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 $B = \{(x, y, z): x^2 + y^2 + z^2 \le 1\}$

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 $ln(1 + x), -1 < x \le 1$to find an approximate value of$ln2$.

3. Find the Fourier series of the function$f(x) = x^2, -2 \le x < 2, f(x + 4) = f(x)$. 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, 10^{th} edition, 2015.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10^{th}Edition, John Wiley & Sons, 2016.

Reference Books

1. J. Stewart, Essential Calculus, Cengage, 2^{nd} 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 $7\times10^{4.}$ 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) 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,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

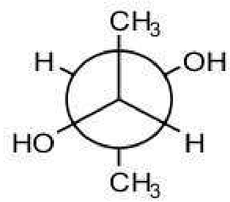
Answer all questions, each carries 3 marks Marks

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. ^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).

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

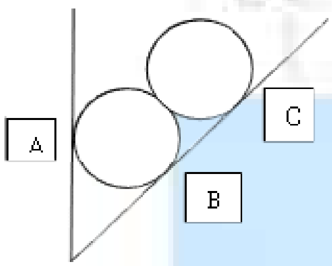
3. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

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.

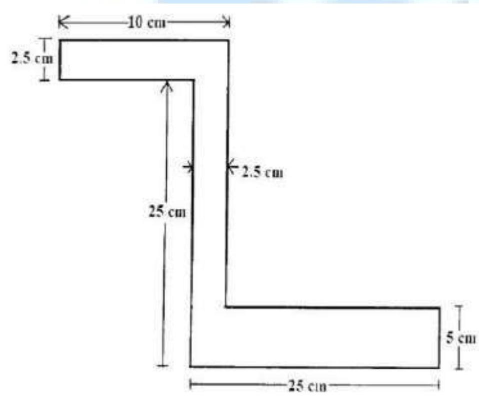


Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent equilibrium state of the body)	4
CO 4	To 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

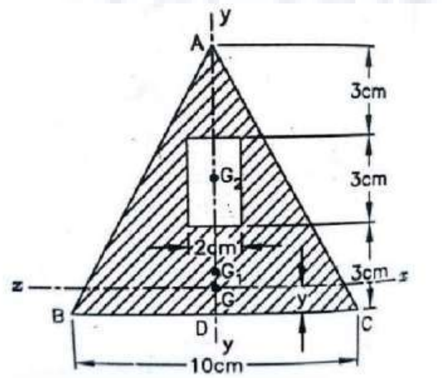
3. Determine the centroid of the given section



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.

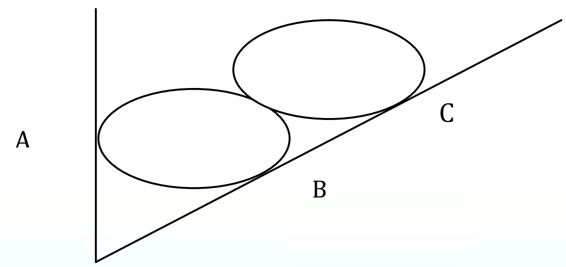
10. Highlight the principles of mechanics applied in the evaluation of elastic collusion of rigid bodies.

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)

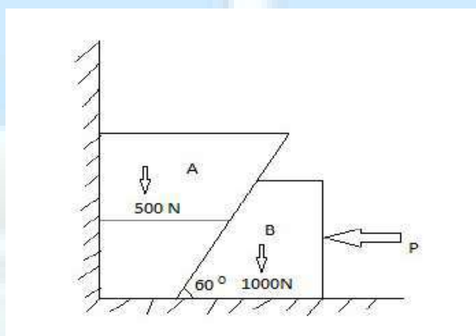


12. A string tied to a wall is made to pass over a pulley placed 2m away from it. A weight P is attached to the string such that the string stretches by 2m from the support on the wall to the location of attachment of weight. Determine the force P required to maintain 200 kg body in position for $\theta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

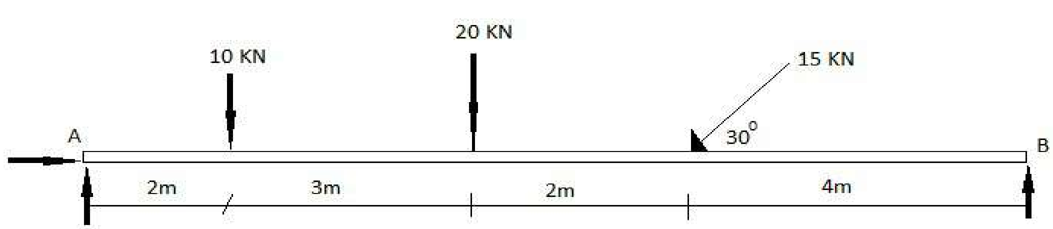
Module – 2

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)

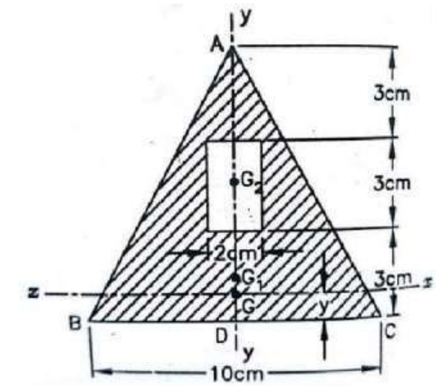


14. A beam is hinged at A and roller supported at B. It is acted upon by loads as shown below.
Find the reactions at A & B. (14 marks)

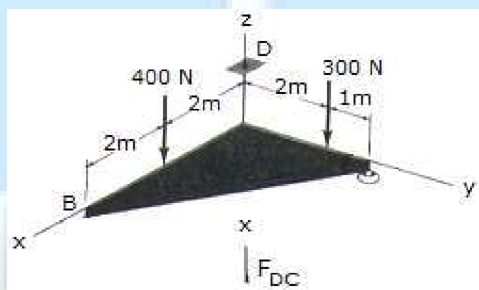


Module – 3

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		

<u>Assessment Pattern</u>

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

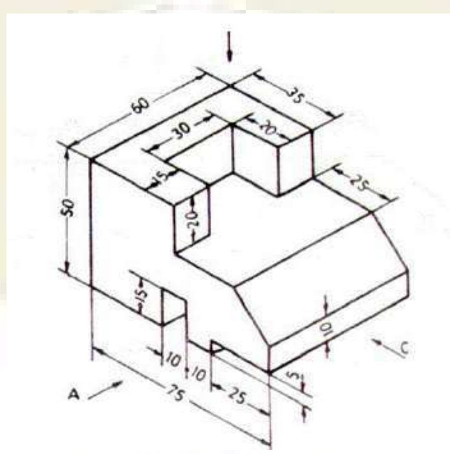
7. The frustum of a cone has base diameter 50mm and top diameter 40mm has a height of 60mm. It is paced centrally on top of a rectangular slab of size 80x60mm and of thickness 20mm. Draw the isometric view of the combination.

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.

<u>CO Questions</u>

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.

<u>CO Questions</u>

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

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

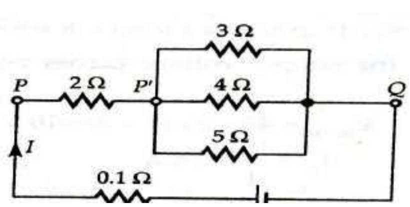
PART I

BASIC ELECTRICAL ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Calculate the current through the $4\,\Omega$ 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.

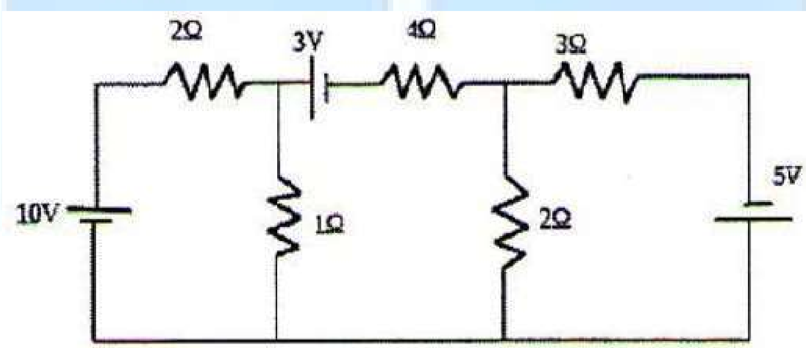
5. Compare electric and magnetic circuits. *(5x4=20)*

PART B

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

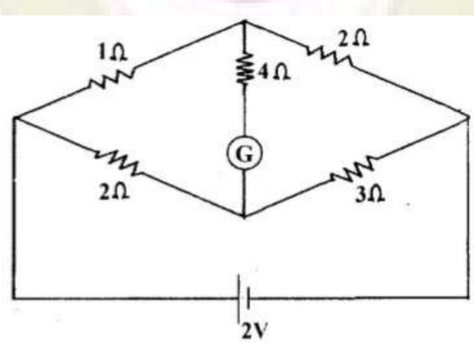
Module 1

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 $5\,\Omega$ 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 $\boldsymbol{F(x,y,z)} = x\boldsymbol{i} + y\boldsymbol{j} + z\boldsymbol{k}$ 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 $\boldsymbol{y'''} + \mathbf{3}y'' + 3y' + y = 30e^{-x}$ given $y(0) = 3, y'(0) = -3$ **,** $y''(0) = -47$

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},$sinax$,$cosax$,$e^{kx}sinax e^{kx}cosax$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

APJ ABDUL KALAM
TECHNOLOGICAL
UNIVERSITY
KTU
2014

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 $7\times10^{4.}$ 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) 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,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

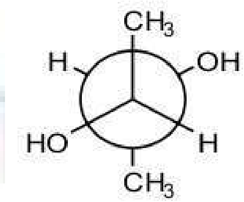
Answer all questions, each carries 3 marks Marks

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

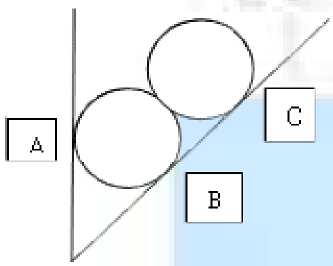
3. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

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.

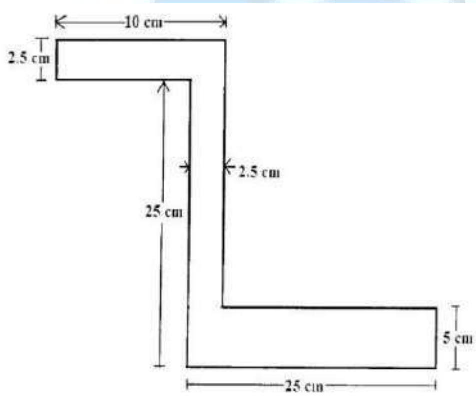


Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent equilibrium state of the body)	4
CO 4	To 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

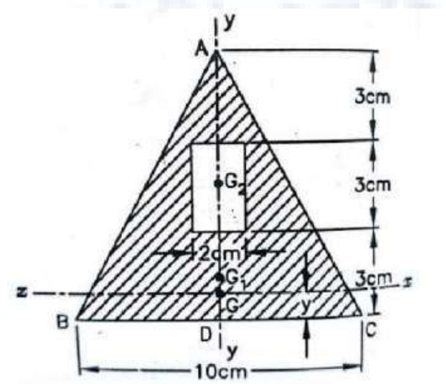
3. Determine the centroid of the given section



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.

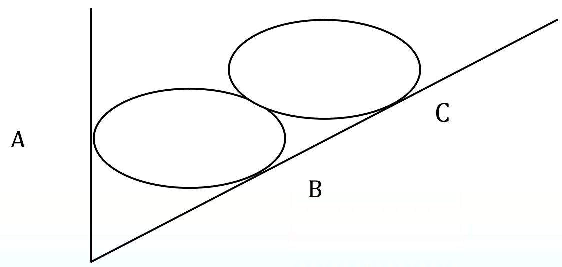
10. Highlight the principles of mechanics applied in the evaluation of elastic collusion of rigid bodies.

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)

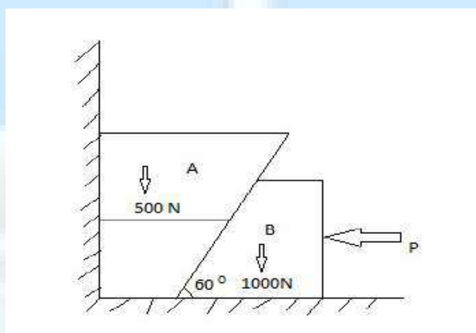


12. A string tied to a wall is made to pass over a pulley placed 2m away from it. A weight P is attached to the string such that the string stretches by 2m from the support on the wall to the location of attachment of weight. Determine the force P required to maintain 200 kg body in position for $\theta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

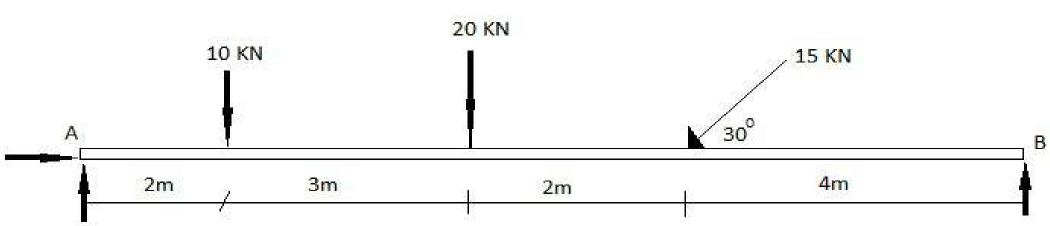
Module – 2

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)

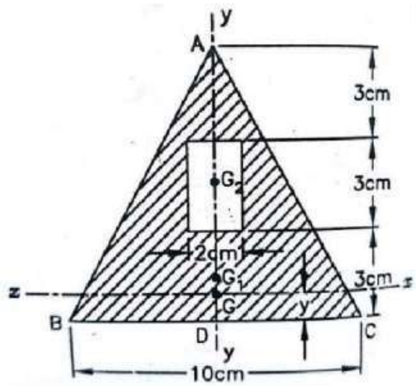


14. A beam is hinged at A and roller supported at B. It is acted upon by loads as shown below.
Find the reactions at A & B. (14 marks)

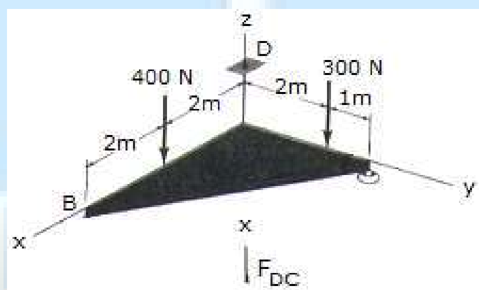


Module – 3

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		

<u>Assessment Pattern</u>

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

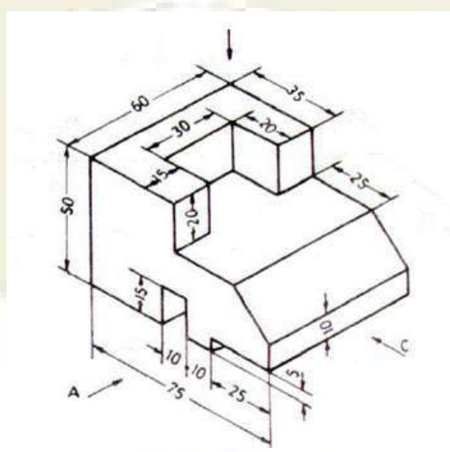
5. A triangular prism of base side 40mm and height 70mm is resting with its base on the ground and having an edge of the base perpendicular to VP. Section the solid such that the true shape of the section is a trapezium of parallel sides 30mm and 10mm. Draw the projections showing the true shape. Find 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^{o}C, 0.1MPa. 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 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

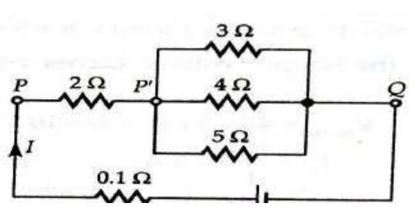
PART I

BASIC ELECTRICAL ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Calculate the current through the 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.

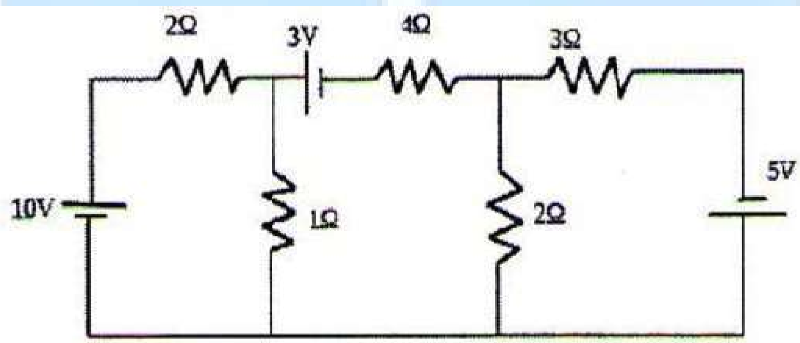
5. Compare electric and magnetic circuits. *(5x4=20)*

PART B

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

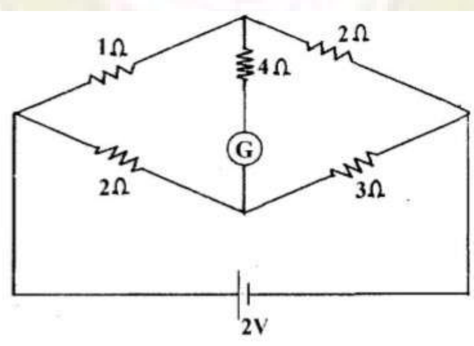
Module 1

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 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.

EST 102	PROGRAMING IN C	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	2	1	2	4	2019

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 ^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 -3

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT 201	Fluid Mechanics and Machinery	PCC	3	1	0	4

Preamble: The objective of learning Fluid Mechanics and Machinery is to understand, the fundamental concepts of fluid mechanics, various flow measuring instruments and their applications, various types of hydraulic pumps and their characteristic parameters. By learning the course, one must be able to analyse various problems on fluid statics, kinetics and dynamics and the various types of hydraulic turbines and their operating principles.

Prerequisite: Introduction to Mechanical Engineering Sciences

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

CO 1	Understand the fundamental concepts of fluid mechanics
CO 2	Analyse various problems on fluid statics, kinetics and dynamics
CO 3	Understand various flow measuring instruments and their applications
CO 4	Analyse the various types of hydraulic turbines and their operating principles
CO 5	Understand the various types of hydraulic pumps and their characteristic parameters
CO 6	Do innovative projects by analysing existing fluid systems and design new fluid systems using the principles learned

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	-	1	1	1	1
CO 2	2	-	1	-	-	1	2	-	-	1	1	2
CO 3	2	1	3	1	-	1	2	-	-	2	1	1
CO 4	2	-	2	-	-	3	2	-	-	2	1	1
CO 5	2	-	1	-	-	1	2	-	-	2	1	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	20	40
Apply	10	10	40
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. State the basic properties of fluid.
2. Differentiate Newtonian and non- Newtonian fluids.
3. Define Newton's law of viscosity.

