	Probability concepts, Sampling Concepts, Generating Random Variables	2 hour
1.2	Exploratory Data Analysis, Monte Carlo Methods for Inferential Statistics, Data Partitioning, Probability Density Estimation, Statistical Pattern Recognition, and Nonparametric Regression.	3 hour
1.3	Basic image analysis, and the 4 core analytics categories used in video surveillance;	2 hour
1.4	VMD, Heuristics, Conventional Object Detection, and Deep Learning Object Detection, deep learning.	2 hour
1.5	neural networks for video analytics, datasets for neural network training (e.g. COCO, ImageNet, Pascal2, Wider, Government datasets)	1 hour
Module - 2 (Pre-processing and Feature Extraction)		(9 hours)

2.1	Preprocessing and Post processing in data mining – Steps in Preprocessing	1 hour
2.2	Discretization, Manual Approach, Binning	2 hour
2.3	Entropy- based Discretization, Gaussian Approximation	1 hour
2.4	K-tile method, Chi Merge	1 hour
2.5	Feature extraction algorithms	1 hour
2.6	Feature selection	1 hour
2.7	Feature construction	1 hour
2.8	Missing Data, Post processing	1 hour
Module - 3 (Video analytic architecture)		(9 hours)
3.1	Video analytic architectures, video analytic hardware devices	2 hour
3.2	Classification trees, Algorithms for Normal Attributes	2 hour
3.3	Information Theory and Information. Entropy,Building tree	2 hour
3.4	Highly- Branching Attributes, ID3 to c4.5	1 hour
3.5	CHAID, CART	1 hour
3.6	Regression Trees, Model Trees, Pruning.	1 hour
Module - 4 (Steps in video processing)		(9 hours)
4.1	Basic Steps of Video Processing: Analog video, Digital Video sampling	1 hour
4.2	Time varying Image Formation models : 3D motion models	2 hour
4.3	Geometric Image formation , Photometric Image formation	2 hour
4.4	video signals, filtering operations	1 hour
4.5	2-D Motion Estimation: Optical flow, general methodologies	2 hour
4.6	pixel based motion estimation, Block matching algorithm.	1 hour
Module - 5 (Video Compression)		(8 hours)
5.1	Motion estimation: Mesh based motion Estimation, global Motion estimation	2 hour
5.2	Region based motion estimation	1 hour
5.3	multi resolution motion estimation	1 hour
5.4	Coding: Waveform based coding	1 hour
5.5	Block based transform coding	1 hour

5.6	predictive coding	1 hour
5.7	Application of motion estimation in video coding.	1 hour

SEMESTER VIII

CDT 402	DEEP LEARNING FOR DATA SCIENCE	CATEGORY	L	T	P	CREDIT
		PCC	2	1	0	3

Preamble: Study of this course provides the learners an overview of the concepts and algorithms involved in deep learning. The course covers the basic concepts in neural networks, deep learning, optimization techniques, regularization techniques, convolutional neural networks, recurrent neural networks, autoencoders, generative models. The students will be able to implement deep learning algorithms to solve real-world problems.

Prerequisite: Sound knowledge in concepts of Machine learning.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Illustrate the basic concepts of neural networks, deep learning and its practical issues **(Cognitive Knowledge Level : Apply)**
CO 2	Describe the standard regularization and optimization techniques for the effective training of deep neural networks. **(Cognitive Knowledge Level: Understand)**
CO 3	**Build convolutional Neural Network (CNN) models for different use cases. (Cognitive Knowledge Level: Apply)**
CO 4	Apply the concepts of Recurrent Neural Network (RNN), Long Short Term Memory(LSTM), Gated Recurrent Unit (GRU**). (Cognitive Knowledge Level: Apply)**
CO 5	Explain the concepts of auto encoder, generative models **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO12
CO1	✔	✔	✔	✔								✔
CO2	✔	✔	✔	✔								✔
CO3	✔	✔	✔	✔	✔							✔
CO4	✔	✔	✔	✔	✔							✔
CO5	✔	✔	✔	✔								✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (percentage)	**Test2 (percentage)**	
Remember	20	20	20
Understand	50	50	50
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance: 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module 1: Introduction to Neural Networks and Deep learning

Introduction, The Basic Architecture of Neural Networks - Single Computational Layer: The Perceptron, Multilayer Neural Networks. Activation functions – Sign, Sigmoid, Tanh, ReLU, leaky ReLU, Hard Tanh, Softmax. Loss function. Training a Neural Network with Backpropagation. Practical issues in neural network training. Overfitting, Underfitting, Hyper parameters and Validation sets, Estimators -Bias and Variance. Introduction to deep learning, Deep feed forward network.

Module 2: Training deep models

Introduction, setup and initialization issues, Vanishing and exploding gradient problems, Optimization techniques - Gradient Descent (GD), Stochastic GD, GD with momentum, GD with Nesterov momentum, AdaGrad, RMSProp, Adam. Regularization Techniques - L1 and L2 regularization, Early stopping, Dataset augmentation, Parameter tying and sharing, Ensemble methods, Dropout.

Module 3: Convolutional Neural Networks

Convolutional Neural Networks –Architecture, Convolution operation, Motivation, pooling. Variants of convolution functions, Structured outputs, Data types, Efficient convolution algorithms, Applications of Convolutional Networks, Pre-trained convolutional Architectures : AlexNet, ZFNet, ResNet

Module 4: Recurrent Neural Networks

Recurrent neural networks – Computational graphs. RNN design. Encoder – decoder sequence to sequence architectures. Language modeling example of RNN. Deep recurrent networks. Recursive neural networks. Challenges of training Recurrent Networks. Gated RNNs LSTM and GRU.

Module 5: Autoencoders and Generative models

Autoencoders, Variational AutoEncoder, Undercomplete Autoencoders, Regularized Autoencoders, Denoising Autoencoders, Applications of Autoencoders

Generative models - Boltzmann machines, Deep Belief Networks, Generative Adversarial Networks.

Reference Books

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Neural Networks and Deep Learning, Aggarwal, Charu C., c Springer International Publishing AG, part of Springer Nature 2018
3. Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms (1st. ed.). Nikhil Buduma and Nicholas Locascio. 2017. O'Reilly Media, Inc.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Suppose you have a 3-dimensional input x = (x1, x2, x3) = (2, 2, 1) fully connected with weights (0.5, 0.3, 0.2) to one neuron which is in the hidden layer with sigmoid activation function. Calculate the output of the hidden layer neuron.
2. Consider the case of the XOR function in which the two points {(0, 0), (1, 1)} belong to

one class, and the other two points {(1, 0), (0, 1)} belong to the other class. Design a multilayer perceptron for this binary classification problem.

3. Sketch the typical learning curves for the training and validation sets, for a setting where overfitting occurs at some point. Assume that the training set and the validation set are of the same size.

Course Outcome 2 (CO2):

1. Explain how L2 regularization improves the performance of deep feed forward neural networks.
2. Explain how L1 regularization method leads to weight sparsity.
3. Derive update rules for parameters in the multi-layer neural network through the gradient descent.

Course Outcome 3(CO3):

1. Give two benefits of using convolutional layers instead of fully connected ones for visual tasks.
2. Suppose that a CNN was trained to classify images into different categories. It performed well on a validation set that was taken from the same source as the training set but not on a testing set. What could be the problem with the training of such a CNN? How will you ascertain the problem? How can those problems be solved?
3. Weight sharing allows CNNs to deal with image data without using too many parameters. Does weight sharing increase the bias or the variance of a model?

Course Outcome 4 (CO4):

1. Illustrate the workings of the RNN with an example of a single sequence defined on a vocabulary of four words.
2. List the differences between LSTM and GRU
3. Show the steps involved in an LSTM to predict stock prices.Give one advantage of using an RNN rather than a convolutional network.

Course Outcome 5 (CO5):

1. Is an autoencoder for supervised learning or for unsupervised learning? Explain briefly.
2. List the difference between Boltzmann Machine and Deep Belief Network.

Model Question Paper

QP CODE:

Reg No: _______________

Name: __________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CDT 402

Course Name: Deep Learning for Data Science

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Illustrate the limitation of a single layer perceptron with an example.
2. Specify the advantages of ReLU over sigmoid activation function.
3. Write weight updating rule in gradient descent when the error function is a) mean squared error b) cross entropy
4. List any three methods to prevent overfitting in neural networks.
5. Illustrate the strengths and weaknesses of convolutional neural networks.
6. What happens if the stride of the convolutional layer increases? What can be the maximum stride? Justify your answer.
7. List the differences between LSTM and GRU.
8. How does a recursive neural network work?
9. List the difference between Boltzmann Machine and Deep Belief Network.
10. How does the variational auto-encoder(VAE) architecture allow it to generate new data points, compared to auto-encoder, which cannot generate new data points? **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain back propagation algorithm for neural network training. **(9)**

(b) How does bias and variance trade-off affect machine learning algorithms? **(5)**

OR

12. (a) With an example classification problem, explain the following terms: a) Hyper parameters b) Training set c) Validation sets d) Bias **(8)**

(b) Compare overfitting and underfitting. How can it affect model generalization? **(6)**

13. (a) Differentiate gradient descent with and without momentum. Give equations for weight updation in GD with and without momentum. Illustrate plateaus, saddle points and slowly varying gradients. **(8)**

(b) Describe the effect in bias and variance when a neural network is modified with more number of hidden units followed with dropout regularization. **(6)**

OR

14. (a) Explain how L2 regularization improves the performance of deep feed forward neural networks. **(7)**

(b) Initializing the weights of a neural network with very small or large random numbers is not advisable. Justify. **(7)**

15. (a) Consider an activation volume of size 13×13×64 and a filter of size 3×3×64. Discuss whether it is possible to perform convolutions with strides 2, 3 and 5. Justify your answer in each case. **(6)**

(b) Suppose that a CNN was trained to classify images into different categories. It performed well on a validation set that was taken from the same source as the training set but not on a testing set. What could be the problem with the training of such a CNN? How will you ascertain the problem? How can those problems be solved? **(8)**

OR

16. (a) Explain the following convolution functions a)tensors b) kernel flipping c) down sampling d) strides e) zero padding. **(10)**

(b) What is the motivation behind convolution neural networks? **(4)**

17. (a) If we have a recurrent neural network (RNN), we can view it as a different type of network by "unrolling it through time". Briefly explain what that means. **(6)**

(b) Explain the architecture of GRU. **(8)**

OR

18. (a) The vanishing gradient problem is more pronounced in RNN than in traditional neural networks. Give reasons. Discuss a solution for the problem. **(6)**

(b) Show the steps involved in an LSTM to predict stock prices.Give one advantage of using an RNN rather than a convolutional network. **(8)**

19. (a) Generative Adversarial Networks(GANs) include a generator and a discriminator. Sketch a basic GAN using those elements, a source of real images, and a source of randomness. **(10)**

(b) The word “adversarial” in the acronym for GANs suggests a two-player game. What are the two players, and what are their respective goals? **(4)**

OR

20. (a) Explain auto encoder with an example. **(7)**

(b) Explain Generative Adversarial Networks using suitable diagram. **(7)**

Teaching Plan

No	Topic	No. of Lectures (**36 Hours**)
1	**Module 1: Introduction to neural network and Deep Learning**	**7**
1.1	Introduction, The Basic Architecture of Neural Networks - Single Computational Layer: The Perceptron.	1 hour
1.2	Multilayer Neural Networks.	1 hour
1.3	Activation functions - Sigmoid, Tanh, ReLU, leaky ReLU, Hard Tanh, Softmax. Loss function.	1 hour
1.4	Training a Neural Network with Backpropagation.	1 hour
1.5	Practical issues in neural network training	1 hour

1.6	Overfitting, Underfitting, Hyper parameters, Validation sets	1 hour
1.7	Estimators -Bias and Variance, Introduction to deep learning, Deep feed forward network	1 hour
2	**Module 2: Training deep models**	**8**
2.1	Introduction, setup and initialization issues	1 hour
2.2	Vanishing and exploding gradient problems	1 hour
2.3	Concepts of optimization, Gradient Descent (GD)	1 hour
2.4	Stochastic GD, GD with momentum, GD with Nesterov momentum	1 hour
2.5	AdaGrad, RMSProp, Adam	1 hour
2.6	Concepts of Regularization, L1 and L2 regularization	1 hour
2.7	Early stopping, Dataset augmentation	1 hour
2.8	Parameter tying and sharing, Ensemble methods, Dropout	1 hour
3	**Module 3: Convolutional Neural Network**	**8**
3.1	Convolutional Neural Networks, Architecture	1 hour
3.2	Convolution operation	1 hour
3.3	Motivation, pooling	1 hour
3.4	Variants of convolution functions	1 hour
3.5	Structured outputs, Data types	1 hour
3.6	Efficient convolution algorithms	1 hour
3.7	Applications of Convolutional Networks	1 hour
3.8	Pretrained Convolutional Architectures : AlexNet, ZFNet,ResNet	1 hour
4	**Module 4 : Recurrent Neural Network**	**7**
4.1	Recurrent neural networks – Computational graphs	1 hour
4.2	RNN design, Encoder – decoder sequence to sequence architectures	1 hour
4.3	Language modeling example of RNN	1 hour
4.4	Deep recurrent networks, Recursive neural networks	1 hour
4.5	Challenges of training Recurrent Networks	1 hour
4.6	LSTM	1 hour
4.7	GRU	1 hour
5	**Module 5 : Autoencoders and Generative models**	**6**
5.1	Autoencoders, Variational AutoEncoder	1 hour
5.2	Undercomplete Autoencoders, Regularized Autoencoders ,	1 hour
5.3	Denoising Autoencoders, Applications of Autoencoders	1 hour
5.4	Boltzmann machines	1 hour
5.5	Deep Belief Networks	1 hour
5.6	Generative Adversarial Networks.	1 hour

CDT404	COMPREHENSIVE COURSE VIVA	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	1	0	0	1	2019

The objective of this Course viva is to ensure the basic knowledge of each student in the most fundamental core courses in the curriculum. The viva voce shall be conducted based on the core subjects studied from third to eighth semester. This course helps the learner to become competent in placement tests and other competitive examinations.

Guidelines

1. The course should be mapped with a faculty and classes shall be arranged for practicing questions based on the core courses listed in the curriculum.
2. The viva voce will be conducted by the same three member committee assigned for final project phase II evaluation. It comprises of Project coordinator, expert from Industry/research Institute and a senior faculty from a sister department.
3. The pass minimum for this course is 25.
4. The mark will be treated as internal and should be uploaded along with internal marks of other courses.
5. Comprehensive Viva should be conducted along with final project evaluation by the three member committee.

Mark Distribution

Total marks: 50, only CIE, minimum required to pass : **25**

CDD416	**PROJECT PHASE II**	**CATEGORY**	**L**	**T**	**P**	**CREDIT**
		PWS	**0**	**0**	**12**	**4**

Preamble: The course 'Project Work' is mainly intended to evoke the innovation and invention skills in a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation. The project extends to 2 semesters and will be evaluated in the 7th and 8th semester separately, based on the achieved objectives. One third of the project credits shall be completed in 7th semester and two third in 8th semester. It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

Course Objectives

- To apply engineering knowledge in practical problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to engineering problems.

Course Outcomes [COs]: After successful completion of the course, the students will be able to:

CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: **Apply**).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: **Apply**).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: **Apply**).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: **Apply**).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: **Analyze**).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: **Apply**).

Mapping of course outcomes with program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	2	1	2	2	2	1	1	1	1	2
CO2	2	2	2		1	3	3	1	1		1	1
CO3									3	2	2	1
CO4					2			3	2	2	3	2
CO5	2	3	3	1	2							1
CO6					2			2	2	3	1	1

Abstract POs defined by National Board of Accreditation			
PO #	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO0	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

PROJECT PHASE II

Phase 2 Targets

- In depth study of the topic assigned in the light of the report prepared under Phase - I;
- Review and finalization of the approach to the problem relating to the assigned topic.
- Preparing a detailed action plan for conducting the investigation, including teamwork.
- Detailed Analysis/ Modeling / Simulation/ Design/ Problem Solving/Experiment as needed.
- Final development of product/ process, testing, results, conclusions and future directions.
- Preparing a paper for Conference Presentation/ Publication in Journals, if possible.
- Presenting projects in Project Expos conducted by the University at the cluster level and/ or state level as well as others conducted in India and abroad.
- Filing Intellectual Property Rights (IPR) if applicable.
- Preparing a report in the standard format for being evaluated by the Department Assessment Board.
- Final project presentation and viva voce by the assessment board including the external expert.

Evaluation Guidelines & Rubrics

Total: 150 marks (Minimum required to pass: 75 marks).

- Project progress evaluation by guide: 30 Marks.
- Two interim evaluations by the Evaluation Committee: 50 Marks (25 marks for each evaluation).
- Final evaluation by the Final Evaluation committee: 40 Marks
- Quality of the report evaluated by the evaluation committee: 30 Marks

(The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor. The final evaluation committee comprises of Project coordinator, expert from Industry/research/academic Institute and a senior faculty from a sister department).

Evaluation by the Guide

The guide/supervisor must monitor the progress being carried out by the project groups on regular basis. In case it is found that progress is unsatisfactory it should be reported to the Department Evaluation Committee for necessary action. The presence of each student in the group and their involvement in all stages of execution of the project shall be ensured by the guide. Project evaluation by the guide: 30 Marks. This mark shall be awarded to the students in his/her group by considering the following aspects:

Project Scheduling & Distribution of Work among Team members: Detailed and extensive Scheduling with timelines provided for each phase of project. Work breakdown structure well defined. (5)

Literature survey: Outstanding investigation in all aspects. (4)

Student's Diary/ Daily Log: The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily/weekly activity diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily/weekly activity diary shall be signed after every day/week by the guide. (7)

Individual Contribution: The contribution of each student at various stages. (9)

Completion of the project: The students should demonstrate the project to their respective guide. The guide shall verify the results and see that the objectives are met. (5)

EVALUATION RUBRICS for PROJECT Phase II: Interim Evaluation - 1						
No.	**Parameters**	**Marks**	**Poor**	**Fair**	**Very Good**	**Outstanding**
2-a	Novelty of idea, and Implementation scope [CO5] [Group Evaluation]	**5**	The project is not addressing any useful requirement. The idea is evolved into a non-implementable one. The work presented so far is lacking any amount of original work by the team.	Some of the aspects of the proposed idea can be implemented. There is still lack of originality in the work done so far by the team. The project is a regularly done theme/topic without any freshness in terms of specifications, features, and/or improvements.	Good evidence of an implementable project. There is some evidence forthe originality of the work done by the team . There is fresh specifications/ features/improvements suggested by the team. The team is doing a design from fundamental principles, and there is some independent learning and engineering ingenuity.	The project has evolved into incorporating an outstandingly novel idea. Original work which is not yet reported anywhere else. Evidence for ingenious way of innovation which is also Implementable. Could be a patentable / publishable work.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
2-b	Effectiveness of task distribution among team members. [CO3] [Group Evaluation]	**5**	No task distribution of any kind. Members are still having no clue on what to do.	Task allocation done, but not effectively, some members do not have any idea of the tasks assigned. Some of the tasks were identified but not followed individually well.	Good evidence of task allocation being done, supported by project journal entries, identification of tasks through discussion etc. However, the task distribution seems to be skewed, and depends a few members heavily than others. Mostly the tasks are being followed by the individual members.	Excellent display of task identification and distribution backed by documentary evidence of team brainstorming, and project journal entries. All members are allocated tasks according to their capabilities, and as much as possible in an equal manner. The individual members are following the tasks in an excellent manner.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
2-c	Adherence to project schedule. [CO4] [Group Evaluation]	**5**	Little or no evidence of continued planning or scheduling of the project. The students did not stick to the plan what they were going to build nor plan on what materials / resources to use in the project. The students do not have any idea on the budget required even after the end of phase - I. No project journal kept or the journal.	There is some improvement in the primary plan prepared during phase I. There were some ideas on the materials /resources required, but not really thought out. The students have some idea on the finances required, but they have not formalized a budget plan. Schedules were not prepared. The project journal has no useful details on the project.	Good evidence of planning done and being followed up to a good extent after phase I. Materials were listed and thought out, but the plan wasn't followed completely. Schedules were prepared, but not detailed, and needs improvement. Project journal is presented but it is neither complete nor updated regularly.	Excellent evidence of enterprising and extensive project planning and follow-up since phase I. Continued use of project management/version control tool to trackthe project. Material procurement if applicable is progressing well. Tasks are updated and incorporated in the schedule. A well-kept project journal showed evidence for all the above, in addition to the interaction with the project guide.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)

2-d	Interim Results. [CO6] [Group assessment]	**5**	There are no interim results to show.	The team showed some interim results, but they are not complete / consistent to the current stage, Some corrections are needed.	The interim results showed were good and mostly consistent/correct with respect to the current stage. There is room for improvement.	There were significant interim results presented which clearly shows the progress.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-e	Presentation [Individual assessment]	**5**	Very poor presentation and there is no interim results. The student has no idea about the project proposal.	Presentation is average, and the student has only a feeble idea about the team work.	Good presentation. Student has good idea about the team's project. The overall presentation quality is good.	Exceptionally good presentation. Student has excellent grasp of the project. The quality of presentation is outstanding.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
Phase-II Interim Evaluation - 1 Total Marks: 25						

EVALUATION RUBRICS for PROJECT Phase II: Interim Evaluation – 2						
No	**Parameters**	**Marks**	**Poor**	**Fair**	**Very Good**	**Outstanding**
2-f	Application of engineering knowledge [CO1] [Individual Assessment]	**10**	The student does not show any evidence of applying engineering knowledge on the design and the methodology adopted. The student's contribution in application of engineering knowledge in the project is poor.	The student appears to apply some basic knowledge, but not able to show the design procedure and the methodologies adopted in a comprehensive manner.	The student is able to show some evidence of application of engineering knowledge in the design and development of the project to good extent.	Excellent knowledge in design procedure and its adaptation. The student is able to apply knowledge from engineering domains to the problem and develop solutions.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
2-g	Involvement of individual members [CO3] [Individual Assessment]	**5**	No evidence of any Individual participation in the project work.	There is evidence for some amount of individual contribution, but is limited to some of the superficial tasks.	The individual contribution is evident. The student has good amount of involvement in core activities of the project.	Evidence available for the student acting as the core technical lead and has excellent contribution to the project.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-h	Results and inferences upon execution [CO5] [Group Assessment]	**5**	None of the expected outcomes are achieved yet. The team is unable to derive any inferences on the failures/ issues observed. Any kind o f observations or studies are not made.	Only a few of the expected outcomes are achieved. A few inferences are made on the observed failures/issues. No further work suggested.	Many of the expected outcomes are achieved. Many observations and inferences are made, and attempts to identify the issues are done. Some suggestions are made for further work.	Most of the stated outcomes are met. Extensive studies are done and inferences drawn. Most of the failures are addressed and solutions suggested. Clear and valid suggestions made for further work.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-i	Documentation and presentation. .[CO6] [Individual assessment]	**5**	The individual student has no idea on the presentation of his/her part. The presentation is of poor quality.	Presentation's overall quality needs to be improved.	The individual's presentation performance is satisfactory.	The individual's presentation is done professionally and with great clarity. The individual's performance is excellent.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
Phase-II Interim Evaluation - 2 Total Marks: 25						

EVALUATION RUBRICS for PROJECT Phase II: Final Evaluation						
No	**Parameters**	**Marks**	**Poor**	**Fair**	**Very Good**	**Outstanding**
2-j	Engineering knowledge. [CO1] [Group Assessment]	10	The team does not show any evidence of applying engineering knowledge on the design and the methodology adopted.	The team is able to show some of the design procedure and the methodologies adopted, but not in a comprehensive manner.	The team is able to show evidence of application of engineering knowledge in the design and development of the project to good extent. There is scope for improvement.	Excellent knowledge in design procedure and its adaptation. The team is able to apply knowledge from engineering domains to the problem and develop an excellent solution.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
2-k	Relevance of the project with respect to societal and/o rindustrial needs. [Group Assessment][CO2]	5	The project as a whole do not have any societal / industrial relevance at all.	The project has some relevance with respect to social and/or industrial application. The team has however made not much effort to explore further and make it better.	The project is relevant to the society and/or industry. The team is mostly successful in translating the problem into an engineering specification and managed to solve much of it.	The project is exceptionally relevant to society and/or industry. The team has made outstanding contribution while solving the problem in a professional and/ or ethical manner.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-i	Innovation / novelty / Creativity [CO5] [Group Assessment]	5	The project is not addressing any useful requirement. The idea is evolved into a non-implementable one. The work presented so far is lacking any amount of original work by the team.	Some of the aspects of the proposed idea appears to be practical. There is still lack of originality in the work done. The project is a regularly done theme/topic without any freshness in terms of specifications, features, and/ or improvements.	Good evidence of an implementable project. There is some evidence for the originality of the work done by the team. There is fresh specifications/ features/improvements suggested by the team. The team is doing a design from fundamental principles, and there is some independent learning and engineering ingenuity. Could be translated into a product / process if more work is done.	The project has evolved into incorporating an outstandingly novel idea. Original work which is not yet reported anywhere else. Evidence for ingenious way of innovation which is also Implementable. Could be a patentable publishable work.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-m	Quality of results / conclusions / solutions. [CO1] [Group Assessment]	10	None of the expected outcomes are achieved. The team is unable to derive any inferences on the failures/issues observed. Any kind of observations or studies is not made.	Only a few of the expected outcomes are achieved. A few inferences are made on the observed failures/issues. No further work suggested.	Many of the expected outcomes are achieved. Many observations and inferences are made, and attempts to identify the issues are done. Some suggestions are made for further work.	Most of the stated outcomes are met. Extensive studies are done and inferences drawn. Most of the failures are addressed and solutions suggested. Clear and valid suggestions made for further work.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)

2-n	Presentation - Part I Preparation of slides. [CO6] [Group Assessment].	5	The presentation slides are shallow and in a clumsy format. It does not follow proper organization.	Presentation slides follow professional style formats to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly, or acknowledged. Presentation slides needs to be more professional.	Presentation slides follow a good style format and there are only a few issues. Organization of the slides is good. Most of references are cited properly. The flow is good and team presentation is neatly organized. Some of the results are not clearly shown. There is room for improvement.	The presentation slides are exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and l i s ted. Results/ inferences clearly highlighted and readable.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
	Presentation - Part II: Individual Communication [CO6] [Individual Assessment].	5	The student is not communicating properly. Poor response to questions.	The student is able to explain some of the content. The student requires a lot of prompts to get to the idea. There are language issues.	Good presentation/ communication by the student. The student is able to explain most of the content very well. There are however, a few areas where the student shows lack of preparation. Language is better.	Clear and concise communication exhibited by the student. The presentation is outstanding. Very confident and tackles all the questions without hesitation. Exceptional traits of communicator.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
Phase-II Final Evaluation, Marks: 40						

EVALUATION RUBRICS for PROJECT Phase II: Report Evaluation						
Sl. No.	**Parameters**	**Marks**	**Poor**	**Fair**	**Very Good**	**Outstanding**
2-o	Report [CO6]	30	The prepared report is shallow and not as per standard format. It does not follow proper organization. Contains mostly unacknowledged content. Lack of effort in preparation is evident. References are not cited. Unprofessional and inconsistent formatting.	Project report follows the standard format to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly in the report. There is lack of formatting consistency.	Project report shows evidence of systematic documentation. Report is mostly following the standard style format and there are only a few issues. Organization of the report is good. Mostly consistently formatted. Most of references/sources are cited/ acknowledged properly.	The report is exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and listed and clearly shown. Language is excellent and follows professional styles. Consistent formatting and exceptional readability.
			(0 - 11 Marks)	(12 - 18 Marks)	(19 - 28 Marks)	(29 - 30 Marks)
Phase - II Project Report Marks: 30						

SEMESTER VIII

PROGRAM ELECTIVE III

AIT 424	Introduction to Business Analytics	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: The course aims to introduce the fundamental concepts of business analytics to students. This involves basic concepts of business analytics, descriptive analytics, predictive analytics, forecasting techniques, prescriptive analytics and to apply the appropriate analytics for generating solutions.

Prerequisite: Basic knowledge in Probability and Statistical Modelling.

Course Outcomes: After the completion of the course the student will be able to gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.

CO 1	Explain the concept of Business Analytics process and the role of Business Analytics in decision making**. (Cognitive Knowledge level: Understand)**
CO 2	Use appropriate methods for solving problems in Descriptive analytics (**Cognitive knowledge level: Apply)**
CO 3	Use appropriate methods to solve problems using Predictive analytics techniques. (**Cognitive Knowledge level: Apply)**
CO 4	Use appropriate forecasting techniques to inference analyze business trends. (**Cognitive Knowledge level: Apply)**
CO 5	Formulate linear programming model for solving a problem **(Cognitive Knowledge level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓							✓
CO2	✓	✓	✓		✓							✓
CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓		✓							✓
CO5	✓	✓	✓		✓							✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (percentage)	Test2 (percentage)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance: 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module -1 (Introduction To Business Analytics)

Business Analytics - Terminologies, Business Analytics Process, Importance, Relationship of BA process and Organization Decision-Making process, Managing BA Personnel, Data and Technology. Organization Structures aligning BA. Management Issues – Establishing an Information policy, Outsourcing BA, Data quality, Measuring BA contribution, Change Management in BA.

Module -2 (Descriptive Analytics)

Introduction to Descriptive analytics – Visualizing and Exploring Data – Descriptive Statistics - Sampling and Estimation - Probability Distribution for Descriptive Analytics - Marketing/Planning Case Study Example : Descriptive analytics step in the BA process.

Module -3 (Predictive Analytics)

Introduction to Predictive analytics – Predictive Modeling - Logic and Data Driven Models - Predictive Analysis Modeling and procedure. Data Mining: Simple Illustration of Data

Mining, Data Mining Methodologies. Prescriptive Analysis step in the BA Process - Analysis of Predictive analytics.

Module - 4 (Forecasting Techniques)

Introduction - Types of Variation in Time Series Data - Simple Regression Model - Multiple Regression Models - Simple Exponential Smoothing - Smoothing Averages - Fitting Models to Data - How to Select Models and Parameters for Models - Forecasting Practice Problems.

Module - 5 (Prescriptive Analytics)

Introduction to Prescriptive analytics - Prescriptive Modeling - Non Linear Optimization. Prescriptive step in the BA Analysis – Background Review and Prescriptive Analysis.

Linear Programming – Types of Linear Programming Problems/Models - Linear Programming Problems/Model Elements - Linear Programming Problems/Model Formulation Procedure.

Text Books

1. Marc J. Schniederjans, Dara G. Schniederjans and Christopher M. Starkey, "Business Analytics Principles, Concepts, and Applications - What, Why, and How", Pearson Ed, 2014.
2. James R. Evans, "Business Analytics - Methods, Models and Decisions", Pearson Ed, 2012

Reference Books

1. Christian Albright S and Wayne L. Winston, "Business Analytics - Data Analysis and Decision Making", Fifth edition, Cengage Learning, 2015.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Compare business analytics and organization decision-making process.
2. Explain how business analytics can help an organization achieve a competitive advantage.

Course Outcome 2 (CO2):

1. Describe the sampling methods useful in BA. What is sampling estimation and describe how it can aid in the BA process.
2. The Homes Golf Ball Company has made a number of different golf products over the years. Research on thousands of balls revealed the mean flight distance of its Maximum Fly golf ball product to be 450 yards, with a standard error of the mean of 145 yards. The company is hoping to improve the product to fly an additional 290 yards. What is the probability of the improvement from 450 to 740 yards?

Course Outcome 3(CO3):

1. Discuss the logic-driven and data-driven models used in Business analytics.
2. With an investment of \$100,000 in radio commercials and \$300,000 in TV commercials, what is the prediction on dollar product sales. Use the formula

   Y_p= -17150.4555 + 275.691X_1 + 48.341X_2 where

   Y_p= the estimated number of dollars of product sales

   X_1 = the number of dollars to invest in radio commercials

   X_2 = the number of dollars to invest in TV commercials

Course Outcome 4 (CO4):

1. What is forecasting accuracy? Discuss the most commonly used forecast accuracy statistics.
2. Give the forecasting model formula for a weighted moving average. Using a two-value (k) moving average with equal weights of 0.5?

Time Period	Sales
1	49
2	56
3	67
4	78

Course Outcome 5 (CO5):

1. Explain how to formulate a linear programming model?
2. A trucking firm must transport exactly 900, 800, 700 and 1000 units of a product to four cities: A, B, C and D. The product is manufactured and supplied in two other cities X and Y, in the exact amounts to match the total demand. The production of units from the two cities is 1900 and 1500 units respectively to X and Y. The cost per unit to

transport the product between the manufacturing plants in cities X and Y and the demand market cities A, B, C and D are given as :

	DEMAND MARKET			
SUPPLY PLANT	A	B	C	D
X	0.65	0.70	0.80	0.90
Y	0.60	0.60	0.80	0.70

For example, in the table $0.655 is the cost to ship one unit from Supply Plant X to Demand Market A. The trucking firm needs to know how many units should be shipped from each supply city to each demand city in such a way that it minimizes total cost. What is the LP model formulation for this problem?

Model Question paper

QP CODE: PAGES:3

Reg No:__________

Name :__________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

***Course Code:* AIT 424**

Course Name: Introduction to Business Analytics

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Explain the relationship of business intelligence to the subject of business analytics.
2. Justify the statement: “Establishing an information policy affect BA”.
3. Differentiate skewedness and kurtosis.
4. What is the 99 percent confidence interval for a problem with a mean value of 120 and a standard error of the mean 20?
5. Illustrate the importance of establishing clusters in BA.

6. How are neural networks helpful in determining both associations and classification tasks required in BA analyses?
7. Differentiate between additive time series model and multiplicative time series model.
8. What is meant by absolute deviation?
9. List the commonly used prescriptive analytics in the business analytics process.
10. How are prescriptive and descriptive analytics related?