Course Outcome 2 (CO2)

1. State Bernoulli's equation for fluid dynamics
2. List the various pressure measuring instruments.
3. Define Darcy- Weisbach equation

Course Outcome 3(CO3):

1. State the concepts of laminar and turbulent boundary layer
2. List the various flow measuring instruments.
3. Describe the different velocity measuring methods.

Course Outcome 4 (CO4):

1. Explain the impact of jets on vanes.
2. Differentiate Impulse and Reaction Turbines
3. List the importance of draft tubes, surge tanks, cavitation in turbines

Course Outcome 5 (CO5):

1. Illustrate the working of Positive displacement pumps.

2. Explain the importance of multistage pumps

3. Describe about the Rotary motion of liquids.

Course Outcome 6 (CO6):

1. Design an orifice meter to measure the oxygen flow rate for an experiment set-up

2. Compare and analyse the properties Francis and Kaplan turbines

Syllabus

Module 1

Fundamental concepts: Properties of fluid - density, specific weight, viscosity, surface tension, capillarity, vapour pressure, bulk modulus, compressibility, velocity, rate of shear strain, Newton's law of viscosity, Newtonian and non-Newtonian fluids, real and ideal fluids, incompressible and compressible fluids.

Module 2

Fluid statics: Atmospheric pressure, gauge pressure and absolute pressure. Pascal's Law, measurement of pressure - piezo meter, manometers, pressure gauges.
Fluid kinematics and dynamics: Types of flow, path line, streak line and stream line. Continuity equation, Euler's equation, Bernoulli's equation. Reynolds experiment, Reynold's number. Hagen- Poiseuille equation, head loss due to friction, friction, Darcy- Weisbach equation, Chezy's formula (No derivations), compounding pipes, branching of pipes, siphon effect, water hammer transmission of power through pipes (simple problems)

Module 3

Boundary layer theory: Basic concepts, laminar and turbulent boundary layer, displacement, momentum, energy thickness, drag and lift, separation of boundary layer.
Flow rate measurements- venturi and orifice meters, notches and weirs (description only for notches, weirs and meters), practical applications, velocity measurements- Pitot tube and Pitot –static tube.

Module 4

Hydraulic turbines: Impact of jets on vanes - flat, curved, stationary and moving vanes - radial flow over vanes. Impulse and Reaction Turbines – Pelton Wheel constructional features - speed ratio, jet ratio & work done, losses and efficiencies, (theory only)

Francis turbine constructional features, work done and efficiencies – axial flow turbine (Kaplan) constructional features, work done and efficiencies(theory only), draft tubes, surge tanks, cavitation in turbines

Module 5

Positive displacement pumps: reciprocating pump, indicator diagram, air vessels and their purposes, slip, negative slip and work required and efficiency, effect of acceleration and friction on indicator diagram (no derivations), multi cylinder pumps.
Rotary motion of liquids: – free, forced and spiral vortex flows, (no derivations), centrifugal pump, working principle, impeller, casings, manometric head, work, efficiency and losses, priming, specific speed, multistage pumps, selection of pumps, pump characteristics

Text Books

1. *Fluid Mechanics and Hydraulic Machines* by Dr.R.K.Bansal.Revided Ninth Edition.
   Modi P. N. and S. M. Seth, *Hydraulics & Fluid Mechanics*, S.B.H Publishers, New Delhi, 2002.
2. Kumar D. S., *Fluid Mechanics and Fluid Power Engineering,* S. K. Kataria & Sons, New Delhi, 1998.

Reference Books

1. J. F. Douglas, “Fluid Mechanics”*,* Pearson education.
2. Cengel Y. A. and J. M. Cimbala, Fluid Mechanics, Tata McGraw Hill, 2013
3. Robert W. Fox and Mc Donald, “Introduction to fluid dynamics”, John Wiley and sons
4. K. Subrahmanya, “Theory and applications of fluid mechanics”*,* (TMH)
5. Shames. I. H, “Mechanics of fluids”.
6. Jagadish Lal, “Fluid mechanics and Hydraulic machines”.
7. R K Bansal, “Hydraulic Machines

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: MUT 201

Course Name: Fluid Mechanics and Machinery

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

PART A

Answer all Questions.
Each question carries 3 Marks

1. Define the following :
   a. Specific gravity. b.Viscosity.
2. Explain Newton's law of viscosity.
3. Differentiate between gauge pressure and absolute pressure.
4. Explain Reynold's experiment on Laminar flow.
5. Define specific speed of a turbine.
6. Derive the expression for work done by a jet on a curved vane moving with a velocity *u.*
7. Define the working of a reciprocating pump.
8. Explain the function of air vessels.
9. Describe the function of the casing in centrifugal pump.
10. What do you mean by NPSH ?

PART B

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

11. If a mercury barometer reads 700 mm and a Bourdon gauge at a point in a flow system reads 500 kN/m^2. What is the absolute pressure at the point ?

OR

12. A horizontal venturimeter with inlet dia 200 mm and throat dia 100 mm is used to measure the flow of water. The inlet pressure is 0.18 N/mm^2 and the vacuum, pressure at the throat is 280 mm of mercury. Find the rate of flow. Take cd =0.98.

13. In a circular pipe of dia 100 mm a fluid of viscosity 7 poise and sp. gr. 1.5 is flowing. If the maximum shear stress at the wall of the pipe is 196.2 N/m^2 find (i) the pressure gradient ; (ii) the average velocity ; (iii) Reynold's number.

OR

14. A crude oil of viscosity 0.9 paise and relative density 0.9 is flowing through s horizontal pipe of dia 100 mm length 12 m. Calculate the difference of pressure at the two ends of the pipe, if 785 N of the oil is collected in a tank in 25 seconds.
15. A pelton wheel has a mean bucket speed of 12 m/s and is supplied with water at the rate of

0.7 m^3/s under a head of 3 over. If the bucket deflect the jet through an angle of 160° find the power and efficiency of the turbine.

OR

16. A turbine is to operate under a head of 25 m at 200 r.p.m. The discharge is 9 m^3/s. If the overall efficiency is 90% determine :Power generated, Specific speed of turbine, Type of turbine.
17. A single acting reciprocating pump has a piston dia of 150 mm and stroke length 350 mm. The
centre of the pump is 3.5 m above the water surface in the sump and 22 m below the delivery water level. Both the suction and delivery pipes have same dia of 100 mm and are 5 m and 30 m long respectively. If the pump is working at 30 r.p.m. determine (i) the pressure heads on the piston at the beginning, middle and end of both suction and delivery strokes ; (ii) the power required to drive the pump. Take H_{atm} as 10.3 m of water.

OR

18. The bore and stroke of a double-acting single-cylinder reciprocating pump running at 30 r.p.m. are 200 mm and 400 mm respectively. The sump is 1.2 m below the pump axis and draws water thru a suction pipe of 100 mm dia and 3 m long. The water delivers to a tank at 28 m and thru a 100 mm dia pipe and 38 m long. Determine the net force due to fluid pressure on the piston when it has moved thru a distance of 100 m from the IDC. Take 0.006 for both suction and delivery pipes.
19. It is required to pump water out of a deep well under a total head of 90 m. A number of pumps with a design speed of 1000 rpm specific speed 30 and rated capacity of .015 m^3 per second are available. How many pumps are required and how should they be connected whether in series or parallel.

OR

20. A centrifugal pump in which water enters radially has an impeller dia. 360 mm and width 180 mm at the inlet delivers water to a head of 165 mm. At the outlet impeller dia. Is 720 mmand width is 90 mm. The blades are curved backwards at 30° to the tangent at the exit and the discharge is 0.389 m^3 per second. Speed of pump is 1200 rpm. Determine (i) Theoretical head developed (ii) Manometric efficiency (iii) Vane angle at inlet. Take overall efficiency as 70%

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Fundamental concepts**	
1.1	Properties of fluid - density, specific weight	1
1.2	Viscosity, surface tension, capillarity	1
1.3	Capillarity, vapour pressure	1
1.4	Bulk modulus, compressibility	1
1.5	Velocity, rate of shear strain	1
1.6	Newton’s law of viscosity	1
1.7	Newtonian and non-Newtonian fluids	1
1.8	Real and ideal fluids	1
1.9	Incompressible and compressible fluids	1
2	**Fluid statics, kinematics and dynamics**	
2.1	Atmospheric pressure, gauge pressure and absolute pressure	1
2.2	Pascal’s Law	1
2.3	Measurement of pressure - piezo meter, manometers, pressure gauges.	1
2.4	Types of flow, path line, streak line and stream line	1
2..5	Continuity equation, Euler’s equation	1
2.6	Bernoulli’s equation. Reynolds experiment, Reynold’s number	1
2.7	Hagen- Poiseuille equation, head loss due to friction, friction	1
2.8	Darcy- Weisbach equation, Chezy’s formula (No derivations)	1
2.9	Compounding pipes, branching of pipes, siphon effect	1
2.10	Water hammer transmission of power through pipes (simple problems)	1
3	**Boundary layer theory & Flow rate measurements**	
3.1	Boundary layer theory: Basic concepts	1
3.2	Laminar and turbulent boundary layer displacement, momentum, energy thickness	1
3.3	Drag and lift, separation of boundary layer	1
3.4	Flow rate measurements- venturi and orifice meters	1
3.5	Notches and weirs, practical applications	1
3.6	Velocity measurements- Pitot tube	1
3.7	Pitot –static tube	1
4	**Hydraulic turbines**	
4.1	Impact of jets on vanes - flat, curved, stationary vanes	1
	Impact of jets on vanes - moving vanes	1
4.2	Impact of jets on vanes -radial flow over vanes	1
4.3	Impulse and Reaction Turbines- Introduction	1

4.4	Pelton Wheel constructional features - speed ratio, jet ratio & work done, losses and efficiencies	1
4.5	Francis turbine constructional features, work done and efficiencies	2
4.6	Axial flow turbine (Kaplan) constructional features, work done and efficiencies	2
5	**Positive displacement pumps & Rotary motion of liquids**	
5.1	Positive displacement pumps: reciprocating pump, indicator diagram	1
5.2	Air vessels and their purposes, slip, negative slip and work required and efficiency	2
5.3	Effect of acceleration and friction on indicator diagram	1
5.4	Multi cylinder pumps	1
5.5	Rotary motion of liquids: – free, forced and spiral vortex flows	1
5.6	Centrifugal pump, working principle, impeller, casings	1
5.7	Manometric head, work, efficiency and losses	1
5.8	Priming, specific speed, multistage pumps	1
5.9	Selection of pumps, pump characteristics	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT203	AUTO CHASSIS	PCC	4	0	0	4

Preamble: This course aims at providing

- **an in-sight in the area of a vehicle chassis, its different components and arrangements**
- **a deeper knowledge on the functional sub systems in the chassis except the power pack.**
- **Basic understanding on the hybrid and electric vehicle arrangements**

Prerequisite: NIL

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

CO 1	Distinguish between the different types of chassis frame construction and its arrangements
CO 2	Evaluate the different types of front axles and steering systems used in vehicles
CO 3	Identify the suspension system and different classes of wheels used in a vehicle
CO 4	Understand the braking systems and its testing methods
CO 5	Comparing the different types of rear axles and adjoining components

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	-	1	1	1	1
CO 2	2	-	1	-	-	1	2	-	-	1	1	2
CO 3	2	1	3	1	-	1	2	-	-	2	1	1
CO 4	2	-	2	-	-	3	2	-	-	2	1	1
CO 5	2	-	1	-	-	1	2	-	-	2	1	2

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	10	10	20
Apply	20	20	50
Analyse	10	10	20
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. Are you able to identify the different automobile chassis frame constructions and its merits?

Course Outcome 2 (CO2)

1. Can you identify the different type of steering and front axle used in the vehicle?

Course Outcome 3(CO3):

1. Can you decide on the suspension and wheels which are best suited for the vehicle you are making?

Course Outcome 4 (CO4):

1. Are you able to identify the importance of speed and its relation with the braking system of a vehicle?

Course Outcome 5 (CO5):

1. Can you identify the working of differential and type of rear axle being employed in a vehicle?

Model Question paper

QP CODE: **PAGES:…**

Reg. No: _______________ **Name :_______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT 203

Course Name: AUTO CHASSIS

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

Part A

(Answer all questions. Each question carry 3 marks)

1. List down the different chassis layouts used in automobiles according to the position of the prime mover. Explain any one of them
2. What are the different types of stresses coming on the chassis frame? Explain them.
3. Explain the front wheel alignment geometry with neat sketches.
4. With a neat diagram, explain the steering linkage system used for an independent suspension from steering wheel to front wheels.
5. Why do we require a suspension system? Explain the functions of a suspension system.

6. Explain the constructional details of a radial tyre with a cross sectional sketch.
7. What are the differences between disc brakes and drum brakes? Which one is superior and why?
8. Explain the components and working of brake-by-wire system.
9. Why do we need a differential? Explain the working principle of differential with a sketch.
10. Why is axle shaft made of solid bar and propeller shaft made of hollow tube?

Part B

Answer any one full question from each module.

Each question carries 14 Marks

11. (a) List down the material composition used for the frame material (7)

    (b) Explain the different cross sections of the frame (7)

OR

12. (a) Explain ladder frame and X-frame with suitable sketches (9)

    (b)What is the difference between fully forward and semi forward type of heavy-duty chassis construction? Give two examples for both types. (5)

13. Explain Ackermann steering mechanism with a neat sketch and derive the condition for true rolling (14)

OR

14. Explain the working of Davis steering mechanism and state its advantage and disadvantage with Ackermann steering. Why is Davis mechanism not in use now? (14)

15. (a) Explain the most commonly used independent suspension system for cars. (7)

    (b) Explain the construction and working of leaf springs. Why do we require helper springs? (7)

OR

16. Explain the different types of rims used in an automobile with suitable sketches. (14)

17. (a)Why do we have vehicles with disc brakes at front and drum at rear and not vice versa? (7)

    (b)Explain the term leading shoe and trailing shoe in drum brake. Which is more effective in braking based on the equations of brake torque? (7)

OR

18. Explain the term ESP. Explain its working and different types of controls (14)

19. Explain the different types of gears used in final drive for a front engine rear wheel drive vehicle with neat sketches (14)

OR

20. Explain the constructional details of semi floating and fully floating axles with suitable sketches. (14)

Syllabus

Module	Contents	Hours	Sem.Exam Marks
Module 1: INTRODUCTION	Classification of automobiles and their layout with reference to prime mover location and drive, Frame types, Constructional details –Materials – Testing of frames chassis defects., Integrated body construction- loads, moments and stresses on frame members (basics), Types of chassis layout of hybrid and electric vehicles, Types of chassis- fully forward, semi forward, Truck or bus chassis, two & three wheeler chassis layout,	9	20%
Module 2: FRONT AXLE AND STEERING	Front Axle types. Construction details. Materials. Front wheel geometry viz. Camber, kingpin inclination, included angle, caster, toe-in and toe-out. Conditions for true rolling motion of road wheels during steering. Steering mechanisms, Ackermann and Davis steering, Constructional details of steering linkages, Steering linkage layout for conventional and independent suspensions. Different types of steering gear boxes. Turning radius, wheel wobble and shimmy. Power and power assisted steering – Electric steering – Steer by wire	9	20%
Module 3: SUSPENSION SYSTEM, WHEELS AND TYRES	Types of suspension. Factors influencing ride comfort, Suspension springs – leaf spring types, shackle and mounting brackets, coil and torsion bar springs. Spring materials, Independent front and rear suspension systems, inter connected suspension, Rubber, pneumatic, hydro-elasitc, hydro-gas suspension, Active suspension system. Hydraulic dampers, Gas filled dampers, Magneto Rheological fluids. Types of wheels, Construction of wheel assembly, aspect ratio, tyre specifications, Types of tyres and constructional details. Static and rolling properties of pneumatic tyres, Wheel balancing and wheel alignment.	9	20%
Module 4: BRAKES	Types of brakes, Principles of shoe brakes- Constructional details, materials. Braking torque developed by leading and trailing shoes, self energising brakes, Disc brake theory, types, constructional details, advantages. Brake actuating system – mechanical, hydraulic, pneumatic brakes, brake compensation. Factors affecting brake performance viz. operating temperature, area of brake	9	20%

	lining, brake clearance. Exhaust brakes. Power and power assisted brakes - Antilock braking system (ABS) and Electronic stability program(ESP), Retarded engine brakes, eddy retarders ,Regenerative braking system – Brake by wire- Testing of brakes – Road tests, brake bleeding, garage tests and tests for Type Approval under IS:11852		
Module 5: FINAL DRIVE & REAR AXLE:	Purpose of final drive & drive ratio, Different types of final drives, need of differential, Constructional details and working of differential unit, Non-slip differential, Differential lock, Differential housing, Function of rear axle, Construction, Types of loads acting on rear axle, Axle casings, Axle types - semi-floating, three quarter and full floating axle shafts, Final drive lubrication. Twin Speed final drive. Final drive for multi-axle vehicles.	9	20%

Text Books

1. Kripal Singh, Automobile Engineering, ADW Vol II, Standard Publisher, New Delhi , 2006
2. N.K. Giri, Automotive Mechanics, Kanna Publishers, 2007

Reference Books

1. Heldt P.M., Automotive Chassis, Chilton Co., New York, 1990
2. Newton Steeds and Garret, Motor Vehicles, 13th Edition, Butterworth, London, 2005.
3. Heinz Haisler, Advanced Vehicle Technology, Butterworth, London, 2005.
4. Stuart Mills and Julie Wilson, How to Design and Build an Electric Car or Vehicle,
5.Seith Leitman, Build your own electric vehicle, 3rd edition, McGraw Hill education, 2013

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction - Discussion on syllabus, Cos and POs**	
1.1	Classification of automobiles	1
1.2	Layouts based on the location of engine and drive	1
1.3	Frames, Constructional details –Materials	1
1.4	Integrated body construction	1
1.5	Study of loads, moments and stresses on frame members (basics)	1
1.6	Types of chassis layout of hybrid and electric vehicles	1
1.7	Types of chassis- fully forward, semi forward,	1
1.8	Truck or bus chassis,	1
1.9	Two & three wheeler chassis layout.	1

2	**Front axle and Steering**	
2.1	Front Axle types. Construction details. Materials.	1
2.2	Front wheel geometry viz. Camber, kingpin inclination, caster, toe-in and toe-out.	1
2.3	Conditions for true rolling motion of road wheels during steering	1
2.4	Steering geometry. Ackermann and Davis steering	1
2..5	Constructional details of steering linkages	1
2.6	Steering linkage layout for conventional and independent suspensions	1
2.7	Different types of steering gear boxes	1
2.8	Turning radius, wheel wobble and shimmy	1
2.9	Power and power assisted steering – Electric steering – Steer by wire	1
3	**Suspension System, Wheels and Tyres**	
3.1	Types of suspension. Factors influencing ride comfort	1
3.2	Suspension springs – leaf spring, shackle and mounting brackets, coil and torsion bar springs, Spring materials	1
3.3	Independent suspension – front and rear	1
3.4	Rubber, pneumatic, hydro-elasitc, hydro-gas suspension	1
3.5	Hydraulic dampers, Magneto Rheological fluids	1
3.6	Design of leaf springs	1
3.7	Types of wheels. Construction of wheel assembly	1
3.8	Types of tyres and constructional details.	1
3.9	Static and rolling properties of pneumatic tyres, Wheel balancing and alignment	1
4	**Brakes**	
4.1	Types of brakes. Principles of shoe brakes. Constructional details, materials	1
4.2	Braking torque developed by leading and trailing shoes	1
4.3	Disc brake theory, constructional details, advantages	1
4.4	Brake actuating system – mechanical, hydraulic, pneumatic. brake compensation	1
4.5	Factors affecting brake performance viz. operating temperature, area of brake lining, brake clearance.	1
4.6	Exhaust brakes. Power and power assisted brakes	1
4.7	Antilock braking system	1
4.8	Retarded engine brakes, eddy retarders ,Regenerative braking system – Brake by wire	1
4.9	Testing of brakes – Road tests, garage tests and tests for Type Approval under IS:11852	1

5	**Final drive and rear axle**	
5.1	Purpose of final drive & drive ratio	1
5.2	Different types of final drives	1
5.3	Need of differential, Constructional details of differential unit,	1
5.4	Non-slip differential, Differential lock, Differential housing	1
5.5	Function of rear axle, Construction, Types of loads acting on rear axle	2
5.6	Axle types - semi-floating, full floating	1
5.7	Axle shafts, Final drive lubrication	1
5.8	Twin Speed final drive. Final drive for multi-axle vehicles	1

MET 205	METALLURGY & MATERIAL SCIENCE	CATEGORY	L	T	P	Credits	Year of Introduction
		PCC	3	1	0	4	2019

Preamble:

Understanding of the correlation between the chemical bonds and crystal structure of metallic materials to their mechanical properties.

Recognize the importance of crystal imperfections including dislocations in plastic deformation.

Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

Examine the mechanisms of materials failure through fatigue and creep.

To determine properties of unknown materials and develop an awareness to apply this knowledge in material design

Prerequisite: PHT 110 Engineering Physics and CYT 100 Engineering Chemistry

Course Outcomes - At the end of the course students will be able to

CO 1	Understand the basic chemical bonds, crystal structures (BCC, FCC, and HCP), and their relationship with the properties.
CO 2	Analyze the microstructure of metallic materials using phase diagrams and modify the microstructure and properties using different heat treatments.
CO 3	How to quantify mechanical integrity and failure in materials.
CO 4	Apply the basic principles of ferrous and non-ferrous metallurgy for selecting materials for specific applications.
CO 5	Define and differentiate engineering materials on the basis of structure and properties for engineering applications.

Mapping of course outcomes with program outcomes (Minimum requirements)

	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		-	-	2	-	-	-	-	-	-	-	-
CO 4		-	-	-	3	-	-	-	-	-	-	-
CO 5	-	-	-	-		-	-	-	-	-	-	2

ASSESSMENT PATTERN

Bloom's taxonomy	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 11 (Marks)	
Remember	25	25	25
Understand	15	15	15
Apply	30	25	30
Analyze	10	10	10
Evaluate	10	15	10
Create	10	10	10

Mark distribution

Total Marks	CIE marks	ESE marks	ESE duration
150	50	100	3 Hours

Continuous Internal Evaluation (CIE) Pattern:

Attendance	10 marks
Regular class work/tutorials/assignments	15 marks
Continuous Assessment Test (Minimum 2 numbers)	25 marks

End semester 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): Understand the basic chemical bonds, crystal structures (BCC, FCC, and HCP), and their relationship with the properties.

1. What are the attributes of atomic and crystalline structures into the stress - strain curve?
2. Explain the significance of long range and short range order of atomic arrangement on mechanical strength.
3. What is the difference between an allotrope and a polymorphism?
4. Draw the (112) and (111) planes in simple cubic cell.

Course Outcome 2 (CO2): Analyze the microstructure of metallic materials using phase diagrams and modify the microstructure and properties using different heat treatments.

1. What is the driving force for recrystallisation and grain growth of metallic crystals?
2. What is the driving force for the formation of spheroidite.
3. What is tempered martensite?
4. Why 100 % pure metals are weak in strength?

Part -B

Course Outcome 3 (CO3): How to quantify mechanical integrity and failure in materials

1. A small hole is drilled through a steel plate ahead of a crack, whether it can stop the crack's progress until repairs can be made. Explain in detail and derive the equation for the principle.
2. Draw and explain S-N curves for ferrous and non-ferrous metals. Explain different methods to improve fatigue resistance.
3. Explain different stages of creep; Give an application of creep phenomenon. What is superplasticity?

Course Outcome 4 (CO4): Apply the basic principles of ferrous and non-ferrous metallurgy for selecting materials for specific applications.

1. What are the classification, compositions and applications of high speed steel? identify 18:4:1
2. Describe the composition, properties, and use of Bronze and Gun metal.
3. Explain the importance of all the non-ferrous alloys in automotive applications. Elaborate on the composition, properties and typical applications of any five non-ferrous alloys.

Course Outcome 5 (CO5): Define and differentiate engineering materials on the basis of structure and properties for engineering applications.

1. Carbon is allowed to diffuse through a steel plate 15 mm thick. The concentrations of carbon at the two faces are 0.65 and 0.30kgC/m^3Fe, which are maintained constant. If the pre-exponential and activation energy are $6.2x10^{-}7m^2/s$ and 80,000 J/mol, respectively, compute the temperature at which the diffusion flux is 1.43 x $10^{-}9$ kg/m^2-s.
2. Explain the fundamental effects of alloying elements in steel on polymorphic transformation temperatures, grain growth, eutectoid point, retardation of the transformation rates, formation and stability of carbides.
3. Describe the kind of fracture which may occur as a result of a loose fitting key on a shaft.

SYLLABUS

MODULE - 1

Earlier and present development of atomic structure - Primary bonds: - characteristics of covalent, ionic and metallic bond - properties based on atomic bonding: - Secondary bonds: - classification, application. *(Brief review only).*

Crystallography: - SC, BCC, FCC, HCP structures, APF - theoretical density simple problems - Miller Indices: - crystal plane and direction - Modes of plastic deformation: - Slip and twinning -Schmid's law - Crystallization: Effects of grain size, Hall - Petch theory, simple problems.

MODULE - II

Classification of crystal imperfections - forest of dislocation, role of surface defects on crack initiation- Burgers vector –Frank Read source - Correlation of dislocation density with strength and nano concept - high and low angle grain boundaries– driving force for grain growth and applications - Polishing and etching - X – ray diffraction, simple problems –SEM and TEM - Diffusion in solids, fick's laws, mechanisms, applications of diffusion in mechanical engineering, simple problems.

MODULE - III

Phase diagrams: - need of alloying - classification of alloys - Hume Rothery`s rule - equilibrium diagram of common types of binary systems: five types - Coring - lever rule and Gibb`s phase rule - Reactions- Detailed discussion on Iron-Carbon equilibrium diagram with microstructure and properties -Heat treatment: - TTT, CCT diagram, applications - Tempering- Hardenability, Jominy end quench test, applications- Surface hardening methods.

MODULE - IV

Strengthening mechanisms - cold and hot working - alloy steels: how alloying elements affecting properties of steel - nickel steels - chromium steels - high speed steels -cast irons - principal non ferrous alloys.

MODULE - V

Fatigue: - creep -DBTT - super plasticity - need, properties and applications of composites, super alloy, intermetallics, maraging steel, Titanium - Ceramics:- structures, applications.

Text Books

1. Callister William. D., Material Science and Engineering, John Wiley, 2014
2. Higgins R.A. - Engineering Metallurgy part - I – ELBS,1998

Reference

1. Avner H Sidney, Introduction to Physical Metallurgy, Tata McGraw Hill,2009
2. Anderson J.C. *et.al*., Material Science for Engineers, Chapman and Hall,1990
3. Clark and Varney, Physical metallurgy for Engineers, Van Nostrand,1964
4. Dieter George E, Mechanical Metallurgy, Tata McGraw Hill, 1976
5. Raghavan V, Material Science and Engineering, Prentice Hall,2004
6. Reed Hill E. Robert, Physical metallurgy principles, 4th edition, Cengage Learning,2009
7. Myers Marc and Krishna Kumar Chawla, Mechanical behavior of materials, Cambridge University press,2008
8. Van Vlack -Elements of Material Science - Addison Wesley,1989
9. https://nptel.ac.in/courses/113/106/113106032

MODEL QUESTION PAPER

METALLURGY & MATERIAL SCIENCE - MET 205

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

Part – A

Answer all questions.

Answer all questions, each question carries 3 marks

1. What is a slip system? Describe the slip systems in FCC, BCC and HCP metals
2. NASA's *Parker Solar Probe* will be the first-ever mission to "touch" the Sun. The spacecraft, about the size of a small car, will travel directly into the Sun's atmosphere about 4 million miles from the earth surface. Postulate the coolant used in the parker solar probe with chemical bonds.
3. What is the driving force for grain growth during heat treatment
4. What are the roles of surface imperfections on crack initiation
5. Explain the difference between hardness and hardenability.
6. What is tempered martensite? Explain its structure with sketch.
7. Postulate, why cast irons are brittle?
8. How are properties of aluminum affected by the inclusion of (a) copper and (b) silicon as alloying elements?
9. What is the grain size preferred for creep applications? Why. Explain thermal fatigue?
10. Explain fracture toughness and its attributes into a screw jack?

PART -B

Answer one full question from each module.

MODULE – 1

11. **a.** Calculate the APF of SC, BCC and FCC (7 marks).

    b. What is slip system and explain why FCC materials exhibit ductility and BCC and HCP exhibit brittle nature with details of slip systems (7 marks).

OR

12. Explain the effect of: (i) Grain size; (ii) Grain size distribution and (iii) Grain orientation (iv) Grain shape on strength and creep resistance with neat sketches. Attributes of Hall-Petch equation and grain boundaries (14 marks).

MODULE – 2

13. **a**. Describe step by step procedure for metallographic specimen preparation? Name different types etchants used for specific metals and methods to determine grain size (7 marks).

b. Carbon is allowed to diffuse through a steel plate 15 mm thick. The concentrations of carbon at the two faces are 0.65 and 0.30 kgC/m^3Fe, which are maintained constant. If the pre-exponential and activation energy are 6.2x10^-7m^2/s and 80,000 J/mol, respectively, compute the temperature at which the diffusion flux is 1.43 x 10^-9 kg/m^2-s (7 marks).

OR

14. a**.** Explain the fundamental differences of SEM and TEM with neat sketches (7 marks).

b**.** A beam of X-rays wavelength 1.54Å is incident on a crystal at a glancing angle of 8º35' when the first order Bragg's reflection occurs calculate the glancing angle for third order reflection (7 marks).

MODULE – 3

15. Postulate with neat sketches, why 100% pure metals are weaker? What are the primary functions of alloying? Explain the fundamental rules governing the alloying with neat sketches and how is it accomplished in substitution and interstitial solid solutions (14 marks).

OR

16. Draw the isothermal transformation diagram of eutectoid steel and then sketch and label (1) A time temperature path that will produce 100% pure coarse and fine pearlite (2) A time temperature path that will produce 50% martensite and 50% bainite (3) A time temperature path that will produce 100% martensite (4) A time temperature path that will produce 100% bainite (14 marks).

MODULE – 4

17. Explain the effect of, polymorphic transformation temperature, formation and stability of carbides, grain growth, displacement of the eutectoid point, retardation of the transformation rates, improvement of corrosion resistance on adding alloy elements to steel (14 marks).

OR

18. Give the composition, microstructure, properties and applications of (i) Gray iron and SG iron. (ii) White iron and Gray iron. (iii) Malleable iron and Gray iron. (iv) Gray iron and Mottled iron, (v) SG iron and Vermicullar Graphite Iron (14 marks).

MODULE – 5

19. a A small hole is drilled through a steel plate ahead of a crack, whether it can stop the crack's progress until repairs can be made or not? Explain in detail and derive the equation (7 marks).

b What is ductile to brittle transition in steel DBTT? What are the factors affecting ductile to brittle transition? Narrate with neat sketch (7 marks).

OR

20. Classify ceramics with radius ratio with neat sketches. Explain with an example for each of the AX, AmXp, AmBmXp type structures in ceramics with neat sketch (14 marks).

COURSE CONTENT AND LECTURE SCHEDULES.

Module	TOPIC	No. of hours	Course outcomes
1.1	Earlier and present development of atomic structure; attributes of ionization energy and conductivity, electronegativity; correlation of atomic radius to strength; electron configurations; - Primary bonds: - characteristics of covalent, ionic and metallic bond: attributes of bond energy, cohesive force, density, directional and non-directional - properties based on atomic bonding:- attributes of deeper energy well and shallow energy well to melting temperature, coefficient of thermal expansion - attributes of modulus of elasticity in metal cutting process -Secondary bonds:- classification- hydrogen bond and anomalous behavior of ice float on water, application- specific heat, applications. (Brief review only).	2	CO1
1.2	Crystallography:- Crystal, space lattice, unit cell- SC, BCC, FCC, atomic packing factor and HCP structures - short and long range order - effects of crystalline and amorphous structure on mechanical properties.	2	CO1 CO2
1.3	Coordination number and radius ratio; theoretical density; simple problems - Polymorphism and allotropy.	1	
1.4	Miller Indices: - crystal plane and direction - Attributes of miller indices for slip system, brittleness of BCC, HCP and ductility of FCC - Modes of plastic deformation: - Slip and twinning.	1	CO5
1.5	Schmid's law, equation, critical resolved shear stress, correlation of slip system with plastic deformation in metals and applications.	1	
1.6	Mechanism of crystallization: Homogeneous and heterogeneous nuclei formation, under cooling, dendritic growth, grain boundary irregularity - Effects of grain size, grain size distribution, grain shape, grain orientation on dislocation/strength and creep resistance - Hall - Petch theory, simple problems.	2	CO2
2.1	Classification of crystal imperfections: - types of point and dislocations.	1	CO2
2.2	Effect of point defects on mechanical properties - forest of dislocation, role of surface defects on crack initiation - Burgers vector.	1	
2.3	Dislocation source, significance of Frank-Read source in metals deformation - Correlation of dislocation density with strength and nano concept, applications.	3	CO2
2.4	Significance high and low angle grain boundaries on dislocation – driving force for grain growth and applications during heat treatment.		
2.5	Polishing and etching to determine the microstructure and grain size- Fundamentals and crystal structure determination by X – ray diffraction, simple problems –SEM and TEM.	2	CO2 CO5
2.6	Diffusion in solids, fick’s laws, mechanisms, applications of diffusion in mechanical engineering, simple problems.	1	

3.1	Phase diagrams: - Limitations of pure metals and need of alloying - classification of alloys, solid solutions, Hume Rothery`s rule - equilibrium diagram of common types of binary systems: five types.	2	CO2 CO5
3.2	Coring - lever rule and Gibb`s phase rule - Reactions: - monotectic, eutectic, eutectoid, peritectic, peritectoid.	1	
3.3	Detailed discussion on Iron-Carbon equilibrium diagram with microstructure and properties changes in austenite, ledeburite, ferrite, cementite, special features of martensite transformation, bainite, spheroidite etc.	3	CO2 CO5
3.4	Heat treatment: - Definition and necessity – TTT for a eutectoid iron–carbon alloy, CCT diagram, applications - annealing, normalizing, hardening, spheroidizing.		
3.5	Tempering:- austermpering, martempering and ausforming - Comparative study on ductility and strength with structure of pearlite, bainite, spherodite, martensite, tempered martensite and ausforming.	1	CO2
3.6	Hardenability, Jominy end quench test, applications- Surface hardening methods:- no change in surface composition methods :- Flame, induction, laser and electron beam hardening processes- change in surface composition methods :carburizing and Nitriding; applications.	2	CO2
4.1	Cold working: Detailed discussion on strain hardening; recovery; re-crystallization, effect of stored energy; re- crystallization temperature - hot working, Bauschinger effect and attributes in metal forming.	1	
4.2	Alloy steels:- Effects of alloying elements on steel: dislocation movement, polymorphic transformation temperature, alpha and beta stabilizers, formation and stability of carbides, grain growth, displacement of the eutectoid point, retardation of the transformation rates, improvement in corrosion resistance, mechanical properties	1	CO4
4.3	Nickel steels, Chromium steels etc. – change of steel properties by adding alloying elements: - Molybdenum, Nickel, Chromium, Vanadium, Tungsten, Cobalt, Silicon, Copper and Lead - High speed steels - Cast irons: Classifications; grey, white, malleable and spheroidal graphite cast iron etc, composition, microstructure, properties and applications - Principal Non ferrous Alloys: - Aluminum, Copper, Magnesium, Nickel, study of composition, properties, applications, reference shall be made to the phase diagrams whenever necessary.(Topic 4.3 may be considered as a assignment).	4	CO4 CO5
4.4	Fatigue: - Stress cycles – Primary and secondary stress raisers - Characteristics of fatigue failure, fatigue tests, S-N curve.	1	CO3
4.5	Factors affecting fatigue strength: stress concentration, size effect, surface roughness, change in surface properties, surface residual stress - Ways to improve fatigue life – effect of temperature on fatigue, thermal fatigue and its applications in metal cutting.	2	

5.1	Fracture: – Brittle and ductile fracture – Griffith theory of brittle fracture – Stress concentration, stress raiser – Effect of plastic deformation on crack propagation - transgranular, intergranular fracture - Effect of impact loading on ductile material and its application in forging, applications - Mechanism of fatigue failure.	2	CO3
5.2	Structural features of fatigue: - crack initiation, growth, propagation - Fracture toughness (definition only), applications - Ductile to brittle transition temperature (DBTT) in steels and structural changes during DBTT, applications.	1	
5.3	Creep: - Creep curves – creep tests - Structural change:- deformation by slip, sub-grain formation, grain boundary sliding - Mechanism of creep deformation - threshold for creep, prevention against creep - Super plasticity: need and applications	2	CO3
5.4	Composites: - Need of development of composites; fiber phase; matrix phase; only need and characteristics of PMC, MMC, and CMC.	2	CO3 CO5
5.5	Modern engineering materials: - only fundamentals, need, properties and applications of, intermetallics, maraging steel, super alloys, Titanium-Ceramics:-coordination number and radius ratios- AX, A_mX_p, $A_mB_mX_p$ type structures – applications.	3	

<table>
<tr><td rowspan="2">MEL201</td><td rowspan="2">COMPUTER AIDED MACHINE DRAWING</td><td>CATEGORY</td><td>L</td><td>T</td><td>P</td><td>Credits</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: To introduce students to the basics and standards of engineering drawing related to machines and components.