(10x3=30)

PART B

Answer any one Question from each module. Each question carries 14 Marks

11. (a) The complete business analytic process involves the three major component steps applied sequentially to a source of data. Justify. (8 marks)

(b) Compare business analytics and organization decision-making process. (6 marks)

OR

12. (a) Explain how business analytics can help an organization to achieve a competitive advantage. (7 marks)

(b) Discuss the general management issues related to a BA program. (7 marks)

13. (a) Describe various types of statistical charts and how to apply them. (8 marks)

(b) Discuss the use of confidence intervals and probability distributions. (6 marks)

OR

14. (a) Describe the sampling methods useful in BA. What is sampling estimation and describe how it can aid in the BA process. (8 marks)

(b) The Homes Golf Ball Company has made a number of different golf products over the years. Research on thousands of balls revealed the mean flight distance of its Maximum Fly golf ball product to be 450 yards, with a standard error of the mean of 145 yards. The company is hoping to improve the product to fly an additional 290 yards. What is the probability of the improvement from 450 to 740 yards? (6 marks)

15. (a) Discuss the logic-driven and data-driven models used in Business analytics. (7 marks)

(b) With an investment of \$100,000 in radio commercials and \$300,000 in TV commercials, what is the prediction on dollar product sales. Use the formula (7 marks)

Y_p= -17150.4555 + 275.691X_1 + 48.341X_2 where

Y_p= the estimated number of dollars of product sales

X_1 = the number of dollars to invest in radio commercials

X_2 = the number of dollars to invest in TV commercials

OR

16. (a) Explain how data mining is an ideal predictive analytics tool used in the BA process. (7 marks)

(b) Assume for this problem the following table would have held true for the resulting marketing/planning case study problem. Which combination of variables is estimated here to be the best predictor set? Explain why. (7 marks)

Variable Combination	R –Square	R –Square (Adjusted)	F-Ratio
POS/radio	0.057	0.009	2.977
POS/TV	0.120	0.100	3.662
POS/radio/TV	0.179	0.101	4.315
Radio/TV	0.879	0.853	122.555

17. (a) What is forecasting accuracy? Discuss the most commonly used forecast accuracy statistics. (8 marks)

(b) Give the forecasting model formula for a weighted moving average. Using a two-value (k) moving average with equal weights of 0.5? (6 marks)

Time Period	Sales
1	49
2	56
3	67
4	78

OR

18. (a) Use the following data to construct a linear regression model for the auto insurance premium as a function of driving experience. (6 marks)

Driving Experience (in years)	5	2	12	9	15	6	25	16
Monthly auto insurance premium(\$)	64	87	50	71	44	56	42	60

(b) Explain multiple regression models with an example. Discuss the limitations on the use of multiple regression models in forecasting time series data. (8 marks)

19. (a) Explain how to formulate a linear programming model? (7 marks)

(b) A trucking firm must transport exactly 900, 800, 700 and 1000 units of a product to four cities: A, B, C and D. The product is manufactured and supplied in two other cities X and Y, in the exact amounts to match the total demand. The production of units from the two cities is 1900 and 1500 units respectively to X and Y. The cost per unit to transport the product between the manufacturing plants in cities X and Y and the demand market cities A, B, C and D are given as : (7 marks)

	DEMAND MARKET			
SUPPLY PLANT	A	B	C	D
X	0.65	0.70	0.80	0.90
Y	0.60	0.60	0.80	0.70

For example, in the table $0.655 is the cost to ship one unit from Supply Plant X to Demand Market A. The trucking firm needs to know how many units should be shipped from each supply city to each demand city in such a way that it minimizes total cost. What is the LP model formulation for this problem?

OR

20. (a) Explain the linear programming complications that prevent the simplex method from generating a desired optimal solution? (8 marks)

(b) Describe the five necessary assumptions that need to be met for Linear Programming to be used in a modeling situation. (6 marks)

Teaching Plan

	Topics	No. of Lecture Hours (33)
	Module - 1 (Introduction To Business Analytics)	**(6 hours)**
1.1	Business Analytics - Terminologies, Business Analytics Process	1 hour
1.2	Relationship of BA process and Organization Decision-Making process	1 hour
1.3	Managing BA Personnel, Data and Technology	1 hour
1.4	Organization Structures aligning BA.	1 hour
1.5	Management Issues – Establishing an Information policy, Outsourcing BA	1 hour

1.6	Data quality, Measuring BA contribution, Change Management in BA	1 hour
	Module - 2 (Descriptive Analytics)	**(6 hours)**
2.1	Introduction to Descriptive analytics	1 hour
2.2	Visualizing and Exploring Data, Descriptive Statistics	1 hour
2.3	Sampling and Estimation	1 hour
2.4	Probability Distribution for Descriptive Analytics	1 hour
2.5	Marketing/Planning Case Study Example	1 hour
2.6	Descriptive analytics step in the BA process	1 hour
	Module - 3 (Predictive Analytics)	**(7 hours)**
3.1	Introduction to Predictive analytics, Predictive Modeling	1 hour
3.2	Logic and Data Driven Models	1 hour
3.3	Predictive Analysis Modeling and procedure	1 hour
3.4	Data Mining: Simple Illustration of Data Mining	1 hour
3.5	Data Mining Methodologies	1 hour
3.6	Prescriptive Analysis step in the BA Process	1 hour
3.7	Analysis of Predictive analytics.	1 hour
	Module - 4 (Forecasting Techniques)	**(7 hours)**
4.1	Introduction - Types of Variation in Time Series Data	1 hour
4.2	Simple Regression Model	1 hour
4.3	Multiple Regression Models	1 hour
4.4	Simple Exponential Smoothing	1 hour
4.5	Smoothing Averages, Fitting Models to Data	1 hour
4.6	How to Select Models and Parameters for Models	1 hour
4.7	Forecasting Practice Problems	1 hour
	Module - 5 (Prescriptive Analytics)	**(7 hours)**
5.1	Introduction to Prescriptive analytics - Prescriptive Modeling	1 hour
5.2	Non Linear Optimization	1 hour
5.3	Prescriptive step in the BA Analysis	1 hour
5.4	Background Review and Prescriptive Analysis	1 hour
5.5	Linear Programming – Types of Linear Programming Problems/Models	1 hour

5.6	Linear Programming Problems/Model Elements	1 hour
5.7	Linear Programming Problems/Model Formulation Procedure.	1 hour

CDT 464	BIG DATA SECURITY	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble:
The course explores the foundations of big data, including its foundations in computing technology and statistics. The course also gives an understanding of the nature of underlying technical challenges and statistical assumptions used to understand relationships in a variety of applied fields, with a focus on the fields of fraud detection and communication monitoring.

Course Outcomes: After the completion of the course, the student will be able to

CO#	Course Outcomes
CO1	Explain the basics of Big Data and their challenges. **(Cognitive knowledge level: Understand)**
CO2	Explain the difference between predictive analytics and descriptive analytics **(Cognitive knowledge level: Understand)**
CO3	Trace out the role played by authentication in security**(Cognitive knowledge level: Apply)**
CO4	Describe the security concerns of big-data. **(Cognitive knowledge level: Understand)**
CO5	Escalate the applications of security analytics. **(Cognitive knowledge level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	✓	✓	✓									✓
CO2	✓	✓	✓									✓
CO3	✓	✓	✓		✓							✓

CO4	✓	✓	✓		✓							✓
CO5	✓	✓	✓		✓							✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and teamwork
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	Test 1 (Marks in percentage)	Test 2 (Marks in percentage)	End Semester Examination (Marks in percentage)
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:
Attendance : **10 marks**
Continuous Assessment Test : **25 marks**
Continuous Assessment Assignment : **15 marks**

Internal Examination Pattern: Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus. The second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have a maximum 2 subdivisions and carries 14 marks.

Syllabus

Module 1 (Introduction to Big Data)

Introduction to Big Data, Evolution of Big data, Characteristics. Big Data Analytics, Big Data framework - fundamental concepts of Big Data management and analytics - Current challenges and trends in Big Data Acquisition.

Module 2 (Data Analytics)

Predictive Analytics: Regression, Decision Tree, Neural Networks - Descriptive Analytics: Association Rules, Sequence Rules, Survival Analysis: Survival Analysis Measurements, Kaplan Meir Analysis, Parametric Survival Analysis - Social Network Analytics: Social Network Learning Relational Neighbor Classification

Module 3 (Introduction to Security Analytics)

Introduction to Security Analytics – Techniques in Analytics – Analysis in everyday life – Challenges in Intrusion and Incident Identification – Simulation and Security Process, Analytical Software's and tools, Malware Analysis – static and dynamic analysis - Security Intelligence – Security Breaches

Module 4(Applications of Security Analytics)

Access Analytics – Analysis of Log file -Security analysis with text mining –Machine Learning and data mining applications for security: Intrusion detection and network anomaly detection. Big data analytics for security: Analyzing DDOS – Distributed Denial of Service attack: counter based method, and access pattern based method – Machine learning for Ransomware detection and prevention.

Module 5 (Big Data Privacy and Applications)

Data Masking – Privately Identified Information (PII) -Privacy preservation in Big Data- Popular Big Data Techniques and tools- Map Reduce paradigm and the Hadoop system – Applications- Social Media Analytics- Recommender Systems- Fraud Detection.

Text Books

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", John Wiley & Sons, 2014
2. Min Chen, Shiwen Mao, Yin Zhang, Victor CM Leung, “Big Data: Related Technologies, Challenges and Future Prospects” , Springer, 2014.
3. Michael Minelli, Michele Chambers, AmbigaDhiraj ,“Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends”, John Wiley & Sons, 2013.

References

1. Raj, Pethuru, “Handbook of Research on Cloud Infrastructures for Big Data Analytics”, IGI Global.
2. Douglas R. Stinson ,“Cryptography Theory and Practice ”, Chapman & Hall/CRC, 3rd Edition, 2006.
3. Mark Talabis, Robert McPherson, I Miyamoto and Jason Martin, “Information Security Analytics: Finding Security Insights, Patterns, and Anomalies in Big Data”, Syngress Media, U.S., 2014.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the Evolution of Big Data and their characteristics

2. Describe any five characteristics of Big Data.

Course Outcome 2 (CO2):

1. Describe the prediction error and regression techniques

2. Explain the three categories of Prediction methodologies.

Course Outcome 3 (CO3):

1. Identify the various challenges in Intrusion and Incident Identification.

Course Outcome 4 (CO4):

1. How machine learning helps in Ransom ware detection and prevention.

Course Outcome 5 (CO5):

1. What is Privacy preservation? Discuss its importance in Big Data.

Model Question Paper

QP CODE:

Reg No:_______________

Name :________________ **PAGES : 3**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CDT 464

Course Name: BIG DATA SECURITY

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Explain the Evolution of Big Data.

2. Describe any five characteristics of Big Data
3. How decision trees aid in big data analytics.
4. What is regression analysis? How is it done?
5. Why data Analytics is needed?
6. How is security analytics done?
7. Explain DDOS attack.
8. How does analysis of log files assist in security analytics?
9. Define Data masking.
10. How map reduce is performed in hadoop?

PART B

Answer any one Question from each module.

Each question carries 14 Marks

11. a) Illustrate the various phases involved in Big Data Analytics with a neat diagram. (7)
b) Explain the trends in big data acquisition. (7)

OR

12. a) Describe the challenges in big data acquisition (7)
b) Explain Big data framework. (7)

13. a) Illustrate Kaplan Meir Analysis with an example (8)
b) Describe Social network Analytics (6)

OR

14. a) Compare predictive and descriptive analysis. (7)
b) Describe Parametric Survival Analysis. (7)

15. a) Compare and contrast static and dynamic malware analysis. (7)
b) Describe the various security breaches possibilities in big data scenarios. (7)

OR

16. a) Summarize various challenges in Intrusion and Incident Identification. (8)
b) Briefly explain various methods used in security analytics. (6)

17. a) Differentiate between counter based method and access pattern based method. (8)

b) Describe how network anomaly detection is done (6)

OR

18. a) How machine learning helps in Ransomware detection and prevention. (8)

b) Explain the scope of Security analysis with text mining. (6)

19. a)Describe Popular Big Data Techniques and tools. (8)

b) Explain the significance of Privately Identified Information. (6)

OR

20.a) How is Privacy preservation in Big Data achieved (8)

b) Describe the role of Recommender Systems (6)

TEACHING PLAN

Sl.No.	Contents	No of Lecture Hrs (35)
Module 1 (Introduction to Big Data) (6 hrs)		
1.1	Introduction to Big Data	1 hour
1.2	Evolution of Big data, Characteristics	1 hour
1.3	Big Data Analytics, Big Data framework	1 hour
1.4	Fundamental concepts of Big Data management and analytics	1 hour
1.5	Current challenges in Big Data Acquisition	1 hour
1.6	Trends in Big Data Acquisition	1 hour
Module 2 (Data Analytics) (8 hrs)		
2.1	Predictive Analytics: Regression, Decision Tree	1 hour

2.2	Neural Networks	1 hour
2.3	Descriptive Analytics: Association Rules, Sequence Rules.	1 hour
2.4	Survival Analysis: Survival Analysis Measurements	1 hour
2.5	Kaplan Meir Analysis	1 hour
2.6	Parametric Survival Analysis	1 hour
2.7	Social Network Analytics	1 hour
2.8	Social Network Learning Relational Neighbor Classification	1 hour
Module 3 (Introduction to Security Analytics) (8 hrs)		
3.1	Introduction to Security Analytics	1 hour
3.2	Techniques in Analytics – Analysis in everyday life	1 hour
3.3	Challenges in Intrusion and Incident Identification	1 hour
3.4	Simulation and Security Process	1 hour
3.5	Analytical Softwares and tools	1 hour
3.6	Malware Analysis	1 hour
3.7	Static and dynamic analysis	1 hour
3.8	Security Intelligence – Security Breaches	1 hour
Module 4(Applications of Security Analytics) (7 hrs)		
4.1	Access Analytics – Analysis of Log file	1 hour
4.2	Security analysis with text mining.	1 hour

4.3	Machine Learning and data mining applications for security:	1 hour
4.4	Intrusion detection and network anomaly detection.	1 hour
4.5	Big data analytics for security: Analyzing DDOS –	1 hour
4.6	Distributed Denial of Service attack: counter based method, and access pattern based method	1 hour
4.7	Machine learning for Ransom ware detection and prevention.	1 hour
Module 5 (Big Data Privacy and Applications) (6 hrs)		
5.1	Data Masking – Privately Identified Information (PII).	1 hour
5.2	Privacy preservation in Big Data.	1 hour
5.3	Popular Big Data Techniques and tools- Map Reduce paradigm	1 hour
5.4	Hadoop system.	1 hour
5.5	Applications- Social Media Analytics	1 hour
5.6	Recommender Systems- Fraud Detection.	1 hour

CST424	PROGRAMMING PARADIGMS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: The course provides the learners a clear understanding of the main constructs of contemporary programming languages and the various systems of ideas that have been used to guide the design of programming languages. This course covers the concepts of Names, Bindings & Scope, Statement-Level Control Structures, Sub Programs, Support for Object Oriented Programming, Exception Handling, Concurrency Control, Functional Programming and Logic Programming. This course helps the learners to equip with the knowledge necessary for the critical evaluation of existing and upcoming programming languages. It also enables the learner to choose the most appropriate language for a given programming task, apply that language's approach to structure or organize the code, classify programming languages based on their features and to design new generation languages.

Prerequisite: Sound knowledge in Programming in C and Object-Oriented Programming.

Mapping of course outcomes with program outcomes

CO1	Explain the criteria for evaluating programming languages and compare Imperative, Functional and Logic programming languages (**Cognitive Knowledge Level: Understand**)
CO2	Illustrate the characteristics of data types and variables (**Cognitive Knowledge Level: Apply**)
CO3	Comprehend how control flow structures and subprograms help in developing the structure of a program to solve a computational problem (**Cognitive Knowledge Level: Apply)**
CO4	Explain the characteristics of Object-Oriented Programming Languages (**Cognitive Knowledge Level: Understand)**
CO5	Compare concurrency constructs in different programming languages (**Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔									✔
CO2	✔	✔										✔
CO3	✔	✔	✔	✔								✔
CO4	✔	✔										✔
CO5	✔	✔	✔									✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	40	40	40

Apply	**30**	**30**	**30**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3**

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests (Average of Internal Tests 1 & 2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the two completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed two modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Compare any three programming languages based on the language evaluation criteria. Prepare a list of characteristics that affect the language evaluation criteria.
2. Identify the advantages and disadvantages of imperative, functional and logic programming languages.

Course Outcome 2 (CO2):

1. Two most important design issues that are specific to character string types are
   (1) whether a string is simply a special kind of character array or a primitive type.
   (2) whether strings have static or dynamic length.
   Identify the implementations options for the above two cases.
2. Consider the following records of a particular language. Let the size of each char variable be 1 byte, int be 4 bytes and and Boolean be 1 bit.

```
Struct Student
{
        int id;
        char name[2];
        int age;
        boolean scholarship;
}
```

   Draw and comment on the possible memory layouts for the record for a 32-bit aligned machine

Course Outcome 3(CO3):

1. Explain three situations where a combined counting and logical looping statement is needed.
2. Describe the ways that aliases can occur with pass-by-reference parameters.
3. Identify the two fundamental design considerations for parameter-passing methods.
4. What will be the output of the given program segment if it uses the following parameter passing mechanisms:
   a) call by reference
   b) call by value

```
x : integer – – global
procedure foo(y : integer)
y := 3
print x
. . .
```

```
x := 2
foo(x)
print x
```

Course Outcome 4 (CO4):

1. Describe the role of a virtual method table in implementing dynamic method binding.
2. Identify the merits and demerits of inheritance.

Course Outcome 5 (CO5):

1. Evaluate the use of semaphores and monitors for providing competition synchronization and cooperation synchronization.

Syllabus

Module – 1

Introduction – Role of Programming Languages, Programming Domains, Language Evaluation Criteria, Influence on Language Design, Language Design Trade-offs, Implementation Methods. Names, Bindings & Scope – Names, Variables, Concept of Binding, Scope and Lifetime, Referencing Environments.

Module - 2

Data Types – Primitive Data Types, Character String Types, User-Defined Ordinal Types, Array Types, Record Types, List Types, Pointer & Reference Types, Type Checking, Strong Typing, Type Equivalence. Expressions – Arithmetic Expressions, Overloaded Operators, Type Conversions, Relational and Boolean Expressions, Short-Circuit Evaluation. Assignment - Assignment Statements, Mixed-mode Assignment.

Module - 3

Statement-Level Control Structures – Selection Statements, Iterative Statements, Unconditional Branching, Guarded Commands. Subprograms – Design Issues of Subprograms, Local Referencing Environments, Parameter Passing Methods, Subprograms as Parameters, Overloaded Subprograms, Closures, Co-routines

Module - 4

Support for Object Oriented Programming – Inheritance, Dynamic Binding, Design Issues for Object Oriented Languages, Support for Object Oriented Programming in C++, Implementation of Object-oriented Constructs. Exception Handling – Basic Concepts, Design Issues.

Module - 5

Concurrency – Subprogram Level Concurrency, Semaphores, Monitors, Message Passing. Functional Programming Languages – Introduction to LISP and Scheme, Comparison of

Functional and Imperative Languages. Logic Programming Languages – Basic Elements of Prolog, Applications of Logic Programming.

Text Books

1. Robert W Sebesta, Concepts of Programming Languages, 10th Edition, Pearson.
2. Scott M L, Programming Language Pragmatics, 3rd Edition, Morgan Kauffman Publishers.

ReferenceBooks

1. Kenneth C. Louden, Programming Languages: Principles and Practice, 2nd Edition, Cengage Learning.
2. Tucker A. B. and R. E. Noonan, Programming Languages: Principles and Paradigms, 2nd Edition. –TMH.
3. Ravi Sethi, Programming Languages: Concepts & Constructs, 2nd Edition., Pearson Education.
4. David A. Watt, Programming Language Design Concepts, Wiley Dreamtech.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST424

Course Name: Programming Paradigms

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Differentiate between readability and writability.
2. Define binding and binding time.
3. What are the advantages of user-defined enumeration types?
4. Define narrowing and widening conversions.
5. Why for statement in C language is more flexible than that of older languages?

6. What are the advantages and disadvantages of dynamic local variables in subprograms?

7. Illustrate the concept of dynamic method binding with an example.

8. Is it mandatory to use constructors in object-oriented languages? Justify your answer.

9. What are the applications of logic programming languages?

10. Explain the working of let and let-rec constructs in Scheme.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain different criteria used for evaluating languages. **(7)**

(b) Consider the following pseudocode: **(7)**

```
x : integer := 3
y : integer := 4
procedure add
x := x + y
procedure second(P : procedure)
x : integer := 5
P()
procedure first
y : integer := 6
second(add)
first()

write integer(x)
```

(a) What does this program print if the language uses static scoping? Give reasons.

(b) What does it print if the language uses dynamic scoping? Give reasons.

OR

12. (a) With respect to storage binding, explain the meanings, purposes, advantages and disadvantages of four categories of scalar variables. **(7)**

(b) What is meant by referencing environment of a statement? Show the **(7)** referencing environment at the indicated program points (1), (2), (3) & (4) for the following program segment. Assume that the programming language is statically scoped.

```
program example;
        var a, b : integer;
        procedure sub1;
             var x, y: integer;
                  begin { sub1 }
                  ………..                (1)
                  end { sub1 }
        procedure sub2;
             var x : integer;
             ……..
             procedure sub3;
                  var x: integer;
                       begin { sub3 }
                            ………..     (2)
                       end { sub3 }
                  begin { sub2 }
                       ………..          (3)
                  end { sub2}
        begin {example}
                       ………..          (4)
        end {example }
```

13. (a) Explain any two issues associated with the pointer data types and also indicate how dangling pointer problem can be solved. **(7)**

(b) Describe the lazy and eager approaches for reclaiming garbage. **(7)**

OR

14. (a) What is meant by side effect and illustrate the advantages of referential transparency? **(8)**

(b) Explain the terms: compound assignment operator, coercion and short circuit evaluation. **(6)**

15. (a) Illustrate the different categories of iteration control statements. **(8)**

(b) Explain the techniques used for identifying the correct referencing environment for a subprogram that was sent as a parameter. **(6)**

OR

16. (a) Describe the implementation models of Parameter passing. **(10)**

(b) Differentiate coroutines from conventional subprograms. **(4)**

17. (a) What is meant by an exception handler? Explain how exceptions are handled in object-oriented languages. **(7)**

(b) Describe the design issues in object-oriented languages. **(7)**

OR

18. (a) Illustrate how a virtual method table can be used for implementing dynamic method binding. **(7)**

(b) Explain the different categories, merits and demerits of inheritance. **(7)**

19. (a) Compare functional and imperative programming languages. **(7)**

(b) Explain the role of monitors in concurrency. **(7)**

OR

20. (a) Explain the searching strategies used in Prolog. Why backward chaining is preferred over forward chaining in Prolog? **(10)**

(b) **(4)**

```
(let ((a 6)
(b 8)
(square (lambda (x) (* x x)))
(plus +))
(sqrt (plus (square a) (square b))))
```

Write the output of the above code? Explain how let and lambda construct works?

Teaching Plan

No	Contents	No. of Lecture Hours (36 hrs.)
	Module-1 (7 hours)	
1.1	Introduction: Reasons for studying Concepts of programming languages, Programming Domains	1 hour
1.2	Language Evaluation Criteria	1 hour
1.3	Influence on Language Design, Language Design Trade-offs	1 hour
1.4	Implementation Methods	1 hour
1.5	Names, Variables	1 hour
1.6	Concept of Binding	1 hour
1.7	Scope and Lifetime, Referencing Environments	1 hour
	Module-2 (7 hours)	
2.1	Primitive Data Types, Character String Types	1 hour
2.2	User-Defined Ordinal Types, Array Types	1 hour
2.3	Record Types, List Types, Pointer and Reference Types	1 hour
2.4	Implementation of pointer and reference types, Type Checking, Strong Typing, Type Equivalence	1 hour
2.5	Expressions and Assignment Statements, Arithmetic Expressions	1 hour
2.6	Overloaded Operators, Type Conversions	1 hour
2.7	Relational and Boolean Expressions, Short-Circuit Evaluation, Assignment Statements, Mixed-mode Assignment	1 hour
	Module-3 (8 hours)	
3.1	Selection Statements, Iterative Statements	1 hour
3.2	Unconditional Branching	1 hour

3.3	Guarded Commands	1 hour
3.4	Subprograms: Design Issues of Subprograms	1 hour
3.5	Local Referencing Environments	1 hour
3.6	Parameter Passing Methods	1 hour
3.7	Subprograms as Parameters, Overloaded Subprograms	1 hour
3.8	Closures, Co-routines	1 hour
Module-4 (7 hours)		
4.1	Inheritance	1 hour
4.2	Dynamic Binding	1 hour
4.3	Design Issues for Object Oriented Languages	1 hour
4.4	Support for Object Oriented Programming in C++	1 hour
4.5	Implementation of Object-Oriented Constructs	1 hour
4.6	Exception Handling – Basic Concepts	1 hour
4.7	Exception Handling - Design Issues	1 hour
Module-5 (7 hours)		
5.1	Subprogram Level Concurrency	1 hour
5.2	Semaphores, Monitors	1 hour
5.3	Message Passing	1 hour
5.4	Introduction to LISP and Scheme	1 hour
5.5	Comparison of Functional and Imperative Languages	1 hour
5.6	Basic Elements of Prolog	1 hour
5.7	Applications of Logic Programming	1 hour

CST434	NETWORK SECURITY PROTOCOLS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course helps the learners to explore various network and system security protocols. This course covers authentication protocols, firewalls and security protocols from different layers such as data link, network, transport and application. The concepts covered in this course enable the learners in effective use of security protocols for securing network applications.

Prerequisite: A fundamental knowledge in the concepts of Security in Computing.

Course Outcomes: After the completion of the course, the student will be able to

CO1	Explain authentication protocols, X.509 authentication service and Public Key Infrastructure (PKI).**(Cognitive Knowledge Level: Understand)**
CO2	Identify the security mechanisms in E mail security services. **(Cognitive Knowledge Level: Understand)**
CO3	Summarize the network and transport layer security services provided in a secure communication scenario. **(Cognitive Knowledge Level: Apply)**
CO4	Describe real time communication security and application layer security protocols. **(Cognitive Knowledge Level: Apply)**
CO5	Explain the concepts of firewalls and wireless network security. **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔									✔
CO2	✔	✔	✔									✔
CO3	✔	✔	✔									✔
CO4	✔	✔	✔			✔						✔
CO5	✔	✔	✔									✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Test 1 (%)	Test 2 (%)	End Semester Examination (%)
Remember	20	20	20
Understand	50	50	50
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment Test : **25 marks**

Continuous Assessment Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1 (Authentication Protocols)

Authentication Protocols – Mutual authentication, One way authentication. Kerberos – Kerberos Version 4, Kerberos Version 5. X.509 Authentication service. Public Key Infrastructure (PKI) – Trust models, Revocation.

Module-2 (E-mail Security)

Pretty Good Privacy (PGP) – Operational Description, Cryptographic keys and key rings, Message format, PGP message generation, PGP message reception, Public key management. S/MIME – Functionality, Messages, Certificate processing, Enhanced security services.

Module-3 (Network Layer Security and Web Security)

Internet Protocol Security (IPSec) – Overview, IP security architecture, Authentication Header (AH), Encapsulating Security Payload (ESP), Combining Security Associations, Key management. Internet Key Exchange (IKE) - Phases. Web Security – Web security considerations. Secure Socket Layer and Transport Layer Security (SSL/TLS) – SSL Architecture, SSL protocols, Cryptographic computations, Transport layer security.

Module-4 (Real-time Security and Application Layer Security)

Real-time communication security – Perfect Forward Secrecy (PFS), Denial-of-Service protection, Endpoint identifier hiding, Live partner reassurance. Hypertext Transfer Protocol Secure (HTTPS) – Connection initiation, Closure. Secure Shell (SSH) – Transport layer protocol, User authentication protocol, Connection protocol. Secure Electronic Transaction (SET) – Overview, Features, Participants, Dual signature, Payment processing.

Module-5 (System Security and Wireless Security)

Firewalls – Firewall characteristics, Types of Firewalls, Firewall configurations, Encrypted Tunnels, Trusted systems – Data access control, The concept of Trusted Systems, Trojan horse defense. IEEE 802.11i wireless LAN security - Services, Phases of operation, Wired Equivalent Privacy (WEP), Wi-Fi Protected Access (WPA), WPA2.

Text Books

1. William Stallings, Cryptography and Network Security Principles and Practice, 4/e, Pearson Ed.
2. C. Kaufman, R. Perlman and M. Speciner, “Network Security: Private Communication in a Public World”, 2/e, PHI.

References

1. Behrouz A. Forouzan, DebdeepMukhopadhyay, “Cryptography and Network Security”, 3/e, Tata McGraw Hill.
2. Tyler Wrightson, “Wireless Network Security A Beginner’s Guide”, 2012, Tata McGraw Hill.
3. William Stallings, “Network Security Essentials: Applications and Standards”, 4/e, Prentice Hall.
4. Schiller J., Mobile Communications, 2/e, Pearson Education.
5. Roberta Bragg et. al., “Network Security: The Complete Reference”, Tata McGraw Hill

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Identify the threats associated with user authentication over a network or Internet.
2. In the context of Kerberos, mention the significance of a realm.

Course Outcome 2 (CO2):

1. Mention the use of R64 conversion for an e-mail application.
2. Give the general structure of Private and Public Key rings in PGP.

Course Outcome 3 (CO3):

1. In AH protocol, identify the fields in an IP header which are included in MAC calculation. For each of the fields in the IP header, indicate whether the field is immutable, mutable but predictable, or mutable. Justify your decision for each field.

2. Is it possible for the receiver to reorder SSL record blocks that arrive out of order? If so, explain how it can be done. If not, why?

Course Outcome 4 (CO4):

1. Devise a protocol based on a pre-shared secret key that hides identities and gives Perfect Forward Secrecy (PFS) for identity hiding. Make two variants, one in which an active attacker can learn only the initiator's identity, and one in which an active attacker can learn only the target's identity.
2. Explain the tasks performed by the payment gateway during Payment Authorization in SET.

Course Outcome 5 (CO5):

1. List the weaknesses of a packet-filtering router.
2. Give the relevance of pair wise keys and group keys in IEEE 802.11i.
3. State the design goals of firewalls.

Model Question Paper

QP CODE: **PAGES: ___**

Reg No:_______________
Name:_________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST434
Course Name: NETWORK SECURITY PROTOCOLS

Max Marks: 100 **Duration: 3 Hours**

PART A
(Answer All Questions. Each question carries 3 marks)

1. List any three requirements of Kerberos.
2. Specify the significance of key pair recovery. When is the key pair updated?
3. Why does PGP generate signature before applying compression?
4. List the four principal services provided by S/MIME.
5. Explain the significance of Alert protocol in SSL and list out any three Alert messages with their uses.
6. Specify the purpose of MAC during the change cipher spec TLS exchange.

7. What is the advantage, if any, of not including the MAC in the scope of packet encryption in SSH packets?

8. Givethe significance of dual signature in SET.

9. List the IEEE 802.11i services.

10. How is the concept of association related to that of mobility in wireless networks? **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Describe the requirements for a public-key certificate scheme. **(8)**

    (b) Explain the significance of chain of certificates. **(6)**

OR

12. (a) Specify the purpose of the X.509 standard. How is an X.509 certificate revoked? **(8)**

    (b) Describe the management functions of a PKI. What is a cross certificate? **(6)**

13. (a) List the services provided by PGP and explain how authentication and confidentiality are provided. **(8)**

    (b) Explain the functionalities provided by S/MIME. **(6)**

OR

14. (a) Give the format of a PGP message and specify the significance of each field in the message. **(8)**

    (b) Explain the enhanced security services provided in S/MIME. **(6)**

15. (a) Explain the parameters that identify an SSL session state. **(8)**

    (b) Differentiate between transport mode and tunnel mode in IPSec. **(6)**

OR

16. (a) The IPsec architecture document states that when two transport mode SAs arebundled to allow both AH and ESP protocols on the same end-to-end flow, only one ordering of security protocols seems appropriate: performing the ESP protocol before performing the AH protocol. Why is this approach **(8)**

recommended rather than authentication before encryption?

(b) List and explain the purpose each Alert Codes supported by SSL. **(6)**

17. (a) Illustrate the significance ofperfect forward secrecy. **(6)**

(b) Explain the key features provided by SET. **(8)**

OR

18. (a) List and explain the SSH protocols. **(8)**

(b) “The HTTPS capability is built into all modern web browsers”. Justify. **(6)**

19. (a) Explain the phases of operations in IEEE 802.11i. **(8)**

(b) Give the significances of Encrypted Tunnels **(6)**

OR

20. (a) Compare the features of three types of firewalls. **(8)**

(b) Compare the Wireless LAN protocols WEP, WPA and WPA2 **(6)**

TEACHING PLAN

No	Contents	No.of Lecture Hours (35 Hrs)
	Module-1 (Authentication Protocols)(7hrs)	
1.1	Authentication Protocols – Mutual authentication, One way authentication	1
1.2	Kerberos –Version 4	1
1.4	Differences between Kerberos Version 4 and Version 5, Kerberos Version 5	1
1.5	X.509 Authentication service – Certificates, Authentication Procedures, X.509 Version 3	1
1.6	Public Key Infrastructure (PKI) – Trust models	1
1.7	Public Key Infrastructure (PKI) – Revocation	1

Module-2 (E-mail Security) (6 hrs)		
2.1	Pretty Good Privacy (PGP) – Operational Description	1
2.2	Cryptographic keys and key rings, Message format	1
2.3	PGP message generation, PGP message reception	1
2.4	PGP -Public key management	1
2.5	S/MIME – Overview of MIME, Functionality, Messages	1
2.6	S/MIME - Certificate processing, Enhanced security services	1
Module-3 (Network Layer Security and Web Security)(8 hrs)		
3.1	Internet Protocol Security (IPSec) – Overview, IP security architecture	1
3.2	Authentication Header (AH)	1
3.3	Encapsulating Security Payload (ESP)	1
3.4	Combining Security Associations, Key management	1
3.5	Internet Key Exchange (IKE) – Phases	1
3.6	Web Security – Web security considerations. Secure Socket Layer and Transport Layer Security (SSL/TLS) – SSL Architecture	1
3.7	SSL Protocols - Record Protocol, Change Cipher Spec Protocol, Alert Protocol	1
3.8	SSL Handshake Protocol, Cryptographic computations, Transport Layer Security	1
Module-4 (Real-time Security and Application Layer Security) (8hrs)		
4.1	Real-time communication security – Perfect Forward Secrecy (PFS)	1
4.2	Denial-of-Service protection, Endpoint identifier hiding, Live partner reassurance	1
4.3	Hypertext Transfer Protocol Secure (HTTPS) – Connection initiation, Closure	1
4.4	Secure Shell (SSH) – Transport layer protocol	1
4.5	User authentication protocol	1

4.6	Connection protocol	1
4.7	Secure Electronic Transaction (SET) – Overview, Features, Participants	1
4.8	Dual signature, Payment processing	1
Module-5 (System Security and Wireless Security) (6 hrs)		
5.1	Firewalls – Firewall characteristics, Types of Firewalls	1
5.2	Firewalls – Firewall configurations, Encrypted Tunnels	1
5.3	Trusted systems – Data Access Control, The Concept of Trusted Systems, Trojan Horse Defense	1
5.4	IEEE 802.11i wireless LAN security - Services, Phases of operation	1
5.5	Wired Equivalent Privacy (WEP)	1
5.6	Wi-Fi Protected Access (WPA), WPA2	1

CST444	SOFT COMPUTING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course enables the learners to understand the concepts of Soft Computing techniques and its applications. It covers Artificial Neural Networks, operations and models of fuzzy logic, genetic algorithms and multi objective optimization techniques. This course helps the students to develop algorithms and solutions for different real world applications.