To make studentsfamiliarize with different types of riveted and welded joints, surface roughness symbols; limits, fits and tolerances.

To convey the principles and requirements of machine and production drawings.

To introduce the preparation ofdrawings of assembled and disassembled view of important valves and machine components used in mechanical engineering applications.

To introduce standard CAD packages for drafting andmodelingof engineering components.

Prerequisite: EST 110 - Engineering Graphics

Course Outcomes - At the end of the course students will be able to

CO1	Apply the knowledge of engineering drawings and standards to prepare standard dimensioned drawings of machine parts and other engineering components.
CO2	Preparestandard assembly drawings of machine components and valvesusing part drawings and bill of materials.
CO3	Apply limits and tolerances to components and choose appropriate fits for given assemblies
CO 4	Interpret the symbols of welded, machining and surface roughness on the component drawings.
CO 5	Prepare part and assembly drawings and Bill of Materials of machine components and valves using CAD software.

Mapping of course outcomes with program outcomes (Minimum requirements)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3									3		
CO2	3		2							3		
CO3	3	2										
CO4	3											
CO5	3				3					3		1

Assessment Pattern

Bloom's taxonomy	Continuous Assessment Tests	
	Test 1 PART A Sketching and Manual Drawing	Test 2 PART B CAD Drawing
Remember	25	20
Understand	15	15
Apply	30	20
Analyse	10	10
Evaluate	10	15
Create	10	20

Mark Distribution

Total Marks	CIE Marks	ESE marks	ESE duration
150	75	75	2.5 hours

Continuous Internal Evaluation (CIE) Pattern:

Attendance	15 marks
Regular class work/Drawing/Workshop Record/Lab Record and Class Performance	30 marks
Continuous Assessment Test (minimum two tests)	30 marks

End semester examination pattern

End semester examination shall be conducted on Sketching and CAD drawing on based complete syllabus

The following general guidelines should be maintained for the award of marks

Part A Sketching – 15 marks
Part B CAD drawing – 50marks
Viva Voce – 10 marks.

Conduct of University Practical Examinations

The Principals of the concerned Engineering Colleges with the help of the Chairmen/Chairperson will conduct the practical examination with the approval from the University and bonafide work / laboratory record, hall ticket, identity card issued by college are mandatory for appearing practical University examinations. No practical examination should be conducted without the presence of an external examiner appointed by the University.

END SEMSTER EXAMINATION

MODEL QUESTION PAPER

MEL 201: COMPUTER AIDED MACHINE DRAWING

Duration : 2.5 hours　　　　Marks : 75

Note :

1. All dimensions in mm
2. Assume missing dimensions appropriately
3. A4 size answer booklet shall be supplied
4. Viva Voce shall be conducted for 10 marks

PART A (SKETCHING)
(Answer any TWO questions).　　　　**15 marks**

1. Sketch two views of a single riveted single strap butt joint. Take dimensions of the plate as 10mm. Mark the proportions in the drawing.

2. Show by means of neat sketches, any three methods employed for preventing nuts from getting loose on account of vibrations

3. Compute the limit dimensions of the shaft and the hole for a clearance fit based on shaft basis system if:

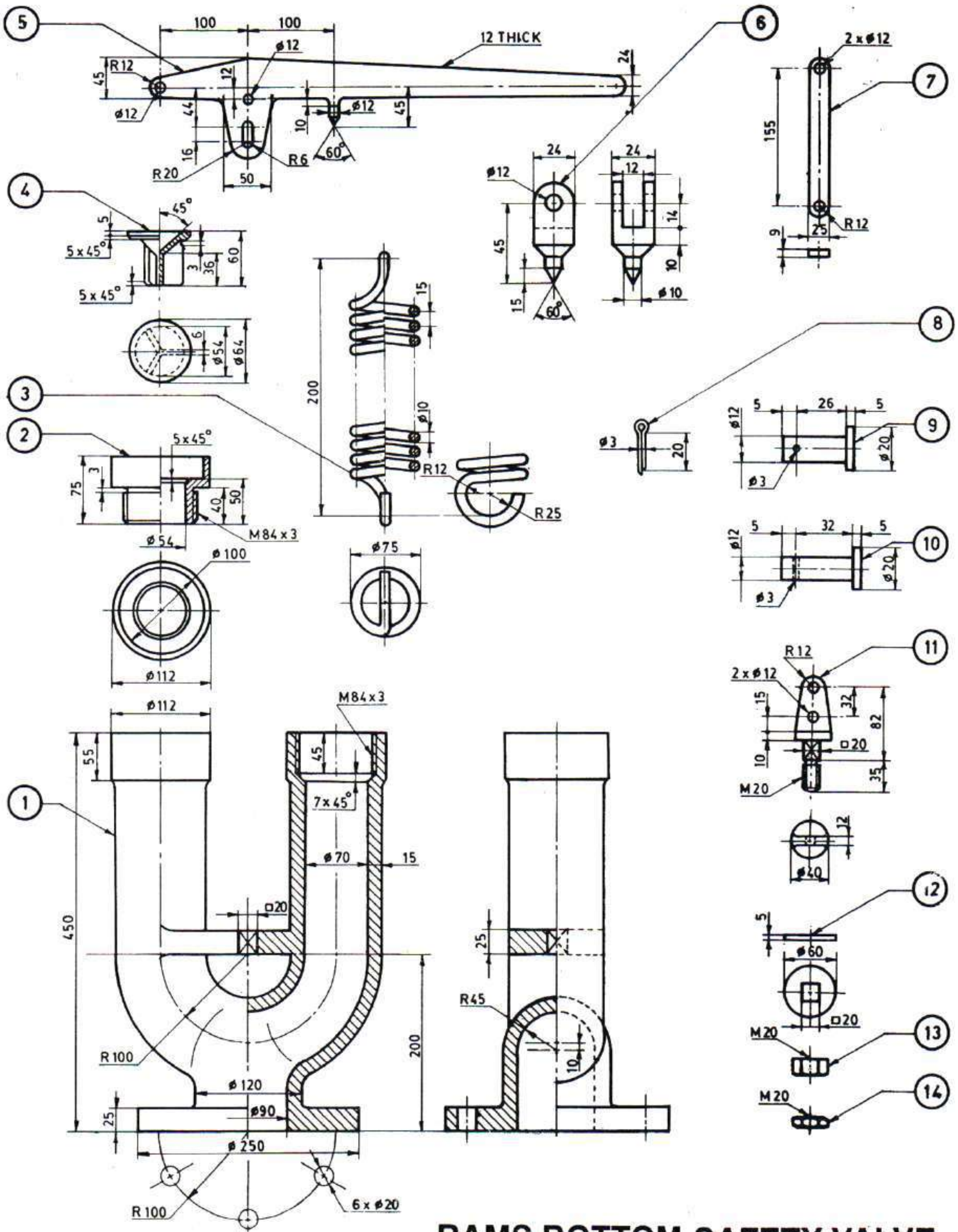
   Basic size= ϕ30 mm
   Minimum clearance = 0.007 mm
   Tolerance on hole = 0.021 mm
   Tolerance on shaft= 0.021 mm

   Check the calculated dimensions. Represent the limit dimensions schematically.

PART B (CAD DRAWING)　　　　**50 marks**

4. Draw any two assembled views of the Rams Bottom Safety Valve as per the details given in the figure using any suitable CAD software. Also prepare bill of materials and tolerance data sheet.

Item	Description	Qty	Material	**Item**	Description	Qty	Material
1	Body	1	C.I.	**8**	Split Pin	3	M.S.
2	Valve Seat	2	G.M.	**9**	Pin for Link	2	M.S.
3	Spring	1	Steel	**10**	Pin for Pivot	1	M.S.
4	Valve	2	G.M.	**11**	Shackle	1	M.S.
5	Lever	1	M.S.	**12**	Washer	1	M.S.
6	Pivot	1	M.S.	**13**	Nut	1	M.S.
7	Link	2	M.S.	**14**	Lock Nut	1	M.S.



RAMS BOTTOM SAFETY VALVE

SYLLABUS

Introduction to machine drawing, drawing standards, fits, tolerances, surface roughness, assembly and part drawings of simple assemblies and subassemblies of machine parts viz., couplings, clutches, bearings, I.C. engine components, valves, machine tools, etc; introduction to CAD etc.

Text Books:
1. N. D. Bhatt and V.M. Panchal, Machine Drawing, Charotar Publishing House.
2. P I Varghese and K C John, Machine Drawing, VIP Publishers.

Reference Books
1. Ajeet Singh, Machine Drawing Includes AutoCAD, Tata McGraw-hill.
2. P S Gill, Machine Drawing, Kataria& Sons.

Course content and drawing schedules.

No:	List of Exercises	Course outcomes	No. of hours
	PART –A (Manual drawing) *(Minimum 6 drawings compulsory)*		
1	**Temporary Joint:** Principles of drawing, free hand sketching, Importance of machine Drawing. BIScode of practice for Engineering Drawing, lines, types of lines, dimensioning, scales of drawing, sectional views, **Riveted joints.**	CO 1	**3**
2	**Fasteners:** Sketching of conventional representation of welded joints,Bolts and Nuts **or** Keys and Foundation Bolts.	CO 1	**3**
3	**Fits and Tolerances:** Limits, Fits – Tolerances of individual dimensions – Specification of Fits – basic principles of geometric & dimensional tolerances. **Surface Roughness:** Preparation of production drawings and reading of part and assembly drawings, surface roughness, indication of surface roughness, etc.	CO 2	**3**
4	Detailed drawing of Cotter joints, Knuckle joint and Pipe joints	CO 2	**3**
5	**Assembly drawings(2D):** Stuffing box and Screw jack	CO 1 CO3 CO4	**3**

	PART –B **(CAD drawing)** *(Minimum 6 drawings compulsory)*		
6	Introduction to drafting software like Auto CAD, basic commands, keyboard shortcuts. Coordinate and unit setting, Drawing, Editing, Measuring, Dimensioning, Plotting Commands, Layering Concepts, Matching, Detailing, Detailed drawings.	CO 1 CO 2 CO 3 CO5	**3**
7	Drawing of Shaft couplings and Oldham's coupling	CO 1 CO 2 CO 3 CO5	**3**
8	**Assembly drawings(2D)with Bill of materials:** Lathe Tailstock and Universal joint	CO 1 CO3 CO5	**3**
9	**Assembly drawings(2D)with Bill of materials:** Connecting rod and Plummer block	CO 1 CO3 CO5	**3**
10	**Assembly drawings(2D)with Bill of materials:** Rams Bottom Safety Valve **OR** steam stop valve	CO 1 CO3 CO5	**3**

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUL203	FM & HM LAB	PCC	0	0	3	2

Preamble:

This lab is mainly focussed to develop a platform where the students can enhance their engineering knowledge in the fluid mechanics domain by applying their theoretical knowledge acquired.

Prerequisite: MET203 Mechanics of Fluids

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Determine the coefficient of discharge of flow measuring devices (notches, orifice meter and Venturi meter)
CO 2	Calibrate flow measuring devices (notches, orifice meter and Venturi meter)
CO 3	Evaluate the losses in pipes
CO 4	Determine the metacentric height and stability of floating bodies
CO 5	Determine the efficiency and plot the characteristic curves of different types of pumps and turbines

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	3	2		2
CO 2	2	1						2	3	2		2
CO 3	2	1						2	3	2		2
CO 4	2	1						2	3	2		2
CO 5	2	1						2	3	2		2

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	:	15 marks
Continuous Assessment	:	30 marks
Internal Test (Immediately before the second series test)	:	30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work	: 15 Marks
(b) Implementing the work/Conducting the experiment	: 10 Marks
(c) Performance, result and inference (usage of equipments and trouble shooting)	: 25 Marks
(d) Viva voce	: 20 marks
(e) Record	: 5 Marks

General instructions:

Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

SYLLABUS

LIST OF EXPERIMENTS

1. Determination of coefficient of discharge and calibration of Notches.

2. Determination of coefficient of discharge and calibration of Orifice meter.

3. Determination of coefficient of discharge and calibration of Venturi meter.

4. Determination of hydraulic coefficients of orifices.

5. Determination of Chezy’s constant and Darcy’s coefficient on pipe friction apparatus.

6. Determine the minor losses in pipe.

7. Experiments on hydraulic ram.

8. Reynolds experiment.

9. Bernoulli’s experiment.

10. Determination of metacentric height and radius of gyration of floating bodies.

11. Performance test on positive displacement pumps.

12. Performance test on centrifugal pumps, determination of operating point and efficiency.

13. Performance test on gear pump.

14. Performance test on Impulse turbines.

15. Performance test on reaction turbines (Francis and Kaplan Turbines).

16. Speed variation test on Impulse turbine.

17. Determination of best guide vane opening for Reaction turbine.

18. Impact of jet.

Note: 12 experiments are mandatory

Reference Books

1. Yunus A. Cenegel, John M. Cimbala; Fluid Mechanics- Fundamentals and Applications (in SI Units); McGraw Hill, 2010.
2. Bansal R.K, Fluid Mechanics and Hydraulic Machines (SI Units); Laxmi Publications, 2011.
3. Modi P.N and Seth S.M, “Hydraulics and Fluid Mechanics Including Hydraulic Machines” Standard Book House, New Delhi, 20th Edition, 2015
4. Graebel. W. P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
5. Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, “Fluid Mechanics and Machinery”, John Wiley and sons, 2015.
6. J. Frabzini, 'Fluid Mechanics with Engineering Applications', McGraw Hill, 1997.

SEMESTER -3
MINOR

MUT 281	FUNDAMENTALS OF AUTOMOBILE ENGINEERING	CATEGORY	L	T	P	CREDIT
		VAC	4	0	0	4

Preamble: The aim of this subject is to offer the students a general understanding of the anatomy of automobile and

- ✓ To get basic idea about the basics of Automobile engineering.
- ✓ To understand the working of different automotive systems and subsystems
- ✓ To understand the importance of electronics in automobiles
- ✓ To update the latest developments in automobiles

Prerequisite:

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

CO 1	Explain the basics of Automobiles and IC engines
CO 2	Categorize the fuel supply system and ignition system
CO 3	Illustrate and identify starting, braking and steering systems
CO 4	Categorize the comfort and electrical components in automobile
CO 5	Illustrate the latest developments in automobiles

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
CO 2	2	-	-	-	-	-	-	-	-	-	-	1
CO 3	2	-	-	-	-	-	-	-	-	-	-	1
CO 4	2	-	-	-	-	-	-	-	-	-	-	1
CO 5	2	-	-	-	2	-	-	-	-	-	-	1

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	25	25	50
Understand	25	25	50
Apply			
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. Define operating cycles for SI and CI engines

2. Identify the combustion characteristics of IC engines

3. Explain the various alternate fuels for SI and CI engines

Course Outcome 2 (CO2)

1. Distinguish between CI and SI fuel injection system

2. Classify the fuel injection systems

3. Classify and identify the ignition systems in SI engines

Course Outcome 3(CO3):

1. To illustrate the working of starting system

2. Explain and identify the alternator and its working

3. Describe about the function of braking system

4 .Explain the various steering parameters

Course Outcome 4 (CO4):

1. To illustrate the working of electrical accessories

2. Describe the working principle of automotive air conditioner ?

3. Explain the principle of automobile illumination

Course Outcome 5 (CO5):

1. Categorize the electronics and microprocessors in automobile.

2. To illustrate the latest developments in automobiles .

3. Discuss the details of onboard diagnosis and security systems in automobile.

Model Question paper

QP CODE: **PAGES: 02**

Reg. No: _______________ **Name :_______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT 281

Course Name: FUNDAMENTALS OF AUTOMOBILES ENGINEERING

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

PART A

Answer all Questions.
Each question carries 3 Marks

1. Enumerate the history of automobile.

2. Differentiate between SI and CI engines.

3. With the help of neat figure explain the working of CRDI.

4. Explain the working principle of TAC (transistor assisted contact) ignition system.

5. Explain the various types of fire tenders used in firefighting.

6. Discuss about the starting system in automobile

7. With the aid of neat figure explain the working of hydraulic braking system.

8. What you mean by electronic fuel gauge differentiate it from analog gauges?

9. Explain 1) Throttle position sensor 2) fuel flow sensor

10. Discuss about the need for electric and hybrid vehicles

PART B

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

Module 1

11. a) With the aid of neat sketch explain the constructional details of IC engine . (7)

    b) Differentiate between Cetane and octane number (7)

12. a) Discuss about the thermodynamic cycles for IC engines. (7)

    b) Explain in detail the factors contributing the combustion chamber design. (7)

Module 2

13. Describe the fuel supply systems in CI engines (14)

14. a) With the aid of neat sketch explain DTSI,Electronic, solid state ignition system (7)

    b) With neat sketch explain distributor less ignition system (7)

Module 3

15. Discuss salient features of Antilock Brake Systems. (14)

16. a) Explain the working principle of DC generators used in automobiles. (7)

    b) Enumerate on the working of pneumatic brakes (7)

Module 4

17. Explain the Principle and constructional details of automobile illumination. (14)

18. Discuss on the design factors and concepts related to air conditioning system (14)

Module 5

19. What are the common Electronic / Microprocessor control systems used in automobiles? (14)

20. a) What are the components an electric vehicle and also explain salient features of hybrid vehicles (7)

    b) Write a note Limitations of electric vehicles. (7)

SYLLABUS

Module 1

Fundamentals of Automobiles - Automobile history and development. Introduction to IC engines. Thermodynamic cycle" of spark ignition (SI) and compression ignition (CI) engines. Construction and working principles SI and CI engines. Four stroke and two stroke engines. Comparison of SI and CI engines. Introduction to combustion in SI and CI engines, Stages of combustion, Combustion chambers for SI and CI engines, Importance of Swirl, squish and turbulence. Factors controlling the combustion. Conventional and alternate fuels for IC engines: desirable characteristics of gasoline, desirable characteristics of diesel fuel alternative fuels for SI engines and CI engines. Cetane and octane number.