Prerequisite: NIL.

Mapping of course outcomes with program outcomes

CO1	Describe soft computing techniques and the basic models of Artificial Neural Network **(Cognitive Knowledge Level: Understand)**
CO2	Solve practical problems using neural networks **(Cognitive Knowledge Level: Apply)**
CO3	Illustrate the operations, model and applications of fuzzy logic **(Cognitive Knowledge Level: Apply)**
CO4	Illustrate the concepts of Genetic Algorithm **(Cognitive Knowledge Level: Apply)**
CO5	Describe the concepts of multi-objective optimization models and the need for using hybrid soft computing approaches**(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔									✔
CO2	✔	✔	✔	✔								✔
CO3	✔	✔	✔	✔								✔
CO4	✔	✔	✔	✔								✔
CO5	✔	✔	✔									✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests(Average of Internal Tests 1 & 2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

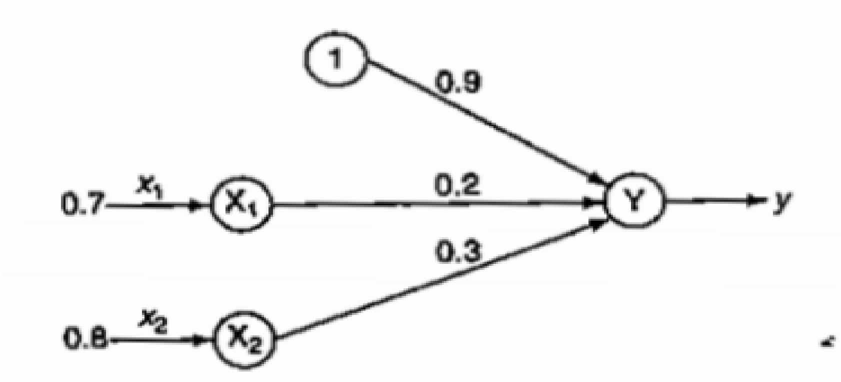
End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Describe the necessity of Activation function? Examine the various aspects of sigmoidal activation function. List the drawbacks. Calculate the net output of the following neural network using the bipolar and binary sigmoidal activation function.



2. Explain the architecture of McCulloch-Pitts Neuron network model. Implement NAND(NOT-AND) gate function using M-P Neuron Model(with binary input).

Course Outcome 2(CO2):

1. Find the weights required to perform classification of patterns shown below using perceptron network. The patterns (1,1,-1) and (1, -1,-1) are belonging to the target class -1. The patterns (-1,1,1) and (-1,-1,1) are belonging to the target class +1. Assume suitable learning rate and initial weights.
2. Explain the architecture and training algorithm of Adaline network . Use Adaline nerwork to train NOR logic function with bipolar inputs and targets. Perform 2 epochs of training.

Course Outcome 3(CO3):

1. There is an imprecise relationship between the ambient temperature for clay masonry bricks and their compressive strengths. Let X be a fuzzy set of fracture strengths and Y be a fuzzy set of temperatures with the following membership functions:

$$X=\left\{\frac{1.0}{1500}+\frac{0.8}{2175}+\frac{0.6}{7000}+\frac{0.5}{12750}+\frac{0.3}{16500}+\frac{0.1}{20000}\right\}$$

$$Y=\left\{\frac{0.2}{20}+\frac{0.4}{25}+\frac{0.5}{32}+\frac{1.0}{50}+\frac{0.6}{90}+\frac{0.3}{105}\right\}$$

(a) Find the Cartesian Product of X and Y and represent it as relation R.
Suppose there is a second fuzzy set of masonry lengths given as

$$Z=\left\{\frac{0.4}{1500}+\frac{0.5}{2175}+\frac{0.6}{7000}+\frac{0.8}{12750}+\frac{0.9}{16500}+\frac{1.0}{20000}\right\}$$

(b) Find S=ZoR using max-min composition (c) Find T=ZoR using max-product composition

2. Given two universes X={x1,x2,x3,x4,x5} and Y={y1,y2,y3,y4,y5},the fuzzy sets A defined on X and fuzzy set B defined on Y are given below:

   $A = \left\{\frac{0.4}{x1} + \frac{0.7}{x2} + \frac{1}{x3} + \frac{0.8}{x4} + \frac{0.6}{x5}\right\} B = \left\{\frac{0.2}{y1} + \frac{0.6}{y2} + \frac{1}{y3} + \frac{0.9}{y4} + \frac{0.7}{y5}\right\}$

   (i)Find the relation R = A × B

   Consider another fuzzy set C defined on the universe V={v1,v2,v3}, $C = \left\{\frac{0.4}{v1} + \frac{1}{v2} + \frac{0.8}{v3}\right\}$

   (ii) Find P = B × C. Using max-min composition, Find RoP.

Course Outcome 4(CO4):

1. Illustrate the various types of cross over with suitable examples.
2. Using Genetic algorithm with Roulette wheel selection method maximize the function f(x)=x2 over {0, 1, 2, ..., 31} with initial x values of (13, 24, 8, 19). Show one crossover and mutation.

Course Outcome 5(CO5):

1. Explain strong dominance and weak pareto-optimality.
2. What are the different classifications of neuro-fuzzy hybrid systems?

Syllabus

Module – 1 (Introduction to Soft Computing & Artificial Neural Network)

Introduction to Soft Computing. Difference between Hard Computing & Soft Computing. Applications of Soft Computing. Artificial Neurons Vs Biological Neurons. Basic models of artificial neural networks – Connections, Learning, Activation Functions. McCulloch and Pitts Neuron. Hebb network.

Module – 2 (Supervised Learning Network)

Perceptron Networks– Learning rule, Training and testing algorithm. Adaptive Linear Neuron– Architecture, Training and testing algorithm. Back propagation Network – Architecture, Training and testing algorithm.

Module - 3 (Fuzzy Logic & Defuzzification)

Fuzzy sets – properties, operations on fuzzy set. Fuzzy membership functions, Methods of membership value assignments – intuition, inference, Rank Ordering. Fuzzy relations– operations on fuzzy relation. Fuzzy Propositions. Fuzzy implications. Defuzzification– Lamda cuts, Defuzzification methods.

Module - 4 (Fuzzy Inference System & Genetic Algorithm)

Fuzzy Inference Systems - Mamdani and Sugeno types. Fuzzy Logic Controller. Concepts of genetic algorithm. Operators in genetic algorithm - coding, selection, cross over, mutation. Stopping condition for genetic algorithm.

Module - 5 (Multi Objective Optimization & Hybrid Systems)

Multi objective optimization problem. Principles of Multi- objective optimization, Dominance and pareto-optimality. Optimality conditions. Neuro-fuzzy hybrid systems. Genetic – neuro hybrid systems.

Text Books

1. S.N.Sivanandam and S.N. Deepa, Principles of Soft Computing , 2nd Edition, John Wiley & Sons.
2. Kalyanmoy Deb, Multi-objective Optimization using Evolutionary Algorithms, 1st Edition, John Wiley & Sons.

ReferenceBooks

1. Timothy J Ross, Fuzzy Logic with Engineering Applications, John Wiley & Sons, 2016.
2. T.S.Rajasekaran, G.A.Vijaylakshmi Pai “Neural Networks, Fuzzy Logic & Genetic Algorithms Synthesis and Applications”, Prentice-Hall India.
3. Simon Haykin, “Neural Networks- A Comprehensive Foundation”, 2/e, Pearson Education.
4. Zimmermann H. J, “Fuzzy Set Theory & Its Applications”, Allied Publishers Ltd.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 444

Course Name: Soft Computing

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Explain the architecture of a simple Artificial Neural network? Compare it with a biological neuron.

2. A 4-input neuron has weights 1, 2, 3 and 4. The transfer function is linear with the constant of proportionality being equal to 2. The inputs are 4, 10, 5 and 20 respectively. Predict the output?

3. Explain the Widrow-Hoff learning rule for supervised learning in neural networks with help of an example. Why is it sometimes called the LMS learning rule?

4. Implement one epoch of Adaline algorithm for AND logic function with binary inputs and bipolar outputs. Initial weights are w1=0.2, w2=0.1 and learning rate parameter η=0.2.

5. Consider two fuzzy sets $A = \left\{\frac{0.2}{0} + \frac{0.3}{1} + \frac{1}{2} + \frac{0.1}{3} + \frac{0.5}{4}\right\}$ $B = \left\{\frac{0.1}{0} + \frac{0.25}{1} + \frac{0.9}{2} + \frac{0.7}{3} + \frac{0.3}{4}\right\}$ Find the following: (a) Algebraic sum (b) Algebraic product(c) Bounded sum.

6. Using your own intuition and definition of universe of discourse, plot membership

functions for liquid level (Empty, very less, less, full, very full) in a tank.

7. Explain Stochastic Universal Sampling with an example.

8. Explain any two mutation methods.

9. Differentiate between linear and nonlinear Multi Objective Optimization Problem.

10. What are the characteristics of neuro fuzzy hybrid systems?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Implement XOR function using M-P Neuron Model (with binary input).Why M-P neuron is widely used in processing binary data? **(8)**

(b) Using Hebb Network calculate the weight required to perform the following classification of given input pattern. **(6)**

L □belongs to the members of the class(+)□target value +1

U□does not belongs to members of class(.)□target value -1

+	•	•
+	•	•
+	+	+

L

+	•	+
+	•	+
+	+	+

U

OR

12. (a) Compare the three learning approaches in Artificial Neural Network. How is the critic information used in learning process. **(8)**

(b) Define Hebb Law. Design a Hebb Network to implement logical AND function. Use bipolar input and targets. **(7)**

13. (a) Discuss the training algorithm and explain the weight updates in back propagation networks. **(10)**

(b) Implement one epoch of Perceptron training algorithm for OR logic function with binary input and bipolar output. **(4)**

OR

14. (a) Explain how synaptic weights are adapted iteration by iteration using error correction rule in Perceptron convergence algorithm for an OR gate with bipolar inputs and outputs. Initial weights are all zero and learning rate parameter η=0.1. **(10)**

(b) Explain Perceptron convergence theorem and discuss Perceptron algorithm based on XOR logic function. **(4)**

15. (a) Three fuzzy sets are defined as follows: **(10)**

$A = \left\{\frac{0.1}{30} + \frac{0.2}{60} + \frac{0.3}{90} + \frac{0.4}{120}\right\}, B = \left\{\frac{1}{1} + \frac{0.2}{2} + \frac{0.5}{3} + \frac{0.7}{4} + \frac{0.3}{5} + \frac{0}{6}\right\},$

$$C = \left\{\frac{0.33}{100} + \frac{0.65}{200} + \frac{0.92}{300} + \frac{0.21}{400}\right\}$$

Find: (i)$R = A \times B$ (ii)$S = B \times C$ (iii)$T = RoS$, using Max-Min composition (iv)$T = RoS$, using Max-Product composition.

(b) For the fuzzy sets given $A = \left\{\frac{0.5}{x_1} + \frac{0.2}{x_2} + \frac{0.9}{x_3}\right\}$ and$B = \left\{\frac{1}{y_1} + \frac{0.5}{y_2} + \frac{1}{y_3}\right\}$. Find relation R by performing Cartesian product over the given fuzzy sets. **(4)**

OR

16. (a) Using inference approach, find the membership values for each of the triangular shapes (I, R, IR, T) for a triangle with angles 120°, 50°, 10°. **(8)**

(b) Using Zadeh's notation, determine the ʎ - cut sets for the given fuzzy sets: **(6)**

$$S_1 = \left\{\frac{0}{0} + \frac{0.5}{20} + \frac{0.65}{40} + \frac{0.85}{60} + \frac{1.0}{80} + \frac{1.0}{100}\right\}$$

$$S_2 = \left\{\frac{0}{0} + \frac{0.45}{20} + \frac{0.6}{40} + \frac{0.8}{60} + \frac{0.95}{80} + \frac{1.0}{100}\right\}$$

Express the following for $\lambda = 0.5$: a) $S_1 \cup S_2$ b) S_2' c) $S_1 \cap' S_2$

17. (a) Differentiate between value encoding and permutation encoding. **(8)**

(b) Explain the stopping conditions for genetic algorithm. **(6)**

OR

18. (a) Apply Mamdani fuzzy model to design a controller to determine the wash time of a domestic washing machine. Assume input is dirt and grease of the cloth. Use three descriptors for input variable and five descriptors for output variables .Derive the set of rules for controller action and defuzzification. Design should be supported by figure wherever possible. **(10)**

(b) Explain Single-Point Crossover and Two-Point Crossover with example. **(4)**

19. (a) Explain convex and non convex MOOP? How to find a non dominated set. **(10)**

(b) What are the properties of dominance relation? **(4)**

OR

20. (a) Explain Genetic Neuro-Hybrid System with block diagram. Also write the advantages of Genetic- Neuro Hybrid systems. **(8)**

(b) Discuss the classification of Neuro-Fuzzy Hybrid System. **(6)**

Teaching Plan

No	Contents	No. of Lecture Hours (35 hrs)
Module-1 (Introduction to Soft Computing & Artificial Neural Network) (6 hours)		
1.1	Introduction to Soft Computing	1 hour
1.2	Difference between Hard Computing & Soft Computing & Applications of Soft Computing	1 hour
1.3	Artificial Neurons Vs Biological Neurons, Basic models of artificial neural networks	1 hour
1.4	Activation Functions	1 hour
1.5	McCulloch and Pitts Neuron	1 hour
1.6	Hebb network	1 hour
Module-2 (Supervised Learning Network) (7 hours)		
2.1	Perceptron networks – Learning rule, Training and testing algorithm	1 hour
2.2	Perceptron networks – Problems	1 hour
2.3	Adaptive Linear Neuron (Lecture I)	1 hour
2.4	Adaptive Linear Neuron (Lecture II)	1 hour
2.5	Adaptive Linear Neuron-Problems (Lecture III)	1 hour
2.6	Back propagation Network (Lecture I)	1 hour
2.7	Back propagation Network (Lecture II)	1 hour
Module-3 (Fuzzy Logic & Defuzzification) (8 hours)		
3.1	Introduction to Fuzzy Set, Properties & operations on fuzzy sets	1 hour
3.2	Fuzzy membership functions, Fuzzification	1 hour
3.3	Methods of membership value assignments	1 hour
3.4	Fuzzy relations, Operations on Fuzzy Relation	1 hour

3.5	Fuzzy Propositions & Fuzzy Implications	1 hour
3.6	Lamda cuts for fuzzy sets	1 hour
3.7	Defuzzification methods(Lecture I)	1 hour
3.8	Defuzzification methods(Lecture II)	1 hour
Module-4 (Fuzzy Inference System & Genetic Algorithm) (6 hours)		
4.1	Fuzzy Inference Systems - Mamdani type	1 hour
4.2	Fuzzy Inference Systems - Sugeno type	1 hour
4.3	Fuzzy Logic Controller	1 hour
4.4	Introduction to genetic algorithm, operators in genetic algorithm - coding	1 hour
4.5	Selection, Cross over	1 hour
4.6	Mutation, stopping condition for genetic algorithm	1 hour
Module-5 (Multi-Objective Optimization & Hybrid System) (8 hours)		
5.1	MOOP-Linear &Non linear, Convex & Non Convex	1 hour
5.2	Principles of MOO-Illustrating Pareto Optimal Solutions, Objectives in MOO	1 hour
5.3	Dominance & Pareto-Optimality-Concept of Domination	1 hour
5.4	Properties of Dominance Relation, Pareto Optimality	1 hour
5.5	Procedure for finding a non dominated set	1 hour
5.6	Optimality Conditions	1 hour
5.7	Neuro Fuzzy hybrid system-Classification& characteristics	1 hour
5.8	Genetic –neuro hybrid systems	1 hour

CST454	FUZZY SET THEORY AND APPLICATIONS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course equips the students to understand the concepts of fuzziness and its use in building better solutions to problems. The course covers basic concepts of fuzzy sets, fuzzy relations, fuzzy logic and building of fuzzy approximation-based solutions. It helps students to design and develop fuzzy based solutions to real world applications.

Prerequisite: Basic knowledge in set theory.

Course Outcomes: After the completion of the course, the student will be able to

CO1	Explain fuzzy logic based problem solving **(Cognitive Knowledge Level: Understand)**
CO2	Summarize the concepts of crisp sets, crisp relations, crisp logic with fuzzy sets, fuzzy relations and fuzzy logic**(Cognitive Knowledge Level: Apply)**
CO3	Develop fuzzy systems by selecting appropriate membership functions, fuzzification and defuzzification methods **(Cognitive Knowledge Level: Apply)**
CO4	Develop solutions using graphical and rule-based methods**(Cognitive Knowledge Level: Apply)**
CO5	Make use of fuzzy logic inference to solve real world problems**(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✔											✔
CO2	✔	✔	✔									✔
CO3	✔	✔	✔	✔	✔							✔
CO4	✔	✔	✔	✔	✔							✔

CO5	✔	✔		✔	✔							✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember	**20**	**20**	**20**
Understand	**50**	**50**	**50**
Apply	**30**	**30**	**30**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	**50**	**100**	**3**

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests(Average of Internal Tests1&2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Basic Fuzzy Set Theory)

The case for imprecision, Utility and Limitations of Fuzzy Systems, Fuzzy Sets and Membership, Classical Sets – Properties, Operations, Fuzzy Sets – Properties and Operations, Classical Relations – Cartesian Product, Operations and Properties of Crisp Relations, Composition, Fuzzy Relations – Cardinality, Operations, Properties, Fuzzy Cartesian Product and Composition.

Module – 2 (Fuzzy Membership Functions)

Tolerance and Equivalence Relations – Crisp and Fuzzy, Similarity Methods – Cosine, Min-max, Fuzzy Membership Functions – Features, Fuzzification, Defuzzification to Crisp Sets, λ-Cutsfor Fuzzy Relations, Linguistic Hedges.

Module - 3 (Fuzzification and Defuzzification Methods)

Development of Membership Functions –Intuition, Inference, Rank ordering, Inductive reasoning. Defuzzification to Scalars - Max membership principle, Centroid method, Weighted average method, Mean max membership, Center of sums, Center of largest area, First (or last) of maxima.

Module - 4 (Fuzzy Inference)

Classical Logic, Fuzzy Logic, Approximate Reasoning, Fuzzy (Rule-Based) Systems - Multiple conjunctive antecedents, Multiple disjunctive antecedents, Aggregation of fuzzy rules, Graphical Techniques of Inference.

Module - 5 (Fuzzy Applications)

Applications of Fuzzy Systems - Fuzzy Classification, Fuzzy Pattern Recognition, Fuzzy Control Systems, Fuzzy Systems and Neural Networks, Fuzzy Clustering, Fuzzy Databases and Information retrieval systems.

Text Books

1. Fuzzy Logic with Engineering Applications – Timothy J. Ross, Third Edition, John Wiley and Sons, 2010
2. Fuzzy Sets and Fuzzy Logic: Theory and Applications - George J. Klir and Bo Yuan , Prentice Hall, 1995.

Reference Books

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications with Combinatorics and GraphTheory, Seventh Edition, MGH,2011
2. Trembly J.P and Manohar R, “Discrete Mathematical Structures with Applications to Computer Science”, TataMc Graw Hill Pub. Co. Ltd., New Delhi,2003.
3. Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, “Discrete Mathematical Structures”, Pearson Education Pvt Ltd., New Delhi,2003
4. Kenneth H .Rosen, “Discrete Mathematics and its Applications”, 5/e, TataMc Graw Hill Pub. Co. Ltd, New Delhi2003

Course Level Assessment Questions

Course Outcome1 (CO1):

1. What are the limitations of crisp systems?
2. Explain the difference between randomness and fuzziness.
3. Find some examples of prospective fuzzy variables in daily life.

Course Outcome 2(CO2):

1. The strength of two types of concrete needs to be compared. Four concrete masonry units (CMUs) from each type of concrete are stressed until they fail. The lowest stress at failure of a CMU is denoted 1, and the highest stress at failure is denoted 4,so the CMUs are rank ordered by failure stress, that is, X = {1, 2, 3, 4}. Since “failure” of CMUs is fuzzy, the membership value for a specific CMU represents the judgment that the CMU really failed. The following fuzzy sets represent the failure estimates for the two different concrete types:

$$A = \left\{\frac{0 \cdot 15}{1} + \frac{0.25}{2} + \frac{0 \cdot 6}{3} + \frac{0.9}{4}\right\}$$

$$B = \left\{\frac{0.2}{1} + \frac{0.3}{2} = + \frac{0.5}{3} + \frac{0.8}{4}\right\}$$

Calculate the union, intersection and difference for the two concrete types.

2. An engineer is testing the properties, strength and weight of steel. Suppose he has two fuzzy sets A , defined on a universe of three discrete strengths, $\{s1, s2, s3\}$, and B, defined on a universe of three discrete weights, $\{w1, w2, w3\}$. Suppose A and B represent a "high-strength steel" and a "near-optimum weight," respectively, as shown below

$$A = \left\{\frac{1}{s_1} + \frac{0.5}{s_2} + \frac{0.2}{s_3}\right\}$$

$$B = \left\{\frac{1}{w_1} + \frac{0.5}{w_2} + \frac{0.2}{w_3}\right\}$$

a) Find the fuzzy relation for the Cartesian product, R, of A and B
b) Introducing another fuzzy set, C, which represents a set of "moderately good" steel strengths

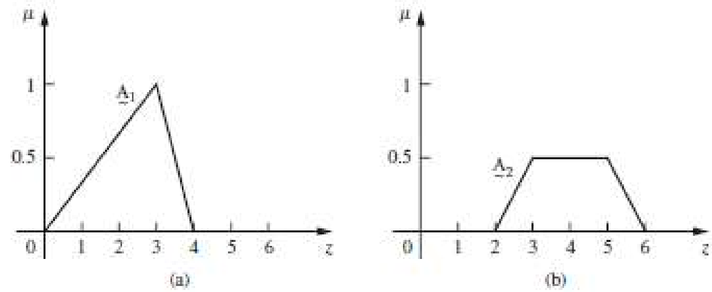
$$C = \left\{\frac{0.1}{s_1} + \frac{0.6}{s_2} + \frac{1}{s_3}\right\}$$

Find C∘R using max–min composition

Course Outcome 3(CO3):

1. Using your own intuition and your own definitions of the universe of discourse,plot fuzzy membership functions for "age of people" who are:
   (i) very young
   (ii) young
   (iii) middle-aged
   (iv) old
2. a) Define membership functions for approximately isosceles triangle, approximately equilateral and approximately right-angled triangles.

   b) Find the membership value for the triangle represented by the angles 80°, 75°, 25°, in the above triangles.
3. In metallurgy, materials are made with mixtures of various metals and other elements to achieve certain desirable properties. In a particular preparation of steel, three elements, namely, iron, manganese, and carbon, are mixed in two different proportions. The samples obtained from these two different proportions are placed on a normalized scale and are represented as fuzzy sets A1 and A2. Do a logical union of the membership functions A1 and A2 and find the defuzzified value of the resulting membership function.



Course Outcome 4(CO4): .

1. Consider the following two discrete fuzzy sets, which are defined on universeX = {−5, 5}:

$$A = \text{"}zero\text{"} = \left\{\frac{0}{-2} + \frac{0.5}{-1} + \frac{1}{0} + \frac{0.5}{1} + \frac{0}{2}\right\}$$

$$B = \text{"}positive\ medium\text{"} = \left\{\frac{0}{0} + \frac{0.6}{1} + \frac{1}{2} + \frac{0.6}{3} + \frac{0}{4}\right\}$$

   Construct the relation for IF *x* is "zero" THEN *y* is "positive medium"

2. A metro train system uses fuzzy logic in ensuring smooth ride on the train. The metro train system has fixed stops and the distance between the stops are known. The system uses fuzzy logic in deciding the pressure applied on the brakes. The amount of pressure applied depends on the distance to the next stop and the speed of the train. Design appropriate membership functions for the input and illustrate the use of Mamdani Inference in arriving at the brake pressure.

Course Outcome 5(CO5):

1. A fuzzy systems needs to be designed to provide a rating for a web store as "excellent", "good" or "poor". The web store can be rated based on the products available, the customer service and the discount provided. Design appropriate membership functions and fuzzy rules for generating the fuzzy based rating system.
2. Design a fuzzy control system for an air-conditioning application. Make appropriate decisions regarding inputs and outputs.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST454

Course Name: Fuzzy Set Theory and Applications

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Illustrate where a fuzzy logic based application is suitable.

2. Consider a LAN using Ethernet protocol with maximum bandwidth of 10 Mbps. Traffic rates can be represented using two fuzzy variables, Quiet and Congested. If the universal set X = {0,1,2,3,4,5,6,7,8,9,10} represents bandwidth usage in Mbps, then draw possible membership functions for the fuzzy variables.

3. Define fuzzy tolerance and equivalence relations.

4. Given two data points, illustrate how a similarity measure between them can be computed.

5. Define a convex normalized fuzzy set.

6. How does augmented query help in information retrieval.

7. Given the propositions
   (i) $C \vee D$
   (ii) $\sim H \Rightarrow (A \wedge \sim B)$
   (iii) $(C \vee D) \Rightarrow \sim H$

(iv) $(A \wedge \sim B) \Rightarrow (R \vee S)$

Infer $(R \vee S)$ from the above propositions and state the tautologies used.

8. Write a predicate logic statement for "Ram likes all kinds of food".

9. Given the relation R below, find λ-cut for the relation using suitable λ value.

$$\begin{bmatrix} 1 & 0.8 & 0 & 0.1 & 0.2 \\ 0.8 & 1 & 0.4 & 0 & 0.9 \\ 0 & 0.4 & 1 & 0 & 0 \\ 0.1 & 0 & 0 & 1 & 0.5 \\ 0.2 & 0.9 & 0 & 0.5 & 1 \end{bmatrix}$$

10. Define maximum approaching degree.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) An engineer is testing the properties, strength and weight of steel. Suppose he has two fuzzy sets A, defined on the universe of three discrete strengths { s1, s2, s3 } and B, defined on the universe of discrete weights { w1, w2, w3}. Suppose A represents a "high-strength steel" and B a "near-optimum weight". **(4)**

$$A = \left\{\frac{1}{s1} + \frac{0.5}{s2} + \frac{0.2}{s3}\right\},\ B = \left\{\frac{1}{w1} + \frac{0.5}{w2} + \frac{0.3}{w3}\right\}$$

Find fuzzy Cartesian product, R, of A and B.

(b) Let a fuzzy set $C = \left\{\frac{0.1}{s1} + \frac{0.6}{s2} + \frac{1}{s3}\right\}$ be introduced, which represents a set of "moderately good" steel strength. Find the max-min composition of C and R. **(5)**

(c) Define 5 operations associated with crisp relations. **(5)**

OR

12. (a) How is excluded middle axiom different for crisp and fuzzy sets? **(4)**

(b) Differentiate between crisp and fuzzy sets with respect to their membership functions. **(4)**

(c) Illustrate any 4 operations associated with a fuzzy relation. **(6)**

13. (a) A structural designer is considering four different kinds of structural beams { S1, S2, S3, S4} for a new building. Laboratory experiments on the deflection resistance for these four kinds of beams have been performed, and the engineer wants to determine their suitability in the new structure. The following data have been observed based on the overall deflection capacity of each beam type: **(10)**

		S1	S2	S3	S4
No deflection	X_1	0.3	0.6	0.5	0.8
Some deflection	X_2	0.6	0.3	0.5	0.2
Excessive deflection	X_3	0.1	0.1	0	0

Use cosine amplitude method to determine the similarity of the four beam types.

(b) Given a fuzzy set "tall" = $\left\{\frac{0.1}{s1} + \frac{0.6}{s2} + \frac{1}{s3}\right\}$, illustrate how the fuzzy set "very tall" be defined? **(4)**

OR

14. (a) Define tolerance and equivalence relations. Check whether the relation R given below is tolerance or equivalence relation. **(4)**

$$\begin{bmatrix} 1 & 0.8 & 0 & 0.1 & 0.2 \\ 0.8 & 1 & 0.4 & 0 & 0.9 \\ 0 & 0.4 & 1 & 0 & 0 \\ 0.1 & 0 & 0 & 1 & 0.5 \\ 0.2 & 0.9 & 0 & 0.5 & 1 \end{bmatrix}$$

(b) Given the following data regarding three cities and the quality of their bridges, find the similarity between the cities using max-min method. **(10)**

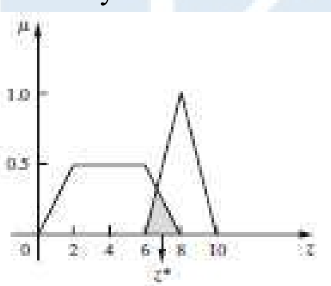
		C1	C2	C3
Poor	Q_1	0.00	0.10	0.10
Fair	Q_2	0.04	0.04	0.08
Good	Q_3	0.02	0.04	0.06

15. (a) Explain the process of developing membership functions using the inference method. **(6)**

(b) The following raw data were determined in a pair wise comparison of new premium car preferences in a poll of 100 people. When it was compared with a Porsche (P), 79 of those polled preferred a BMW (B), 85 preferred a Mercedes (M), 59 preferred a Lexus (L), and 67 preferred an Infinity (I). When a BMW was compared, the preferences were 21 – P, 23 – M, 37 – L, and 45 – I. When a Mercedes was compared, the preferences were 15 – P, 77 – B, 35 – L, and 48 – I. When a Lexus was compared, the preferences were 41 – P, 63 – B, 65 – M, and 51 – I. Finally, when an Infinity was compared, the preferences were 33 – P, 55 – B, 52 – M, and 49 – L. Using rank ordering, plot the membership function for "most preferred car." **(8)**

OR

16. (a) **1.** Defuzzify the following region using centroid method. **(9)**



(b) 2. Defuzzify the region given in 16(a) using weighted average method. **(5)**

17. (a) For a distillation process, the objective is to separate components of a mixture in the input stream. The relationship between the input variable, temperature, and the output variable, distillate fractions, is not precise but the human operator of this process has developed an intuitive understanding of this relationship. The universe for each of these variables is **(8)**

X = universe of temperatures (degree fahrenheit) = {160, 165, 170, 175, 180, 185, 190, 195}.
Y = universe of distillate fractions (percentage) = {77, 80, 83, 86, 89, 92, 95, 98}.
Given two fuzzy sets
A = "temperature of input steam is hot" $= \left\{\frac{0}{175} + \frac{0.7}{180} + \frac{1}{185} + \frac{0.4}{190}\right\}$

B = "separation of mixture is good" $=\left\{\frac{0}{89}+\frac{0.5}{92}+\frac{0.8}{95}+\frac{1}{98}\right\}$.

Find the fuzzy relation corresponding to " IF x is $\tilde{A}$, THEN y is $\tilde{B}$

(b) Show how inference is done using Generalized Modus Ponens **(6)**

OR

18. (a) Illustrate how graphical inference is done using Mamdani method. **(6)**

(b) A restaurant uses a fuzzy inference system to calculate the tips given to its employees. The tips are based on the timeliness of service and quality of service of the waiters. Design appropriate membership functions for the input and illustrate the use of Sugeno Inference in arriving at the tip amount. **(8)**

19. (a) Explain fuzzy pattern recognition using multiple features. **(7)**

(b) Describe how fuzziness in information retrieval can enhance the quality of search results. **(7)**

OR

20. (a) Design a fuzzy control system for an air-conditioning system. **(7)**

(b) Illustrate how the join operation is performed in fuzzy databases. **(7)**

Teaching Plan

No	Contents	No. of Lecture Hours (36 hrs)
	Module-1(Basic Fuzzy Set Theory) (6 hours)	
1.1	Introduction to Fuzzy Concepts – Case for imprecision- utility and limitations of Fuzzy Systems	1 hour
1.2	Classical Sets – Properties, Operations	1 hour
1.3	Fuzzy Sets – Properties, Operations	1 hour
1.4	Classical Relations – Properties, Operations – Cartesian Product,	1 hour

	Composition	
1.5	Fuzzy Relations – Properties, Operations, Cardinality	1 hour
1.6	Fuzzy Cartesian Product, Fuzzy Composition	1 hour
	Module-2 (Fuzzy Membership Functions) (6 hours)	
2.1	Tolerance and Equivalence Relations - Crisp	1 hour
2.2	Tolerance and Equivalence Relations - Fuzzy	1 hour
2.3	Similarity Methods – Cosine, Minmax	1 hour
2.4	Fuzzy Membership Functions- Features	1 hour
2.5	Fuzzification, Defuzzification to crisp sets – λ-cuts	1 hour
2.6	Linguistic Hedges	1 hour
	Module-3 (Fuzzification and Defuzzification Methods) (7 hours)	
3.1	Development of Membership Functions – Intuition, Inference	1 hour
3.2	Development of Membership Functions – Rank Ordering	1 hour
3.3	Development of Membership Functions – Inductive reasoning	1 hour
3.4	Defuzzification – Max membership principle, weighted average method, mean max membership	1 hour
3.5	Defuzzification – Centroid method	1 hour
3.6	Defuzzification – Center of Sums, Center of Largest area, First/Last of maxima	1 hour
3.7	Defuzzification - exercises	1 hour
	Module-4 (Fuzzy Inference) (9 hours)	
4.1	Classical Logic – Propositional Logic	1 hour
4.2	Classical Logic – Predicate Logic	1 hour
4.3	Fuzzy Logic	1 hour
4.4	Fuzzy Approximation based reasoning	1 hour
4.5	Fuzzy Rule based systems	1 hour
4.6	Multiple conjunctive and disjunctive antecedents, aggregation	1 hour
4.7	Graphical Techniques for Inference	1 hour
4.8	Illustration of Graphical Techniques for Inference	1 hour

4.9	Fuzzy Inference - Exercises	1 hour
Module-5 (Fuzzy Applications) (8 hours)		
5.1	Fuzzy Control Systems	1 hour
5.2	Illustration of Fuzzy Control Systems	1 hour
5.3	Fuzzy Classification	1 hour
5.4	Fuzzy Pattern Recognition	1 hour
5.5	Fuzzy Systems and Neural Networks	1 hour
5.6	Fuzzy Clustering	1 hour
5.7	Fuzzy Databases	1 hour
5.8	Fuzzy Information Retrieval Systems	1 hour

CST474	COMPUTER VISION	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: Computer vision is a field of artificial intelligence (AI) that enables computers and systems to derive meaningful information from digital images, videos and other visual inputs. The curriculum covers the basics of image formation, key computer vision concepts, methods, techniques, pattern recognition, various problems in designing computer vision and object recognition systems. This course enables the learners to understand the fundamentals of computer vision and develop applications in computer vision.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to

CO1	Summarize basic concepts, terminology, theories, models and methods in the field of computer vision. **(Cognitive Knowledge Level: Understand)**
CO2	Explain basic methods of computer vision related to multi-scale representation, edge detection, detection of other primitives, stereo, motion and object recognition. **(Cognitive Knowledge Level: Understand)**
CO3	Describe principles of Segmentation, Motion Segmentation and Classification **(Cognitive Knowledge Level: Understand)**
CO4	Select appropriate object Tracking and detection methods for computer vision applications **(Cognitive Knowledge Level: Understand).**
CO5	Implement a computer vision system for a specific problem **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔		✔									✔
CO2	✔		✔									✔
CO3	✔		✔									✔

CO4	✔		✔									✔
CO5	✔	✔	✔	✔	✔							✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember	**30**	**30**	**30**
Understand	**50**	**50**	**50**
Apply	**20**	**20**	**20**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests(Average of Internal Tests1&2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Image Formation and Filtering)

Geometric Camera Models - Pinhole perspective, Intrinsic and Extrinsic Parameters, Geometric Camera Calibration. Linear Filters- Linear Filters and Convolution, Shift Invariant Linear Systems. Filters as Templates - Normalized Correlation and Finding Patterns.