Module 2

Fuel supply system in IC engines : Quantity & hit and miss governing. Working of a carburetor, Introduction and fuel system circuit. Air fuel ratio requirements. Types of gasoline fuel injection system, MPFI - L Jetronic and D jetronic systems, GDI, electrical fuel pump, electronically controlled fuel supply system, electronically controlled exhaust gas re-circulation system, Diesel fuel injection systems- Engine governor, Jerk pumps, distributor pumps, types of nozzles, Electronic fuel supply system in diesel engines - CRDI.

Components of Ignition systems. Ignition system: Types of ignition, spark plug, firing order, magneto and coil ignition, constructional details, distributor, spark plugs, ignition coil, ignition timing, TAC (transistor assisted contact) ignition system, CD Ignition system, DTSi, Electronic / solid state ignition system,. Microprocessor controlled ignition system, advantages, simplified operational diagram of a distributor less ignition system, automatic ignition advance methods, ignition timing, spark plugs-construction, principle of electronic ignition and ignition advance.

Module 3

Starting and charging systems: Starter motor- Principle, condition at starting, series motor and its characteristics, types of drives, types of starter switches. Principle of generation of DC generator, constructional details, armature reaction, third bush control, voltage & current regulators, construction and working, construction of A.C. generators (alternators), advantages.

Steering and braking system: -Basic principle of a steering system: - swinging beam system Ackermann, over steer and under steer, slip angle, camber, caster etc. Brakes: - mechanical and hydraulic brakes- layout, master cylinder, wheel cylinder, Pneumatic brakes, properties of friction lining and pad materials, efficiency, stopping distance, theory of internal shoe brake, Braking efficiency and stopping distance. components, power brakes, Antilock Brake Systems, parking brake.

Module 4

Lighting and electrical accessories: Principle of automobile illumination, head lamp, mounting and construction, sealed beam, composite headlights, auxiliary lighting, horn, wind screen wipers, signalling devices, electrical gauges - analog fuel gauge, oil gauge, temperature gauges, electronic speedometers, electronic fuel gauge.

Terminology, design factors and concepts related to air conditioning system - Construction and working principles of Thermostatic Expansion valve and Orifice tube based system- Heating system types -detailed study of HVAC components like compressor, evaporator, condenser, TXV, orifice tube , Receiver-drier, heater core etc. Location of air conditioning components in a vehicle, refrigerants & air management systems and automatic climate control system

Module 5

Electronic / Microprocessor control systems: Concept of CPU and computer memory used in automobiles, sensors- Pressure sensor, Throttle position sensor, fuel flow sensor, thermistor sensor, oxygen sensor, speed sensors, knock detecting sensor, actuators solenoids and stepper motor. Electronic dash board instruments - Onboard diagnosis system, security and warning system.

Introduction to Electric Vehicles: Need of electric vehicles hybrid vehicles comparative study of diesel, petrol, pure electric and hybrid vehicles. Hybrid and Electric vehicle –. Layout, Merits, demerits and components, various modes of operation of hybrid vehicles, Electronic control system – Different configurations of Hybrid vehicles. Power split device. Energy regeneration. High energy and power density batteries – Introduction to fuel cell vehicles, PEM Fuel cell. Limitations of electric vehicles. Specification of some electric and hybrid vehicles

Text Books

1. Crouse W. H. and D. L. Anglin, Automotive Mechanics, Tata McGraw Hill, 2003.

2. Kirpal Singh, Automobile Engineering- Vol. I & II, Standard Publishers, 2008.

3. Kohli P. L., Automotive Electrical Equipment, Tata McGraw Hill, New Delhi, 2004.

4. Narang G. B., Automobile Engineering, Khanna Publishers, New Delhi,

5. Joseph Hietner, Automotive Mechanics, East- West Press Pvt. Ltd, Madras, 2006.

6. Jain K. K. and R. B. Asthana, Automobile Engineering, Tata McGraw Hill, 1999.

7. . Giri N.K, Automobile Mechanics, 8/e, Khanna Publishers

Reference Books

1. Gupta R.B. Auto design , Satya Prakash, New Delhi, 2015
2. Heinz Heisler, Advanced engine technology, Butterworth-Heinemann,1995

3. Heinz Heisler, Advanced vehicle technology, Society of Automotive Engineers Inc, 2002
4. Hillier and Peter Coobes, Fundamentals of motor vehicle technology, Nelson Thornes, 2004
5. Tom Denton, Automobile mechanical and electrical systems, Butterworth-Heinemann, 2011

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Module 1 (11 hours)**	
1.1	Automobile history and development. Introduction to IC engines.	1
1.2	Thermodynamic cycle‟s and constructional details of spark ignition (SI) and compression ignition (CI) engines. Working principles.	3
1.3	Two stroke SI engines – construction and working. Valve timing and port timing diagram. Comparison of SI and CI engines and four stroke and two stroke engines. Introduction to combustion in SI and CI engines, Stages of combustion, Combustion chambers for SI and CI engines, Importance of Swirl, squish and turbulence.	3
1.4	Factors controlling combustion chamber design. Conventional and alternate fuels for IC engines: desirable characteristics of gasoline desirable characteristics of diesel fuel alternative fuels for SI engines and CI engines	2
2	**Module 2 (10 hours)**	
2.1	Fuel supply system in IC engines : Quantity & hit and miss governing. Working of a carburetor, Introduction and fuel system circuit. Air fuel ratio requirements. Types of gasoline fuel injection system, TBI, MPFI - L Jetronic and D jetronic systems.	2
2.2	GDI, electrical fuel pump, electronically controlled fuel supply system, electronically controlled exhaust gas re-circulation system, Diesel fuel injection systems- Engine governor, Jerk pumps, distributor pumps, types of nozzles, Electronic fuel supply system in diesel engines - CRDI.	2
2.3	Components of Ignition systems. Ignition system: Types of ignition, spark plug, firing order, magneto and coil ignition, constructional details, distributor, spark plugs, ignition coil, ignition timing, TAC (transistor assisted contact) ignition system.	3
2.4	CD Ignition system, DTSi, Electronic / solid state ignition system,. Microprocessor controlled ignition system, advantages, simplified operational diagram of a distributor less ignition system, automatic ignition advance methods, ignition timing, spark plugs-	3

	construction, principle of electronic ignition and ignition advance	
3	**Module 3 (9 hours)**	
3.1	Starting and charging systems: Starter motor- Principle, condition at starting, series motor and its characteristics, types of drives, types of starter switches. Principle of generation of DC generator, constructional details, armature reaction, third bush control, voltage & current regulators, construction and working, construction of A.C. generators (alternators), advantages.	3
3.2	Steering and braking system: -Basic principle of a steering system: -swinging beam system Ackermann, over steer and under steer, slip angle, camber, caster etc. Brakes: - mechanical and hydraulic brakes-layout, master cylinder, wheel cylinder,	3
3.3	Pneumatic brakes, properties of friction lining and pad materials, efficiency, stopping distance, theory of internal shoe brake, Braking efficiency and stopping distance. components, power brakes, Antilock Brake Systems, parking brake.	3
4	**Module 4 (8hours)**	
4.1	Lighting and electrical accessories: Principle of automobile illumination, head lamp, mounting and construction, sealed beam, composite headlights, auxiliary lighting, horn, wind screen wipers, signalling devices, electrical gauges - analog fuel gauge, oil gauge, temperature gauges, electronic speedometers, electronic fuel gauge.	4
4.2	Terminology, design factors and concepts related to air conditioning system - Construction and working principles of Thermostatic Expansion valve and Orifice tube based system-Heating system types -detailed study of HVAC components like compressor, evaporator, condenser, TXV, orifice tube , Receiver-drier, heater core etc. Location of air conditioning components in a vehicle, refrigerants & air management systems and automatic climate control system	4
5	**Fire Fighting and Investigation (10 hours)**	
5.1	Electronic / Microprocessor control systems: Concept of CPU and computer memory used in automobiles, sensors- Pressure sensor, Throttle position sensor, fuel flow sensor, thermistor sensor, oxygen sensor, speed sensors, knock detecting sensor, actuators solenoids and stepper motor. Electronic dash board instruments -Onboard diagnosis system, security and warning system.	4
5.2	Introduction to Electric Vehicles: Need of electric vehicles hybrid vehicles comparative study of diesel, petrol, pure electric and hybrid vehicles. Hybrid and Electric vehicle –. Layout, Merits, demerits and components, various modes of operation of hybrid vehicles.	3

5.3	Electronic control system – Different configurations of Hybrid vehicles. Power split device. Energy regeneration. High energy and power density batteries – Introduction to fuel cell vehicles, PEM Fuel cell. Limitations of electric vehicles. Specification of some electric and hybrid vehicles	3

SEMESTER -4

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MET202	**ENGINEERING THERMODYNAMICS**	**PCC**	**3**	**1**	**-**	**4**

Preamble :

Thermodynamics is the study of energy . Without energy life cannot exist. Activities from breathing to the launching of rockets involves energy transactions and are subject to thermodynamic analysis. Engineering devices like engines, turbines, refrigeration and air conditioning systems, propulsion systems etc., work on energy transformations and must be analysed using principles of thermodynamics. So, a thorough knowledge of thermodynamic concepts is essential for a mechanical engineer. This course offers an introduction to the basic concepts and laws of thermodynamics.

Prerequisite : NIL

Course Outcomes :

After completion of the course the student will be able to

CO1	Understand basic concepts and laws of thermodynamics
CO2	Conduct first law analysis of open and closed systems
CO3	Determine entropy and availability changes associated with different processes
CO4	Understand the application and limitations of different equations of state
CO5	Determine change in properties of pure substances during phase change processes
CO6	Evaluate properties of ideal gas mixtures

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										2
CO2	2	2	1	1								1
CO3	3	3	2	2								1
CO4	2	2	2	2								1
CO5	3	3	2	1								1
CO6	3	3	2	2								1

Assessment Pattern

Blooms Category	CA			ESA
	Assignment	Test - 1	Test - 2	
Remember	25	20	20	10
Understand	25	40	40	20
Apply	25	40	40	70
Analyse	25			
Evaluate				
Create				

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

Mark distribution & Duration of Examination :

Total Marks	CA	ESE	ESE Duration
150	50	100	3 Hours

End semester 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

1. Discuss the limitations of first law of thermodynamics.

2. Second law of thermodynamics is often called a directional law . Why?

3. Explain Joule-Kelvin effect. What is the significance of the inversion curve ?

Course Outcome 2

1. A mass of 2.4 kg of air at 150 kPa and 12°C is contained in a gas – tight, frictionless piston – cylinder device. The air is now compressed to a final pressure of 600 kPa . During this process, heat is transferred from the air such that the temperature inside the cylinder remains constant. Calculate the work input during this process.

2. Carbon dioxide enters an adiabatic nozzle steadily at 1 MPa and 500°C with a mass flow rate of 600 kg/hr and leaves at 100 kPa and 450 m/s. The inlet area of the nozzle is 40 cm^2. Determine (a) the inlet velocity and (b) the exit temperature

3. A vertical piston – cylinder device initially contains 0.25 m^3 of air at 600 kPa and 300°C. A valve connected to the cylinder is now opened and air is allowed to escape until three-quarters of the mass leave the cylinder at which point the volume is 0.05 m^3. Determine the final temperature in the cylinder and the boundary work during this process.

Course Outcome 3

1.An adiabatic vessel contains 2 kg of water at 25˚C. B paddle – wheel work transfer, the temperature of water is increased to 30˚C.   If the specific heat of water is assumed to be constant at 4.186 kJ/kg.K, find the entropy change of the universe.

2. Two kilograms of water at 80°C is mixed adiabatically with 3 kg of water at 30°C in a constant pressure process at 1 atm. Find the increase in entropy of the total mass of water due to the mixing process.

3. Argon enters an insulated turbine operating under steady state at 1000˚C and 2 MPa and exhausts at 350 kPa. The mass flow rate is 0.5 kg/s and the turbine develops power at the rate of 120 kW. Determine (a)the temperature of the argon at the turbine exit, (b) the irreversibility of the turbine and (c) the second law efficiency. Neglect KE and PE effects. Take T_o = 20˚C and P_o = 1 bar

Course Outcome 4

1. What are the limitations of ideal gas equation and how does Van der Waals equation overcome these limitations ?

2. Discuss law of corresponding states and its role in the construction of compressibility chart.

3. A rigid tank contains 2 kmol of N_2 and 6 kmol of CH_4 gases at 200 K and 12 MPa. Estimate the volume of the tank, using (a) ideal gas equation of state (b) the compressibility chart and Amagat's law

Course Outcome 5

1.Steam is throttled from 3 MPa and 600˚C to 2.5 MPa. Determine the temperature of the steam at the end of the throttling process.

2. Determine the change in specific volume, specific enthalpy and quality of steam as saturated steam at 15 bar expands isentropically to 1 bar. Use steam tables

3. Estimate the enthalpy of vapourization of steam at 500 kPa, using the Clapeyron equation and compare it with the tabulated value

Course Outcome 6

1. A gaseous mixture contains , by volume, 21%nitrogen, 50% hydrogen and 29 % carbon dioxide. Calculate the molecular weight of the mixture, the characteristic gas constant of the mixture and the value of the reversible adiabatic expansion index - γ. At 10˚C, the C_p values of nitrogen, hydrogen and carbon dioxide are 1.039, 14.235 and 0.828 kJ/kg.K respectively.

2. A mixture of 2 kmol of CO_2 and 3 kmol of air is contained in a tank at 199 kPa and 20˚C. Treating air to be a mixture of 79% N_2 and 21% O_2 by volume , calculate (a) the individual mass of CO_2 , N_2 and O_2, (b) the percentage content of carbon by mass in the mixture and (c) the molar mass , characteristic gas constant and the specific volume of the mixture

3. A gas mixture in an engine cylinder has 12% CO_2, 11.5 % O_2 and 76.5% N_2 by volume. The mixture at 1000˚C expands reversibly, according to the law $PV^{1.25}$ = constant, to 7 times its initial volume. Determine the work transfer and heat transfer per unit mass of the mixture.

SYLLABUS

Module 1: Role of Thermodynamics and it's applications in Engineering and Science –Basic Concepts Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic System and Control Volume, Surrounding, Boundaries, Types of Systems, Universe, Thermodynamic properties, Process, Cycle, Thermodynamic Equilibrium, Quasi – static Process, State, Point and Path function. Zeroth Law of Thermodynamics, Measurement of Temperature, reference Points, Temperature Scales.

Module 2: Energy - Work - Pdv work and other types of work transfer, free expansion work, heat and heat capacity. Joule's Experiment- First law of Thermodynamics - First law applied to Non flow Process- Enthalpy- specific heats- PMM1, First law applied to Flow Process, Mass and Energy balance in simple steady flow process. Applications of SFEE, Transient flow –Filling and Emptying Process, Limitations of the First Law.

Module 3: Second Law of Thermodynamics, Thermal Reservoir, Heat Engine, Heat pump – Kelvin-Planck and Clausius Statements, Equivalence of two statements, Reversibility, Irreversible Process, Causes of Irreversibility, PMM2, Carnot's theorem and its corollaries, Absolute Thermodynamic Temperature scale. Clausius Inequality, Entropy- Entropy changes in various thermodynamic processes, principle of increase of entropy and its applications, Entropy generation, Entropy and Disorder, Reversible adiabatic process- isentropic process, Third law of thermodynamics, Available Energy, Availability and Irreversibility- Second law efficiency.

Module 4: Pure Substances, Phase Transformations, Triple point, properties during change of phase, T-v, p-v and p-T diagram of pure substance, p-v-T surface, Saturation pressure and Temperature, T-h and T-s diagrams, h-s diagrams or Mollier Charts, Dryness Fraction, steam tables. Property calculations using steam tables. The ideal Gas Equation, Characteristic and Universal Gas constants, Deviations from ideal Gas Model: Equation of state of real substances, Vander Waals Equation of State, Virial Expansion, Compressibility factor, Law of corresponding state, Compressibility charts.

Module 5: Mixtures of ideal Gases – Mole Fraction, Mass fraction, Gravimetric and volumetric Analysis, Dalton's Law of partial pressure, Amagat's Laws of additive volumes, Gibbs-Dalton's law Equivalent Gas constant and Molecular Weight, Properties of gas mixtures: Internal Energy, Enthalpy, specific heats and Entropy, Introduction to real gas mixtures- Kay's rule. General Thermodynamic Relations – Combined First and Second law equations – Helmholtz and Gibb's functions - Maxwell's Relations, Tds Equations. The Clapeyron Equation, equations for internal energy, enthalpy and entropy, specific heats, Throttling process, Joule Thomson Coefficient, inversion curve.

Text Books

1. P. K. Nag, Engineering Thermodynamics, McGraw Hill, 2013

2. E. Rathakrishnan Fundamentals of Engineering Thermodynamics, PHI, 2005

3. Y. A. Cengel and M. A. Boles, Thermodynamics an Engineering Approach, McGraw Hill, 2011

Reference Books:

1. Moran J., Shapiro N. M., Fundamentals of Engineering Thermodynamics, Wiley, 2006

2. R. E. Sonntag and C. Borgnakke, Fundamentals of Thermodynamics, Wiley, 2009

3. Holman J. P. Thermodynamics, McGraw Hill, 2004

4. M. Achuthan, Engineering Thermodynamics, PHI, 2004

COURSE PLAN

Module	Topics	Hours Allotted
1	Role of Thermodynamics and it's applications in Engineering and Science – Basic Concepts Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic System and Control Volume, Surrounding, Boundaries, Types of Systems, Universe	1L
	Thermodynamic properties, Process, Cycle, Thermodynamic Equilibrium, Quasi – static Process, State, Point and Path function.	1L
	Zeroth Law of Thermodynamics, Measurement of Temperature, reference Points, Temperature Scales.	2L + 1T
2	Energy - Work - Pdv work and other types of work transfer, free expansion work, heat and heat capacity.	2L + 1T
	Joule's Experiment- First law of Thermodynamics - First law applied to Non flow Process- Enthalpy- specific heats- PMM1	2L + 1T
	First law applied to Flow Process, Mass and Energy balance in simple steady flow process. Applications of SFEE	2L + 1T
	Transient flow –Filling and Emptying Process, Limitations of the First Law.	1L + 1T
3	Second Law of Thermodynamics, Thermal Reservoir, Heat Engine, Heat pump – Kelvin-Planck and Clausius Statements, Equivalence of two statements	2L
	Reversibility, Irreversible Process, Causes of Irreversibility, PMM2, Carnot's theorem and its corollaries, Absolute Thermodynamic Temperature scale.	2L + 1T
	Clausius Inequality, Entropy- Entropy changes in various thermodynamic processes, principle of increase of entropy and its applications, Entropy generation, Entropy and Disorder, Reversible adiabatic process- isentropic process, Third law of thermodynamics	2L + 1T
	Available Energy, Availability and Irreversibility- Second law efficiency.	2L + 1T
	Pure Substances, Phase Transformations, Triple point, properties during change of phase, T-v, p-v and p-T diagram of pure substance, p-v-T surface,	2L

4	Saturation pressure and Temperature, T-h and T-s diagrams, h-s diagrams or Mollier Charts, Dryness Fraction, steam tables. Property calculations using steam tables	2L + 1T
	The ideal Gas Equation, Characteristic and Universal Gas constants, Deviations from ideal Gas Model: Equation of state of real substances, Vander Waals Equation of State, Virial Expansion, Compressibility factor, Law of corresponding state, Compressibility charts.	2L +1T
5	Mixtures of ideal Gases – Mole Fraction, Mass fraction, Gravimetric and volumetric Analysis, Dalton's Law of partial pressure, Amagat's Laws of additive volumes, Gibbs-Dalton's law.	2L
	Equivalent Gas constant and Molecular Weight, Properties of gas mixtures: Internal Energy, Enthalpy, specific heats and Entropy	1L +1T
	Introduction to real gas mixtures- Kay's rule	1L
	General Thermodynamic Relations – Combined First and Second law equations – Helmholtz and Gibb's functions - Maxwell's Relations	2L
	Tds Equations. The Clapeyron Equation, equations for internal energy, enthalpy and entropy, specific heats, Throttling process, Joule Thomson Coefficient, inversion curve.	2L + 1T

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code : MET202

Course Name : ENGINEERING THERMODYNAMICS

(Permitted to use Steam Tables and Mollier Chart)

Max. Marks : 100 Duration : 3 Hours

Part – A

Answer all questions.