Module - 2(Local Image Features and Stereo Vision)

Image Gradients - Computing the Image Gradient, Gradient Based Edge and Corner Detection. Stereopsis- Binocular Camera Geometry, Epipolar Constraint, Binocular Reconstruction, Local Methods for Binocular Fusion, Global Methods for Binocular Fusion.

Module - 3 (Segmentation)

Segmentation - Background subtraction, Interactive segmentation, Forming image regions. Segmentation by clustering - Watershed Algorithm. Motion Segmentation by Parameter Estimation- Optical Flow and Motion, Flow Models, Motion Segmentation with Layers.

Module- 4 (Classification and Tracking)

Classification - Classification Basics, Two-class and Multiclass classifiers, Error, Overfitting and Regularization, Cross Validation, Classifying Images of Single Objects.
Tracking - Tracking Basics, Simple Tracking Strategies, Tracking by detection, Tracking Linear Dynamical models with Kalman filters.

Module - 5 (Finding Objects and other Applications)

Object detection - The Sliding Window Method. Object Recognition -Goals of Object Recognition System. Applications - Robot Navigation by stereo vision, Face detection, Face recognition, Activity Recognition, Tracking people.

Text Books

1. Forsyth, David, and Jean Ponce. Computer vision: A modern approach. Prentice hall, 2011.

Reference Books

1. Szeliski, Richard, Computer vision: algorithms and applications. Springer Science & Business Media, 2010.
2. Medioni, Gerard, Emerging topics in computer vision. and Sing Bing Kang. Prentice Hall PTR, 2004.
3. Trucco, Emanuele, and Alessandro Verri, Introductory techniques for 3-D computer vision. Vol. 201. Englewood Cliffs: Prentice Hall, 1998.
4. Faugeras, Olivier, and Olivier Autor Faugeras, Three-dimensional computer vision: a geometric viewpoint. MIT press, 1993.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the relationship between coordinates involved in a pinhole camera imaging setup.
2. Explain the basic principle behind geometric camera calibration**.**
3. Describe how linear filters can be used for smoothing digital images.
4. How does normalised correlation help in matching patterns in images?

Course Outcome 2 (CO2):

1. Describe edge detection methods for computer vision.
2. List any five applications of object recognition.
3. Explain how the epipolar constraint simplifies the correspondence search between two stereo images.
4. List and explain the different methods used for binocular fusion.
5. Explain the different corner detection methods.

Course Outcome 3 (CO3):

1. Explain the principle of background subtraction.
2. Describe the watershed algorithm for image segmentation.
3. What is meant by optical flow? How can it be utilized for segmenting images?
4. Describe motion segmentation with layers.
5. What is overfitting in the context of classification?
6. Explain the principle behind classification of single images.

Course Outcome 4 (CO4):

1. Explain 'Mean Shift Algorithm' to track an object using matching.

2. Describe an algorithm to track a moving object (dynamic object).

3. Explain the sliding window method for object detection.

4. Assume that we have the dynamics

$$x_i \sim N(d_i x_{i-1}, \sigma_{d_i}^2)$$

$$y_i \sim N(m_i x_i, \sigma_{m_i}^2)$$

a. $P(x_i|x_{i-1})$ is a normal density with mean $d_i x_{i-1}$ and variance $\sigma_{d_i}^2$. Whatis$(x_{i-1}|x_i)$?

b. Show how to obtain a representation of $P(x_i|y_{i+1}, \ldots, y_N)$ usinga KalmanFilter.

Course Outcome 5(CO5):

1. Explain how to implement a computer vision system.
2. Illustrate a computer vision system with the help of a neat diagram.
3. Discuss the components of a computer vision system for object recognition.
4. Explain how activity recognition can be done using computer vision.
5. Illustrate a face recognition system with the help of a diagram.

Assignment Questions

6. Implement a voxel-based approach to visual hull construction.
7. Implement a computer vision system for object recognition.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 3**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST474

Course Name: COMPUTER VISION

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. State three properties of shift invariant linear systems.
2. Explain the term normalized correlation.
3. What is image rectification? Mention its significance?
4. Illustrate epipolar geometry and showepipolar lines and epipoles.
5. Explain the term flow model.
6. How does background subtraction help in segmenting an image?
7. What is a Kalman filter? Give its applications.
8. State any three simple tracking strategies.
9. State the goals of an object recognition system.
10. Explain the task of face recognition. **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Demonstrate the relationship between a point in the world coordinate frame and its corresponding image point using camera parameters. **(9)**

(b) Show that convolving a function with a δ function simply reproduces the original function. **(5)**

OR

12. (a) What is linear filtering? Explain two applications of linear filtering to image processing. **(7)**

(b) Explain an application of normalised correlation to find patterns. **(7)**

13. (a) Show that smoothing an image and then computing the gradient is same as convolving an image with the derivative of a smoothing function. **(5)**

(b) State the epipolar constraint and derive its representations using the Essential matrix and the Fundamental matrix. **(9)**

OR

14. (a) Explain the algorithm for computing edges using gradients. **(9)**

(b) Define binocular fusion. Explain two local methods for binocular fusion. **(5)**

15. (a) Discuss the different interactive segmentation approaches. **(7)**

(b) What is meant by optical flow? How can it be utilized for segmenting images? **(7)**

OR

16. (a) Explain the Watershed algorithm. **(7)**

(b) How can we perform motion segmentation by parameter estimation? **(7)**

17. (a) Explain tracking algorithm using Kalman filtering. **(7)**

(b) Illustrate the tracking by detection algorithm. **(7)**

OR

18. (a) Explain the various kinds of errors in classification and the relationship between them. **(7)**

(b) What is overfitting and how does regularization help to minimise it? **(7)**

19. (a) Explain human activity recognition with appearance features. **(7)**

(b) Describe the Sliding window method for detecting objects in images. **(7)**

OR

20. (a) Explain the principle of detecting faces in an image. **(7)**

(b) What are the various strategies for object recognition? **(7)**

Teaching Plan

No	Contents	No. of Lecture Hours (36hrs)
Module 1 Image Formation and Filtering (7)		
1.1	Geometric Camera model - Pinhole perspective	1
1.2	Geometric Camera model - Intrinsic Parameters	1
1.3	Geometric Camera model - Extrinsic Parameters	1
1.4	Geometric Camera Calibration – Linear Approach	1
1.5	Linear Filters and Convolution	1
1.6	Shift Invariant Linear Systems - Discrete convolution	1
1.7	Normalized Correlation and Finding patterns	1
Module 2 Local Image Features and Stereo Vision (8)		
2.1	Local Image Features - Computing the Image Gradient	1
2.2	Gradient Based Edge Detection	1
2.3	Gradient Based Corner Detection	1
2.4	Stereopsis - Binocular Camera Geometry and Epipolar Constraint	1
2.5	Essential Matrix and Fundamental Matrix	1
2.6	Binocular Reconstruction	1
2.7	Local Methods for Binocular Fusion	1
2.8	Global Methods for Binocular Fusion	1
Module 3 Segmentation (6)		

3.1	Segmentation basics	1
3.2	Applications - Background Subtraction, Interactive Segmentation	1
3.3	Forming Image Regions	1
3.4	Segmentation by clustering - The Watershed Algorithm	1
3.5	Motion Segmentation by Parameter Estimation - Optical Flow and Motion	1
3.6	Flow Models and Motion Segmentation with Layers	1
Module 4 Classification and Tracking (8)		
4.1	Classification Basics, Two-class and Multiclass classifier	1
4.2	Error, Overfitting and Regularization	1
4.3	Cross Validation, Classifying Images of Single Objects	1
4.4	Tracking Basics, Simple Tracking Strategies	1
4.5	Tracking by detection	1
4.6	Linear Dynamical models	1
4.7	The Kalman Filter background	1
4.8	Kalman filter algorithm	1
Module 5 Finding Objects and other Applications (7)		
5.1	Detecting Objects in Images- The Sliding Window Method	1
5.2	Object Recognition - Goals of Object Recognition System	1
5.3	Application of binocular stereo vision - Robot Navigation	1
5.4	Face detection	1
5.5	Face recognition	1
5.6	Activity recognition	1
5.7	Tracking people	1

SEMESTER VIII

PROGRAM ELECTIVE IV

AMT 416	HUMAN COMPUTER INTERACTION	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble:.This course provides an overview of Human-Computer Interaction (HCI), with an understanding of user interface design in general. The course covers topics which include user-centered design, human cognitive and physical abilities, prototyping and evaluation techniques, graphical design fundamentals and emerging areas of HCI research including mobile interaction, augmented-reality and ubiquitous computing. This course helps the learners to design and evaluate interactive systems by following the fundamental principles of human-computer interaction.

Prerequisite: Skill in any programming language. Exposure to web designing is preferred.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Describe the usability based on a variety of classic universal user-centric models**. (Cognitive Knowledge level: Understand)**
CO 2	Comprehend the different interaction styles and the methodologies for designing interactive systems. **(Cognitive Knowledge level: Understand)**
CO 3	Investigate the core and complex user experience design issues. **(Cognitive Knowledge level: Understand)**
CO 4	Examine the evaluation methodologies of interactive system design. **(Cognitive Knowledge level: Apply)**
CO 5	Explore the different contexts and suggest suitable designs for applications related to web, mobile and wearable computing. **(Cognitive Knowledge level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓		✓						✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓	✓	✓						✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (percentage)	Test2 (percentage)	
Remember	20	20	20
Understand	60	60	60
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module -1(Introduction to HCI and Usability)

Introduction- - Components of Interaction – Ergonomics Designing Interactive systems – Understanding Users cognition and cognitive frameworks, User Centered approaches, Usability goals and measures, Universal Usability-Diverse Cognitive and Perceptual abilities, Personality differences, Cultural and International diversity, Users with disabilities- Older Adult users and Children. Guidelines, Principles and Theories.

Module -2 (Design Process and Interaction Styles)

HCI patterns, Design frameworks, Design methods, Prototyping. Understanding interaction styles - Direct Manipulation and Immersive environments, Fluid navigation - Navigation by Selection, Small Displays, Content Organization, Expressive Human and Command Languages-Speech Recognition, Traditional Command Languages, Communication and Collaboration-Models of Collaboration, Design considerations.

Module -3 (User Experience Design)

Frameworks for User Centric Computing, Computational models of users, Advancing the User Experience- Display Design, View (Window) Management, Animation, Webpage Design, Color. Timely user Experience-Models of System Response Time (SRT) Impacts, Frustrating Experiences, Information Search- Five Stage Search Framework, Data Visualization-Tasks in Data Visualization, Challenges

Module -4 (Cognitive Systems and Evaluation of HCI)

Cognitive Models- Goal and task hierarchies, GOMS Model. Introducing Evaluation-Types of Evaluation, Other Issues to Consider When Doing Evaluation. Conducting Experiments. Usability testing – Heuristic evaluation and walkthroughs, Analytics and predictive models.

Module -5 (Contexts for Designing UX)

Designing apps and websites – Website and app development, The information architecture of apps and websites. Social media -Social Networking, Sharing with others. Collaborative environments- Issues for cooperative working, Technologies to support cooperative working, AI and Interface Agents, Ubiquitous computing -Blended Spaces. Mobile Computing – Designing for Mobiles. Wearable Computing- Smart Materials, Material Design.

Text Book

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, NiklasElmqvist“Designing the User Interface: Strategies for Effective Human-Computer Interaction”, Sixth Edition, Pearson Education, 2017.
2. Preece, J., Sharp, H., Rogers, Y., “Interaction Design: Beyond Human-Computer Interaction”, Fifth Edition, Wiley, 2019.

3. David Benyon, “Designing User Experience: A guide to HCI, UX and interaction design”, 4th Edition, Pearson, 2018.

Reference Books

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, Third Edition, Prentice Hall, 2004.
2. The essential guide to user interface design, Wilbert O Galitz, Wiley Dream Tech
3. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, “Research Methods in Human-Computer Interaction”, Wiley, 2010.
4. Samit Bhattacharya, “Human-Computer Interaction: User-Centric Computing for Design”, McGraw-Hill India, 1st Edition, 2019.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What are the general principles of user interface design?
2. How can designers encourage novice users to use a system?
3. Define user interface. List and explain the benefits of good design.

Course Outcome 2 (CO2):

1. Design a touch screen music jukebox, which allows the user to select from a menu of the five most popular songs of the week. Draw a sketch of this interface for each of the following menu types—binary menu, multiple-item menu, check boxes, pull-down menus. Argue which design serves the user best.
2. List several situations when command languages can be attractive for users.

Course Outcome 3(CO3):

1. Explain how data visualization caters to the perceptual abilities of humans.
2. Demonstrate the five stage framework in designing the advanced search interface.

Course Outcome 4 (CO4):

1. Discuss the GOMS Model
2. Explain how Fitt’s Law predictive model has been influential in HCI and Interaction design.

Course Outcome 5 (CO5):

3. Distinguish between GUI and Web user interface.
4. List the issues faced for cooperative working.

Model Question paper

			Total Pages: 2
Reg No.:_______________		**Name:__________________________**	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AMT 416

Course Name: HUMAN COMPUTER INTERACTION

Max. Marks: 100 | **Duration: 3 Hours**

PART A

		Answer all questions, each carries 3 marks.	Marks
1		Define Principles, Standards, Guidelines and Rules.	(3)
2		Explain the term Universal Usability.	(3)
3		Prototyping will solve all problems associated with user interface design. Justify this statement.	(3)
4		List the three principles of direct manipulation.	(3)
5		Describe frustrating experiences.	(3)
6		List any three reasons for using animation in display design.	(3)
7		Explain how Fitt's Law predictive model has been influential in HCI and Interaction design.	(3)
8		Coordination is a task concept that describes how information objects change based on user actions. Cite any two coordination that should be supported by interface designers.	(3)
9		Discuss any three principles of designing rich web interface.	(3)
10		Summarize three guidelines for developing applications for pocket PCs.	(3)

PART B

Answer any one full question from each module, each carries 14 marks.

		Module I	
11	a)	Explain the relationship between the user experience and usability.	(7)
	b)	Describe user-centered design. What are its benefits?	(7)
		OR	
12	a)	Explain the difference between good and poor interaction design.	(4)
	b)	What is cognitive and perceptual ability? Discuss with an example cognitive perception.	(10)
		Module II	

13	a)	Outline the various interface styles used in interactive systems.	(7)
	b)	Discuss the obstacles to speech recognition and production.	(7)
		OR	
14	a)	Data entry is challenging for small devices. Explain the ways in which this issue can be addressed?	(7)
	b)	Explain the different phases involved in an interactive design process.	(7)
		Module III	
15	a)	How do rule and heuristics help interface designers in taking account of cognitive psychology? Illustrate your answer with the design of Microsoft Office Word.	(8)
	b)	Discuss three human values that are necessary to be understood by interface designers in order to ensure a timely user experience. State any three system response time (SRT) guidelines.	(6)
		OR	
16	a)	Explain how data visualization caters to the perceptual abilities of humans.	(9)
	b)	Colour displays are attractive to users and can often improve task performance, but the danger of misuse is high. List five guidelines for using colour and give an example of each.	(5)
		Module IV	
17	a)	What is meant by design evaluation? Describe the approaches to expert analysis.	(8)
	b)	What is a cognitive model? Classify cognitive models and discuss the same.	(6)
		OR	
18	a)	How are download delays masked by well-designed websites?	(7)
	b)	Discuss the GOMS Cognitive task analysis model.	(7)
		Module V	
19	a)	List and explain the key attributes of wearable computing.	(8)
	b)	Describe how the UCAMP framework helps designers of wearable systems to focus on the key design issues.	(6)
		OR	
20	a)	Illustrate any two applications of agent-based interaction.	(8)
	b)	Describe the main types of technologies that support cooperative working.	(6)

****

Teaching Plan

	Topics	No. of Lecture Hours (36 Hours)
Module -1 (Introduction to HCI and Usability)		**(8 hours)**
1.1	Introduction- - Components of Interaction – Ergonomics	1 hour
1.2	Designing Interactive systems – Understanding Users cognition and cognitive frameworks	1 hour
1.3	User Centered approaches, Usability goals and measures	1 hour
1.4	Universal Usability	1 hour
1.5	Diverse Cognitive and Perceptual abilities	1 hour
1.6	Personality differences, Cultural and International diversity,	1 hour
1.7	Users with disabilities- Older Adult users and Children.	1 hour
1.8	Guidelines, Principles and Theories.	1 hour
Module -2 Design Process and Interaction Styles		**(6 hours)**
2.1	HCI patterns, Design frameworks. Design considerations.	1 hour
2.2	Understanding interaction styles- Direct Manipulation and Immersive environments,	1 hour
2.3	Fluid navigation -Navigation by Selection, Small Displays, Content Organization	1 hour
2.4	Expressive Human and Command Languages-Speech Recognition, Traditional Command Languages	1 hour
2.5	Communication and Collaboration-Models of Collaboration	1 hour
2.6	Design methods, Prototyping	1 hour
Module -3 User Experience Design		**(7 hours)**
3.1	Frameworks for User Centric Computing	1 hour
3.2	Computational models of users,	1 hour
3.3	Advancing the User Experience- Display Design, View (Window) Management,	1 hour
3.4	Animation, Webpage Design, Color	1 hour

3.5	Timely user Experience-Models of System Response Time (SRT) Impacts, Frustrating Experiences.	1 hour
3.6	Information Search- Five Stage Search Framework,	1 hour
3.7	Data Visualization-Tasks in Data Visualization, Challenges	1 hour
Module -4 Cognitive Systems and Evaluation of HCI		**(7 hours)**
4.1	Cognitive Models- Goal and task hierarchies.	1 hour
4.2	GOMS Model.	1 hour
4.3	Introducing Evaluation- Types of Evaluation	1 hour
4.4	Other Issues to Consider When Doing Evaluation.	1 hour
4.5	Conducting Experiments	1 hour
4.6	Usability testing – Heuristic evaluation and walkthroughs	1 hour
4.7	Analytics and predictive models	1 hour
Module -5 Contexts for Designing UX		**(8 hours)**
5.1	Designing apps and websites – Website and app development	1 hour
5.2	The information architecture of apps and websites.	1 hour
5.3	Social media -Social Networking, Sharing with others.	1 hour
5.4	Collaborative environments- Issues for cooperative working, Technologies to support cooperative working	1 hour
5.5	AI and Interface Agents	1 hour
5.6	Ubiquitous computing -Blended Spaces.	1 hour
5.7	Mobile Computing – Designing for Mobiles.	1 hour
5.8	Wearable Computing- Smart Materials, Material Design.	1 hour

AIT426	Mining of Massive Data Sets	Category	L	T	P	Credit	Year of Introduction
		PEC	2	1	0	3	2019

Preamble:

This course introduces concepts in mining of massive data sets. It covers different mining algorithms, distributed file systems and map-reduce as a tool for creating parallel algorithms that succeed on very large amounts of data.
Prerequisite: Sound knowledge in Data Analytics

Course Outcomes: After the completion of the course the student will be able to

CO1	Describe the process of extracting useful features in developing models(**Cognitive Knowledge level: Understand)**	
CO2	Make use of the concepts of MapReduce methodology for exploiting parallelism in computing clouds. (**Cognitive Knowledge level: Apply**)	
CO3	Explain applications of hashing that make management of stream data (Cognitive Knowledge level: **Understand)**	
CO4	Examines the problem of clustering to analyse a large amount of data and partition it into subsets.(Cognitive Knowledge level: **Apply**	
CO5	Describe on-line advertising, social networks and algorithms for their analysis. (Cognitive Knowledge level: **Understand**)	

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔										✔
CO2	✔	✔	✔	✔								✔
CO3	✔	✔										✔
CO4	✔	✔	✔	✔								✔
CO5	✔	✔	✔									✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember	**20**	**20**	**20**
Understand	**60**	**60**	**60**
Apply	**20**	**20**	**20**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	**50**	**100**	**3**

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests(Average of Internal Tests1&2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module -1(Data Mining)

Data Mining- Statistical Modeling, Machine Learning, Computational Approaches to Modeling, Summarization, Feature Extraction. Statistical Limits on Data Mining- Total Information Awareness, Bonferroni's Principle, Importance of Words in Documents, Hash Functions, Secondary Storage, The Base of Natural Logarithms, Power Laws.

Module -2(MapReduce and the New Software Stack)

Distributed File Systems, MapReduce-The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Details of MapReduce Execution, Algorithms Using MapReduce- Matrix-Vector Multiplication by MapReduce, If the Vector v Cannot Fit in Main Memory, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce, Computing

Natural Join by MapReduce, Grouping and Aggregation by MapReduce, Matrix Multiplication, Matrix Multiplication with One MapReduce Step, Extensions to MapReduce.

Module -3 (Mining Data Streams)

The Stream Data Model, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments- Definition of Moments, The Alon-Matias-Szegedy Algorithm for Second Moments, Counting Ones in a Window.

Module -4(Clustering)

Introduction to Clustering Techniques-Points, Spaces, and Distances, Clustering Strategies, The Curse of Dimensionality, Hierarchical Clustering, K-means Algorithms, The CURE Algorithm, Clustering in Non-Euclidean Spaces, Clustering for Streams and Parallelism- The Stream-Computing Model, A Stream-Clustering Algorithm, Initializing Buckets, Merging Buckets, Answering Queries, Clustering in a Parallel Environment

Module -5 (Advertising on the Web)

Issues in On-Line Advertising, On-Line Algorithms, The Matching Problem, The Adwords Problem, Adwords Implementation. Mining Social-Network Graphs:Social Networks as Graphs, Clustering of Social-Network Graphs.

Text Book

1. Anand Rajaraman, Jure Leskovec, and Jeffrey D. Ullman "Mining of Massive Datasets"

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Explain the Total Information Awareness
2. Discuss the Base of Natural Logarithms

Course Outcome 2(CO2):

1. Explain the Cluster Computing
2. What are the Applications of MapReduce

Course Outcome 3(CO3):

1. Demonstrate the Bloom Filters.
2. Discuss Moments of Streams.

Course Outcome 4(CO4): .

1. How CURE Algorithm works.
2. Differentiate Centroids and Clustroids

Course Outcome 5(CO5):

1. Discuss how Greedy Algorithms work.
2. Explain Competitive Ratio

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AIT426

Course Name: Mining of Massive Data Sets

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. State Bonferroni's Principle.
2. Explain Power laws.
3. Illustrate the concepts of Map Reduce.
4. Explain Distributed File Systems.
5. List the Issues in Stream Processing.
6. How counting distinct elements is done in a stream.

7. How CURE algorithm begin in clustering.

8. To Merge two consecutive buckets, what things are done in clustering.

9. What are the Issues in On-Line Advertising.

10. List any three essential characteristics of a social network.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Discuss Some of the important kinds of feature extraction from large-scale data. **(7)**

(b) Explain Term Frequency times Inverse Document Frequency (TF.IDF) measure of word importance in a documents. **(7)**

OR

12. (a) Explain Hash Function and their use with an example in data mining. **(10)**

(b) Demonstrate Statistical Modelling in data mining with an example. **(4)**

13. (a) What are the relational algebra operations used in data base queries of map reduce. **(8)**

(b) Illustrate Matrix-Vector Multiplication by MapReduce. **(6)**

OR

14. (a) How Grouping and Aggregation can be done by MapReduce. **(7)**

(b) Design MapReduce algorithms to take a very large file of integers and produce as output: **(7)**

(a) The largest integer.

(b) The average of all the integers.

(c) The same set of integers, but with each integer appearing only once.

(d) The count of the number of distinct integers in the input.

15. (a) Why the Alon-Matias-Szegedy Algorithm Works. **(7)**

(b) How stream data arises naturally in the stream data model. **(7)**

OR

16. (a) Explain The Flajolet-Martin Algorithm. **(7)**

(b) With a motivating example explain sampling data in a stream **(7)**

17. (a) Illustrate K-means Algorithm. **(8)**

(b) Perform a hierarchical clustering of the one-dimensional set of points 1, 4, 9, 16, 25, 36, 49, 64, 81, assuming clusters are represented by their centroid (average), and at each step the clusters with the closest centroids are merged. **(6)**

OR

18. (a) Explain Clustering in non- Euclidean spaces. **(7)**

(b) Summarize the alternative rules for controlling hierarchical clustering in a Euclidean space. **(7)**

19. (a) Illustrate the problem of matching ads to search queries with an example. **(7)**

(b) Explain the Adwords Problem. **(7)**

OR

20. (a) Explain the clustering of social networks graph. **(7)**

(b) What are the varieties of social networks when we consider social network as a graph. **(7)**

Teaching Plan

No	Contents	No. of Lecture Hours (36 hrs)
Module -1 (Data Mining)(6 hours)		
1.1	Data Mining- Statistical Modeling, Machine Learning	1 hour
1.2	Computational Approaches to Modeling, Summarization, Feature Extraction	1 hour
1.3	Statistical Limits on Data Mining- Total Information Awareness, Bonferroni’s Principle	1 hour
1.4	Importance of Words in Documents, Hash Functions	1 hour
1.5	Indexes, Secondary Storage	1 hour
1.6	The Base of Natural Logarithms, Power Laws	1 hour
Module -2 (MapReduce and the New Software Stack) (8 hours)		
2.1	Distributed File Systems, The Communication Cost Model	1 hour
2.2	MapReduce-The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners	1 hour
2.3	Details of MapReduce, Coping with Node Failures	1 hour
2.4	Algorithms Using MapReduce- Matrix-Vector Multiplication by MapReduce, If the Vector v Cannot Fit in Main Memory	1 hour
2.5	Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce	1 hour
2.6	Union, Intersection, and Difference by MapReduce, Computing Natural Join by MapReduce	1 hour
2.7	Grouping and Aggregation by MapReduce, Matrix Multiplication, Matrix Multiplication with One MapReduce Step	1 hour
2.8	Extensions to MapReduce	1 hour
Module -3 (Mining Data Streams) (7 hours)		
3.1	The Stream Data Model	1 hour
3.2	Sampling Data in a Stream	1 hour
3.3	Filtering Streams	1 hour

3.4	Counting Distinct Elements in a Stream	1 hour
3.5	Estimating Moments- Definition of Moments, The Alon-Matias-Szegedy Algorithm for Second Moments	1 hour
3.6	Counting Ones in a Window	1 hour
3.7	Storage Requirements for the DGIM Algorthim	1 hour
Module -4(Clustering) (8 hours)		
4.1	Introduction to Clustering Techniques-Points, Spaces, and Distances, Clustering Strategies, The Curse of Dimensionality	1 hour
4.2	Hierarchical Clustering	1 hour
4.3	K-means Algorithms	1 hour
4.4	The CURE Algorithm	1 hour
4.5	Clustering in Non-Euclidean Spaces	1 hour
4.6	Clustering for Streams and Parallelism- The Stream-Computing Model, A Stream-Clustering Algorithm	1 hour
4.7	Initializing Buckets, Merging Buckets	1 hour
4.8	Answering Queries, Clustering in a Parallel Environment	1 hour
Module -5 (Advertising on the Web) (7 hours)		
5.1	Issues in On-Line Advertising	1 hour
5.2	On-Line Algorithms	1 hour
5.3	The Matching Problem	1 hour
5.4	The Adwords Problem	1 hour
5.5	Adwords Implementation	1 hour
5.6	Mining Social-Network Graphs: Social Networks as Graphs	1 hour
5.7	Clustering of Social-Network Graphs	1 hour

AIT 456	INTODUCTION TO REINFORCEMENT LEARNING	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: This course covers fundamental principles and techniques in reinforcement learning. Reinforcement learning is concerned with building programs that learn how to predict and act in a stochastic environment, based on past experience. Applications of reinforcement learning range from classical control problems, such as dynamical system control, to game playing, inventory control, and many other fields. Topics include Markov decision process, dynamic programming, Monte Carlo, temporal difference, function approximation reinforcement learning algorithms, and applications of reinforcement learning. This course enables the leaners to apply reinforcement learning on real world applications and research problems.

Prerequisite: Computational Fundamental for Machine Learning

Course Outcomes: After the completion of the course the student will be able to

CO 1	Solve computational problems using probability and random variables **(Cognitive Knowledge Level : Apply)**
CO 2	Apply policy iteration and value iteration reinforcement learning algorithms **(Cognitive Knowledge Level: Apply)**
CO 3	Employ Monte Carlo reinforcement learning algorithms. **(Cognitive Knowledge Level: Apply)**
CO 4	Apply temporal-difference reinforcement learning algorithms **(Cognitive Knowledge Level: Apply)**
CO 5	Apply on-policy and off-policy reinforcement learning algorithms with function approximation **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓								✓

CO4	✔	✔	✔	✔								✔
CO5	✔	✔	✔	✔	✔							✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks**
	Test1 (percentage)	**Test2 (percentage)**	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	**CIEMarks**	**ESEMarks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance: **10 marks**

Continuous Assessment Tests :**25 marks**

Continuous Assessment Assignment: **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks
First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module 1: Review of Probability Concepts

Probability concepts review - Axioms of probability, concepts of random variables, probability mass function, probability density function, cumulative density functions, Expectation of random variables. Concepts of joint and multiple random variables, conditional and marginal distributions. Correlation and independence.

Module 2: Markov Decision Process

Introduction to Reinforcement Learning (RL) terminology - Examples of RL, Elements of RL, Limitations and Scope of RL. Finite Markov Decision Processes - The Agent–Environment Interface, Goals and Rewards, Returns and Episodes, Policies and Value Functions.

Module 3: Prediction and Control

Dynamic Programming - Policy Evaluation (Prediction), Policy Improvement, Policy Iteration, Value Iteration. Monte Carlo Prediction, MonteCarlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-policy Prediction via Importance Sampling.

Module 4: Temporal-Difference (TD) Methods for Model Free Prediction And Control

TD Methods - TD Prediction, Advantages of TD Prediction Methods, Optimality of TD(0), Sarsa: On-policy TD Control, Q-learning: Off-policy TD Control, Expected Sarsa. n-step TD Prediction, n-step Sarsa, n-step Off-policy Learning. Off -policy Learning without Importance Sampling – The n step Tree Backup Algorithm

Module 5: Function Approximation Method

On-policy Prediction with Approximation - Value-function Approximation, The Prediction Objective, Stochastic-gradient Methods, Linear Methods.

Eligibility Traces - The λ-return, TD(λ), n-step Truncated λ-return Methods, Sarsa(λ).

Reference Books

1. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction, , 2nd Edition
2. 2 Alberto Leon-Garcia, Probability, Statistics, and Random Processes for Electrical Engineering, 3rd Edition,

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Let ***J*** and ***T*** be independent events, where ***P(J)=0.4***and ***P(T)=0.7***. Find $P(J\cap T)$, $P(J\cup T)$ and $P(J\cap T')$
2. 2 Let ***A*** and ***B*** be events such that ***P(A)=0.45*** ,***P(B)=0.35*** and $P(A\cup B)=0.5$. Find $P(A\mid B)$.

3. A random variable **R**has the probability distribution as shown in the following table:

r	1	2	3	4	5
P(R=r)	0.2	a	b	0.25	0.15

Given that ***E(R)=2.85***, find ***a*** and ***b***and ***P(R>2)***.

A biased coin (with probability of obtaining a head equal to ***p> 0***) is tossed repeatedly and independently until the first head is observed. Compute the probability that the first head appears at an even numbered toss.

Course Outcome 2 (CO2):

1. What are the main differences between supervised learning and reinforcement learning?
2. Give examples of Markovian and non-Markovian environments?
3. Define the optimal state-value function **V*(s)** for an MDP.

Course Outcome 3(CO3):

1. Explain policy iteration and value iteration? What are their similarities and differences?
2. Why Monte Carlo methods for learning value functions require episodic tasks? How is it that n-step TD methods avoid this limitation and can work with continuing tasks?
3. List any three uses of the depth parameter in the Monte-Carlo tree search procedure.

Course Outcome 4 (CO4):

1. Draw the backup diagram for 2-step Sarsa. Write the corresponding learning rule for 2- step Sarsa.
2. Why is Sarsa an on-policy algorithm while Q-learning is an off-policy algorithm?
3. How would you differentiate between learning algorithms using on-policy from those that use off-policy?
4. When using Temporal Difference learning, why is it better to learn action values (Q-values) rather than state values (V-values)?

Course Outcome 5 (CO5):

1. How do you deal with a large possible action space in reinforcement learning?
2. List any two benefits of policy gradient methods over value function-based methods.
3. What is the relation between Q-learning and policy gradients methods?

Model Question paper

QP CODE: PAGES:5

Reg No:_____________

Name :_____________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: **AIT - 456**

Course Name: Introduction to Reinforcement Learning

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all questions, each carries 3 marks.

1 The first three digits of a telephone number are 452. If all the sequences of the remaining four digits are equally likely, what is the probability that a randomly selected telephone number contains seven distinct digits?

2 If X is a discrete uniform random variable, i.e., $P(X = k) = 1/n$ for $k = 1, 2, \dots , n$, find $E(X)$and $Var(X)$.

3 Explain the Limitations and Scope of RL ?

4 Write down the Bellman expectation equation for state-value functions.

5 What is Monte Carlo Prediction ?

6 List any three advantages of Monte Carlo methods over dynamic programming techniques?

7 Draw the backup diagram for 2-step Q-learning. Write the corresponding learning rule

for 2-step Q-learning.

8 Why Monte Carlo methods for learning value functions require episodic tasks. How does **n**-step TD methods avoid this limitation and can work with continuing tasks?

9 What is Stochastic-gradient Methods

10 Value function based methods are oriented towards finding deterministic policies whereas policy search methods are geared towards finding stochastic policies. True or false? Justify.