1. Define thermodynamics. List a few of its applications

2.Differentiate between intensive and extensive properties.

3. Differentiate between heat and work.

4. Explain system approach and control volume approach as applied in the analysis of a flow process.

5. An inventor claims to have developed an engine that delivers 26 kJ of work using 82 kJ of heat while operating between temperatures 120°C and 30°C. Is his claim valid ? Give the reason for your answer.

6. Show that two reversible adiabatics cannot intersect

7.Define (i)critical point and (ii) triple point, with respect to water

8. Why do real gases deviate from ideal gas behaviour? When do they approach ideal behaviour?

9. Define Helmholtz function and Gibbs function and state their significance

10. Explain Kay's rule of real gas mixtures

(3 x 10 = 30 marks)

Part – B

Answer one full question from each module.

Module - 1

11.a] Explain macroscopic and microscopic approach to thermodynamics . (7 marks) b] With the aid of a suitable diagram, explain the working of constant volume gas thermometer. (7 marks)

OR

12.a] What is meant by thermodynamic equilibrium ? What are the essential conditions for a system to be in thermodynamic equilibrium ? (7 marks)

b] Express the temperature of 91^{o}C in (i) Farenhiet (ii) Kelvin (iii) Rankine. (7 marks)

Module – 2

13.a] A mass of 2.4 kg of air at 150 kPa and 12°C is contained in a gas – tight, frictionless piston – cylinder device. The air is now compressed to a final pressure of 600 kPa . During this process, heat is transferred from the air such that the temperature inside the cylinder remains constant. Calculate the work input during this process. (7 marks)

b] A 2 m^3 rigid tank initially contains air at 100 kPa and 22^{o}C. The tank is connected to a supply line through a valve. Air is flowing in the supply line at 600 kPa and 22^{o}C. The valve is opened, and air is allowed to enter the tank until the pressure in the tank reaches the line pressure, at which point the valve is closed. A thermometer placed in the tank indicates that the air temperature at the final state is 77^{o}C. Determine, (i) the mass of air that has entered the tank and (ii) the amount of heat transfer. (7 marks)

OR

14.a] A turbine operates under steady flow conditions, receiving steam at the following conditions : pressure 1.2 MPa, temperature 188°C, enthalpy 2785 kJ/kg, velocity 33.3 m/s and elevation 3m. The steam leaves the turbine at the following conditions : pressure 20 kPa, enthalpy 25kJ/kg, velocity 100 m/s, and elevation 0 m. Heat is lost to the surroundings at the rate of 0.29 kJ/s. If the rate of steam flow through the turbine is 0.42 kg/s, what is the power output of the turbine in kW ? (7 marks)

b] State the general energy balance equation for an unsteady flow system and from it, derive the energy balance equation for a bottle filling process, stating all assumptions. (7 marks)

Module – 3

15.a]State the Kelvin-Planck and Clausisus statements of the second law of thermodynamics and prove their equivalence. (7 marks)

b]A heat engine operating between two reservoirs at 1000 K and 300 K is used to drive a heat pump which extracts heat from the reservoir at 300 K at a rate twice that at which the engine rejects heat to it. If the efficiency of the engine is 40 % of the maximum possible and the COP of the heat pump is 50 % of the maximum possible, what is the temperature of the reservoir to which the heat pump rejects heat ? What is the rate of heat rejection from the heat pump, if the rate of heat supply to the engine is 50kW ? (7 marks)

OR

16.a] A house is to be maintained at 21°C during winter and at 26°C during summer. Heat leakage through the walls, windows and roof is about 3000 kJ/hr per degree temperature difference between the interior of the house and the environment. A reversible heat pump is proposed for realising the desired heating and cooling. What is the minimum power required to run the heat pump in the reverse, if the outside temperature during summer is 36°C? Also find the lowest environment temperature during winter for which the inside of the house can be maintained at 21°C consuming the same power. (7 marks)

b] Air enters a compressor in steady flow at 140 kPa, 17°C and 70 m/s and leaves at 350 kPa, 127°C and 110 m/s. The environment is at 100 kPa and 7°C. Calculate per kg of air (a) the actual work required (b) the minimum work required and (c) the irreversibility of the process. (7 marks)

Module – 4

17.a]Show the constant pressure transformation of unit mass of ice at atmospheric pressure and -20^{o}C to superheated steam at 220^{o}C on P-v , T-v and P-T coordinate systems and explain their salient features . (7 marks)

b] A rigid vessel of volume 0.3 m^3 contains 10 kg of oxygen at 300 K. Using (i) the perfect gas equation and (ii) the Van der Waal's equation of state, determine the pressure of oxygen in the vessel. Take the Van der Waal's constants for oxygen as a =0.1382 m^6 Pa/ mol^2 and b=0.03186 m^3/ kmol . (7 marks)

OR

18.a]Steam at 25 bar and 300^{o}C expands isentropically to 5 bar. Calculate the change in enthalpy, volume and temperature of unit mass of steam during this process using steam tables and Mollier chart and compare the values (7 marks)

b]Explain law of corresponding states and its significance to the generalized compressibility chart. (7 marks)

Module – 5

19.a] Derive the expressions for the equivalent molecular weight and characteristic gas constant for a mixture of ideal gases. (6 marks)

b] 0.5 kg of Helium and 0.5 kg of Nitrogen are mixed at 20^{o}C and at a total pressure of 100 kPa. Find (i) volume of the mixture (ii) partial volumes of the components (iii) partial pressures of the components (iv) the specific heats of the mixture and (v) the gas constant of the mixture. Take ratio of specific heats for Helium and Nitrogen to be 1.667 and 1.4 respectively. (8 marks)

OR

20.a] 2 kg of carbon dioxide at 38°C and 1.4 bar is mixed with 5 kg of nitrogen at 150°C and 1.03 bar to form a mixture at a final pressure of 70 kPa. The process occurs adiabatically in a steady flow apparatus. Calculate the final temperature of the mixture and the change in entropy during the mixing process. Take specific heat at constant pressure for CO_2 and N_2 as 0.85 kJ/kg.K and 1.04 kJ/kg respectively. (7 marks)

b]Derive the Maxwell relations. Explain their significance ? (7 marks)

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT204	AUTO POWERPLANT	PCC	3	1	0	4

Preamble: This course aims at providing

- ✓ **an in-sight in the area of AN IC Engine, its different components and arrangements**
- ✓ **a deeper knowledge in the area of combustion.**
- ✓ **Testing of performance of an IC Engine and conformity to the requirements**

Prerequisite: NIL

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

CO 1	Understand various types of IC engines and components of the engine and its functions.
CO 2	Understand the Engine cooling and lubrication systems
CO 3	Gain knowledge on the fuel system components and their working in an SI Engine
CO 4	Gain knowledge on the fuel system components and their working in a CI Engine
CO 5	Evaluate and test the performance of an IC engine based on different parameters

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	1	-	1	1	1	1
CO 2	2	-	1	-	1	1	2	-	1	1	1	1
CO 3	2	1	2	1	-	1	2	-	-	2	1	1
CO 4	2	-	2	-	-	3	2	-	-	2	1	1
CO 5	2	-	1	1	-	1	2	-	2	2	1	2

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	10	10	20
Apply	20	20	50
Analyse	10	10	20
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. Are you able to classify and identify the different components of an IC engine?

Course Outcome 2 (CO2)

1. Are you able to understand the working of cooling and lubrication systems in an IC engine?

Course Outcome 3(CO3):

1. Are you able to identify the different components and working of a modern SI Engine?

Course Outcome 4 (CO4):

1. Are you able to identify the different components and working of a modern CI Engine?

Course Outcome 5 (CO5):

1. Are you able to test and trouble shoot an engine to meet the requirements?

Model Question paper

QP CODE:
PAGES:…

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT 204

Course Name: AUTO POWERPLANT

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

Part A

(Answer all questions. Each question carry 3 marks)

1. List down the different types of power plant used in automobiles

2. What are the different types of cam operating mechanisms .
3. Explain the functions of cooling system in an automobile.
4. With a neat diagram, explain the components of lubrication system
5. Why do we require a fuel supply system in an automobile? Explain the functions of a fuel supply system.
6. Explain the constructional details of Flex Fuel Vehicles.
7. What are the requirements of diesel injection system?
8. Explain the components and working CRDI system.
9. Explain in detail the procedure for measuring the of brake power.
10. What are the components of a heat balance sheet?

Part B

Answer any one full question from each module.

Each question carries 14 Marks

11. (a) Differentiate between otto cycle & diesel cycle (7)
    (b) Explain octane and cetane number (7)

OR

12. (a) Explain different types of cylinder head suitable sketches (7)
    (b)With neat diagram explain difference Types of valve and valve seats (7)
13. Explain dry sump and mist lubrication systems in detail (14)

OR

14. With neat diagram explain the components of components of water cooling system (14)
15. (a) With the aid of a diagram, explain the different circuits in carburetor. (7)
    (b) Explain the construction and working of GDI engines? (7)

OR

16. Explain with suitable sketch, the components of fuel feed systems. (14)

17. (a)Explain the components of diesel injection system .
    (5) (b)Discuss Quadra Jet and Multijet principles ?
    (5)

OR

18. Explain C-AV Bosch pump. Explain its working with neat figure 14)
19. Explain the different performance curves also highlight the effect of various parameters on the performance of the engines. (14)

OR

20. Discuss in detail the procedure of OBD tool for trouble shooting in automobiles

(14)

Syllabus

Module	Contents	Hours	Sem.Exam Marks
I	Introduction: Types of power plant, Basic engine nomenclature, classification of IC engines (Classification by cylinder arrangement, Valve arrangement and Type of valves), Engine cycles-Otto cycle & Diesel cycle, Comparison of SI and CI engines, working of 2 -stroke and 4 stroke engines with relative merits and demerits, Numbering of cylinders, firing order. SI and CI engine fuel requirement, Octane and Cetane number, Air-fuel ratio, stages of combustion in SI engines and CI engines, abnormal combustion- detonation and diesel knock. ***Constructional details of engine components:*** Moving parts and stationary parts, Cylinder block and crank case-types, cylinder liners, types of cylinder head, piston & piston rings, piston pins, connecting rod, crank shaft, flywheel-dual mass flywheel, Main Bearings, camshaft, camshaft drives-DOHC, Types of valve and valve seats, hydraulic tappets, valve actuating mechanisms (mechanisms with side camshaft and overhead camshaft), inlet and exhaust manifold construction, Components of intake and exhaust systems in modern engines	9	20%
II	Lubrication system: lubrication principles, classification of lubricants, properties of lubricants, service ratings of oils, oil additives, specification of lubricants, crankcase ventilation, wet sump, dry sump and mist lubrication systems, pre-lubrication systems, effect of engine conditions on lubricating oil, consumption of lubricating oil, Components of lubrication system (oil strainers, oil filters, oil pumps, oil coolers), chassis lubrication. Cooling system: Necessity of engine cooling and correct operating temperatures, types of cooling systems like Direct air cooling, Indirect or water cooling, Liquid cooling, Pressure sealed cooling, Evaporative cooling or steam cooling, oil coolers, components of water cooling system (thermostat, water pump, radiator, cooling fan etc), coolants and antifreeze solution, temperature gauges.	9	20%
III	Fuel supply system in petrol engines: Types of fuel feed systems, fuel tank, fuel pumps and fuel filters (types and construction), air filter types and construction, combustion and ignition limits in SI engines, carburetion, properties of air-petrol mixtures, mixture requirements for steady state operation, transient mixture requirements, simple carburetor, different circuits in carburetor, type of carburetors like Solex, SU, Carter	9	20%

	etc, Electronically controlled engines- sensors & actuators, injectors, ECU, MPFI engines, GDI engines, TSI, Flex Fuel Vehicles, EGR, SCR & other emission control in SI engines.		
IV	Fuel supply system in diesel engines: Requirements of diesel injection system, combustion chambers, swirl types, Components of diesel injection system, Diesel filters, fuel feed pump, hand pump, heavy duty air filters, Diesel injection pump types - simple and multiple unit pump, C-AV Bosch pump, Modem distributor type pumps, injection nozzles, governors (mechanical, pneumatic and hydraulic governors), cold starting devices., Electronically controlled engines-CRDI, and types of injectors, multiple injection, UPCR, Quadra Jet and Multijet principles, DPF, DOC & other emission control in CI engines.	9	20%
V	Performance test- Engine Dynamometers, chassis dynamometer, Standard testing procedure of IC engines – Performance curves, effect of various parameters on the performance of the engines, Measurement of brake power, Indicated power, Fuel consumption, Air consumption, Heat balance test – heat carried away by exhaust gases, Morse test on IC engines, CAFE standard, star labelling, Drive cycles-MIDC, emission standards. Use of OBD tool for trouble shooting, DLC, MIL, DTC, engine scan tools-types. Brake testing and fuel economy test of vehicles.	9	20%

Text Books

1. 1 Ganesan V, “Internal combustion engines”, 4th edition, Tata McGraw Hill Education, 2012.
2. 2 Rajput R. K, “A textbook of Internal Combustion Engines”, 2nd edition, Laxmi Publications (P) Ltd, 2007.
3. Mathur and Sharma, “A course on Internal combustion Engines”, Dhanpat Rai & Sons, 1985.

Reference Books

1. John. B, Heywood, “Internal Combustion Engine Fundamentals”, McGraw Hill Publishing Co., New York,1900 .
2. Ramalingam K. K, “Internal Combustion Engines”, Second Edition, Scitech Publications,2009
3. Edward F, Obert, “Internal Combustion Engines and Air Pollution”, Intext Education Publishers, 1980.

Course Contents and Lecture Schedule

N0	Topics	No of lectures
I	Introduction: Types of power plant, Basic engine nomenclature, classification of IC engines (Classification by cylinder arrangement, Valve arrangement and Type of valves), Engine cycles-Otto cycle & Diesel cycle, Comparison of SI and CI	1
1.1	engines, working of 2 -stroke and 4 stroke engines with relative merits and demerits, Numbering of cylinders, firing order. SI and CI engine fuel requirement, Octane and Cetane number, Air-fuel ratio, stages of combustion in SI engines and CI engines, abnormal combustion- detonation and diesel knock.	2
1.2	***Constructional details of engine components:*** Moving parts and stationary parts, Cylinder block and crank case-types, cylinder liners, types of cylinder head, piston & piston rings, piston pins, connecting rod, crank shaft, flywheel-dual mass flywheel, Main Bearings, camshaft, camshaft drives-DOHC,	3
1.3	Types of valve and valve seats, hydraulic tappets, valve actuating mechanisms (mechanisms with side camshaft and overhead camshaft), inlet and exhaust manifold construction, Components of intake and exhaust systems in modern engines	3
2	Lubrication system: lubrication principles, classification of lubricants, properties of lubricants, service ratings of oils, oil additives, specification of lubricants, crankcase ventilation, wet sump, dry sump and mist lubrication systems, pre-lubrication systems, effect of engine conditions on lubricating oil,	3
2.1	consumption of lubricating oil, Components of lubrication system (oil strainers, oil filters, oil pumps, oil coolers), chassis lubrication. Cooling system: Necessity of engine cooling and correct	3
2.3	operating temperatures, types of cooling systems like Direct air cooling, Indirect or water cooling, Liquid cooling, Pressure sealed cooling, Evaporative cooling or steam cooling, oil coolers, components of water cooling system (thermostat, water pump, radiator, cooling fan etc), coolants and antifreeze solution, temperature gauges.	3

3	Fuel supply system in petrol engines: Types of fuel feed systems, fuel tank, fuel pumps and fuel filters (types and construction), air filter types and construction, combustion and ignition limits in SI engines, carburetion, properties of air-petrol mixtures, mixture requirements for steady state operation,	6
3.1	transient mixture requirements, simple carburetor, different circuits in carburetor, type of carburetors like Solex, SU, Carter etc, Electronically controlled engines- sensors & actuators, injectors, ECU, MPFI engines, GDI engines, TSI, Flex Fuel Vehicles, EGR, SCR & other emission control in SI engines.	3
4	Fuel supply system in diesel engines: Requirements of diesel injection system, combustion chambers, swirl types, Components of diesel injection system, Diesel filters, fuel feed pump, hand pump, heavy duty air filters, Diesel injection pump types - simple and multiple unit pump, C-AV Bosch pump,	6
4.1	Modem distributor type pumps, injection nozzles, governors (mechanical, pneumatic and hydraulic governors), cold starting devices., Electronically controlled engines-CRDI, and types of injectors, multiple injection, UPCR, Quadra Jet and Multijet principles, DPF, DOC & other emission control in CI engines.	3
5	Performance test- Engine Dynamometers, chassis dynamometer, Standard testing procedure of IC engines – Performance curves, effect of various parameters on the performance of the engines, Measurement of brake power, Indicated power, Fuel consumption, Air consumption, Heat balance test – heat carried away by exhaust gases, Morse test on	5
5.1	IC engines, CAFE standard, star labelling, Drive cycles-MIDC, emission standards. Use of OBD tool for trouble shooting, DLC, MIL, DTC, engine scan tools-types. Brake testing and fuel economy test of vehicles.	4

CODE MUT206	COURSE NAME MECHANICS OF SOLIDS	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble:

This course helps the students to understand the concept of stress and strain in different types of structure/machine under various loading conditions. The course also covers simple and compound stresses due to forces, stresses and deflection in beams due to bending, torsion in circular section, strain energy, different theories of failure, stress in thin cylinder thick cylinder and spheres due to external and internal pressure.