(10x3=30)

Part B

Answer any one Question from each module. Each question carries 14 Marks

11	a)	Three players play 10 independent rounds of a game, and each player has probability 1/3 of winning each round. Find the joint distribution of the numbers of games won by each of the three players.	**(7)**
	b)	exponential random variables with parameter λ. Show that $X + Y$ and $X/Y$are independent.	**(7)**
12	a)	An experiment consists of throwing a fair coin four times. Find the probability mass function and the cumulative distribution function of the following random variables: i) the number of heads before the first tail ii) the number of heads following the first tail iii) the number of heads minus the number of tails iv) the number of tails times the number of heads.	**(7)**
	b)	Let X be a continuous random variable with probability density function on $0 <= x <= 1$ defined by $f(x) = 3x2$. Find the pdf of $Y = X2$.	**(7)**
13	a)	What is the difference between a state value function **V(s)** and a state-action value function **Q(s,a)**?	**(4)**
	b)	Consider designing a recycling robot whose job is to collect empty bottles around the building. The robot has a sensor to detect when a bottle is in front of it, and a gripper to pick up the bottle. It also senses the level of its battery. The robot can navigate, as well as pick up a bottle and throw a bottle it is holding in the trash. There is a battery charger in the building, and the robot should not run out of battery. i. Describe this problem as an MDP. What are the states and actions? ii. Suppose that you want the robot to collect as many bottles as possible, while	**(10)**

not running out of battery. Describe what rewards would enable it to achieve this task.

OR

14	a)	Define the state-value function **Vπ(s)** for a discounted MDP.	**(5)**
	b)	Consider a 4x4 grid world where the agent starts in the top left, the bottom righ state is terminal, rewards are always **-1**, **γ = 1** , and state transitions ar deterministic. Consider the policy that always chooses the action to move down except when it is on the bottom row, at which point it chooses the action to mov right. Starting with **v0(s) = 0** for all **s**, compute **v1, v2, ... , v7**.	**(10)**
15	a)	During a single iteration of the Value Iteration algorithm, we typically iterate over the states in **S** in some order to update **Vt(s)** to **Vt+1(s)** for all states **s**. Is it possible to do this iterative process in parallel? Explain why or why not.	**(7)**
	b)	Explain n-step TD Prediction, n-step Sarsa and n-step Off-policy Learning	**(7)**

OR

16	a)	Suppose you are given a finite set of transition data. Assuming that the Markov model that can be formed with the given data is the actual MDP from which the data is generated, will the value functions calculated by the MC and TD methods necessarily agree? Justify.	**(4)**
	b)	With respect to the expected Sarsa algorithm, is exploration required as it is in the normal Sarsa and Q-learning algorithms? Justify.	**(5)**
	c)	For a specific MDP, suppose we have a policy that we want to evaluate through the use of actual experience in the environment alone and using Monte Carlo methods. We decide to use the first-visit approach along with the technique of always picking the start state at random from the available set of states. Will this approach ensure complete evaluation of the action value function corresponding to the policy?	**(5)**
17	a)	Consider the following **Q[S,A]** table	**(9)**

	State 1	State 2
Action 1	1.5	2.5
Action 2	4	3

Assume the discount factor, γ= **0.5**, and the step size, α = **0.1**. After the experience**(s, a, r, s') = (1, 1, 5, 2),** which value of the table gets updated and what is its new value?

b) What is the difference between Q-learning and Sarsa? (5)

OR

18 a) Consider the following **Q[S,A]** table Assume the discount factor, γ= **0.5**, and the step size, α = **0.1**. After the experience **(s, a, r, s', a')=(1, 1, 5, 2, 1),** which value of the table gets updated and what is its new value? (9)

	State 1	State 2
Action 1	1.5	2.5
Action 2	4	3

b) For Q-learning to converge we need to correctly manage the exploration vs.exploitation tradeoff. What property needs to be hold for the exploration strategy? (5)

19 a) Given the following sequence of states observed from the beginning of an episode, **s2, s1, s3, s2, s1, s2, s1, s6**, what is the eligibility value, **e7(s1)**, of state **s1**at time step 7 given trace decay parameter λ, discount rate γ, and initial value, **e0(s1) = 0**, when accumulating traces are used? What is the eligibility value if replacing traces are used? (8)

b) Suppose that we are using a policy gradient method to solve a reinforcement learning problem and the policy returned by the method is not optimal. Give three plausible reasons for such an outcome? (6)

20 a) Suppose that we have a Q-value function represented as a sigmoid function of a set of features: (8)

$$Q(\phi, a) = \frac{1}{1 + e^{\theta^T \phi}}$$

Write down the update rule that Sarsa would give for this function.

b) Suppose that in a particular problem, the agent keeps going back to the same state in a loop. What is the maximum value that can be taken by the eligibility trace of such a state if we consider accumulating traces with λ = **0.25** and γ = **0.8**? (6)

(14X5=70)

Teaching Plan

No	Topic	No. of Lectures **(35 Hours)**
1	**Module 1: Review of Probability Concepts**	**8**
1.1	Axioms of probability, concepts of random variables,	1 hour
1.2	probability mass function	1 hour
1.3	probability density function	1 hour
1.4	cumulative density functions	1 hour
1.5	Expectation of random variables	1 hour
1.6	Concepts of joint and multiple random variables	1 hour
1.7	conditional and marginal distributions	1 hour
1.8	Correlation and independence.	1 hour
2	**Module 2: Markov Decision Process**	**6**
2.1	Introduction to Reinforcement Learning (RL) terminology - Examples of RL, Elements of RL, Limitations and Scope of RL.	1 hour
2.2	Finite Markov Decision Processes	1 hour
2.3	The Agent–Environment Interface	1 hour
2.4	Goals and Rewards	1 hour
2.5	Returns and Episodes	1 hour
2.6	Policies and Value Functions	1 hour
3	**Module 3: Prediction and Control**	**7**
3.1	Dynamic Programming - Policy Evaluation (Prediction),	1 hour
3.2	Policy Improvement	1 hour
3.3	Policy Iteration, Value Iteration	1 hour
3.4	Monte Carlo Prediction	1 hour
3.5	MonteCarlo Estimation of Action Values,	1 hour
3.6	Monte Carlo Control without Exploring Starts	1 hour
3.7	Off-policy Prediction via Importance Sampling	1 hour
4	**Module 4: Temporal-Difference (TD) Methods**	**8**
4.1	TD Prediction, Advantages of TD Prediction Methods	1 hour
4.2	Optimality of TD(0)	1 hour
4.3	Sarsa: On-policy TD Control	1 hour
4.4	Q-learning: Off-policy TD Control	1 hour

4.5	Expected Sarsa	1 hour
4.6	n-step TD Prediction, n-step Sarsa	1 hour
4.7	n-step Off-policy Learning	1 hour
4.8	Off -policy Learning without Importance Sampling – The n step Tree ackupAlgorithm	1 hour
5	**Iodule 5: Function Approximation Method**	**6**
5.1	Value-function Approximation,	1 hour
5.2	The Prediction Objective	1 hour
5.3	Stochastic-gradient Methods	1 hour
5.4	Linear Methods.	1 hour
5.5	Eligibility Traces - The λ-return, TD(λ)	1 hour
5.6	-step Truncated λ-return Methods, Sarsa(λ).	1 hour

AIT 476	BIO-INSPIRED OPTIMIZATION TECHNIQUES	Category	L	T	P	Credit
		PEC	3	0	0	3

Preamble:

The aim of this course is to provide the students with the knowledge and skills required to design and implement Bio-inspired optimization techniques to problems for which a direct solution is impractical or unknown. This course covers concepts of evolutionary algorithms like genetic algorithms and various swarm optimization techniques like ACO, PSO. The learners will be able to provide Bio-inspired optimization solutions to real world problems.

Course Outcomes: After the completion of the course the student will be able to

CO1	Understand the fundamentals in bio-inspired optimization techniques which influence computing **(Cognitive Knowledge Level: Understand)**
CO2	Make use of the concepts of Evolutionary Algorithms, genetic algorithms in various domains. **(Cognitive Knowledge Level: Apply)**
CO3	Comprehend the concepts of Swarm Intelligence and collective systems such as ACO, PSO **(Cognitive Knowledge Level: Understand)**
CO4	Illustrate the concepts of biologically inspired algorithmic design**(Cognitive Knowledge Level: Understand)**
CO5	Select the most appropriate types of algorithms for different data analysis problems **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔											✔
CO2	✔	✔			✔							✔
CO3	✔	✔			✔							✔
CO4	✔	✔			✔							✔

CO5	✔	✔			✔							✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	**20**	**20**	**20**
Understand	**70**	**70**	**70**
Apply	**10**	**10**	**10**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests(Average of Internal Tests1&2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Optimization Techniques) (7 hours)

Optimization Techniques: Understanding optimization process- Objective function, minima & maxima, convergence. Optimization methods- conventional methods, Gradient descent algorithm- drawbacks. Introduction to Optimization Problems – classification- Single and Muti- objective Optimization – Classical Techniques – Overview of various Optimization methods . Bio-inspired Computing (BIC): Motivation – Overview of BIC – usage of BIC – merits and demerits of BIC.

Module– 2(Evolutionary Computing) (7 hours)

Evolutionary Computing: Motivation, Genetic Algorithm and Genetic Programming: Basic concept – encoding – representation – fitness function – Population, Operators – Selection, Mutation, Crossover, Reproduction – Types of Evolutionary Algorithms, Differences between GA and Traditional optimization methods – Applications.

Module- 3 (Ant Colony Systems) (8 hours)

Swarm intelligent systems – Background. Ant colony systems – Biological systems, Development of the ant colony system- - Working of ACO Algorithm - Pheromone updating- Types of ant systems- ACO algorithms for TSP.

Module- 4 (Particle Swarm Optimization) (7 hours)

Foraging for food – Clustering of objects – Collective Prey retrieval – Scope of Swarm Robotics – Social Adaptation of Knowledge: Particle Swarm – Particle Swarm Optimization (PSO) – Particle Swarms for Dynamic Optimization Problems – Bee-inspired optimization, Artificial Bee Colony (ABC) Optimization , applications.

Module- 5 (Case Studies) (6 hours)

Other Swarm Intelligence algorithms: Fish Swarm – Bacteria foraging – Intelligent Water Drop Algorithms – Applications of biologically inspired algorithms in engineering. Case Studies: ACO for NP-hard problems – Routing problems – Assignment problems – Scheduling problems.

ReferenceBooks

1. A. E. Elben and J. E. Smith, “Introduction to Evolutionary Computing”, Springer,2010.
2. S. N. Sivanandam and S.N. Deepa, Principles of Soft Computing , 2nd Edition, John Wiley & Sons.
3. Marco Dorigo and Thomas Stutzle, “Ant Colony optimization”, Prentice Hall of India, New Delhi,2005.
4. FloreanoD. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories,Methods, and Technologies", MIT Press, Cambridge, MA, 2008.
5. Leandro Nunes de Castro, " Fundamentals of Natural Computing, BasicConcepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor andFrancis Group, 2007.
6. SatyobrotoTalukder, Blekinge Institute of Technology, Mathematical Modelling and Applications of Particle Swarm Optimization, February 2011.
7. Christian Blum and Daniel Merkle, “Swarm Intelligence Introduction and Application”, Springer 2008.

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Explain the need for bio-inspired computation algorithms.
2. Differentiate between Bio-inspired optimization and other optimization techniques.

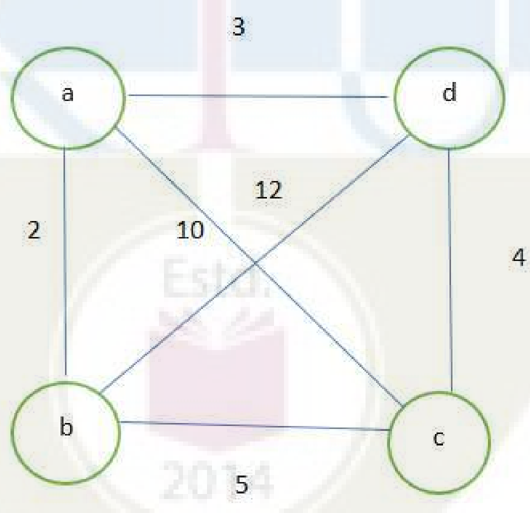
Course Outcome 2(CO2):

1. Describe how the Roulette wheel is used for selection. Draw the Roulette wheel for six chromosomes corresponding to the table given below.

Chromosome #	***Fitness***
1	10
2	5
3	25
4	15
5	30
6	20

Course Outcome 3(CO3):

1. Consider an Ant Colony System based on the Ant Quantity model for solving the following Travelling Salesman Problem. Compute the pheromone content at each of the edges after 4 steps (1 iteration). Assume pheromone decay factor ρ= 0.1, Q = 120. Assume an initial pheromone of 50 units at each of the edges and that three ants k1, k2 and k3 follow the paths given below in the first iteration. k1= a b c d a; k2=a c b d a; k3=a d c b a



Course Outcome 4(CO4): .

1. Consider a particle swarm optimization system composed of three particles and maximum velocity 10. Assume that both the random numbers r1 and r2 used for computing the movement of the particle towards the individual best position and social best position are 0.5. Also assume that the space of solutions is the two dimensional real valued space and the current state of swarm is as follows: Position of particles: x1 = (4,4); x2 = (8,3); x3 = (6,7) Individual best positions : x14,4 = (*); x27,3 = (*); x35,6 = (*) Velocities: v1 = (2,2);

v2 = (3,3); v3 = (4,4) .What would be the next position of each particle after one iteration of the PSO algorithm if the inertia parameter ω that is used along with current velocity update formula is 0.8 ?

Course Outcome 5(CO5):

1. Discuss applications of bio-optimization techniques (ACO) for solving NP-hard problems.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AIT 476

Course Name: Bio-Inspired Optimization Techniques

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Differentiate Optimization and Constraint Satisfaction problems.
2. Define bio-Inspired Optimization.
3. Specify the importance of objective (fitness) function in genetic algorithm.
4. Compare Single-Point Crossover and Two-Point Crossover.
5. Describe how pheromone is updated.

6. Define Swarm Intelligence and list the algorithms under SI.

7. What is the significance of pbest and gbest particles in solving problems with particle swarm optimization?

8. List the scope of swarm robotics.

9. What is Fish Swarm optimization algorithm.

10. Define an assignment problem? List the different types of Assignment problems.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Discuss about Optimization, modelling, and simulation problems. **(7)**

(b) Differentiate between Bio-inspired optimization and other optimization techniques **(7)**

OR

12. (a) What is Bio-Inspired Computing? Explain the working of BIC algorithms. **(7)**

(b) Discuss the merits and demerits of BIC. **(7)**

13. (a) Explain any procedure to map a solution to the corresponding chromosome and vice versa in genetic algorithms. Also illustrate it with an example: **(7)**

(b) Describe two methods used to select individuals from a population for the mating pool in Genetic Algorithms. **(7)**

OR

14. (a) Explain any two mutation methods. **(4)**

(b) Differentiate between value encoding and permutation encoding. **(10)**

15. (a) Describe Ant Colony System. What are the different types of Ant systems? **(7)**

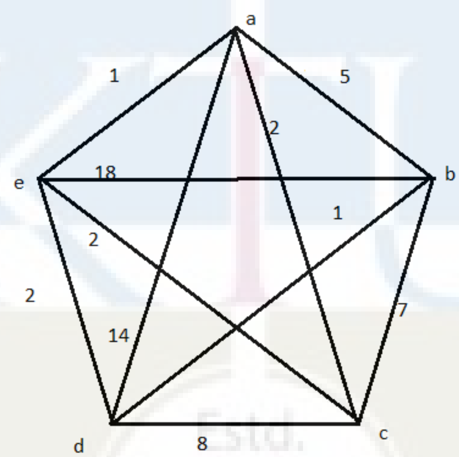
(b) Using the equation $T_{ij}(t+1)=(1-\rho)T_{ij}(t) + \Delta T_{ij}(t,t+1)$, compute the T_{ij} of the edge when 10 ants uses the edges, using the following models: **(7)**

i. Ant Density Model (Constant Q=10)

ii. Ant Quantity Model(Constant Q=100) , where Q is the constant related to the pheromone updation

OR

16. (a) Consider the TSP with the following edge costs. Given the evaporation factor ρ =0.02 and initial pheromone at all edges Tij=100. **(4)**



Compute the cost of the best tour?

(b) Describe ACO algorithm for TSP problems. **(10)**

17. (a) Illustrate Artificial Bee Colony optimization **(10)**

(b) List the advantages of Particle Swarm Optimization (PSO). **(4)**

OR

18. (a) Discuss Particle Swarm Optimization (PSO). **(6)**

(b) Explain the working of Particle Swarm Optimization (PSO) Algorithm. **(8)**

19. (a) Describe the working of Bacteria Foraging Algorithms. **(7)**

(b) Explain Intelligent Water Drop Algorithms . **(7)**

OR

20. (a) Discuss the different types of routing problems. **(6)**

(b) Discuss any four Applications of biologically inspired algorithms in engineering. **(8)**

Teaching Plan

No	Contents	No. of Lecture Hours (35hrs)
Module-1(Optimization Techniques) (7 hours)		
1.1	Understanding optimization process- Objective function, minima & maxima, convergence. Optimization methods- Gradient descent algorithm- drawbacks.	2hour
1.2	Introduction to Optimization Problems – classification- Single and Muti-objective Optimization	1 hour
1.3	Classical Techniques	1 hour
1.4	Overview of various Optimization methods	1 hour
1.5	Bio- inspired Computing (BIC): Motivation – Overview of BIC	1 hour
1.6	Usage of BIC – merits and demerits of BIC.	1 hour
Module-2 (Evolutionary Computing) (7hours)		
2.1	Evolutionary Computing: Motivation, Genetic Algorithm and Genetic Programming: Basic concepts	1 hour
2.2	Encoding – Representation	1 hour

2.3	Fitness function, Population, Reproduction	1 hour
2.4	Operators - Selection, Mutation	1 hour
2.5	Crossover, Reproduction	1 hour
2.6	Types of Evolutionary Algorithms	1 hour
2.7	Differences between GA and Traditional optimization methods – Applications.	1 hour
Module-3 (Ant colony systems) (8 hours)		
3.1	Swarm intelligent systems	1 hour
3.2	Background…	1 hour
3.3	Ant colony systems – Biological systems	1 hour
3.4	Development of the ant colony system	1 hour
3.5	Working of ACO Algorithm	1 hour
3.6	Pheromone updating	1 hour
3.7	Types of ant systems	1 hour
3.8	ACO algorithms for TSP	1 hour
Module-4 (Particle Swarm Optimization)) (7 hours)		
4.1	Foraging for food	1 hour
4.2	Clustering of objects	1 hour
4.3	Collective Prey retrieval	1 hour
4.4	Scope of Swarm Robotics	1 hour
4.5	Particle Swarm — Particle Swarms for Dynamic Optimization Problems	1 hour
4.6	Particle Swarm Optimization (PSO)	1 hour
4.7	Bee-inspired optimization, Artificial Bee Colony (ABC) Optimization , Applications	1 hour
Module-5 (CASE STUDIES) (6 hours)		
5.1	Other Swarm Intelligence algorithms: Fish Swarm	1 hour
5.2	Bacteria foraging	1 hour
5.3	Intelligent Water Drop Algorithms	1 hour
5.4	Applications of biologically inspired algorithms in engineering	1 hour

5.5	Case Studies: ACO for NP-hard problems – Routing problems – Assignment problems	1 hour
5.6	Scheduling problems	1 hour

CST436	PARALLEL COMPUTING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course helps the learners to understand basic and advanced concepts of parallel computing. It covers Principles of Parallel Algorithm Design, Communication operations, Programming Using the Message Passing Paradigm, Programming Shared Address Space Platforms Thread Basics, and GPU Programming. This course enables a learner to design solutions to complex real world problems using parallel computing paradigms including thread parallelism, shared memory program, message passing interfaces, and vector processing.

Prerequisite: Knowledge in Computer Organization and Architecture.

Course Outcomes: After the completion of the course the students will be able to

CO1	Summarize the key parallel computational models **(Cognitive Knowledge Level : Understand)**
CO2	Appreciate and apply parallel and distributed algorithms in problem Solving **(Cognitive Knowledge Level :Apply)**
CO3	Appreciate the communication models for parallel algorithm development (**Cognitive Knowledge Level : Understand**)
CO4	Develop parallel algorithms using message passing paradigm **(Cognitive Knowledge Level : Apply)**
CO5	Formulate parallel algorithms for shared memory architectures. **(Cognitive Knowledge Level : Apply)**
CO6	Demonstrate the fundamental skills of heterogeneous computing with GPUs**(Cognitive Knowledge Level : Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓	✓									✓
CO3	✓	✓										✓
CO4	✓	✓	✓	✓	✓							✓

CO5	✓	✓	✓	✓	✓							✓
CO6	✓	✓	✓	✓	✓							✓

Abstract POs Defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and teamwork
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Blooms Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Percentage)	Test 2 (Percentage)	
Remember	30	20	20
Understand	50	40	40
Apply	20	40	40

Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus, and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have a maximum 2 subdivisions and carries 14 marks.

Syllabus

Module- 1 (Principles of Parallel Algorithm Design)

Basic Introduction to Parallel Processing platforms. Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models.

Module- 2 (Communication Operations)

Basic Communication Operations - One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operation

Module-3 (Programming Using the Message Passing Paradigm)

Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations, MPI: The Message Passing Interface, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators.

Module 4 (Programming Shared Address Space Platforms Thread Basics)

Thread Basics, Why Threads? The POSIX Thread Application Programme Interface, Synchronization Primitives in POSIX, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs, OpenMP: a Standard for Directive Based Parallel Programming, Specifying Concurrent Tasks in OpenMP, Synchronization Constructs in OpenMP, Data Handling in OpenMP, OpenMP Library Functions, OpenMP Applications: Parallel algorithm development for Matrix multiplication

Module 5 (GPU Programming)

Heterogeneous Parallel Computing, Architecture of a Modern GPU, Speeding up Real Applications, Data parallel computing, CUDA C Program Structure, A Vector Addition Kernel, Device Global Memory and Data Transfer, Kernel Functions and Threading, Kernel Launch, CUDA Thread Organization, Mapping Threads to Multidimensional Data, Synchronization and Transparent Scalability, Resource Assignment, Querying Device Properties, Thread Scheduling and Latency Tolerance, Importance of Memory Access Efficiency, Cuda Memory Types, Tiling for Reduced Memory Traffic, Tiled Matrix Multiplication Kernel, Boundary Checks

Text Books

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Introduction to Parallel Computing, 2nd Ed, Addison-Wesley, 2003
2. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors: A Hands-on Approach, 3rd Ed., Morgan Kaufman, 2016.

References

1. Steven Brawer, Introduction to Parallel Computing, Academic Press, (1989)
2. Barbara Chapman, Gabriele Jost, Ruud van der Pas, Using OpenMP: Portable Shared Memory Paralwlel Programming , MIT Press, 2008.
3. William Gropp, Ewing Lusk, Anthony Skjellum Using MPI: Portable Parallel Programming with the Message-Passing Interface, 3rd Ed, MIT Press, 2014.
4. Thomas Rauber, Gudula Rünger, Parallel Programming for Multicore and Cluster Systems, Springer, 2010

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Differentiate between static and dynamic task mapping
2. Explain partitioning of data with an example

Course Outcome 2 (CO2):

1. Explain the handshaking sequence of Blocking Non-Buffered Send/Receive operation with a neat diagram.
2. In the algorithm, assume a decomposition such that each execution of Line 7 is a task. Draw a task-dependency graph and a task-interaction graph.

```
1. procedure FFT_like_pattern(A, n)
2. begin
3. m := log2 n;
4. for j := 0 to m - 1 do
5. k := 2j;
6. for i := 0 to n - 1 do
7. A[i] := A[i] + A[i XOR 2j];
8. end  // for
9. end    // FFT_like_pattern
```

Course Outcome 3 (CO3):

1. Write a procedure for performing all-to-all reduction on a mesh
2. Give a hypercube algorithm to compute prefix sums of n numbers if *p* is the number of nodes and n/p is an integer greater than 1. Assuming that it takes time t_{add} to add two numbers and time ts to send a message of unit length between two directly-connected nodes, give an exact expression for the total time taken by the algorithm.

Course Outcome 4(CO4):

1. Show how the two-dimensional matrix-vector multiplication program needs to be changed so that it will work correctly for a matrix of size *n x m* on a *q x r* process grid
2. One of the advantages of non-blocking communication operations is that they allow the transmission of the data to be done concurrently with computations. Discuss the type of restructuring that needs to be performed on a program to allow for the maximal overlap of computation with communication. Is the sending process in a better position to benefit from this overlap than the receiving process

Course Outcome 5(CO5):

1. Implement a multi-access threaded queue with multiple threads inserting and multiple threads extracting from the queue. Use mutex-locks to synchronize access to the queue. Document the time for 1000 insertions and 1000 extractions each by 64 insertion threads (producers) and 64 extraction threads (consumers).
2. Implement a producer-consumer framework in OpenMP using sections to create a single producer task and a single consumer task. Ensure appropriate synchronization using locks.

Course Outcome 6 (CO6):

1. Consider a hypothetical block with 8 threads executing a section of code before reaching a barrier. The threads require the following amount of time (in microseconds) to execute the sections: 2.0, 2.3, 3.0, 2.8, 2.4, 1.9, 2.6, and 2.9 and to spend the rest of their time waiting for the barrier. What percentage of the total execution time of the thread is spent waiting for the barrier?
2. Write and explain the CUDA program for vector addition.

Model Question Paper

QP CODE: PAGES :3

Reg No: _______________

Name: _________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST436

Course Name: PARALLEL COMPUTING

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Explain partitioning of data with an example

2. Which are the characteristics of tasks influencing the selection of mapping scheme?

3. Describe the scatter - gather communication.

4. Explain the Circular Shift operation.

5. Explain the handshaking sequence of Blocking Non-Buffered Send/Receive operation with a neat diagram.

6. Describe the six fundamental routines of MPI.

7. Explain thread cancellation.

8. Explain how concurrent tasks are specified in openMP

9. Explain the architecture of modern GPU with a diagram.

10. Describe how the data transfer between GPU device and the host memories are managed. **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Describe recursive decomposition with an example. **(8)**

(b) Compare various parallel algorithm models **(6)**

OR

12. (a) Differentiate between static and dynamic task mapping **(8)**

(b) In the algorithm, assume a decomposition such that each execution of Line 7 is a task. Draw a task-dependency graph and a task-interaction graph. **(6)**

```
1. procedure FFT_like_pattern(A, n)
2. begin
3. m := log2 n;
4. for j := 0 to m - 1 do
5. k := 2j;
6. for i := 0 to n - 1 do
7. A[i] := A[i] + A[i XOR 2j];
8. end  // for
9. end    // FFT_like_pattern
```

13. (a) Illustrate the All-to-All Broadcast and Reduction with an example **(8)**

(b) Explain any three techniques to improve the speed of communication operations **(6)**

OR

14. (a) Explain the One-to-All Broadcast and All-to-One Reduction with an example **(8)**

(b) Explain the Ring and Mesh techniques of All-to-All Personalized communication. **(6)**

15. (a) Explain Collective Communication and Computation Operations in MPI **(9)**

(b) Show the impact of finite buffers in message passing. **(5)**

OR

16. (a) Write algorithm for Collective Communication and Computation Operations **(9)**

using MPI.

(b) How is deadlock avoided in *MPI_Send* and *MPI_Recv* **(5)**

17. (a) Explain how mutual exclusion for shared variables are accomplished in threads. **(6)**

(b) Explain the nesting of parallel directives with a suitable example. **(8)**

OR

18. (a) Explain the compilation operations of an example openMP program along with its *pThread* translations. **(4)**

(b) Explain the parallel matrix multiplication using openMP **(10)**

19. (a) Describe the CUDA Kernel functions. **(6)**

(b) How is synchronization between CUDA threads achieved? **(8)**

OR

20. (a) Explain the two-level hierarchical organization of CUDA threads. **(10)**

(b) Write and explain the CUDA program for vector addition. **(4)**

TEACHING PLAN

No	Contents	No of Lecture Hrs (37)
Module – 1 (Basic Introduction to Parallel Processing) (TB-1, Ch. 3) (7 hrs)		
1.1	Basic Introduction to Parallel Processing platforms. Preliminaries	1
1.2	Decomposition Techniques – Recursive, Data	1
1.3	Decomposition Techniques – Exploratory, Speculative, Hybrid	1
1.4	Characteristics of Tasks and Interactions	1
1.5	Mapping Techniques for Load Balancing -Static	1
1.6	Mapping Techniques for Load Balancing - Dynamic	1
1.7	Methods for Containing Interaction Overheads, Parallel Algorithm Models.	1
Module- 2 (Basic Communication Operations) (TB-1, Ch. 4) (6hrs)		
2.1	One-to-All Broadcast and All-to-One Reduction	1
2.2	All-to-All Broadcast and Reduction	1
2.3	All-Reduce and Prefix-Sum Operations, Scallter Gather	1
2.4	All-to-All Personalized Communication	1
2.5	Circular Shift	1
2.6	Improving the Speed of Some Communication Operation	1
Module- 3 (Programming Using the Message Passing Paradigm) (TB-1, Ch. 6) (7 hrs)		
3.1	Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations	1
3.2	MPI: The Message Passing Interface	1
3.3	MPI: The Message Passing Interface : Illustration	1

3.4	Overlapping Communication with Computation	1
3.5	Overlapping Communication with Computation : Illustration	1
3.6	Collective Communication and Computation Operations	1
3.7	Collective Communication and Computation Operations : Illustration	1
Module 4 (Programming Shared Address Space Platforms) (TB-1, Ch. 7, 8) (8hrs)		
4.1	Thread Basics, Why Threads? The POSIX Thread API	1
4.2	Synchronization Primitives in POSIX	1
4.3	Controlling Thread and Synchronization Attributes	1
4.4	Thread Cancellation, Composite Synchronization Constructs,	1
4.5	OpenMP: a Standard for Directive Based Parallel Programming	1
4.6	Specifying Concurrent Tasks in OpenMP, Synchronization Constructs in OpenMP	1
4.7	Data Handling in OpenMP, OpenMP Library Functions	1
4.8	OpenMP Applications: Parallel algorithm development for Matrix multiplication	1
Module 5 (GPU Programming) (TB-2, Ch. 1, 2) (9 hrs)		
5.1	Heterogeneous Parallel Computing, Architecture of a Modern GPU, Speeding up Real Applications	1
5.2	Data parallel computing – CUDA C Program Structure	1
5.3	Vector Addition Kernel, Device Global Memory and Data Transfer	1
5.4	Kernel Functions and Threading, Kernel Launch	1

5.5	CUDA Thread Organization, Mapping Threads to Multidimensional Data	1
5.6	Synchronization and Transparent Scalability, Resource Assignment, Querying Device Properties, Thread Scheduling and Latency Tolerance	1
5.7	Importance of Memory Access Efficiency, Cuda Memory Types	1
5.8	Tiling for Reduced Memory Traffic	1
5.9	Tiled Matrix Multiplication Kernel, Boundary Checks	1

CST446	DATA COMPRESSION TECHNIQUES	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course helps the learners to understand compression techniques on text, image, audio and video data. It covers lossy &lossless compression, RLE, JPEG, MPEG and its variants. This course enables the students to develop and implement compression algorithms on different domains.

Prerequisite: Knowledge of probability theory, computation on matrices, basic topics in data structures, storage and efficiency

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Describe the fundamental principles of data compression**(Cognitive Knowledge level: Understand)**
CO2	Make use of statistical and dictionary based compression techniques for various applications **(Cognitive Knowledge level: Apply)**
CO3	Illustrate various image compression standards. **(Cognitive Knowledge level: Apply)**
CO4	Summarize video compression mechanisms to reduce the redundancy in video.**(Cognitive Knowledge level: Understand)**
CO5	Use the fundamental properties of digital audio to compress audio data.**(Cognitive Knowledge level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔											✔
CO2	✔	✔	✔		✔							✔
CO3	✔	✔	✔		✔							✔
CO4	✔											✔
CO5	✔	✔	✔									✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests(Average of SeriesTests1& 2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1 (Modelling and types of compression)) 1

Introduction to Compression Techniques- Lossy compression & Lossless compression, Measures of Performance, Modeling and coding. Mathematical modelling for Lossless and lossy compression - Physical models and probability models.

Module – 2 (Basic Compression Methods)

Basic Compression Technique- Run length encoding, RLE Text compression. Statistical Methods- Prefix Codes, Binary Huffman coding, non-binary Huffman Algorithms, Arithmetic Coding.

Module - 3 (Text & Image Compression)

Dictionary based Coding- LZ77, LZ78 and LZW compression.Image Compression- Image standards, JPEG image Compression- Baseline JPEG, JPEG-LS.

Module - 4 (Video Compression)

Video Compression- Analog video, Digital Video, Motion Compensation. MPEG standards- MPEG 1, MPEG 4

Module - 5 (Audio Compression)

Audio Compression- Basics of Digital Audio, Basic Audio Compression Techniques, MPEG Audio Compression-Layer 1 coding, Layer 2 coding and Layer 3 coding.

Text Book

1. David Solomon, Data compression: the complete reference, 4/e, Springer, January 2007
2. Khalid Sayood, Introduction to data compression, Morgan Kaufmann Publishers,2003.

References

1) Stephen Welstead, Fractal and wavelet Image Compression techniques, PHI, 1999.
2) Sleinreitz, Multimedia System, Addison Wesley.
3) Mark Nelson and Jean-loup Gailly, The Data Compression Book, M&T Books.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Discuss different types of compression performance metrics
2. Explain mathematical model for lossless compression

Course Outcome 2 (CO2):

1. Explain RLE based text compression and identify a example with compression ratio of 2.
2. Given the eight symbols A, B, C, D, E, F, G, and H with probabilities 1/30, 1/30, 1/30, 2/30, 3/30, 5/30, 5/30, and 12/30, draw three different Huffman trees with heights 5 and 6 for these symbols and calculate the average code size for each tree.

Course Outcome 3 (CO3):

1. Differentiate the LZ77 and LZ78 performance with the input given as ‘sirsideastmaneasilyteasesseasickseals’
2. Explain why the continuous-tone images is required for JPEG and the main steps used in image compression.