Prerequisite: EST100 ENGINEERING MECHANICS

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Analyse the stresses, strains and deformations of structures under 2- and 3-dimensional loading by tensorial and graphical (Mohr's circle) approaches
CO 2	Analyse the strength of materials using stress-strain relationships for structural and thermal loading
CO 3	Use Shear Force and Bending Moment diagrams to estimate the deflection of beams, and strain energy methods to determine the deformation of structures subjected to various loading conditions
CO 4	Apply the theory of pure bending to study the structural behaviour of beams and perform basic design of shafts subjected to torsional loading
CO 5	Estimate the strength of thin cylinders, spherical vessels and columns, and appreciate the theories of failures and its relevance in mechanical design

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	2	1								1
CO 2	3	3	2	1								1
CO 3	3	3	1	1								2
CO 4	3	3	1	2								1
CO 5	3	3	1	1								1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember			
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	50
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 a maximum of 2 subdivisions and carry 14 marks.

COURSE LEVEL ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Determine the resultant traction at a point in a plane using the stress tensor.

2. Evaluate the principal stresses, principal strains and their directions from a given state of stress or strain.

3. Write the stress tensor and strain tensor.

Course Outcome 2 (CO2)

1. Write the generalized Hooke's law for stress-strain relations.

2. Estimate the state of strain from a given state of stress.

3. Analyse the strength of a structure subjected to thermal loading.

Course Outcome 3(CO3):

1. Draw the shear force and bending moment diagrams.

2. Apply strain energy method to estimate the deformation of a structure.

3. Use strain energy method to estimate the loads acting on a structure for a maximum deflection.

Course Outcome 4 (CO4):

1. Determine the bending stress on a beam subjected to pure bending.

2. Design a shaft to transmit power and torque.

3. Analyse the stress and deflection of a structure subjected to bending and twisting.

Course Outcome 5 (CO5):

1. Estimate the stresses on a thin cylinder or spherical vessel.

2. Analyse a column for buckling load.

3. A bolt is subjected to a direct tensile load of 20 kN and a shear load of 15 kN. Suggest suitable size of this bolt according to various theories of elastic failure, if the yield stress in simple tension is 360 MPa. A factor of safety 2 should be used. Assume poisson's ratio as 0.3.

SYLLABUS

Module 1: Analysis of deformable bodies: stress, stress at a point using Cartesian stress tensor, Cauchy's equation for stress on a given plane, normal stress & shear stress; Strain, deformation and displacement (in Cartesian coordinates), strain components, 2D plane stress and plane strain problems, principal stresses (2D & 3D), stress invariants, Mohr's circle representation for stress in 2D and problems, representation 3D stress in Mohr's circle using principal stresses as input.

Module 2: Stress-strain relations for isotropic materials (3D, 2D plane stress, 2D plain strain), Elastic constants (μ, λ, E, G, ν and K), Relation between elastic constants; Calculation of stress and strain in axially loaded members (single and composite materials). Concept of thermal strain and stress, Simple problems on thermal stress in axially loaded members.

Module 3: Bending moment and shear force. Shear force and bending moment diagrams for cantilever, and simply supported beams. Strain energy, Equations for strain energy due to axial load, transverse shear, bending moment and torque. Expressions in terms of load & deflection. Expressions in terms of elastic constants and dimensions of the body. Simple problems to solve elastic deformations. Second theorem of Castigliano and simple problems to solve deflection of beams.

Module 4: Theory of pure bending and bending stresses, Derivation of bending equation (Flexural formula), Section modulus, Flexural rigidity, problems to calculate bending stress, solving the deflection of beams using Macaulay's method, Torsion of circular shafts, Derivation of torsion equation, simple problems. Simple problems on combined torsion and bending.

Module 5: Thin cylinders and spherical vessels. Introduction to buckling of columns, Euler's theory and Rankine's formula for columns. Theories of failure: Rankine theory, Guest's theory, Saint-Venant's theory, Hencky-von Mises theory and Haigh's theory

Text Books

1. Mechanics of materials in S.I.units, R .C. Hibbeler, Pearson Higher Education 2018

2. Advanced Mechanics of Solids, L. S. Srinath, TMH

3. Design of Machine Elements, V. B Bhandari

Reference Books

1. Strength of Materials, Surendra Singh, S. K. Kataria& Sons

2. Engineering Mechanics of Solids, Popov E., PHI 2002

3. Mechanics of Materials S. I. units, Beer, Johnston, Dewolf, McGraw Hills 2017

4. Strength of Materials, Rattan, McGraw Hills 2011

COURSE PLAN

No	Topic	No. of Lectures
1	**Module 1: Stress and Strain Analysis**	**9 hrs**
1.1	Describe the deformation behaviour of elastic solids in equilibrium under the action of a system of forces. Describe method of sections to illustrate stress as resisting force per unit area. Stress vectors on Cartesian coordinate planes passing through a point and writing stress at a point in the form of a matrix.	1 hr
1.2	Direction cosines of a plane. Equality of cross shear (Derivation not required). Write Cauchy's equation (Derivation not required) for stress on a plane as the product of stress tensor and direction cosine vector. Normal and tangential (shear) components of stress on a plane.	1 hr
1.3	Deformation, displacement, gradient of deformation and strains in elastic solids. Cartesian components of strain and Cauchy's strain-displacement relationships (small-strain only). Strain tensor in 2D and 3D. Write the stress tensor and strain tensor for Plane stress and Plane Strain analysis.	1 hr
1.4	Stress on an oblique plane under axial loading, Discuss principal planes, characteristic equation to find principal stresses for 2D and 3D state of stress, stress invariants. Evaluate principal stresses in 2D and 3D using characteristic equations.	2 hrs
1.5	Discuss the order of principal stress and maximum shear stress. Compare the principal stresses in 2D and 3D state of stress. Represent the state of stress using principal stress tensor. Determine the direction of principal stresses as eigenvectors of the principal stress tensor.	2 hrs
1.6	Represent the 2D and 3D state of stress using principal stress graphically (Mohr's circle). Determine the maximum shear stress by Mohr's circle method and compare with the theoretical relations.	2 hrs
2	**Module 2: Stress - Strain Relationships**	**8 hrs**
2.1	Stress-strain diagram, normal strain under axial loading, deformations of members under axial loading, Stress and strain distribution under axial loading (Saint Venant's principle of end loads). Stress–Strain Behavior of Ductile and Brittle Materials.	2 hr
2.2	Constitutive equations-generalized Hooke's law, equations for linear elastic isotropic solids in 3D and 2D. Hooke's law for Plane stress and plane strain conditions in terms of Young's Modulus and Poisson's ratio. Numerical problems.	2 hrs
2.3	Lame's constants (λ and μ), other elastic constants (E, G, v and K) and the relation between them. Generalized Hooke's law in terms of Lame's constants. Calculation of stress and strain in axially loaded members with single and composite materials	2 hrs

2.4	Effects of thermal loading – thermal stress and thermal strain. Thermal stress on a prismatic bar held between fixed supports. Numerical problems.	2 hrs
3	**Shear Force-Bending Moment Diagrams and Strain Energy Principles**	**9 hrs**
3.1	Shear force and bending moment diagrams for cantilever and simply supported beams with UDL, point load and varying load	2 hrs
3.2	Load-deflection diagram, concept of strain energy, strain energy density, modulus of resilience	1 hr
3.3	Linear elastic loading, elastic strain energy and Complementary strain energy. Elastic strain energy for axial loading, transverse shear, bending and torsional loads (short derivations in terms of loads and deflections).	1 hr
3.4	Strain energy due to impact loading, simple numerical problems	1 hr
3.5	Expressions for strain energy in terms of load, geometry and material properties of the body for axial, shearing, bending and torsional loads. Simple problems to solve elastic deformations	2 hrs
3.6	Castigliano's second theorem to find displacements, reciprocal relation, proof for Castigliano's second theorem.	1 hr
3.7	Simple problems to find the deflections of beams due to various loads	1 hr
4	**Pure Bending and Torsion of shafts**	**9 hrs**
4.1	Fundamentals of beam bending including sign conventions, pure bending, curvature of a beam, normal stresses in beams, moment-curvature formula	2 hrs
4.2	Derivation of flexural formula, section modulus, flexural rigidity, numerical problems to evaluate bending stress	2 hrs
4.3	Deflection of beams using Macauley's method (procedure and problems with multiple loads)	2 hrs
4.4	Torsional deformation of circular shafts, assumptions for shafts subjected to torsion within elastic deformation range, derivation of torsion formula	1 hr
4.5	Torsional rigidity, Polar moment of inertia, basic design of transmission shafts. Simple problems to estimate the stress in a solid and hollow shafts	1 hr
4.6	Numerical problems for basic design of circular shafts subjected to externally applied torques	1 hr
5	**Combined loadings and Theories of Failure**	**8 hrs**
5.1	Circumferential and Longitudinal stress in a thin cylindrical vessel, stresses in a thin spherical vessel (short derivations) and numerical problems	2 hrs
5.2	Fundamentals of bucking and stability, critical load, equilibrium diagram for buckling of an idealized structure	1 hr
5.3	Buckling of columns with pinned ends, Euler's buckling theory for long columns	2 hrs

5.4	Critical stress, slenderness ratio, Rankine’s formula for short columns	1 hr
5.5	Introduction to Theories of Failure. Rankine’s theory for maximum normal stress, Guest’s theory for maximum shear stress, Saint-Venant’s theory for maximum normal strain	1 hr
5.6	Hencky-von Mises theory for maximum distortion energy, Haigh’s theory for maximum strain energy	1 hr

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code : MUT206

Course Name : MECHANICS OF SOLIDS

Max. Marks : 100 Duration : 3 Hours

PART – A

(*ANSWER ALL QUESTIONS, EACH QUESTION CARRIES 3 MARKS*)

1. Express the stress invariants in terms of Cartesian components of stress and principal stress.
2. Write down the Cauchy's strain displacement relationships in 3D polar form.
3. Distinguish between the states of plane stress and plane strain.
4. Represent the generalized Hooke's law for an isotropic material in terms of Lame's constants.
5. Discuss reciprocal relation for multiple loads on a structure.
6. Express the strain energy for a cantilever beam subjected to a transverse point load at free end.
7. List any three important assumptions in the theory of torsion.
8. Write the significance of flexural rigidity and section modulus in the analysis of beams.
9. Compare the strength of a thin spherical vessel and a thin cylindrical vessel on the basis of hoop stress.
10. Discuss Saint-Venant's theory of failure.

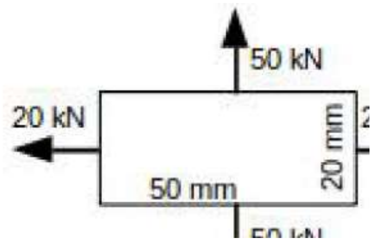
PART – B

(*ANSWER ONE FULL QUESTION FROM EACH MODULE*)

MODULE – 1

11. a) The state of stress at a point is given by σ_{xx} = 12.31 MPa, σ_{yy} = 8.96 MPa, σ_{zz} = 4.34 MPa, τ_{xy} = 4.2 MPa, τ_{yz} = 5.27 MPa, τ_{xz} = 0.84 MPa. Determine the principal stresses. (7 marks)

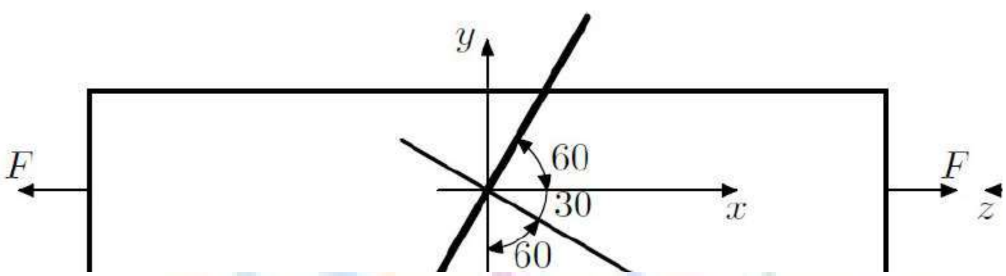
    b) An aluminum alloy plate of size 50 mm × 20 mm with thickness 5 mm is loaded as shown. Find the change in thickness? What must be the load to be applied to have the same change in thickness if load is applied only along thickness direction? Take Young's Modulus as 60 GPa and Poisson's ratio as 0.3. (7 marks)



OR

12. a) The displacement field for a body is given by **u**= $(x^2 + y)\boldsymbol{i}$+ $(3 + z)\ \boldsymbol{j}$ + $(x^2 + 2y)\boldsymbol{k}$. What is the deformed position of a point originally at (3,1,–2)? Write the strain tensor at the point (−3,−1,2).
(7 marks)

b) An axially loaded square bar of cross sectional area 10 mm^2 is subjected to an average force of F = 10 N as shown in figure. Write down the stress tensor. For a plane parallel to z axis and inclined at 60 degree with the x-axis, determine for any point on the plane, the resisting traction normal stress and shear stress. (7 marks)



MODULE – 2

13. a) A 2.5m long steel pipe of 300 mm outer diameter and 15 mm wall thickness is used as a column to carry a 700 kN axial centric load. Take E = 200 GPa and ν = 0.3, determine the change in length of the pipe, change in outer diameter, and the change in wall thickness.
(7 marks)

b) A copper strip 20 × 2.5 mm^2 in section is held between two strips of steel of the same size. Find the stresses in steel and copper due to temperature rise of 6°C. Take $\alpha_s = 1.2 \times 10^{-5}$ / °C, $\alpha_c = 1.85 \times 10^{-5}$ / °C, $E_s = 2 \times 10^5$ N/mm^2 and $E_c = 1.2 \times 10^5$ N/mm^2.
(7 marks)

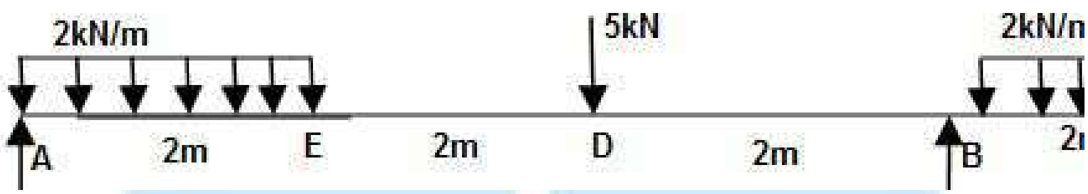
OR

14. a) A brass bar 20mm diameter is enclosed in a steel tube of 25mm internal diameter and 50mm external diameter. Both bar and tube is of same length and fastened rigidly at their ends. The composite bar is free of stress at 20°C. To what temperature the assembly must be heated to generate a compressive stress of 48MPa in brass bar? Also determine the stress in steel tube. E_{steel} = 200GPa and E_{brass} = 84GPa, $\alpha_{steel} = 12 \times 10^{-6}$ / °C and $\alpha_{brass} = 18 \times 10^{-6}$ / °C.
(9 marks)

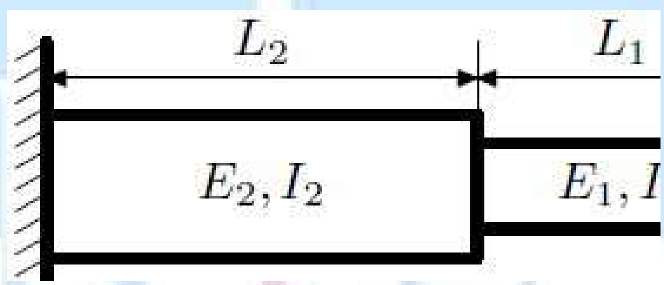
b) Draw the stress-strain diagram for a ductile material and explain the salient points. (5 marks)

MODULE – 3

15. a) Draw shear force and bending moment diagram for the beam given in the figure and mark all the salient points. 9 marks)



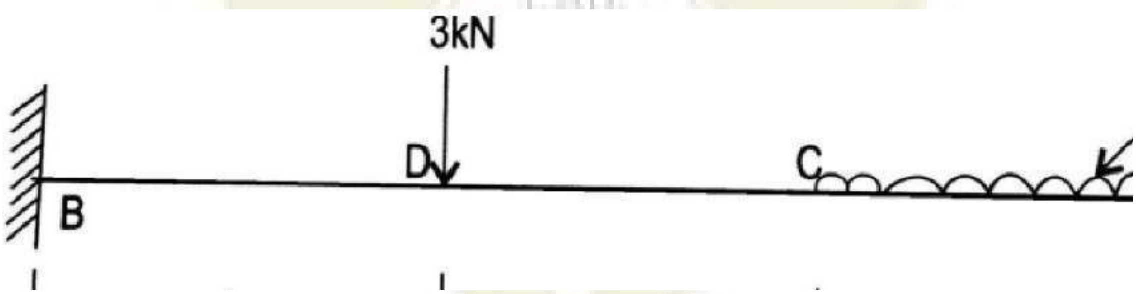
b) Determine the deflection at the free end of the stepped beam using strain energy method.



(5 marks)

OR

16. a) Draw the SFD and BMD of a cantilever beam loaded as shown in figure. (5 marks)



b) The displacement field of a body is $\mathbf{u} = [(x^2 + y)\,\hat{\mathbf{i}} + (3+z)\,\hat{\mathbf{j}} + (x^2 + 2y)$. Use the small strain theory to compute the strain energy per unit volume at the point (2,3,1). Given that $G = 80\times10^6$ kPa and $E = 207\times10^6$ kPa.
(9 marks)

MODULE – 4

17. a) A horizontal girder of steel having uniform section is 14 m long and is simply supported at its ends. It carries concentrated loads of 120 kN and 80 kN at two points 3 m and 4.5 m from the two ends respectively. Moment of inertia for the section of the girder is 16×10^8 mm^4 and E_s = 210 kN/mm^2. Calculate the deflection of the girder at points under the two loads and maximum deflection using Macaulay's method. (10 marks)

    b) Compare the strength of a hollow shaft of diameter ratio 0.75 to that of a solid shaft by considering the permissible shear stress. Both the shafts are of same material, of same length and weight. (4 marks)

OR

18. a) A solid aluminium shaft 1 m long and 50 mm diameter is to be replaced by a tubular steel shaft of the same length and the same outside diameter such that each of the two shafts could have the same angle of twist per unit torsional moment over the total length. What must the inner diameter of the tubular steel shaft be? Modulus of rigidity of the steel is three times that of aluminium.
    (9 marks)

    b) Derive the equation for the theory of pure bending. (5 marks)

MODULE – 5

19. a) Find the crippling load for a hollow steel column 50mm internal diameter and 5mm thick. The column is 5m long with one end fixed and other end hinged. Use Rankine's formula and Rankine's constant as 1/7500 and σ_c = 335 N/mm^2.
    (8 marks)

    b) Explain the maximum normal stress theory, maximum strain energy theory and maximum shear stress theory of failure.
    (6 marks)

OR

20. a) A cylindrical shell 3m long closed at the ends has an internal diameter of 1m and wall thickness 15mm. Calculate the circumferential and longitudinal stresses induced and also the change in dimensions of the shell, if it is subjected to an internal pressure of 1.5MPa. Take E = 2×10^5 N/mm^2 and ν = 0.3.
    (9 marks)

    b) Derive Euler's formula for a column with one end is hinged and the other end fixed. (5 marks)

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUL202	MATERIALS TESTING LAB	PCC	0	0	3	2

Preamble:

The objective of this course is to give a broad understanding of common materials related to mechanical engineering with an emphasis on the fundamentals of structure-property-application and its relationships. A group of 6/7 students can conduct experiment effectively. A total of six experiments for the duration of 2 hours each is proposed for this course.