Course Outcome 4 (CO4):

1. Briefly explain MPEG-4 video compression standard
2. How H.261 video compression is completed.

Course Outcome 5 (CO5):

1. Explain critical bands, thresholding and masking related to audio compression
2. Explain the working of -law encoder and decoder with an example

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 2**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST446

Course Name: Data Compression Techniques

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Specify different quantities used to measure the performance of a data compression technique
2. Explain mathematical model for lossless compression
3. State and prove Kraft-McMillan inequality
4. Compare Huffman and Arithmetic coding
5. Describe LZ77 approach of encoding a string with the help of an example
6. Compare and contrast JPEG and JPEG-LS differences in working.
7. Discuss different components of video
8. Identify the advantage of MPEG-4 over MPEG
9. Explain critical bands, thresholding and masking related to audio compression
10. Explain the working of -law encoder and decoder with an example

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain mathematical model for lossy compression and lossless compression **(10)**

(b) Define compression ratio with an example **(4)**

OR

12. (a) Discuss any probability model and identify the shortcoming of the solution. **(7)**

(b) Identify the mathematical preliminaries for Lossless Compression **(7)**

13. (a) With a help of flowchart discuss the RLE text compression for text data given below **(10)**

‘*ABBBBBBBBBCDEEEEF*’

(b) calculate the compression ratio for the example while taking repetitions = 4 **(4)**

OR

14. (a) Illustrate with a example why Huffman coding is preferred than Shannon Fano Algorithm for compression **(10)**

(b) How Huffman coding is handling the unpredictability of input data stream **(4)**

15. (a) Explain in detail the working of LZ78 with example and dictionary Tree **(10)**

(b) Illustrate with example, how the compression factor LZW differ from the LZ78 **(4)**

OR

16. (a) How quantization and coding helps in compression and their role in JPEG. **(6)**

(b) With the help of the given example illustrate the compression ratio of JPEG and JPEG-LS **(8)**

17. (a) With the help of equations discuss Composite and Components Video **(7)**

(b) Differentiate the major changes in MPEG - 2 and MPEG-4 Video **(7)**

OR

18. (a) Describe in details about functionalities for MPEG-4 **(8)**

(b) How Motion Compensation help in video compression **(6)**

19. (a) How The Human Auditory System limitations can be taken in audio **(7)**

compressions

(b) Discuss the complexity of Layer III compared to others in MPEG Audio Coding **(7)**

OR

20. (a) Discuss Format of Compressed Data and encoding in layer I and II **(9)**

(b) Differentiate Spectral and Temporal Masking **(5)**

TEACHING PLAN

No	**Contents**	**No of Lecture Hrs (36 Hours)**
Module – 1 (Modelling and types of compression) (7 hrs)		
1.1	Introduction to Compression Techniques- Lossy compression & Lossless compression, Measures of Performance	2
1.2	Modelling and coding.	1
1.3	Physical model for lossless compression	1
1.4	Physical model for lossy compression	1
1.5	Probability model for lossless compression	1
1.6	Probability model for lossly compression	1
Module - 2 (Basic Compression Methods) (8 hrs)		
2.1	Run length encoding, RLE Text compression	1
2.2	Statistical methods-Prefix Codes	1
2.3	Binary Huffman coding	1
2.4	Illustration of Binary Huffman coding	1
2.5	Non-binary Huffman Algorithms	1
2.6	Arithmetic Coding algorithm	1
2.7	Illustration of Arithmetic Coding algorithm	2

Module - 3 (Text & Image Compression) (8 hrs)		
3.1	LZ77 compression	2
3.2	LZ78 Compression	1
3.3	LZW Compression	1
3.4	Basics of Image compression and Image standards	1
3.5	Baseline JPEG Image compression	1
3.6	JPEG-LS Image compression	1
Module - 4 (Video Compression) (7 hrs)		
4.1	Basics of Video Compression- Analog video and Digital Video.	2
4.2	Motion Compensation	1
4.3	MPEG-1 standard and Video Syntax	1
4.4	MPEG-1 Pel Reconstruction	1
4.5	MPEG-4 standard	1
4.6	Functionalities for MPEG-4	1
Module - 5 (Audio Compression) (6 hrs)		
5.1	Basics of Audio Compression, Digital Audio	1
5.2	Basic Audio Compression Techniques	1
5.3	MPEG Audio Compression basics- Frequency Domain Coding	1
5.4	Encoding: Layers I and II	1
5.5	Encoding: Layer II -Psychoacoustic Models	1
5.6	Psychoacoustic Models - Encoding: Layer III	1

CST466	DATA MINING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course helps the learner to understand the concepts of data mining and data warehousing. It covers the key processes of data mining, data preprocessing techniques, fundamentals and advanced concepts of classification, clustering, association rule mining, web mining and text mining. It enables the learners to develop new data mining algorithms and apply the existing algorithms in real-world scenarios.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Employ the key process of data mining and data warehousing concepts in application domains. (**Cognitive Knowledge Level: Understand**)
CO2	Make use of appropriate preprocessing techniques to convert raw data into suitable format for practical data mining tasks (**Cognitive Knowledge Level**: **Apply**)
CO3	Illustrate the use of classification and clustering algorithms in various application domains (**Cognitive Knowledge Level: Apply**)
CO4	Comprehend the use of association rule mining techniques. (**Cognitive Knowledge Level: Apply)**
CO5	Explain advanced data mining concepts and their applications in emerging domains (**Cognitive Knowledge Level: Understand**)

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PO1 2
CO1	✔	✔										✔
CO2	✔	✔	✔	✔	✔							✔
CO3	✔	✔	✔	✔	✔							✔

CO4	✔	✔	✔	✔	✔							✔
CO5	✔	✔										✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember	**20**	**20**	**20**
Understand	**30**	**30**	**30**
Apply	**50**	**50**	**50**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	**50**	**100**	**3**

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Test(Average of Internal Test1&2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the seven questions, a student should answer any five.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have a maximum 2 subdivisions and carries 14 marks.

Syllabus

Module – 1 (Introduction to Data Mining and Data Warehousing)

Data warehouse-Differences between Operational Database Systems and Data Warehouses, Multidimensional data model- Warehouse schema, OLAP Operations, Data Warehouse Architecture, Data Warehousing to Data Mining, Data Mining Concepts and Applications, Knowledge Discovery in Database Vs Data mining, Architecture of typical data mining system, Data Mining Functionalities, Data Mining Issues.

Module - 2 (Data Preprocessing)

Data Preprocessing-Need of data preprocessing, Data Cleaning- Missing values, Noisy data, Data Integration and Transformation, Data Reduction-Data cube aggregation, Attribute subset selection, Dimensionality reduction, Numerosity reduction, Discretization and concept hierarchy generation.

Module - 3 (Advanced classification and Cluster analysis)

Classification- Introduction, Decision tree construction principle, Splitting indices -Information Gain, Gini indexDecision tree construction algorithms-ID3, Decision tree construction with presorting-SLIQ, Classification Accuracy-Precision, Recall.

Introduction to clustering-Clustering Paradigms, Partitioning Algorithm- PAM, Hierarchical Clustering-DBSCAN, Categorical Clustering-ROCK

Module 4: (Association Rule Analysis)

Association Rules-Introduction, Methods to discover Association rules, Apriori(Level-wise algorithm), Partition Algorithm, Pincer Search Algorithm, Dynamic Itemset Counting Algorithm, FP-tree Growth Algorithm.

Module 5 (Advanced Data Mining Techniques)

Web Mining - Web Content Mining, Web Structure Mining- Page Rank, Clever, Web Usage Mining- Preprocessing, Data structures, Pattern Discovery, Pattern Analysis. Text Mining-Text Data Analysis and information Retrieval, Basic measures for Text retrieval, Text Retrieval methods, Text Indexing Techniques, Query Processing Techniques.

Text Books

1. Dunham M H, “Data Mining: Introductory and Advanced Topics”, Pearson Education, New Delhi, 2003.
2. Arun K Pujari, “Data Mining Techniques”, Universities Press Private Limited,2008.
3. Jaiwei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Elsevier, 2006

Reference Books

1. M Sudeep Elayidom, “Data Mining and Warehousing”, 1st Edition, 2015, Cengage Learning India Pvt. Ltd.
2. MehmedKantardzic, “Data Mining Concepts, Methods and Algorithms”, John Wiley and Sons, USA, 2003.
3. Pang-Ning Tan and Michael Steinbach, “Introduction to Data Mining”, Addison Wesley, 2006.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. (a) Explain the OLAP operations in a multidimensional model.
   (b) Compare the techniques used in ROLAP, MOLAP and HOLAP
2. Explain the various data mining issues with respect to mining methodology, user interaction and diversity of data types.
3. Suppose that a data warehouse consists of the three dimensions time, doctor, and patient, and the two measures count and charge, where charge is the fee that a doctor charges a patient for a visit.
   a) Draw star and snowflake schema diagrams for the data warehouse.
   b) Starting with the base cuboid [day; doctor; patient], what specific OLAP operations should be performed in order to list the total fee collected by each doctor in 2004?

Course Outcome 2 (CO2):

1. Use the methods below to normalize the following group of data:100, 200, 300, 400,550, 600, 680, 850, 1000
   (a) min-max normalization by setting min = 0 and max = 1
   (b) z-score normalization
   (c) Normalization by decimal scaling
   Comment on which method you would prefer to use for the given data, givingreasons as to why.
2. Identify a suitable dataset from any available resources and apply different preprocessing steps that you have learned. Observe and analyze the output obtained. (Assignment)

Course Outcome 3 (CO3):

1. Illustrate the working of ID3 algorithm with the following example

MOTOR	WHEEELS	DOORS	SIZE	TYPE	CLASS
NO	2	0	small	cycle	bicycle
NO	3	0	small	cycle	tricycle
YES	2	0	small	cycle	motorcycle
YES	4	2	small	automobile	Sports car
YES	4	3	medium	automobile	minivan
YES	4	4	medium	automobile	sedan
YES	4	4	large	automobile	sumo

2. Illustrate the working of K medoid algorithm for the given dataset. A1=(3,9), A2=(2,5), A3=(8,4), A4=(5,8), A5=(7,5), A6=(6,4), A7=(1,2), A8=(4,9).

3. Take a suitable dataset from available resources and apply all the classification and clustering algorithms that you have studied on original and preprocessed datasets. Analyze the performance variation in terms of different quality metrics. Give a detailed report based on the analysis. (Assignment)

Course Outcome 4 (CO4):

1. A database has five transactions. Let min sup = 60% and min con f = 80%.

TID	*items_bought*
T100	{M, O, N, K, E, Y}
T200	{D, O, N, K, E, Y }
T300	{M, A, K, E}
T400	{M, U, C, K, Y}
T500	{C, O, O, K, I ,E}

a) Find all frequent item sets using Apriori and FP-growth, respectively. Compare the efficiency of the two mining processes.

b) List all of the strong association rules (with support s and confidence c) matching the following metarule, where X is a variable representing customers, and $item_i$ denotes variables representing items (e.g., "A", "B", etc.)

$$\forall x \in transaction, buys(X, item_1) \wedge buys(X, item_2) \Rightarrow buys\ (X, item_3) \quad [s, c]$$

2. Identify and list some scenarios in which association rule mining can be used, and then use at least two appropriate association rule mining techniques in one of the two scenarios. (Assignment)

Course Outcome 5 (CO5):

1. Consider an e-mail database that stores a large number of electronic mail (e-mail) messages. It can be viewed as a semi structured database consisting mainly of text data. Discuss the following.
   a. How can such an e-mail database be structured so as to facilitate multidimensional search, such as by sender, by receiver, by subject, and by time?
   b. What can be mined from such an e-mail database?
   c. Suppose you have roughly classified a set of your previous e-mail messages as junk, unimportant, normal, or important. Describe how a data mining system may take this as the training set to automatically classify new e-mail messages or unclassified ones.
2. Precision and recall are two essential quality measures of an information retrieval system.
   (a) Explain why it is the usual practice to trade one measure for the other.
   (b) Explain why the F-score is a good measure for this purpose.

(c) Illustrate the methods that may effectively improve the F-score in an information retrieval system.

3. Explain HITS algorithm with an example.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST466

Course Name: Data Mining

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Differentiate between OLTP and OLAP.

2. Compare the techniques of ROLAP, MOLAP and HOLAP

3. Explain Concept hierarchy with an example.

4. Explain heuristic methods of attribute subset selection techniques.

5. Consider a two-class classification problem of predicting whether a photograph contains a man or a woman. Suppose we have a test dataset of 10 records with expected outcomes and a set of predictions from our classification algorithm.

	Expected	Predicted
1	man	woman
2	man	man
3	woman	woman
4	man	man
5	woman	man
6	woman	woman
7	woman	woman
8	man	man
9	man	woman
10	woman	woman

Calculate precision, recall of the data.

6. Given two objects represented by the tuples (22,1,42,10) and (20,0, 36,8). Compute the Euclideanand Manhattan distance between the two objects.

7. The pincer search algorithm is a bi-directional search, whereas the level wise algorithm is a unidirectional search. Express your opinion about the statement.

8. Define support, confidence and frequent set in association data mining context.

9. Distinguish between focused crawling and regular crawling.

10. Describe any two-text retrieval indexing techniques. **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Suppose a data warehouse consists of three measures: customer, account and branch and two measures count (number of customers in the branch) and balance. Draw the schema diagram using snowflake schema and star schema. **(7)**

(b) Explain three- tier data warehouse architecture with a neat diagram. **(7)**

OR

12 (a) Illustrate different OLAP operations in multidimensional data model **(7)**

(b) Describe different issues in data mining **(7)**

13 (a) Suppose that the data for analysis includes the attribute age. The age values for the data tuples are (in increasing order) 13, 15, 16, 16, 19, 20, 20, 21, 22, 22, 25, 25, 25, 25, 30, 33, 33, 35, 35, 35, 35, 36, 40, 45, 46, 52, 70. **(8)**

(a) Use min-max normalization to transform the value 35 for age onto

the
range [0-1].

(b) Use z-score normalization to transform the value 35 for age, where the standard deviation of age is 12.94 years.

(c) Use normalization by decimal scaling to transform the value 35 for age.

(d) Use smoothing by bin means to smooth the above data, using a bin depth of 3. Illustrate your steps. Comment on the effect of this technique for the given data.

(b) With proper illustration, explain how PCA can be used for dimensionality reduction? Explain **(6)**

OR

14 (a) Suppose a group of 12 sales price records has been sorted as follows: 5, 10, 11, 13, 15, 35, 50, 55, 72, 92, 204, 215. Sketch examples of each of the following sampling techniques: SRSWOR, SRSWR, cluster sampling, stratified sampling. Use samples of size 5 and the strata "youth," "middle-aged," and "senior." **(8)**

(b) Partition the above data into three bins by each of the following methods: **(6)**
(i) equal-frequency (equi-depth) partitioning
(ii) equal-width partitioning

15 (a) Explain the concept of a cluster as used in ROCK. Illustrate with examples **(9)**

(b) Consider the following dataset for a binary classification problem. **(5)**

A	B	Class Label
T	F	+
T	T	+
T	T	+
T	F	-
T	T	+
F	F	-
F	F	-
F	F	-
T	T	-
T	F	-

Calculate the gain in Gini index when splitting on A and B respectively. Which attribute would the decision tree induction algorithm choose?

OR

16 (a) For a sunburn dataset given below, find the first splitting attribute for the decision tree by using the ID3 algorithm. **(10)**

Name	**Hair**	**Height**	**Weight**	**Lotion**	**Class**
Sarah	Blonde	Average	Light	No	Sunburn
Dana	Blonde	Tall	Average	Yes	None
Alex	Brown	Tall	Average	Yes	None
Annie	Blonde	Short	Average	No	Sunburn
Emily	Red	Average	Heavy	No	Sunburn
Pete	Brown	Tall	Heavy	No	None
John	Brown	Average	Heavy	No	None
Katie	Blonde	Short	Light	Yes	None

(b) Explain the working of SLIQ algorithm. **(4)**

17 (a) Illustrate the working of Pincer Search Algorithm with an example. **(7)**

(b) Describe the working of dynamic itemset counting technique? Specify when to move an itemset from dashed structures to solid structures? **(7)**

OR

18 (a) A database has six transactions. Let min_sup be 60% and min_conf be 80%. **(9)**

TID	*items_bought*
T1	I1, I2, I3
T2	I2, I3, I4
T3	I4, I5
T4	I1, I2, I4
T5	I1, I2, I3, I5
T6	I1, I2, I3, I4

Find frequent itemsets using FP Growth algorithm and generate strong association rules from a three item dataset.

(b) Write partitioning algorithm for finding large itemset and compare its efficiency with apriori algorithm **(5)**

19 (a) Describe web content mining techniques. **(7)**

(b) Write an algorithm to find maximal frequent forward sequences to mine log traversal patterns. Illustrate the working of this algorithm. **(7)**

OR

20 (a) Explain how web structure mining is different from web usage mining and web content mining? Write a CLEVER algorithm for web structure mining. **(7)**

(b) Describe different Text retrieval methods. Explain the relationship between text mining and information retrieval and information extraction. **(7)**

Teaching Plan

No	Contents	No. of lecture hours (36 Hrs)
Module 1(Introduction to Data Mining and Data Warehousing) (Text3) (6 hours)		
1.1	Data warehouse-Differences between Operational Database Systems and Data Warehouses, Multidimensional data model- Warehouse schema	1
1.2	OLAP Operations	1
1.3	DataWarehouse Architecture, Data Warehousing to Data Mining	1
1.4	Datamining Concepts and Applications, Knowledge Discovery in Database Vs Data mining	1
1.5	Architecture of typical data mining system,Data Mining Functionalities	1
1.6	Data Mining Functionalities, Data Mining Issues	1
Module 2(Data Preprocessing) (6 hours) (Text3)		
2.1	Data Preprocessing: Need of Data Preprocessing, Data Cleaning- Missing values, Noisy data.	1
2.2	Data integration	1
2.3	Data transformation	1
2.4	Data Reduction-Data cube aggregation, Attribute subset selection	1
2.5	Data Reduction-Dimensionality reduction	1

2.6	Numerosity reduction, Discretization and concept hierarchy generation	1
Module 3(Advanced classification and Cluster analysis)(9 hours)(Text2,Text3)		
3.1	Classification- Introduction, Decision tree construction principle, Splitting indices-Information Gain, Gini index	1
3.2	Decision Tree- ID3	1
3.3	Decision Tree- ID3	1
3.4	Decision tree construction with presorting- SLIQ	1
3.5	Accuracy and error measures, evaluation	1
3.6	Introduction to clustering, Clustering Paradigms	1
3.7	Partitioning Algorithm- PAM	1
3.8	Hierarchical Clustering-DBSCAN	1
3.9	Categorical Clustering-ROCK	1
Module 4(Association Rule Analysis) (8 hours) (Text2,Text3,Text1)		
4.1	Association Rules: Introduction, Methods to discover association rules	1
4.2	A priori algorithm (Level-wise algorithm)	1
4.3	A priori algorithm (Level-wise algorithm)	1
4.4	Partition Algorithm	1
4.5	Pincer Search Algorithm	1
4.6	Pincer Search Algorithm	1
4.7	Dynamic Itemset Counting Algorithm	1
4.8	FP-tree Growth Algorithm	1
Module 5(Advanced Data Mining Techniques) (7 hours) (Text1, Text3		
5.1	Web Mining - Web Content Mining	1
5.2	Web Structure Mining- Page Rank	1
5.3	Web Structure Mining –Clever algorithm	1
5.4	Web Usage Mining- Preprocessing, Data structures	1

5.5	Web Usage Mining -Pattern Discovery, Pattern Analysis	1
5.6	Text Mining-Text Data Analysis and information Retrieval, Basic measures for Text retrieval	1
5.7	Text Retrieval methods, Text Indexing Techniques Query Processing Techniques	1

SEMESTER VIII

PROGRAM ELECTIVE V

CST418	HIGH PERFORMANCE COMPUTING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course helps the learners to understand the different architectural features of high-end processors. This course discusses the Basics of high-end processors Architecture, Instruction-Level Parallelism, Data-Level Parallelism, Thread Level Parallelism, and GPU Architectures. This course enables the students to provide solutions to real-world problems making use of the capabilities of HPC systems.

Prerequisite: Basic knowledge in Computer System architecture, Microprocessors, Operating systems, and System software.

Course Outcomes: After the completion of the course the student will be able to

CO1	Describe different types of modern processing environments and parallel computing hardware (**Cognitive Knowledge Level: Understand**)
CO2	Summarize the concepts of Instruction Level Parallelism (**Cognitive Knowledge Level: Understand**)
CO3	Appreciate the idea of Data Level Parallelism (**Cognitive Knowledge Level: Apply**)
CO4	Demonstrate the concept of Thread Level Parallelism (**Cognitive Knowledge Level: Apply**)
CO5	Describe the basics of GPU architecture. (**Cognitive Knowledge Level: Understand**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔										✔
CO2	✔	✔										✔
CO3	✔	✔	✔									✔
CO4	✔	✔	✔									✔
C05	✔	✔										✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and teamwork
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	50	50	50
Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks.	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests (Average of Internal Tests 1 & 2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations have to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which students should answer anyone. Each question can have a maximum of 2 sub-divisions and carries 14 marks.

Syllabus

Module-1 (Basics of Architecture)

Classes of Computers - Classes of Parallelism and Parallel Architectures – Defining Computer Architecture – Dependability – Quantitative Principles of Computer Design – Basics of Memory Hierarchies – Virtual Memory and Virtual Machines – Pipelining

Module-2 (Instruction-Level Parallelism)

Instruction-Level Parallelism: Concepts and Challenges – Basic Compiler Techniques for Exposing ILP – Reducing Branch Costs With Advanced Branch Prediction – Hardware-Based Speculation – Multithreading: Exploiting Thread-Level Parallelism to Improve Uniprocessor Throughput

Module-3 (Data-Level Parallelism)

Vector Architecture – SIMD Instruction Set Extensions for Multimedia – Graphics Processing Units – Detecting and Enhancing Loop-Level Parallelism

Module-4 (Thread Level Parallelism)

Multiprocessor Architecture: Issues and Approach – Centralized Shared-Memory Architectures – Performance of Symmetric Shared-Memory Multiprocessors– Distributed Shared-Memory and Directory-Based Coherence – Synchronization: The Basics – Introduction to Memory Consistency

Module-5 (GPU Architectures)

The CPU-GPU system as an accelerated computational platform – The GPU and the thread engine – Characteristics of GPU memory spaces – The PCI bus: CPU to GPU data transfer overhead – Multi-GPU platforms – Potential benefits of GPU – accelerated platforms

Text Books

1. John L. Hennessy, David A. Patterson Computer Architecture, Sixth Edition A Quantitative Approach, Morgan Kaufman, Fifth Edition, 2012.
2. Robert Robey, Yuliana Zamora, Parallel and High-Performance Computing, Manning Publications, First Edition, 2021.

Reference Books

1. Thomas Sterling, Matthew Anderson, and MaciejBrodowicz, High-Performance Computing – Modern Systems and Practices, First Edition, 2017.
2. Charles Severance, Kevin Dowd,High-Performance Computing, O'Reilly Media, Second Edition, 1998.
3. Kai Hwang, Faye Alaye Briggs, Computer Architecture and Parallel Processing, McGraw-Hill, 1984.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Differentiate different classes of computer-based on features like microprocessor cost, system cost, and system design issues.
2. Explain the different methods by which computer hardware exploits application-level parallelism.
3. Explain in detail the instruction set architecture
4. Describe the encoding scheme specified as part of ISA

Course Outcome 2 (CO2):

1. Differentiate data, name, and control dependencies with suitable examples.
2. Explain loop unrolling with suitable coding demonstration
3. Explain in detail about Tournament Predictors.
4. Describe the unique features of very long instruction word processors.

Course Outcome 3 (CO3):

1. What are the three things conveyed through a data dependence? Explain the Data Dependencies of the following code:

```
Loop:  fld     f0,0(x1)     //f0=array element
       fadd.d  f4,f0,f2     //add scalar in f2
       fsd     f4,0(x1)     //store result
       addi    x1,x1,-8     //decrement pointer 8 bytes
       bne     x1,x2,Loop   //branch x1≠x2
```

2. Assume a single-issue pipeline. Unroll the loop as many times as necessary to schedule it without any stalls, collapsing the loop overhead instructions. How many times must the loop be unrolled? Show the instruction schedule. What is the execution time per element of the result?
3. Explain the SIMD Instruction Set Extensions for Multimedia.

Course Outcome 4 (CO4):

1. With the help of a neat diagram illustrate a single-chip multicore with a distributed cache.
2. Demonstrate the Implementation of cache coherence in a distributed-memory multiprocessor by adding a directory to each node with a suitable diagram.
3. Consider the following code segments running on two processors P1 and P2. Assume A, and B, are initially 0. Explain how an optimizing compiler might make it impossible for B to be ever set to 2 in a sequentially consistent execution model.

P1:	P2:
A=1;	B=1;
A=2;	While (A <> 1);
While (B == 0);	B= 2;

Course Outcome 5 (CO5):

1. Explain the benefits of potential GPU.
2. Illustrate GPU system as an accelerated computational platform.
3. Discuss CPU to GPU data transfer overhead.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST418

Course Name: High Performance Computing

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Differentiate between Data level parallelism and Task level parallelism
2. Explain the principle of locality
3. Define Instruction Level Parallelism with an example.
4. Devise the importance of loop unrolling with an example.
5. What is the equation of CPI (cycles per instruction) for a pipelined processor? How can we set the ideal pipeline CPI?
6. Explain the two types of name dependencies between an instruction i that precedes instruction j in program order.
7. Differentiate between module reliability and module availability measures with suitable examples.
8. Why SMP architectures are called UMA multiprocessors and DSM multiprocessors as NUMA processors.

9. Explain the need for GPU.

10. List the characteristics of GPU memory spaces.

3x10=30

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Describe the quantitative principle of computer design with Amdahl's law. (8)

(b) Discuss in detail the importance of considering processor performance for the design of an efficient computer system. (6)

OR

12. (a) Illustrate how processes are protected with the help of virtual memory. (7)

(b) Discuss the role played by virtual machines in providing protection for processes. (7)

13. (a) Explain in detail data dependence and hazards. **(8)**

(b) With neat sketches explain how data-level parallelism is achieved in vector, and SIMD architectures. **(6)**

OR

14. (a) Describe the unique features of very long instruction word processors. **(8)**

(b) Consider a three-way superscalar machine renaming these three instructions concurrently: **(6)**

```
addi x1, x1, x1
addi x1, x1, x1
addi x1, x1, x1
```

If the value of x1 starts at 5, then what will be its value when after this sequence is executed?

15. (a) The following loop has multiple types of dependences. Find all the true dependences, output dependencies, and anti-dependencies, and eliminate the output dependencies and anti-dependencies by renaming. **(8)**

```
for (i=0; i<100; i=i+1) {
    Y[i] = X[i] / c;  /* S1 */
    X[i] = X[i] + c;  /* S2 */
    Z[i] = Y[i] + c;  /* S3 */
    Y[i] = c - Y[i];  /* S4 */
}
```

(b) Describe the limitations of Symmetric Shared-Memory Multiprocessors and Snooping Protocols **(6)**

OR

16. (a) Demonstrate the different types of hardware approaches required for the working of multithreading. **(8)**

(b) Consider the following loop: **(6)**

```
for (i=0;i<100;i++) {
 A[i] = A[i] + B[i]; /* S1 */
 B[i+1] = C[i] + D[i]; /* S2 */
}
```

Are there exist dependencies between S1 and S2? Determine whether the above loop is parallel? If not, show how to make it parallel.

17. (a) Consider an 8-processor multicore where each processor has its own L1 and L2 caches. Here snooping is performed on a shared bus among the L2 caches. Assume that the average L2 request is 15 cycles for a coherence miss or other miss and a clock rate of 3.0 GHz, a CPI of 0.7, and a load/store frequency of 40%. If the goal set is that no more than 50% of the L2 bandwidth is consumed by coherence traffic, then what is the maximum coherence miss rate per processor? **(8)**

(b) Explain the basic structure of a centralized shared-memory multiprocessor **(6)** based on a multicore chip.

OR

18. (a) Suppose an application running on a 100-processor multiprocessor use 1, 50, or 100 processors. If for 95% of the time all 100 processors are used, illustrate how the remaining 5% of the execution time employs 50 processors for a speedup of 80? **(6)**

(b) With a neat diagram, demonstrate invalidate cache coherence protocol for a private write-back cache, showing the states and state transitions for each block in the cache. **(8)**

19. (a) Explain the multi-GPU platform. **(8)**

(b) Explain some of the benefits of GPU. **(6)**

OR

20. (a) Discuss in detail the characteristics of GPU memory spaces. **(8)**

(b) Explain about GPU thread engine. **(6)**

Teaching Plan

No	Contents	No. of Lecture Hours (36 hrs)
Module 1 - Basics of Architecture (7 hours)		
1.1	Classes of Computers	1 hour
1.2	Classes of Parallelism and Parallel Architectures	1 hour
1.3	Dependability	1 hour
1.4	Quantitative Principles of Computer Design.	1 hour

1.5	Basics of Memory Hierarchies	1 hour
1.6	Virtual Memory and Virtual Machines	1 hour
1.7	Pipelining	1 hour
Module -2 (Introduction to Syntax Analysis) (7 hours)		
2.1	Instruction-Level Parallelism: Concepts and Challenges	1 hour
2.2	Basic Compiler Techniques for Exposing ILP	1 hour
2.3	Reducing Branch Costs With Advanced Branch Prediction	1 hour
2.4	Hardware-Based Speculation	1 hour
2.5	Multithreading	1 hour
2.6	Exploiting Thread-Level Parallelism to Improve Uniprocessor Throughput – Lecture 1.	1 hour
2.7	Exploiting Thread-Level Parallelism to Improve Uniprocessor Throughput – Lecture 2.	1 hour
Module- 3 - Data-Level Parallelism (7 hours)		
3.1	Vector Architecture -Lecture 1	1 hour
3.2	Vector Architecture -Lecture 2	1 hour
3.3	SIMD Instruction Set Extensions for Multimedia – Lecture 1	1 hour
3.4	SIMD Instruction Set Extensions for Multimedia – Lecture 2	1 hour
3.5	Graphics Processing Units	1 hour
3.6	Detecting and Enhancing Loop-Level Parallelism – Lecture 1	1 hour
3.7	Detecting and Enhancing Loop-Level Parallelism – Lecture 2	1 hour
Module 4– Thread Level Parallelism (8 hours)		
4.1	Multiprocessor Architecture: Issues and Approach	1 hour
4.2	Centralized Shared-Memory Architectures – Lecture 1	1hour
4.3	Centralized Shared-Memory Architectures – Lecture 2	1hour
4.4	Performance of Symmetric Shared-Memory Multiprocessors	1hour
4.5	Distributed Shared-Memory	1hour
4.6	Directory-Based Coherence	1hour
4.7	Synchronization	1hour

4.8	Introduction to Memory Consistency	1hour
	Module 5 – GPU Architectures (7 hours)	
5.1	The CPU-GPU system as an accelerated computational platform	1 hour
5.2	The GPU and the thread engine – Lecture 1	1 hour
5.3	The GPU and the thread engine – Lecture 2	1 hour
5.4	Characteristics of GPU memory spaces	1hour
5.5	PCI bus: CPU to GPU data transfer overhead	1hour
5.6	Multi-GPU platforms	1hour
5.7	Potential benefits of GPU-accelerated platforms	1hour

CST428	BLOCKCHAIN TECHNOLOGIES	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: The purpose of this course is to create awareness and understanding among students on the foundation of blockchain technology. The course introduces the cryptographic principles behind blockchain and helps the students understand concepts like consensus, crypto-currency, smart contracts, use cases etc. The course enables students to develop simple decentralized applications using blockchain networks such as Ethereum.

Prerequisite: Basic knowledge in data structures and operating systems.

Course Outcomes: After the completion of the course the student will be able to

CO1	Illustrate the cryptographic building blocks of blockchain technology. **(Cognitive Knowledge Level: Understand)**
CO2	Explain the fundamental concepts of blockchain technology. **(Cognitive Knowledge Level: Understand)**
CO3	Summarize the classification of consensus algorithms. (**Cognitive Knowledge Level: Understand)**
CO4	Explain the concepts of first decentralized cryptocurrency bitcoin. (**Cognitive Knowledge Level: Understand)**
CO5	Explain the use of smart contracts and its use cases. **(Cognitive Knowledge Level: Understand)**
CO6	Develop simple applications using Solidity language on Ethereum platform. **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔										✔
CO2	✔	✔										✔

CO3	✓	✓										✓
CO4	✓	✓										✓
CO5	✓	✓										✓
CO6	✓	✓	✓	✓	✓							✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember	**30**	**30**	**30**
Understand	**50**	**50**	**50**
Apply	**20**	**20**	**20**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests(Average of Internal Tests 1 & 2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Fundamentals of Cryptography)

Introduction to Cryptography, Symmetric cryptography – AES. Asymmetric cryptography – RSA. Elliptic curve cryptography, Digital signatures – RSA digital signature algorithms. Secure Hash Algorithms – SHA-256. Applications of cryptographic hash functions – Merkle trees, Distributed hash tables.

Module – 2 (Fundamentals of Blockchain Technology)

Blockchain – Definition, architecture, elements of blockchain, benefits and limitations, types of blockchain. Consensus – definition, types, consensus in blockchain.

Decentralization – Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Blockchain and full ecosystem decentralization.

Module - 3 (Consensus Algorithms and Bitcoin)

Consensus Algorithms, Crash fault-tolerance (CFT) algorithms – Paxos, Raft. Byzantine fault-tolerance (BFT) algorithms – Practical Byzantine Fault Tolerance (PBFT), Proof of work (PoW), Proof of stake (PoS), Types of PoS.
Bitcoin – Definition, Cryptographic keys – Private keys, public keys, addresses. Transactions – Lifecycle, coinbase transactions, transaction validation. Blockchain – The genesis block.
Mining – Tasks of miners, mining algorithm, hash rate. Wallets – Types of wallets.

Module - 4 (Smart Contracts and Use cases)

Smart Contracts – Definition, Smart contract templates, Oracles, Types of oracles, Deploying smart contracts. Decentralization terminology – Decentralized applications, Decentralized Autonomous Organizations.
Use cases of Blockchain technology – Government, Health care, Finance, Supply chain management.
Blockchain and allied technologies – Blockchain and Cloud Computing, Blockchain and Artificial Intelligence.

Module - 5 (Ethereum and Solidity)

Ethereum – The Ethereum network. Components of the Ethereum ecosystem – Keys and addresses, Accounts, Transactions and messages. The Ethereum Virtual Machine, Blocks and blockchain.
The Solidity language – The layout of a Solidity source code, Structure of a smart contract, variables, data types, control structures, events, inheritance, libraries, functions, error handling.
Smart contracts Case study: Voting, Auction.

Text Book

1. Imran Bashir, Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, Packt Publishing, Third edition, 2020.

References

2. Ritesh Modi, Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain, Packt Publishing, First edition, 2018.

3. Kumar Saurabh, Ashutosh Saxena, Blockchain Technology: Concepts and Applications, First Edition, Wiley Publications, First edition, 2020.

4. Chandramouli Subramanian, Asha A George, et al, Blockchain Technology, Universities Press (India) Pvt. Ltd, First edition, August 2020.

5. Lorne Lantz, Daniel Cawrey, Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, O'Reilly Media, First edition, 2020.

6. Andreas M. Antonopoulos, Gavin Wood, Mastering Ethereum: Building Smart Contracts and DApps, O'Reilly Media, First edition, 2018.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Distinguish between Symmetric cryptography and asymmetric cryptography.
2. Explain the working of AES algorithm.

Course Outcome 2 (CO2):

1. Categorize consensus mechanism used in blockchain.
2. Define Blockchain. Explain how decentralization of computing or processing power is achieved by a blockchain.

Course Outcome 3 (CO3):

1. Explain how Proof of Stake can achieve consensus among peers.
2. Explain the working of Raft protocol.

Course Outcome 4 (CO4):

1. Describe the use of genesis block.
2. Explain the mining algorithm used in bitcoin.

Course Outcome 5 (CO5):

1. Illustrate how blockchain technology can be used in supply chain management.
2. What are oracles in a blockchain ecosystem? Explain the generic data flow from a smart contract to an oracle.

Course Outcome 6 (CO6):

1. Develop a smart contract for voting process. In this application, delegated voting is allowed and the counting is automatic and completely transparent at the same time.
2. Develop a smart contract for auction process. The contract should be a blind auction where it is not possible to see the actual bid until the bidding period ends.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 2**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST428

Course Name: BLOCK CHAIN TECHNOLOGIES

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Discuss the role of secure hash functions in blockchain.
2. List out the properties of digital signatures.
3. Illustrate the blockchain based decentralized system.
4. Explain how Proof of Stake can achieve consensus among peers.
5. If your blockchain network has 5 Byzantine nodes, what is the minimum number of nodes that are required to ensure Byzantine fault tolerance using PBFT protocol?
6. How are transactions verified in a Bitcoin network?
7. Explain how smart contracts can be used for enforcing agreements between parties in the form of business logic.
8. Explain the concept of blockchain-based digital identity cards.
9. Explain error handling in Solidity language.

10. With the help of a figure show the relationship between the transaction, transaction trie, and block header in Ethereum. **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain the design of SHA-256 and its compression function using a diagram. **(9)**

(b) Explain how hash functions are used to build Merkle trees in blockchain. **(5)**

OR

12. (a) Explain public and private keys. Perform encryption and decryption using RSA for p=3, q=11, e= 7 and M=5. **(7)**

(b) Explain elliptic curve digital signature algorithm. **(7)**

13. (a) Illustrate and explain how blockchain works using a neat diagram. **(7)**

(b) Explain the benefits, features and limitations of blockchain. **(7)**

OR

14. (a) Explain consensus mechanisms used in blockchain. List out any six consensus algorithms used in the context of blockchain. **(7)**

(b) Define blockchain. Explain how decentralization of computing or processing power is achieved by a blockchain. **(7)**

15. (a) Explain and illustrate how Paxos protocol can be used to achieve consensus. **(7)**

(b) Show how Practical Byzantine Fault Tolerance can achieve consensus in the presence of Byzantine faults. **(7)**

OR

16. (a) Describe the various fields that make up a transaction in Bitcoin. **(7)**

(b) What is the role of a Bitcoin miner? Explain the mining algorithm used in **(7)**

Bitcoin with the help of a flowchart.

17. (a) Illustrate how blockchain technology can be implemented in finance sector. **(7)**

(b) Discuss oracles in a blockchain ecosystem. Explain the generic data flow from a smart contract to an oracle. **(7)**

OR

18. (a) Explain the design process of decentralized applications with diagrams. **(7)**

(b) Explain the use of blockchain technology in supply chain management. **(7)**

19. (a) Using Solidity language, create a simple bank contract that allows a user to deposit, withdraw and view balance. **(7)**

(b) Define block difficulty. Explain how block difficulty is adjusted in Ethereum blockchain network. **(7)**

OR

20. (a) Using Solidity language, create a simple voting smart contract where a chairperson will give the right to vote to each address individually. **(7)**

(b) Explain the concept of Gas in Ethereum. Explain how transaction cost can be calculated in an Ethereum blockchain network. **(7)**

Teaching Plan

No	Contents	No. of Lecture Hours (35 hours)
Module-1 (Fundamentals of Cryptography) (7 hours)		
1.1	Introduction to cryptography	1 hour
1.2	Symmetric cryptography, AES	1 hour
1.3	Asymmetric cryptography, RSA	1 hour
1.4	Elliptic curve cryptography	1 hour
1.5	Digital signatures – RSA digital signature algorithm	1 hour
1.6	Secure Hash Algorithms – SHA-256	1 hour
1.7	Applications of cryptographic hash functions – Merkle trees, Distributed hash tables	1 hour
Module-2 (Fundamentals of Blockchain Technology) (6 hours)		
2.1	Blockchain – definition and architecture	1 hour
2.2	Elements of blockchain.	1 hour
2.3	Blockchain – benefits and limitations, types.	1 hour
2.4	Consensus – definition, types, consensus in blockchain	1 hour
2.5	Decentralization using blockchain, Methods of decentralization	1 hour
2.6	Routes to decentralization, Blockchain and full ecosystem decentralization	1 hour
Module-3 (Consensus Algorithms and Bitcoin) (7 hours)		
3.1	Consensus Algorithms – Crash fault-tolerance (CFT) algorithms – Paxos, Raft (working is expected).	1 hour
3.2	Byzantine fault-tolerance (BFT) algorithms – Practical Byzantine Fault Tolerance (PBFT) (working is expected).	1 hour
3.3	Proof of work (PoW), Proof of stake (PoS), Types of PoS	1 hour
3.4	Bitcoin – Definition, Cryptographic keys – Private keys, public keys, addresses.	1 hour
3.5	Transactions – Lifecycle, coinbase transactions, transaction validation	1 hour

3.6	Blockchain – The genesis block. Mining – Tasks of miners	1 hour
3.7	Mining – mining algorithm, hash rate. Wallets – Types of wallets.	1 hour
Module-4 (Smart Contracts and Use cases) (6 hours)		
4.1	Smart Contracts – Definition, Smart contract templates	1 hour
4.2	Oracles, Types of oracles, Deploying smart contracts.	1 hour
4.3	Decentralization terminology –Decentralized applications, Decentralized Autonomous Organizations.	1 hour
4.4	Use cases of Blockchain technology – Government, Health care.	1 hour
4.5	Use cases of Blockchain technology – Finance, Supply chain management.	1 hour
4.6	Blockchain and Allied Technologies – Blockchain and Cloud Computing, Blockchain and Artificial Intelligence.	1 hour
Module-5 (Ethereum and Solidity) (9 hours)		
5.1	Ethereum - The Ethereum network, Components of the Ethereum ecosystem – Keys and addresses, Accounts	1 hour
5.2	Components of the Ethereum ecosystem – Transactions and messages	1 hour
5.3	The Ethereum Virtual Machine	1 hour
5.4	Ethereum Blocks and blockchain	1 hour
5.5	The Solidity language – The layout of a Solidity source code, Structure of a smart contract, variables, data types	1 hour
5.6	The Solidity language – control structures, events, inheritance, libraries	1 hour
5.7	The Solidity language – functions, error handling.	1 hour
5.8	Smart contracts Case study: Voting.	1 hour
5.9	Smart contracts Case study: Auction.	1 hour

CST438	IMAGE PROCESSING TECHNIQUE	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course helps the learners understand the core concepts and applications of Digital Image Processing. It covers Digital Image Fundamentals, Image Transforms, Image Enhancement in Spatial and Frequency Domain, Image Restoration & Image Segmentation and Morphological Operations & Representation and Description. The learners will be able to develop new algorithms, tools, and application software for real-world applications involving image processing.

Prerequisite: A basic knowledge of Computer Graphics and Image representation

Course Outcomes: After the completion of the course, the student will be able to

CO1	Explain the concepts of image formation and the basis of digital image processing. **(Cognitive Knowledge Level: Understand)**
CO2	Demonstrate the role of image transforms in representing, highlighting, and modifying image features. **(Cognitive Knowledge Level: Apply)**
CO3	Solve image enhancement problems using spatial and frequency domain techniques. **(Cognitive Knowledge Level: Apply)**
CO4	Make use of the concept of image restoration and image segmentation techniques in real-world problems. **(Cognitive Knowledge Level: Apply)**
CO5	Interpret morphological operations, image representation, and description techniques. **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔										✔
CO2	✔	✔			✔							✔
CO3	✔	✔	✔									✔
CO4	✔	✔	✔	✔	✔	✔						✔
CO5	✔	✔										✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and teamwork
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests (Average of Internal Tests 1 & 2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which students should answer anyone. Each question can have a maximum 2 subdivisions and carries 14 marks.

Syllabus

Module – 1 (Digital Image Fundamentals)

Elements of Visual Perception, A Simple Image Formation Model. Spatial and Intensity Resolution. Image Interpolation. Classification of Digital Images. Image Types. Image Storage Mechanisms. Arithmetic and Logical Operations. Geometric Spatial Transformations and Image Registration. Image File Formats. Colour Fundamentals and Colour Models.

Module - 2 (Image Transforms)

Basic concept of spatial domain and frequency domain, Unitary transform, Discrete Fourier Transform- 2D DFT, 4 order DFT Transform coefficients, Forward and inverse transform, Discrete Cosine Transform- 2D DCT, 4 order DCT Transform Coefficients(No derivation needed), Forward and Inverse DCT, Hadamard Transform.

Module - 3 (Image Enhancement in Spatial and Frequency Domain)

Point operations- Clipping and Thresholding, Digital Negative, Intensity Level Slicing, Bit Extraction, Range Compression. Spatial Operations- Fundamentals of spatial convolution and correlation, Spatial averaging and spatial Low pass filtering, Directional Smoothing, Median Filtering, Unsharp masking and Crispening.

Basics of Filtering in Frequency Domain, Filters, Smoothing Frequency Domain Filters-Sharpening Frequency Domain Filters

Module - 4 (Image Restoration & Image Segmentation)

Image degradation model, Noise models, Mean Filters, Order Statistic filter, Adaptive filters.
Edge Detection, gradient operators, Laplace operators and zero crossings. Thresholding, Basic Global Thresholding, Optimum global thresholding using Otsu method, Multiple thresholds, Variable thresholding, Multivariable thresholding. Region-Based Approach to Segmentation.

Module - 5 (Morphological Operations & Representation and Description)

Structuring Element, Dilation and Erosion, Opening and Closing, Hit or Miss Transformation.

Boundary Following. Chain Codes. Polygonal Approximation. Boundary Descriptors. Regional Descriptors. Relational Descriptors.

Text Books

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing (English) 3rd Edition, Pearson India, 2013
2. A K. Jain, Fundamentals of digital image processing, Prentice Hall of India, 1989.

Reference Books

1. Al Bovik, The Essential Guide to Image Processing, Academic Press, 2009.
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, Image Processing, Analysis, and Machine Vision, Thomson Learning, 2008.
3. S Jayaraman, S Esakkirajan and T Veerakumar, Digital Image Processing, McGraw Hill Education, 2009.

Course Level Assessment Questions

Course Outcome1 (CO1) :

1. Find the number of bits required to store a 256 X 256 image with 32 gray levels.
2. Explain the reasons for blocking artifacts and false contours in an image.

Course Outcome 2 (CO2) :

1. Compare different image transforms based on their roles, properties and applications.
2. Compute the inverse 2D DFT of the transform coefficients F(k,l) given below.

$$F(k, l) = \begin{pmatrix} 64 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

3. Use Discrete Fourier transform to construct 2D DFT for a 4x4 image given below. Assume that indices start from (0,0)

6	6	6	6
6	6	6	6
6	6	6	6
6	6	6	6

Course Outcome 3 (CO3) :

1. Perform intensity level slicing on the 3 BPP (Bit Per Pixel) image. Let r1=3 and r2=5. Draw the modified image with/without background transformations.

$$\begin{bmatrix} 2 & 1 & 2 & 2 & 1 \\ 2 & 3 & 4 & 5 & 2 \\ 6 & 2 & 7 & 6 & 0 \\ 2 & 6 & 6 & 5 & 1 \\ 0 & 3 & 2 & 2 & 1 \end{bmatrix}$$

2. Let y(m) = {2,3,8,4,2}. Obtain the median filter output for the window W = [-1,0,1,2] and show how salt and pepper noise is reduced.
3. Consider a 3*3 spatial mask that averages the four closest neighbors of a point(x,y), but excludes the point itself from the average.

   (a) Find the equivalent filter H(u,v) in the frequency domain.

   (b) Show that H(u,v) is a lowpass filter (ASSIGNMENT)

Course Outcome 4 (CO4) :

1. Compare Region and Edge-based techniques in segmentation.

2. Consider a noisy image that is restored using arithmetic mean filter of size 3x3 and using the geometric mean filter of the same size. Which image will be less blurred and why?
3. Suppose that you want to help a radiologist to extract the tumor portion from an MRI image for volumetric analysis. This volumetric analysis determines the effect of treatment on the patient, which can be judged from the extracted size and shape of the abnormal portion. Manual tracing of the tumor regions is very difficult since the tumor portion on the MRI image is inhomogeneous, with complex shapes and ambiguous boundaries. Suggest a sequence of steps that you may use to automate this process as an image processing student. (ASSIGNMENT)

Course Outcome 5 (CO5) :

4. Explain the significance of structuring elements in morphological operations with example.
5. Explain how chain codes are used to represent boundaries of a region with examples.

Model Question Paper

QP CODE:

Reg No: _______________

Name: _________________ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST438

Course Name: IMAGE PROCESSING TECHNIQUE

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Give an image representation model and describe how the representation changes in different types of images.
2. Describe any three types of color models.
3. Obtain the HADAMARD basis matrix for N=8.
4. Prove that DFT is a unitary transform.
5. Sketch perspective plot of a 2-D ideal low pass filter transfer function and filter cross-section. List its usefulness in Image enhancement.
6. Explain the significance of directional smoothing technique.
7. Specify the significance of the Zero crossing detector.
8. Describe region growing technique for image segmentation.
9. Define 'Structuring Element' used in morphological operations. Give samples for Structuring Elements.
10. Explain image boundary representation using polygonal approximation.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain a Simple Image Formation Model with the help of a neat diagram. **(7)**

    (b) Explain the relationship between image size, spatial resolution, and image quality. Compare gray level and intensity resolution. **(7)**

OR

12. (a) Describe arithmetic, logical and geometrical operations on Image. **(7)**

(b) Explain the significance of image interpolation and describe its various types. **(7)**

13. (a) State the advantages of Discrete Cosine Transform over Discrete Fourier Transform. **(4)**

(b) You are given a 4 X 4 image patch Compute 2D DCT for the image patch. Reconstruct the original image patch by neglecting the last four coefficients in 2D DCT. Comment on the observed result. **(10)**

$$\begin{bmatrix} 12 & 4 & 2 & 6 \\ 5 & 10 & 12 & 24 \\ 6 & 8 & 10 & 12 \\ 14 & 12 & 8 & 10 \end{bmatrix}$$

OR

14. (a) Discuss the concept of sequency in Hadamard transform. **(4)**

(b) Find the 2D forward DFT of the image segment **(10)**

1 1 1 1

1 1 1 1

1 1 1 1

Prove the unitary property of the given image segment.

15. (a) Explain the output and application of the following point processing techniques **(9)**

(i)Range Compression (ii) Bit Extraction (iii) Thresholding

(b) State and explain the features of median filtering. Compute the output of the median filtering for Y(m)={2,4,8,3,2} , w={-1,0,1,2} where Y(m) is an array and w is a window. **(5)**

OR

16. (a) Describe the role of Unsharp masking with its applications **(4)**

(b) Explain and compare the basic frequency domain filters for image sharpening **(10)**

17. (a) A 4×4 image is given by **(8)**

2	4	8	7
12	6	9	8
13	7	4	3
8	12	4	9

Filter the above image using

(a) MIN filter (b) MAX filter using the filter mask

0 1 0
1 1 1
0 1 0

(Assume replicate padding of the input image)

(b) Explain any two types of thresholding techniques. Describe the threshold detection algorithm using Otsu's method. **(6)**

OR

18. (a) Explain Image degradation model with the help of a neat diagram. **(8)**

(b) Illustrate the split and merge algorithm for image segmentation using neat sketches. **(6)**

19. (a) Explain the purpose of morphological operations in digital image? Describe the opening and closing operations with examples. **(7)**

(b) Illustrate Hit or Miss Transformation. **(7)**

OR

20. (a) Explain the concept of the chain coding scheme with its applications. **(6)**

(b) Describe in detail any two boundary representation schemes and illustrate with examples. **(8)**

Teaching Plan

No	Contents	No. of Lecture Hours (36 hrs)
	Module-1 (Digital Image Fundamentals) (7 hours)	
1.1	Elements of Visual Perception, A Simple Image Formation Model	1
1.2	Spatial and Intensity Resolution, Image Interpolation, Classification of Digital Image.	1
1.3	Image Types, Image Storage Mechanisms.	1
1.4	Arithmetic and Logical Operations.	1
1.5	Geometric Spatial Transformations and Image Registration.	1
1.6	Image File Formats.	1

1.7	Colour Fundamentals and Colour Models.	1
Module-2 (Image Transforms) (8 hours)		
2.1	Basic concept of spatial domain and frequency domain.	1
2.2	Need of Image Transform, Basic properties of unitary transform.	1
2.3	Discrete Fourier transform, Proof DFT is Unitary.	1
2.4	4 order DFT Transform coefficients (Derivation).	1
2.5	Problems (4 order DFT).	1
2.6	Discrete Cosine Transform- 2D DCT.	1
2.7	4 order DCT Transform Coefficients(No derivation needed).	1
2.8	Hadamard Transform.	1
Module-3 (Image Enhancement in spatial and frequency domain) (8 hours)		
3.1	Point operations- Clipping and Thresholding, Digital Negative. Intensity Level Slicing.	1
3.2	Bit Extraction, Range Compression + (Work out problems).	1
3.3	Spatial Operations-Fundamentals of spatial convolution and correlation.	1
3.4	Spatial averaging and spatial Low pass filtering, Directional Smoothing.	1
3.5	Median Filtering, Unsharp masking and Crispening.	1
3.6	Basics of Filtering in Frequency Domain.	1
3.7	Smoothing Frequency Domain Filters : Ideal Low Pass Filter; Gaussian Low Pass Filter; Butterworth Low Pass Filter;	1
3.8	Sharpening Frequency Domain Filters: Ideal High Pass Filter; Gaussian High Pass Filter; Butterworth High Pass filter.	1
Module-4 (Image Restoration & Image Segmentation) (6 hours)		
4.1	Image degradation model, Noise models.	1
4.2	Mean Filters – Order Statistic filter – Adaptive filters.	1
4.3	Edge Detection, Gradient operators, Laplace operators and zero crossings.	1

4.4	Thresholding- Basic Global Thresholding, Optimum global thresholding using Otsu method.	1
4.5	Multiple thresholds, Variable thresholding, Multivariable thresholding.	1
4.6	Region-Based Approach to Segmentation.	1
Module-5 (Morphological Operations & Representation and Description) (7 hours)		
5.1	Structuring Element. Dilation and Erosion,	1
5.2	Morphological Opening, Closing.	1
5.3	Hit or Miss Transformation.	1
5.4	Boundary Following. Chain Codes, Polygonal Approximation.	1
5.5	Boundary Descriptors.	1
5.6	Regional Descriptors.	1
5.7	Relational Descriptors.	1

<table>
<tr><td rowspan="2">CST448</td><td rowspan="2">INTERNET OF THINGS</td><td>CATEGORY</td><td>L</td><td>T</td><td>P</td><td>CREDIT</td><td>YEAR OF INTRODUCTION</td></tr>
<tr><td>PEC</td><td>2</td><td>1</td><td>0</td><td>3</td><td>2019</td></tr>
</table>

Preamble: This course equips the learners with fundamental of the Internet of Things(IoT) and the IoT ecosystem. It covers the architecture of IoT, communication mechanisms, protocols, hardware, software, data analytics, and the cloud platforms for IoT. This course enables the students to design smart IoT applications for real world problems using Raspberry Pi.

Prerequisite: Basic knowledge in Data Communication, Computer Networks and Programming in Python

Course Outcomes: After the completion of the course the students will be able to

CO1	Outline the fundamentals of IoT and its underlying physical and logical architecture**(Cognitive Knowledge Level: Understand)**
CO2	Explain the hardware architectures for IoT **(Cognitive Knowledge Level : Understand)**
CO3	Outline the Network architectures for IoT**(Cognitive Knowledge Level : Understand)**
CO4	Implement data analytics on the IoT platforms **(Cognitive Knowledge Level : Apply)**
CO5	Appreciate the security considerations in IoT **(Cognitive Knowledge Level : Understand)**
CO6	Implement IoT applications using the available hardware and software. **(Cognitive Knowledge Level : Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔									✔
CO2	✔	✔	✔									✔
CO3	✔	✔	✔									✔
CO4	✔	✔	✔	✔	✔							✔

CO5	✔	✔	✔		✔							✔
CO6	✔	✔	✔	✔	✔	✔						✔

Abstract POs Defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and teamwork
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Blooms Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Percentage)	Test 2 (Percentage)	
Remember	30	20	30
Understand	60	50	40
Apply	10	30	30
Analyze			

Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance **10 marks**
Continuous Assessment Tests **25 marks**
Continuous Assessment Assignment **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First Internal Examination shall be preferably conducted after completing the first half of the syllabus, and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer anyone. Each question can have a maximum 2 subdivisions and carries 14 marks.

Syllabus

Module- 1 (IoT Architecture)

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

Module- 2 (Engineering IoT Networks)

Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies

Module- 3 (IoT Network Layer)

IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods

Module 4 (Data Analytics for IoT)

Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, Differences between IT and OT Security Practices and Systems, Formal Risk Analysis Structures: OCTAVE and FAIR.

Module 5 (Developing IoT Systems)

IoT Logical Design using Python, IoT Physical Devices and Endpoints - Raspberry Pi interfaces, Programming Raspberry Pi using Python, Other IoT devices, IoT Physical devices and Cloud offerings, Cloud Storage Models, WAMP - Autobahn for IoT, Django, Designing RESTful Web API, Cloud Web Services for IoT.

Textbooks

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint)

2. Arshadeep Bahga, Vijay Madisetti, "Internet of Things: A hands-on approach", University Press, 2015 (First edition)

References

1. Rajkamal, "Internet of Things: Architecture and Design Principles", McGraw Hill (India) Private Limited

2. Dieter Uckelmann, Mark Harrison, Michahelles Florian (Ed.), Architecting the internet of things, Springer, 2011

3. Dr. Ovidiu Vermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013

4. Simon Monk, "Programming Arduino: Getting Started with Sketches", McGraw Hill Publications

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Write a short note on the impact of IoT in the real world
2. Explain the challenges of IoT.
3. Compare OT and IT Technology.
4. Describe the elements of one M2M architecture of IoT

Course Outcome 2 (CO2):

1. Mention any four wireless technologies and its architectural characteristics
2. Comment things in IoT
3. Compare biosensors and biodegradable sensors used in IoT
4. Explain the term NBIoT(Narrow Band IoT)

Course Outcome 3 (CO3):

1. Discuss the need for optimization
2. Compare MQTT and COAP
3. Explain different schedule management and packet forwarding models of 6TiSCH

Course Outcome 4(CO4):

1. Compare Bigdata and edge analytics
2. Compare structured and unstructured data
3. Describe the components of FNF

Course Outcome 5(CO5):

1. What are the major challenges in IoT security?
2. Explain the impact of OT Network Characteristics onIoT Security.

Course Outcome 6(CO6):

1. Implement LDR interfacing with Raspberry Pi
2. Explain the development of a RESTful web API.

Model Question Paper

QP CODE: PAGES :3

Reg No: _______________

Name: _________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST448

Course Name: Internet of Things

Max.Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Explain the role of IoT in connected roadways,
2. Describe the functions of the various layers of simplified IoT Architecture Model.
3. Explain the communication protocols employed in Wireless Sensor Networks
4. What are the essential performance considerations of constrained-node networks?
5. Explain the parameters to be considered while choosing between IP adaptation / adoption for last mile communication.
6. With neat diagrams compare the IoT protocol stacks using 6LoWPAN and IP.
7. Differentiate the types of IoT data analytics results.

8. How can the insecure operational protocols be characterized?

9. Write a program to interface an LED and a switch with Raspberry Pi

10. List down the Raspberry Pi interfaces and explain. **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Illustrate the impact of IoT in at least 2 domains of normal human life. **(9)**

(b) Describe the Application and Analytics sublayer of IoT Architecture **(6)**

OR

12. (a) Describe the Standardized IoT architectures. **(8)**

(b) Explain the functions of Access Network Sublayer of IoT Architecture **(6)**

13. (a) Describe the LoRaWAN technology as an IoT communication paradigm. **(10)**

(b) Describe various types of sensors. **(4)**

OR

14. (a) Define actuators. Describe the roles of actuators in IoT systems. **(6)**

(b) Explain the IEEE 802.15.4 standard for wireless communication. **(8)**

15. (a) Explain Message Queuing Telemetry Transport framework and message format. **(8)**

(b) Explain tunneling of legacy SCADA over IP Networks with a neat diagram. **(6)**

OR

16. (a) Explain SCADA Transport over LLNs with MAP-T. **(7)**

(b) Explain RPL encryption and authentication on constrained nodes. **(7)**

17. (a) Explain the Hadoop ecosystem with a neat diagram. **(7)**

(b) Explain the Flexible NetFlow Architecture. **(7)**

OR

18. (a) Explain the "The Purdue Model for Control Hierarchy" and OT network characteristics. **(8)**

(b) Explain any twp formal risk analysis structures **(6)**

19. (a) Explain the working of WAMP protocol. **(8)**

(b) Describehow AWS supports IoT development **(6)**

OR

20. (a) Demonstrate an example of Raspberry Pi applications for Industrial IoT. **(8)**

(b) Explain the Django Architecture **(6)**

TEACHING PLAN

No	Contents	No of Lecture Hrs (35 Hrs)
	Module – 1 (IoT Architecture) (6 hrs) (TB-1, Chapter 1,2)	
1.1	What is IoT, Genesis of IoT, IoT and Digitization,	1
1.2	IoT Impact, Convergence of IT and IoT, IoT Challenges	1
1.3	IoT Network Architecture and Design	1
1.4	Drivers Behind New Network Architectures, Comparing IoT Architectures	1
1.5	A Simplified IoT Architecture,	1

1.6	The Core IoT Functional Stack, IoT Data Management and Compute Stack.	1
Module- 2 (Engineering IoT Networks) (7hrs)(TB-1, Chapter 3,4)		
2.1	Smart Objects: The "Things" in IoT,	1
2.2	Sensors, Actuators, and Smart Objects	1
2.3	Sensor Networks	1
2.4	Connecting Smart Objects	1
2.5	IoT Access Technologies –IEEE 802.15.4 (g/e), 1901.2a	1
2.6	IoT Access Technologies - 802.11ah, LoRaWAN	1
2.7	IoT Access Technologies – LoRaWAN, NBIoT, LTE	1
Module- 3 (IoT Network Layer) (7 hrs)(TB-1, Chapter 5,6)		
3.1	IP as the IoT Network Layer, The Business Case for IP	1
3.2	The need for Optimizing IP for IoT	1
3.3	Optimizing IP for IoT, Profiles, and Compliance	1
3.4	Application Protocols for IoT - CoAP	1
3.5	Application Protocols for IoT - MQTT	1
3.6	The Transport Layer, IoT Application Transport Methods	1
3.7	The Transport Layer, IoT Application Transport Methods	1
Module 4 (Data Analytics for IoT) (6hrs)(TB-1, Chapter 7,8)		
4.1	An Introduction to Data Analytics for IoT, Machine Learning	1
4.2	Big Data Analytics Tools and Technology	1
4.3	Edge Streaming Analytics, Network Analytics	1

4.4	A Brief History of OT Security, Common Challenges in OT Security	1
4.5	Differences between IT and OT Security Practices and Systems	1
4.6	Formal Risk Analysis Structures: OCTAVE and FAIR	1
Module 5 (Developing IoT Systems)(9 hrs) (TB-2, Chapter 6,7,8)		
5.1	IoT Logical Design using Python,	1
5.2	IoT Physical Devices and Endpoints	1
5.3	Raspberry Pi interfaces, Programming Raspberry Pi using Python	1
5.4	Other IoT devices	1
5.5	Cloud Storage Models	1
5.6	WAMP-Autobahn for IoT	1
5.7	Django	1
5.8	Designing RESTful Web API	1
5.9	Cloud Web Services for IoT.	1

CST458	SOFTWARE TESTING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This is a course in theoretical computer science that introduces the concepts and methods in software testing. It covers various techniques for test case design used to test software artifacts, including requirements, design, and code, the different techniques for test case design based on graphs, programming language syntaxes and symbolic execution using PEX tool. It enables the learners to follow a systematic software testing approaches while developing applications.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to:-

CO1	List a range of different software testing techniques and be able to apply specific unit testing method to the projects using Junit**.(Cognitive Knowledge Level: Understand)**
CO2	Illustrate using appropriate tools the mutation testing method for a given piece of code to identify hidden defects that can't be detected using other testing methods.**(Cognitive Knowledge Level: Apply)**
CO3	Explain graph coverage criteria in terms of control flow graph and data flow graph for a given program.**(Cognitive Knowledge Level: Understand**)
CO4	Demonstrate the importance of black-box approaches in terms of domain and functional testing.**(Cognitive Knowledge Level: Apply)**
CO5	Illustrate the use of PEX tool with symbolic execution.**(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12
CO1	✔	✔	✔									✔
CO2	✔	✔	✔	✔	✔					✔		✔
CO3	✔	✔	✔							✔		✔
CO4	✔	✔	✔	✔								✔

CO5	✓	✓	✓	✓	✓					✓		✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks**
	Test 1 (Marks)	**Test 2 (Marks)**	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests(Average of SeriesTests1& 2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module - 1 (Introduction to Software Testing)

Some Popular Errors – Ariane 5, Therac 25, Intel Pentium Bug. What is Software testing? Why should it be tested? Software Quality, Role of Testing. Testing Process - Level 0 thinking, Level 1 thinking, Level 2 thinking, Level 3 thinking, Level 4 thinking. Software Testing Terminologies - Verification, Validation and Testing, Faults, Error and Bug, Test cases, Coverage Criteria. Types of Testing- Unit testing, integration testing, System testing, Acceptance testing, Beta testing, Functional testing, Stress testing, Performance testing, Usability testing and Regression testing. Testing Methods - Black Box testing, White Box testing, Grey Box testing.

Module - 2 (Unit Testing)

Concept of Unit testing. Static Unit testing. Dynamic Unit testing - Control Flow testing, Data Flow testing, Domain testing, Functional Program testing. Mutation testing - Mutation and Mutants, Mutation operators, Mutation score. Junit - Framework for Unit testing. Case Study - Mutation testing using Junit and Muclipse.

Module - 3 (Unit Testing - White Box Approaches)

Overview of Graph Coverage Criteria. Structural Graph Coverage Criteria - Node/vertex coverage, Edge coverage, Edge pair coverage, Path coverage, Complete path coverage, Prime path coverage, Complete round trip coverage, Simple round trip coverage. Data Flow Criteria - du paths, du pairs. Subsumption Relationships among Graph Coverage Criteria. Graph Coverage for Source Code - Control flow graphs for code, CFG: If statement, CFG: If statement with return, CFG: Switch-case, CFG: Loops, CFG: Exceptions (try-catch). Example program – Statistics. Graph Coverage for Design Elements - Call graphs and classes, Class inheritance testing: Coverage criteria, Coverage criteria on inheritance graph, Data flow at the design level, Inter-procedural DU pairs, Coupling du-pairs example. Example - Quadratic Root. Case Study - Graph Based testing using JUnit Framework.

Module - 4 (Unit Testing - Black Box Approaches)

Domain Testing / Input Space Partitioning - Partitions of a set. Input domain modelling - Interface-based approach, Functionality-based approach. Identifying values. Multiple partitions of the input domain - All Combinations Coverage (ACoC), Each Choice Coverage (ECC), Pair-wise Coverage, T-wise Coverage, Base Choice Coverage, Multiple Base Choices Coverage. TriTyp example. Functional Testing - Functional Testing Concepts of Howden. Functional testing - Important Steps. Types of Functional testing - Equivalence Class Partitioning, Boundary Value Analysis, Decision Tables, Random Testing. Case Study - Black Box testing approaches using JUnit.

Module - 5 (Grey Box Testing Approaches)

Introduction to Grey Box testing - Why Grey Box testing, Gray Box Methodology, Advantages and Disadvantages. Techniques of Grey Box Testing - Matrix Testing, Regression Testing, Orthogonal Array Testing or OAT, Pattern Testing. An Introduction to PEX - Parameterized Unit Testing, The Testing Problem. Symbolic Execution – Example, Symbolic execution tree. PEX application Case Study – PEX.

Text Books

1. Paul Ammann and JeffOffutt , Introduction to Software Testing, Cambridge University Press
2. Kshirasagar Naik and Priyadarshi Tripathy, Software Testing And Quality Assurance: Theory And Practice, Wiley.

Reference Materials

1. King, James C, “Symbolic Execution and Program Testing”, Association for Computing Machinery, July 1976.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

Explain the following types of testing methods with examples.

(i) Balck-box testing.

(ii) White-box testing.

(iii) Grey-box testing.

Course Outcome 2 (CO2):

Define 12 mutants for the following method *power*() using effective mutation operators. Try to use each mutation operator at least once. Approximately, how many mutants do you think there would be, if all mutants for *power*() were created?

```
public static int power (int left, int right)
{
//**************************************
// Raises Left to the power of Right
// precondition : Right >= 0
// postcondition: Returns Left**Right
//**************************************
```

```
intrslt;
rslt = Left;
if (Right == 0)
{
rslt = 1;
}
else
{
for (int i = 2; i <= Right; i++)
rslt = rslt * Left;
}
return (rslt);
}
```

Course Outcome 3 (CO3):

Draw the control flow graph and data flow graph of given piece of code.

```
public static double ReturnAverage(int value[],int AS, int MIN, int MAX){
/*
Function: ReturnAverageComputes the averageof all those numbers in the input array in
the positive range [MIN, MAX]. The maximum size of the array is AS. But, the array size
could be smaller than AS in which case the end of input is represented by -999.
*/
int i, ti, tv, sum;
doubleav;
i = 0; ti = 0; tv = 0; sum = 0;
while (ti< AS && value[i] != -999) {
ti++;
if (value[i] >= MIN && value[i] <= MAX) {
tv++;
sum = sum + value[i];
}
i++;
}
```

```
if (tv> 0)
av = (double)sum/tv;
else
av = (double) -999;
return (av);
}
```

Course Outcome 4 (CO4):

Explain the following with examples.

1. Input domain modelling.
2. All Combinations Coverage (ACoC)
3. Each Choice Coverage (ECC)
4. Pair-wise Coverage
5. T-wise Coverage
6. Base Choice Coverage
7. Multiple Base Choices Coverage.

Course Outcome 5 (CO5):

Draw the symbolic execution tree for the following program code and explain the symbolic execution of testme (α1, α2).

```
int twice (int v) {
 return 2 ∗ v;
 }
 void testme (int x, int y ) {
 z = twice ( y);
 if ( z == x ){
 if ( x > y + 10)
ERROR;
 }
 }
int main() {
 x = sym input();
 y = sym input();
testme ( x , y);
```

return(0);

Model Question Paper

QP CODE: **PAGES: 3**

Reg No:______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST458

Course Name: Software Testing

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Explain the differences between Validation and Verification?
2. Explain the differences between Fault, Error, and Bug?
3. Define Ground string, Mutation score, and Mutants?
4. What are the functions of Test driver and Test stubs in dynamic unit testing?
5. Define Node coverage, Edge coverage and Prime path coverage in a control flow graph?
6. What are du paths and du pairs in a data flow graph?
7. Explain the two approaches in input domain modelling?
8. Explain the difference between Equivalence Class Partitioning and Boundary Value Analysis?
9. Briefly explain three techniques of Grey box testing?
10. Explain the concept of symbolic execution with the help of a toy example?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain the following types of testing

(i) Black Box testing (ii) White Box testing (iii) GreyBox testing (iv) Unit testing (v) Integration testing (vi) System testing (vii) Acceptance testing **(14)**

OR

12. (a) Explain the following coverage criterias based on the code fragment given below? (i) Functional coverage (ii) Statement coverage (iii)Conditional coverage (iv)Branch coverage **(8)**

```
int foo (int x, int y){
    int z = 0;
    if ((x > 0) && (y > 0)){
    z = x;}
    return z;
    }
```

(b) Write positive and negative test cases for an ATM Machine? **(6)**

13. (a) Explain Dynamic unit test environment with a neat figure. **(8)**

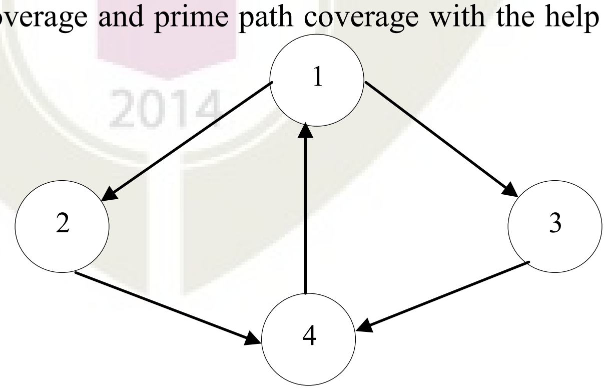
(b) Explain the major difference between control flow testing and data flow testing. **(6)**

OR

14. (a) Explain seven types of mutation operators with neat examples? **(14)**

15. (a) Explain touring, side trips and detours with a neat example **(7)**

(b) Explain simple path coverage and prime path coverage with the help of CFG given below? **(7)**



OR

16. (a) Draw CFG fragment for **(7)**
    (i) Simple *if* (ii) Simple *while* loop (iii) Simple *for* loop

    (b) Explain the following concepts with examples? **(7)**
    (i)Call graph (ii) Inheritance graph (iii) Coupling du-pairs

17. (a) What are the four important steps in functional testing? **(7)**

    (b) Briefly explain input domain modelling approaches? **(7)**

OR

18. (a) Consider the triangle classification program with a specification: **(6)**
    The program reads floating values from the standard input. The three values *A*, *B*, and *C* are interpreted as representing the lengths of the sides of triangle. The program then prints a message to the standard output that states whether the triangle, if it can be formed, is scalene, isosceles, equilateral, orright angled. Determine the following for the above program:
    (i) For the boundary condition $A + B > C$ case (scalene triangle), identify test cases to verify the boundary.
    (ii) For the boundary condition $A = C$ case (isosceles triangle), identify testcases to verify the boundary.
    (iii) For the boundary condition $A = B = C$ case (equilateral triangle), identify testcases to verify the boundary.

    (b) Develop a decision table to generate test cases for this specification. **(8)**

19. (a) Explain the importance of grey box testing, its advantages and disadvantages? **(9)**

    (b) Explain the concept of symbolic execution tree? **(5)**

OR

20. (a) Consider the code fragment given below: - **(7)**

```
1. POWER: PROCEDURE(X, Y);
2. Z ← 1;
```

3. J ← 1;
4. LAB: IF Y ≥ J THEN
5. DO; Z← Z * X;
6. J ← J + 1;
7. GO TO LAB; END;
8. RETURN (Z) ;
9. END;

a) Explain Symbolic execution of POWER (αl, α2).

(b) Explain Execution tree for POWER (αl, α2). **(7)**

TEACHING PLAN

No	Contents	No of Lecture Hrs (35 hrs)
	Module 1 (Introduction to Software Testing) -(7 Hours)	
1.1	Some Popular Errors– Ariane 5, Therac 25, Intel Pentium Bug.	1 Hour
1.2	What is Software testing? Why should it be tested? Software Quality, Role of Testing.	1 Hour
1.3	Testing Process - Level 0 thinking, Level 1 thinking, Level 2 thinking, Level 3 thinking, Level 4 thinking.	1 Hour
1.4	Software Testing Terminologies- Verification, Validation and Testing, Faults, Error and Bug, Test cases, Coverage Criteria.	1 Hour
1.5	Types of Testing- Unit testing, integration testing, System testing, Acceptance testing, Beta testing	1 Hour
1.6	Functional testing, Stress testing, Performance testing, Usability testing and Regression testing.	1 Hour
1.7	Testing Methods - Black Box testing, White Box testing, Grey Box testing.	1 Hour
	Module 2 (Unit testing)- (6 Hours)	
2.1	Concept of Unit testing, Static Unit Testing	1 Hour

2.2	Dynamic Unit testing - Control Flow testing, Data Flow testing, Domain testing, Functional Program testing.	1 Hour
2.3	Mutation testing - Mutation and Mutants, Mutation operators, Mutation score.	1 Hour
2.4	Junit - Framework for Unit testing.	1 Hour
2.5	Case Study - Mutation testing using Junit	1 Hour
2.6	Case Study - Mutation testing using Muclipse	1 Hour
Module 3 (Unit Testing:- White Box Approaches)- (8 Hours)		
3.1	Structural Graph Coverage Criteria - Node/vertex coverage, Edge coverage, Edge pair coverage, Path coverage	1 Hour
3.2	Complete path coverage, Prime path coverage, Complete round trip coverage, Simple round trip coverage.	1 Hour
3.3	Data Flow Criteria - du paths, du pairs	1 Hour
3.4	Subsumption Relationships among Graph Coverage Criteria	1 Hour
3.5	Graph Coverage for Source Code – Control Flow Graphs (CFG) for code, CFG: If statement, CFG: If statement with return, CFG: Switch-case, CFG: Loops, CFG: Exceptions (try-catch). Example program - Statistics	1 Hour
3.6	Graph Coverage for Design Elements – Structural graph coverage and data flow graph coverage for design elements	1 Hour
3.7	Case Study - Graph Based testing using JUnit Framework. (Lecture 1)	1 Hour
3.8	Case Study - Graph Based testing using JUnit Framework. (Lecture 2)	1 Hour
Module 4 (Unit Testing:- Black Box Approaches) -(7 Hours)		
4.1	Domain Testing / Input Space Partitioning - Partitions of a set.	1 Hour
4.2	Input domain modelling - Interface-based approach, Functionality-based approach.	1 Hour

4.3	Multiple partitions of the input domain - All Combinations Coverage (ACoC), Each Choice Coverage (ECC), Pair-wise Coverage, T-wise Coverage, Base Choice Coverage, Multiple Base Choices Coverage.	1 Hour
4.4	Functional Testing - Functional Testing Concepts of Howden. Important Steps.	1 Hour
4.5	Types of Functional testing - Equivalence Class Partitioning, Boundary Value Analysis	1 Hour
4.6	Decision Tables, Random Testing.	1 Hour
4.7	Case Study - Black Box testing approaches using JUnit.	1 Hour
Module 5 (Grey Box Testing Approaches)- (7 Hours)		
5.1	Introduction to Grey Box testing - Why Grey Box testing, Gray Box Methodology, Advantages and Disadvantages.	1 Hour
5.2	Techniques of Grey Box Testing - Matrix Testing, Regression Testing, Orthogonal Array Testing or OAT, Pattern Testing.	1 Hour
5.3	An Introduction to Pex - Parameterized Unit Testing, The Testing Problem.	1 Hour
5.4	Symbolic Execution – Example, Symbolic execution tree.	1 Hour
5.5	Case Study – PEX (Lecture 1)	1 Hour
5.6	Case Study – PEX (Lecture 2)	1 Hour
5.7	Case Study – PEX (Lecture 3)	1 Hour

CST468	BIOINFORMATICS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course helps the learners to understand the fundamental concepts in Molecular Biology, Genomics, Proteomics and Modelling. This course introduces bio macromolecules such as genes and proteins, different biological databases, and tools and algorithms for biological data processing, analysis and interpretation, and the elements of the systems approach to Molecular Biology. This course enables the learners to contribute towards drug discovery and computational analysis and modelling of biological process.

Prerequisite: Basic background in higher secondary biology

Course Outcomes: After the completion of the course, the student will be able to

CO 1	Describe the basic concepts of Bioinformatics with an emphasis on structure, function and synthesis of biomolecules (**Cognitive knowledge level : Understand**)
CO 2	Identify biological data formats and databases, retrieve bio-sequences, and align bio-sequences to identify similarity (**Cognitive knowledge level : Apply)**
CO 3	Employ similarity searching tools and algorithms to align sequences to highlight the similarity, and describe the structure of genes (**Cognitive knowledge level : Apply)**
CO 4	Demonstrate Protein Structure, visualize protein structure using tools, and explain how proteins interact (**Cognitive knowledge level : Apply)**
CO 5	Explain the fundamental aspects of Systems Biology, Computational Modeling and properties of models (**Cognitive knowledge level : Understand**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔										✔
CO2	✔	✔	✔	✔	✔							✔
CO3	✔	✔	✔	✔	✔							✔

CO4	✓	✓	✓	✓								✓
CO5	✓	✓			✓							✓

PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	Test1 (%)	**Test2 (%)**	
Remember	**30**	**30**	**30**
Understand	**50**	**50**	**50**
Apply	**20**	**20**	**20**
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests (Average of Series Tests 1& 2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1 (Introduction to bioinformatics)

Introduction to bioinformatics, Nature & Scope of Bioinformatics, DNA, RNA, and Protein: The Central Dogma, Messenger RNA, tRNA, rRNA, Genetic code, Gene Structure and Control, Transcription, translation

Module-2 (Introduction to bio sequences and analysis)

Introduction to Biological Databases, NCBI, Genbank, Bio sequence formats- FASTA, Sequence alignment- Global Alignment and Local Alignment, Dot Matrix Method, Dynamic Programming Method, Gap Penalties, Amino Acid Scoring Matrices - PAM and BLOSUM

Module-3 (Database Similarity Searching and genomics)

Database Similarity Searching, BLAST – Variants -BLASTN, BLASTP, BLASTX, Statistical Significance, Needleman and Wunsch and Smith–Waterman Method, Multiple Sequence Alignment, scoring function, Clustal, introduction to structure of prokaryotic and eukaryote gene

Module-4 (Proteomics)

Protein Structure, Ramachandran Plot, Hierarchies of Protein Structure, Determination of Protein three-dimensional structure, protein structure database-PDB, Protein structure visualization, introduction to Protein protein interaction, STRING database

Module-5 (Systems Biology)

Introduction to Systems Biology, Models and Modelling, Properties of models, Systems state and steady state, Variables, Parameters, and Constants in modelling, Purpose and Adequateness of Models, Advantages of Computational Modelling, Model Development, Network Versus Elements, Modularity, Robustness and Sensitivity, Data Integration

Text books

1. Zvelebil, Marketa J., and Jeremy O. Baum. *Understanding bioinformatics*. Garland Science, 2007.
2. Xiong, Jin. *Essential bioinformatics*. Cambridge University Press, 2006.
3. Klipp, E., Herwig, R., Kowald, A., Wierling, C., &Lehrach, H. *Systems biology in practice: concepts, implementation and application*. John Wiley & Sons. 2005

References

1. Baxevanis, Andreas D., Gary D. Bader, and David S. Wishart, eds. *Bioinformatics*. John Wiley & Sons, 2020.
2. Shaik, Noor Ahmad, et al. *Essentials of Bioinformatics, Volume I.* Springer, 2019

3. Selzer, Paul M., Richard J. Marhöfer, and Andreas Rohwer, *Applied bioinformatics. An introduction–Springer, Verlag,*, 2008.
4. S C Rastogi, N Mendiratta and PRastogi, *Bioinformatics: Methods and Applications* , PHI Learning Private Limited, New Delhi, 2015.
5. D E Krane and M L Raymer, *Fundamental Concepts of Bioinformatics*, Pearson Education, 2006.
6. Andreas D.Baxevanis, B F Francis Ouellette, *Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins*, Third Edition, John Wiley & Sons INC. , U.K. 2006
7. Neil C Jones and Pavel A Pevzner, *An Introduction to Bioinformatics Algorithms*, MIT press, 2004.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Compare and contrast the DNA and RNA on the basis of structure and functions.
2. Demonstrate with the help of a flow diagram the generation of protein using the transcription and translation process.

Course Outcome 2 (CO2):

1. Download DNA sequence of human insulin form NCBI
2. Identify the following qualifiers for GenBank and give their definitions: [ACCN], [ALL], [AUTH], [ECNO], [FKEY], [GENE], [JOUR], [KYWD]
3. Construct a dot plot and find the sequence alignment between the following two sequences:
   Sequence1: GATTCTATCTAACTA, Sequence2: GTTCTATTCTAAC

Course Outcome 3 (CO3):

1. Apply Needleman-Wunsch Algorithm to perform sequence alignment for the following sequences: CGTGAATTCAT (sequence #1), GACTTAC (sequence #2)
2. Construct a BLAST procedure for sequence alignment(HSP) if a sequence and its corresponding database sequence are given. Assume the necessary data and demonstrate the procedure.

Course Outcome 4 (CO4):

1. Differentiate between the different protein molecular structure visualizations. Also mention the advantages and uses of each visualization technique.
2. Make use of an example and demonstrate the steps in protein comparison. Show how root mean square deviationis calculated while comparing two proteins.

Course Outcome 5 (CO5):

1. Explain how systems biology is used in data integration.
2. Explain the process of model development.

Model Question Paper

QP CODE:

Reg No: _______________

Name: ___________________ **PAGES : 3**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST468

Course Name: Bioinformatics

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Differentiate DNA, Gene, genome and chromosome.
2. What are the functions of mRNA, tRNA and rRNA?
3. What do you mean by Gene expression?
4. Write difference between local and global alignment.
5. Write short note on Gap penalties and its usage in comparing Biological sequences.
6. List any three typesof BLAST and make short description on each.
7. What are the principle underlying the formation of Ramachandran plot?.
8. What are the experimental methods for determining protein structure?
9. What do you mean by steady state in a biological system.
10. Justify the statement - systems are modular. **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) What is the central dogma of molecular biology? **(6)**

    (b) Explain the steps involved in the process of transcription. How is the primary transcript produced by a prokaryote different from that produced by a eukaryotic cell? **(8)**

OR

12. (a) Discuss translation process in protein synthesis. **(6)**

(b) Explain bio-molecules involved in central dogma, its structure and types. **(8)**

13. (a) Explain the importance of Primary and secondary databases in Bioinformatics **(6)**

(b) Illustrate the methods of pairwise sequence alignment. What is the use of assigning gap penalties in alignment? **(8)**

OR

14. (a) Illustrate sequence alignment. What are the applications of sequence alignment in Bioinformatics? **(7)**

(b) What is the use of scoring matrices? Differentiate between PAM and BLOSUM matrices and its usage in alignment. **(7)**

15. (a) Using Needleman and Wunsch dynamic programming method, construct the partial alignment score table for the following two sequences, using the scoring parameters: match score: +5, mismatch score: -1, gap penalty: -2. **(9)**
CCATGCU
GATTACA
Also write down the optimal global alignment between these sequences along with the optimal score.

(b) Interpret the blast result and statistical significance of the alignment by analyzing the results. **(5)**

OR

16. (a) Using Smith Waterman method construct the partial alignment scoring table and obtain the optimal local alignment of the following two sequences: **(9)**
ACGTATCGCGTATA
GATGCTCTCGGAJAA

(b) Illustrate multiple sequence alignment. **(5)**

17. (a) Discuss hierarchies of protein structure. **(6)**

(b) Explain how the protein structure is determined by using experimental techniques. **(8)**

OR

18. (a) Discuss protein interaction. How it contributes to the complexity of an organism? **(9)**

(b) Discuss on Protein Structure Database. **(5)**

19. (a) Discuss systems biology approach of understanding complex biological systems. **(6)**

(b) Explain on Variables, Parameters, and Constants in modeling biological systems. **(8)**

OR

20. (a) Explain on advantages of Computational Modeling of biological system. **(7)**

(b) What are the properties of models in biological system? **(7)**

TEACHING PLAN

No	Contents	No of Lecture (36 Hrs)
	Module-1 (Introduction to bioinformatics)(8 hrs) Text 1 (Relevant topics from chapter 1.1, 1.2, 1.3)	
1.1	Introduction to bioinformatics	1
1.2	Nature & Scope of Bioinformatics	1
1.3	DNA, RNA, and Protein	1
1.4	The Central Dogma introduction	1
1.5	Messenger RNA, tRNA, rRNA,	1
1.6	Genetic code,	1
1.7	Gene Structure and Control	1
1.8	Transcription, Translation	1
	Module-2 (Introduction to bio sequences and analysis) (7 hrs) Text 2 (Relevant topics from chapter 2, 3)	
2.1	Introduction to Biological Databases	1
2.2	NCBI Sequence retrieval	1
2.3	Genbank, Bio sequence formats- FASTA	1
2.4	Sequence alignment- Global Alignment and Local Alignment	1
2.5	Dot Matrix Method, Dynamic Programming Method	1

2.6	Gap Penalties	1
2.7	Amino Acid Scoring Matrices – PAM, BLOSUM	1
Module-3 (Database Similarity Searching and genomics) (7 hrs) Text 2 (Relevant topics from chapter 4 5 and 8)		
3.1	Database Similarity Searching, BLAST, Variants of BLAST - BLASTN, BLASTP, BLASTX	1
3.2	BLAST Analysis - Statistical Significance	1
3.3	Needleman and Wunsch Method	1
3.4	Smith–Waterman Method	1
3.5	Multiple Sequence Alignment, scoring function	1
3.6	Clustal tool	1
3.7	Gene Structure of prokaryotic, eukaryote	1

Module-4 (Proteomics) (7 hrs) Text 2 (Relevant topics from chapter 12, 13 and 19)		
4.1	Protein Structure, Ramachandran Plot	1
4.2	Hierarchies of Protein Structure	1
4.3	Determination of Protein three-dimensional structure	1
4.4	protein structure database-PDB	1
4.5	Protein structure visualization	1
4.6	Protein protein interaction	1
4.7	Protein protein interaction networks, STRING database	1
Module-5 (Systems Biology) (7 hrs) Text 3 (Relevant topics from Section 1.1-1.4)		
5.1	Introduction to Systems Biology, Properties of models	1
5.2	Systems state and steady state	1
5.3	Variables, Parameters, and Constants in modelling	1
5.4	Purpose and Adequateness of Models	1
5.5	Advantages of Computational Modelling ,Model Development (introduction only)	1
5.6	Network Versus Elements, Modularity,	1

5.7	Robustness and Sensitivity, Data Integration	1

CST478	COMPUTATIONAL LINGUISTICS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: The course aims to teach the basics of Computational Linguistics to the students viewing language phenomena from a computational/statistical standpoint. This involves ideas about statstical and computational models and how these could be linked with various language processing tasks. The course helps the learner to appreciate the complexities involved in language processing tasks using a machine, in contrast with the ease with which human beings handle them. Some practical aspects are also discussed using the Python and NLTK framework to equip the student with the capability to design solutions to linguistic problems.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Explain the fundamental concepts of language processing **(Cognitive Knowledge Level: Understand)**
CO2	Demonstrate the concepts of probability, statistical inference and hidden Markov model. **(Cognitive Knowledge Level: Apply)**
CO3	Compare and summarize the various methods of word sense disambiguation, lexical acquisition and selectional preferences. (**Cognitive Knowledge Level: Apply**)
CO4	Make use of different Part-of-Speech Tagging methods for language modelling. **(Cognitive Knowledge Level: Apply)**
CO5	Examine Probabilistic Context Free Grammars and various probabilistic parsing methods **(Cognitive Knowledge Level: Apply)**
CO6	Develop simple systems for linguistic tasks using Python and NLTK. **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											✓
CO2	✓	✓										✓
CO3	✓	✓	✓									✓
CO4	✓		✓		✓							✓
CO5	✓	✓	✓									✓
CO6	✓	✓	✓	✓	✓							✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			

Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3Hrs

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests(Average of SeriesTests1& 2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module- 1 (Preliminaries)

Introduction: Rationalist and Empiricist Approaches to Language-Questions that linguistics should answer-Noncategorical phenomena in language-Language and cognition as probabilistic phenomena

The Ambiguity of Language: Why natural language processing is difficult-Lexical resources-Word counts-Zipf's laws-Collocations-Concordances

Linguistic Essentials:

Parts of Speech and Morphology -Nouns and pronouns-Words that accompany nouns: Determiners and adjectives-Verbs-Other parts of speech-Phrase Structure-Phrase structure grammars -Semantics and Pragmatics-Corpus Based Work

Module -2 (Mathematical Essentials:)

Probability Theory-Probability spaces-Conditional probability and independence-Bayes' theorem-Random variables-Expectation and variance-Notation-Joint and conditional distributions-Standard distributions-Bayesian statistics

Statistical Inference: n-gram Models over Sparse Data-Bins: Forming Equivalence Classes-Reliability vs discrimination-n gram models

Markov Models-Hidden Markov Models-Why use HMMs?-General form of an HMM-Finding the probability of an observation-Finding the best state sequence

Module -3 (Word Sense Disambiguation)

Methodological Preliminaries- Supervised and unsupervised learning-Pseudowords-Upper and lower bounds on performance-Supervised Disambiguation-Bayesian classification-Dictionary based Disambiguation-Disambiguation based on sense definitions-Thesaurus based disambiguation

Lexical Acquisition-Evaluation Measures-Verb Subcategorization -Attachment Ambiguity-PP attachment- Selectional Preferences

Semantic Similarity: Vector space measures-Probabilistic measures

Module -4 (Grammar)

Part-of-Speech Tagging-The Information Sources in Tagging-Markov Model Taggers-Hidden Markov Model Taggers-Applying HMMs to POS tagging-The effect of initialization on HMM training-Transformation Based Learning of Tags

Probabilistic Context Free Grammars-Some Features of PCFGs-Questions for PCFGs -The Probability of a String -Using inside probabilities-Using outside probabilities-Finding the most likely parse for a sentence-parsing for disambiguation-parsing model versus language model

Module -5 (Language Processing with Python)

Introduction to NLTK, Text Wrangling and Text cleansing : Sentence Splitter, Tokenization, Stemming, Lemmatization, Stop word removal , Rare word Removal, Spell Correction. Part of Speech Tagging and NER. Parsing Structure in Text: Shallow versus deep parsing, different types of parsers and dependency parsing.

Text Books :

1. C.D. Manning and H. Schutze. Foundations of Statistical Natural Language Processing. MIT Press.
2. Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python and NLTK. O'reilly Pub.

References:

1. D. Jurafsky and J.H. Martin: Speech and Language Processing: Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, PHI.
2. James Allen: Natural Language Understanding. Pearson Pub.
3. Nitin Hardeniya, Jacob Perkins, Deepti Chopra, Nisheeth Joshi, ItiMathur: Natural Language Processing: Python and NLTK., **1**stEdition. Packt Publishing

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What do you understand by the term *collocations?* List their properties.
2. Define the term phrase structure grammar formally.

Course Outcome 2 (CO2):

1. State Bayes' theorem and explain briefly. Comment on it's usefulness in NLP.
2. How can n-grams be used to model natural language statistically?

Course Outcome 3 (CO3):

1. What is meant by attachment ambiguity? Show it using English sentences
2. What is meant by Word Sense Disambiguation (WSD)? Outline any one WSD algorithm

Course Outcome 4 (CO4):

1. How can HMM be used for Parts of speech tagging?
2. Outline an implementation procedure for HMM

Course Outcome 5 (CO5):

1. Show with an example how can probabilistic grammars be used to model human preferences in parsing.
2. Give the technique of Transformation-Based Learning of Tags

Course Outcome 6 (CO6):

1. Implement a python program for stop word removal in a simple paragraph.
2. Write a code to access a weather site and extract the forecast top temperature for your town or city today.

Model Question Paper

QP CODE:

Reg No: _______________

Name: __________________ **PAGES : 3**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST478

Course Name: Computational Linguistics

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Define Zipf's law.
2. List the uses of a corpus in language processing?
3. What is a Hidden Markov Model?
4. State Bayes' theorem and explain briefly. Comment on its usefulness in NLP.
5. What is meant by supervised disambiguation? What are its prerequisites ?
6. Consider the sentence: "the children ate the cake with a spoon". Construct the parse tree for it and explain the attachment ambiguity.
7. Discuss the properties of Markov chain useful in POS tagging.
8. Explain the features of PCFG.
9. What is NLTK? How is it useful in text processing ?
10. Write a Python program to extract different date formats from a text document.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Write a note on the following terms with example: **(9)**
(i) Collocations (ii) Concordances (iii) Phrase structure grammars

(b) Differentiate stemming and lemmatization with examples. **(5)**

OR

12. (a) Write a note on all parts of speech tags of English language **(9)**

(b) What are the differences between Rationalist and Empiricist to Language approaches **(5)**

13. (a) What do you mean by a probability distribution? **(5)**
What are the approaches used in SNLP to estimate probability distribution of linguistic events?

(b) Give a formal definition of Hidden Markov Model (HMM) and state the relevant assumption while using HMM for language modeling **(9)**

OR

14. (a) Assume that a particular type of syntactic error detected by a system A occurs once in 1,00,000 sentences on an average. This system detects an error correctly with a probability 0.05. Suppose the system reports an error in a test sentence. What is the probability that this is true? **(5)**

(b) List some of the problems associated with sparse data in SNLP. **(9)**
Write a note on n-gram Models over Sparse Data

15. (a) What do you understand by Disambiguation based on sense definitions. **(9)**
Write and explain any one algorithm for this.

(b) With the help of Bayes' rule, explain the Bayesian disambiguation algorithm. **(5)**

OR

16. (a) Write a note on selectional preferences with an example **(5)**

(b) What is meant by attachment ambiguity? List different attachment issues. **(9)**

17. (a) Write a note on Transformation-Based Learning of tags. Give it's algorithm **(9)**

(b) How can HMM be used for parts of speech tagging **(5)**

OR

18. (a) Write the formal definition of PCFG. **(5)**

Apply probabilistic parsing on the following sentence and find the correct parsing using the given grammar

Sentence: Astronomers saw stars with ears.

Probabilistic grammar:

S → NP VP	1.0	NP → NP PP	0.4
PP → P NP	1.0	NP → *astronomers*	0.1
VP → V NP	0.7	NP → *ears*	0.18
VP → VP PP	0.3	NP → *saw*	0.04
P → *with*	1.0	NP → *stars*	0.18
V → *saw*	1.0	NP → *telescopes*	0.1

(b) How do you find the probability of a string using inside and outside probabilities ? **(9)**

19. (a) Write a Python program for PoS tagging using the necessary Python packages. **(9)**

(b) Explain the process of Named Entity Recognition. **(5)**

List its uses and challenges involved.

OR

20. (a) Write a regular expression for removing punctuations, numbers and white spaces in a piece of text. **(9)**

(b) Write a Python program to count the number of sentences, words and line numbers in a given piece of text. Display each sentence along with that. **(5)**

TEACHING PLAN

No	Contents	No of Lecture Hrs (36 hrs)
Module - 1 (Preliminaries) (9 hrs)		
1.1	Introduction: Rationalist and Empiricist Approaches to Language-Questions that linguistics should answer-	1
1.2	Non-categorical phenomena in language-Language and cognition as probabilistic phenomena	1
1.3	The Ambiguity of Language: Why natural language processing is difficult	1
1.4	Lexical resources-Word counts	1
1.5	Zipf's laws-Collocations-Concordances	1
1.6	Linguistic Essentials: Parts of Speech and Morphology -Nouns and pronouns	1
1.7	Words that accompany nouns: Determiners and adjectives-Verbs-Other parts of speech	1
1.8	Phrase Structure-Phrase structure grammars	1
1.9	Semantics and Pragmatics-Corpus Based Work	1
Module – 2 (Mathematical Essentials) (7 hrs)		
2.1	Probability Theory-Probability spaces	1
2.2	Conditional probability and independence-Bayes' theorem	1
2.3	Random variables-Expectation and variance-Notation	1
2.4	Joint and conditional distributions-Standard distributions-Bayesian statistics	1
2.5	Statistical Inference: n-gram Models over Sparse Data-Bins: Forming Equivalence Classes	1
2.6	Markov Models-Hidden Markov Models: Why use HMMs?	1
2.7	General form of an HMM-Finding the probability of an observation-Finding the best state sequence	1
Module – 3 (Word Sense Disambiguation) (7 hrs)		
3.1	Methodological Preliminaries-Supervised and unsupervised learning	1
3.2	Upper and lower bounds on performance-Supervised Disambiguation	1
3.3	Bayesian classification-Dictionary based Disambiguation-	1
3.4	Disambiguation based on sense definitions-Thesaurus based disambiguation	1
3.5	Lexical Acquisition-Evaluation Measures	1

3.6	Verb Subcategorization-Attachment Ambiguity, PP attachment-Selectional Preferences	1
3.7	Semantic Similarity:Vector space measures-Probabilistic measures	1

	Module – 4 (Grammar) (8 hrs)	
4.1	Part-of-Speech Tagging-The Information Sources in Tagging	1
4.2	Markov Model Taggers-Hidden Markov Model Taggers-	1
4.3	Applying HMMs to POS tagging-The effect of initialization on HMM training-	1
4.4	Transformation-Based Learning of Tags	1
4.5	Probabilistic Context Free Grammars-Some Features of PCFGs	1
4.6	Questions for PCFGs	1
4.7	The Probability of a String -Using inside probabilities Using outside probabilities	1
4.8	Finding the most likely parse for a sentence-parsing for disambiguation, parsing model *vs.* language model	1
	Module - 5 (Language Processing with Python) (5 hrs)	
5.1	Introduction to NLTK	1
5.2	Text Wrangling and Text cleansing : Sentence Splitter, Tokenization, Stemming,	1
5.3	Lemmatization, Stop word removal , Rare word Removal, Spell Correction.	1
5.4	Part of Speech Tagging and NER.	1
5.5	Parsing Structure in Text: Shallow versus deep parsing, types of parsers	1

SEMESTER VIII

MINOR

CSD482	MINI PROJECT	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PWS	0	0	3	4	2019

Preamble: The objective of this course is to apply the fundamental concepts of different courses learned in respective Minor Streams: Software Engineering, Machine Learning and Networking. This course helps the learners to get an exposure to the development of application software/hardware solutions/ software simulations in the field of Computer Science and Engineering. It enables the learners to understand the different steps to be followed such as literature review and problem identification, preparation of requirement specification &design document, testing, development and deployment. Mini project enables the students to boost their skills, widen the horizon of thinking and their ability to resolve real life problems.

Prerequisite: A sound knowledge in courses studied in respective minor stream.

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Identify technically and economically feasible problems **(Cognitive Knowledge Level: Apply)**
CO2	Identify and survey the relevant literature for getting exposed to related solutions. **(Cognitive Knowledge Level: Apply)**
CO3	Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions of minimal complexity by using modern tools & advanced programming techniques (**Cognitive Knowledge Level: Apply)**
CO4	Prepare technical report and deliver presentation **(Cognitive Knowledge Level: Apply)**
CO5	Apply engineering and management principles to achieve the goal of the project **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO2	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔
CO3	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CO4	✔	✔	✔	✔	✔			✔	✔	✔	✔	✔
CO5	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Mark Distribution

Total Marks	CIE Marks	ESE Marks
150	75	75

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Project Guide **15 marks**

Project Report **10 marks**

Evaluation by the Committee (will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement) : **40 marks**

Student Groups with 4 or 5 members should identify a topic of interest in consultation with a Faculty Advisor/Project Coordinator/Guide. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives by strictly following steps specified in the teaching plan. Innovative design concepts, performance, scalability, reliability considerations, aesthetics/ergonomic, user experience and security aspects taken care of in the project shall be given due weight.

The progress of the mini project is evaluated based on a minimum of two reviews. The review committee may be constituted by a senior faculty member, Mini Project coordinator and project guide. The internal evaluation shall be made based on the progress/outcome of the project, reports and a viva-voce examination, conducted internally by a 3-member committee. A project report is required at the end of the semester. The project has to be demonstrated for its full design specifications.

End Semester Examination Pattern:

The marks will be distributed as

Presentation	: **30 marks**
Demo	: **20 marks**
Viva	: **25 marks.**
Total	: **75 marks**.

TEACHING PLAN

Students are expected to follow the following steps.

1. Review of Literature and Identification of a problem
2. Create an abstract with a problem statement, solution approach, technology stack, team, etc.
3. Create Requirements Specification
4. Create Design Document . This may include designs like,
    a. System Architecture Design
    b. Application Architecture Design
    c. GUI Design
    d. API Design
    e. Database Design
    f. Technology Stack
5. Deployment, Test Run & Get Results
6. Prepare Project Report

Guidelines for the Report preparation

A bonafide report on the mini project shall be submitted within one week after the final presentation. Minimum number of pages should be 40.

- Use Times New Roman font for the entire report – Chapter/Section Title – Times New Roman18, Bold; Heading 2 – Times New Roman16, Bold; Heading 3 – Times New Roman14, Bold; Body- Times New Roman 12, Normal.
- Line Spacing – Between Heading 2 – 3 lines, between lines in paragraph 1.5 lines.
- Alignments – Chapter/Section Title – Center, Heading 2 & 3 should be Left Aligned. Ensure that all body text is paragraph justified.
- Figures & Tables – Ensure that all Figures and Tables are suitably numbered and given proper names/headings. Write figure title under the figure and table title above the table.

- **Suggestive order of documentation:**

  i. Top Cover
  ii. Title page
  iii. Certification page
  iv. Acknowledgement
  v. Abstract
  vi. Table of Contents
  vii. List of Figures and Tables
  viii. Chapters
  ix. Appendices, if any
  x. References/Bibliography

SEMESTER VIII

HONOURS

CSD496	MINI PROJECT	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PWS	0	0	3	2	2019

Preamble: The objective of this course is to apply the fundamental concepts of courses learned in respective Honors Streams: Security in Computing, Machine Learning and Formal Methods. This course helps the learners to get an exposure to the development of application software/hardware solutions/ software simulations in the field of Computer Science and Engineering. It enables the learners to understand the different steps to be followed such as literature review and problem identification, preparation of requirement specification &design document, testing, development and deployment. Mini project enables the students to boost their skills, widen the horizon of thinking and their ability to resolve real life problems.

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CO2	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔
CO3	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CO4	✔	✔	✔	✔	✔			✔	✔	✔	✔	✔
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