Prerequisite: A course on Engineering Mechanics is required

Course Outcomes:

After the completion of the course the student will be able to

CO 1	To understand the basic concepts of analysis of circular shafts subjected to torsion.
CO 2	To understand the behaviour of engineering component subjected to cyclic loading and failure concepts
CO 3	Evaluate the strength of ductile and brittle materials subjected to compressive, Tensile shear and bending forces
CO 4	Evaluate the microstructural morphology of ductile or brittle materials and its fracture modes (ductile /brittle fracture) during tension test
CO 5	To specify suitable material for applications in the field of design and manufacturing.

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							
CO 2	3	3	1		3				3	2	2	1
CO 3	3	3	3	1	3				3	2	3	2
CO 4	3	3	3	3	3	2	2	1	3	2	3	2
CO 5	3	3	3	1	3	2	2	1	3	2	3	2

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	:	15 marks
Continuous Assessment	:	30 marks
Internal Test (Immediately before the second series test)	:	30 marks

End Semester Examination Pattern:

The following guidelines should be followed regarding award of marks

(a) Preliminary work	: 15 Marks
(b) Implementing the work/Conducting the experiment	: 10 Marks
(c) Performance, result and inference (usage of equipments and troubleshooting)	: 25 Marks
(d) Viva voce	: 20 marks
(e) Record	: 5 Marks

General instructions:

Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

SYLLABUS

LIST OF EXPERIMENTS

1. To conduct tension test on ductile material (mild steel/ tor-steel/ high strength steel) using Universal tension testing machine and Extensometer.
2. To conduct compression test on ductile material (mild steel/ tor-steel/ high strength steel) using Universal tension testing machine and Extensometer.
3. To conduct tension test on Brittle material (cast iron) using Universal tension testing machine and Extensometer.
4. To conduct shear test on mild steel rod.
5. To conduct microstructure features of mild steel/copper/ brass/aluminium using optical microscope, double disc polishing machine, emery papers and etchent.
6. To conduct fractography study of ductile or brittle material using optical microscope.
7. To conduct Hardness test of a given material. (Brinell, Vickers and Rockwell)

8. To determine torsional rigidity of mild steel/copper/brass rod.
9. To determine flexural rigidity of mild steel/ copper/brass material using universal testing machine.
10. To determine fracture toughness of the given material using Universal tension testing machine.
11. To study the procedure for plotting S-N curve using Fatigue testing machine.
12. To conduct a Toughness test of the given material using Izod and Charpy Machine.
13. To determine spring stiffness of close coiled/open coiled/series/parallel arrangements.
14. To conduct bending test on wooden beam.
15. To conduct stress measurements using Photo elastic methods.
16. To conduct strain measurements using strain gauges.
17. To determine moment of inertia of rotating bodies.
18. To conduct an experiment to Verify Clerk Maxwell's law of reciprocal deflection and determine young's Modulus of steel.
19. To determine the surface roughness of a polished specimen using surface profilometer.

Note: 12 experiments are mandatory

Reference Books

1. G E Dieter. Mechanical Metallurgy, McGraw Hill,2013

2. Dally J W, Railey W P, Experimental Stress analysis , McGarw Hill,1991

3. Baldev Raj, Jayakumar T, Thavasimuthu M., Practical Non destructive testing, Narosa Book

Distributors,2015

MUL204	VEHICLE SYSTEMS LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble: The aim of this course is to make the students gain practical knowledge about various systems in automobile and after this course the student will be able to handle any maintenance issue in a vehicle and also identify the troubles of the vehicles from the symptoms shown.

Prerequisite: NIL

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

CO 1	**To study about hand tools, special purpose tools, and their uses in automobile maintenance workshop**
CO 2	**Rectifying and trouble shooting in various system in automobiles** **Disassembling and inspection of various components of automobiles**
CO 3	**Utilize one's ability as an individual or in a team for the effective communication, practical skill and document design.**

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	-	-	2	2	-	-
CO 2	3	2	2	2	1	2	-	-	2	2	-	-
CO 3	3	2	2	2	1	2	-	-	3	3	-	-

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks
Continuous Assessment : 30 marks
Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work	: 15 Marks
(b) Implementing the work/Conducting the experiment	: 10 Marks
(c) Performance, result and inference (usage of equipments and trouble shooting)	: 25 Marks
(d) Viva voce	: 20 marks
(e) Record	: 5 Marks

General instructions: Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. To study about hand tools, special purpose tools, and their uses.

Course Outcome 2 (CO2)

1. Rectifying and trouble shooting in engines
2. Rectifying and trouble shooting in ignition systems
3. Rectifying and trouble shooting in braking system in automobiles
4. Rectifying and trouble shooting in Fuel supply system in automobiles

Course Outcome 3 (CO3):

1. Disassembling of clutch and gear box and to explain the condition of gear box and clutch assembly
2. Dismantle and assembly of various joints in the suspension, steering gear box and transmission systems

LIST OF EXPERIMENTS

List of Exercises/Experiments (Minimum 12 exercises/experiments are mandatory)

1. Servicing of clutch assembly, checking the spring tension of coil springs in spring tester.
2. Dismantling of gear box, inspecting components, servicing, checking the gear ratios.
3. Dismantling of differential assembly, servicing, backlash adjustments, check for drive axis ratio.
4. Servicing master and wheel cylinders in hydraulic brake system & bleeding of brakes.
5. Valve timing setting including valve clearance adjustment.
6. Servicing of steering gear box, checking for end play in shafts.
7. Overhauling of a complete strut type suspension system.

8. Disassembling and servicing of Leaf Spring Assembly

9. Dismantle and assemble C.V joint. Also examine a slip joint, U.J cross in propeller shaft.

10. Compression test of petrol and diesel engine.

11. Disassembling cylinder head, decarbonising, Valve Seat Grinding

12. Disassembling of engine: inspection of engine components, servicing of components, measurement of dimensions of different components of engine, compare with standard specifications, piston ring setting, assembling using special tools.

13. Rectifying the troubles in ignition system, adjusting spark plug and C. B. Point gap, checking ignition timing.

14. Servicing of tire and tube - Tyre removing, inspection, check for cuts, bulges and excessive tread wear, resetting using pneumatic tyre changer, vulcanizing or puncturing of tubes.

15. Testing the injector – testing the pressure of mechanical diesel injector, spray pattern, adjusting of injection pressure

Note: 12 experiments are mandatory

Reference Books

Text Book:

1. Boyce Dwiggins – Automobile Repair guide, Theodor Audel and Co., Indiana – 1978.

2. A. W. Judge – Maintenance of high speed diesel engine, Chapmann Hall Ltd.

3. A. W. Judge – Motor vehicle engine servicing 3rd edition, Pitman paper mark, London, 1969.

4. Vehicle service manuals and reputed manufacturers

SEMESTER -4

MINOR

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT282	AUTOMOTIVE CHASSIS AND ENGINE COMPONENTS	VAC	4	0	0	4

Preamble: This course aims at providing

- ✓ **an in-sight in the area of constructional details of engine ,lubrication system and cooling system**
- ✓ **a deeper knowledge on the function and types of the chassis.**
- ✓ **Basic understanding on the functional sub systems in the chassis.**

Prerequisite: NIL

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

CO 1	Identifying the **constructional details of engine components and lubrication system**
CO 2	Evaluate the different types of cooling system and chassis framework
CO 3	Understand the front axle and steering system
CO 4	Identify the suspension system and different classes of wheels used in a vehicle
CO 5	Comparing the different types of rear axles and adjoining components

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	-	2
CO 2	2	-	1	-	-	1	-	-	-	1	-	2
CO 3	2	-	3	-	-	1	-	-	-	1	-	2
CO 4	2	-	2	-	-	1	-	-	-	1	-	2
CO 5	2	-	1	-	-	1	-	-	-	1	-	2

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	30	30	60
Understand	20	20	40
Apply			
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. Are you able to Identify the constructional details of engine components and lubrication system

Course Outcome 2 (CO2)

1. Are you able to identify the importance of the different types of cooling system and chassis framework

Course Outcome 3(CO3):

1 Can you identify the type of steering and front axle used in the vehicle?

Course Outcome 4 (CO4):

1. . Can you decide on the suspension and wheels which are best suited for the vehicle you are making?

Course Outcome 5 (CO5):

1. Can you identify the working of differential and type of rear axle being employed in a vehicle?

Model Question paper

QP CODE: **PAGES:…**

Reg. No: _______________ **Name :_______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT282

Course Name: AUTOMOTIVE CHASSIS AND ENGINE COMPONENTS

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

Part A

(Answer all questions. Each question carry 3 marks)

1. List down the different layouts used in an automobile according to the position of the prime mover? Explain any one of them
2. What are the different types of vibration damper used in engines.
3. Explain the front wheel geometries with neat sketches

4. With a neat diagram, explain the steering linkage system used for independent suspension front axle from steering wheel to wheels
5. Why do we require a suspension system? Explain the functions of a suspension system
6. Explain the construction details of engine cooling system
7. What are the differences between Wet sump Dry sump lubrication systems)
8. Explain the mechanism of Power and power assisted steering
9. Why do we need a differential? Explain the working of differential
10. Why is axle shaft made of solid bar and propeller shaft made of hollow tube?

Part B

Answer any one full question from each module.

Each question carries 14 Marks

11. (a) List down the types of cylinder head (7)
    (b) Explain the different lubrication systems (7)

OR

12. (a) With neat sketch explain the different types of valve operating mechanisms (14)
13. Explain ackermann steering mechanism with a neat sketch. Derive the condition for true rolling (14)

OR

14. Explain the working of Davis steering mechanism. Compare its advantage and disadvantage with Ackermann steering. Why is Davis mechanism not in use now (14)
15. (a) Explain the most commonly used independent suspension system (7)
    (b) Explain the construction and working of leafsprings. Why do we require helper springs (7)

OR

16. Explain the different types of rims used in an automobile with neat sketch (14)
17. What is necessity of engine cooling and correct operating temperatures, also explain the different types of engine cooling methods. (14)

OR

18. With the aid of neat sketch explain the different layout of chassis & its main components (14)
19. Explain the different types of gears used in final drive for a front engine rear wheel drive vehicle with neat sketches (14)

OR

20. Explain semi floating and fully floating axles with neat sketches (14)

Syllabus

Module	Contents	Hours	Sem.Exam Marks
I	**Constructional details of engine and Lubrication system** **Constructional details of engine components:** Types, components and layout of an automobile. Classification of automotive engines, multi-cylinder reciprocating engine, construction details- main parts: cylinder head, cylinder, crank case, cylinder liners, types of cylinder head, gasket materials pistons, piston rings, connecting rod, flywheel, vibration damper, Main Bearings, crank shaft, cam shaft, different types of valve operating mechanisms- side cam and overhead camshaft mechanisms. Inlet and exhaust manifold construction, hydraulic tappets **Lubrication system**: Function of lubrication system, lubrication principles, classification of lubricants, types of lubricants, properties of lubricants, , crankcase ventilation, lubrication systems (Mist, Wet sump Dry sump lubrication systems), effect of engine conditions on lubricating oil, Components of lubrication system (oil strainers, oil filters, oil pumps, oil coolers), chassis lubrication.	9	20%
II	**Cooling system and introduction to Chassis and Frame** **Cooling system**: Necessity of engine cooling and correct operating temperatures, types of cooling systems like Direct air cooling, Indirect or water cooling, Liquid cooling, Pressure sealed cooling, Evaporative cooling or steam cooling, components of water cooling system (thermostat, water pump, radiator, cooling fan etc), antifreeze solution, temperature gauges. **Chassis and Frame:** Layout of chassis & its main components. Types of frames, conventional frames and unitized chassis, articulated, rigid vehicles, prime movers, hybrid car & electric car.	9	20%
III	**Front Axle and Steering :Front Axle types.** Construction details.Materials. Front wheel geometry viz. Camber, kingpininclination, caster, toe-in and toe-out. Conditions for true rolling motion of road wheels duringsteering. Steering geometry. Ackermann and Davis steering. Constructional details of steeringlinkages. Steering linkage layout for conventional and independent suspensions.Different types of steering gear boxes.Turning radius, wheel wobble and shimmy. Power and power assisted steering – Electric steering – Steer by wire.	9	20%

IV	**Suspension System, Wheels and Tyres** Types of suspension. Factors influencing ride comfort, Suspension springs – leaf spring, shackle and mounting brackets, coil and torsion bar springs. Spring materials, Independent suspension – front and rear. Rubber, pneumatic, hydroelasitc suspension – Active suspension system. Hydraulic dampers, Magneto Rheological fluids . Design of leaf springs, Types of wheels. Construction of wheel assembly. Types of tyres and constructional details. Static and rolling properties of pneumatic tyres, Wheel balancing and alignment.	**9**	**20%**
V	**Final Drive & Rear Axle:** Purpose of final drive & drive ratio, Different types of final drives, need of differential, Constructional details of differential unit, Non-slip differential, Differential lock, Differential housing, Function of rear axle, Construction, Types of loads acting on rear axle, Axle types - semi-floating, full floating, Axle shafts, Final drive lubrication. Twin Speed final drive. Final drive for multiaxle vehicles.	**9**	**20%**

Text Books

1. Kripal Singh, Automobile Engineering, ADWVol II, Standard Publisher, New Delhi , 2006
2. N.K. Giri, Automotive Mechanics, Kanna Publishers, 2007
3. M. L. Mathur, R. P. Sharma - Internal Combustion Engines, Dhanpat Rai Publications
4. R.K. Rajput, Internal Combustion Engines, Laxmi Publications.
5. V Ganesan, Internal Combustion Engine Tata McGraw Hill Publishing Company Ltd., New Delhi 2006.

Reference Books

1. Heldt P.M., Automotive Chassis, Chilton Co., New York, 1990
2. Newton Steeds and Garret, Motor Vehicles, 13th Edition, Butterworth, London, 2005.
3. Heinz Haisler,Advanced Vehicle Technology, Butterworth, London, 2005.
4. Stuart Mills and Julie Wilson, How to Design and Build an Electric Car or Vehicle,
5.SeithLeitman, Build your own electric vehicle, 3rd edition, McGraw Hill education, 2013

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction**	
1.1	Types, components and layout of an automobile. Classification of automotive engines, multi-cylinder reciprocating engine,	1
1.2	construction details- main parts: cylinder head, cylinder, crank case, cylinder liners, types of cylinder head, gasket materials pistons, piston rings, connecting rod, flywheel, vibration damper,	2
1.3	Main Bearings, crank shaft, cam shaft, different types of valve operating mechanisms- side cam and overhead camshaft	2

	mechanisms. Inlet and exhaust manifold construction, hydraulic tappets	
1.4	: Function of lubrication system, lubrication principles, classification of lubricants, types of lubricants, properties of lubricants, , crankcase ventilation	2
1.5	lubrication systems (Mist, Wet sump Dry sump lubrication systems), effect of engine conditions on lubricating oil, Components of lubrication system (oil strainers, oil filters, oil pumps, oil coolers), chassis lubrication.	2
2	**Cooling system and introduction to Chassis and Frame**	
2.1	Necessity of engine cooling and correct operating temperatures, types of cooling systems like Direct air cooling, Indirect or water cooling, Liquid cooling, Pressure sealed cooling	3
2.2	, Evaporative cooling or steam cooling, components of water cooling system (thermostat, water pump, radiator, cooling fan etc), antifreeze solution, temperature gauges.	3
2.3	**Chassis and Frame:** Layout of chassis & its main components. Types of frames, conventional frames and unitized chassis, articulated, rigid vehicles, prime movers, hybrid car & electric car.	3
3	**Front axle and Steering**	
3.1	Front Axle types. Construction details. Materials.	1
3.2	Front wheel geometry viz. Camber, kingpin inclination, caster, toe-in and toe-out.	1
3.3	Conditions for true rolling motion of road wheels during steering	1
3.4	Steering geometry. Ackermann and Davis steering	1
3..5	Constructional details of steering linkages	1
3.6	Steering linkage layout for conventional and independent suspensions	1
3.7	Different types of steering gear boxes	1
3.8	Turning radius, wheel wobble and shimmy	1
3.9	Power and power assisted steering – Electric steering – Steer by wire	1
4	**Suspension System, Wheels and Tyres**	
4.1	Types of suspension. Factors influencing ride comfort	1
4.2	Suspension springs – leaf spring, shackleand mounting brackets, coil and torsion bar springs, Spring materials	1
4.3	Independent suspension –front and rear	1
4.4	Rubber, pneumatic, hydroelasitc suspension	1

4.5	Hydraulic dampers, Magneto Rheological fluids	1
4.6	Design of leaf springs	1
4.7	Types of wheels. Construction of wheel assembly	1
4.8	Types of tyres and constructional details.	1
4.9	Static and rolling properties of pneumatic tyres, Wheel balancing and alignment	1
5	**FINAL DRIVE AND REAR AXLE**	
5.1	Purpose of final drive & drive ratio	1
5.2	Different types of final drives	1
5.3	Need of differential, Constructional details of differential unit,	1
5.4	Non-slip differential, Differential lock, Differential housing	1
5.5	Function of rear axle, Construction, Types of loads acting on rear axle	2
5.6	Axle types - semi-floating, full floating	1
5.7	Axle shafts, Final drive lubrication	1
5.8	Twin Speed final drive. Final drive for multiaxle vehicles	1

SEMESTER -4
HONOURS

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT 292	Incompressible and compressible Flows	VAC	3	1	0	4

Code	Description
T	Theory based courses (other the lecture hours, these courses can have tutorial and practical hours, e.g., L-T-P structures 3-0-0, 3-1-2, 3-0-2 etc.)
L	Laboratory based courses (where performance is evaluated primarily on the basis of practical or laboratory work with LTP structures like 0-0-3, 1-0-3, 0-1-3 etc.)
N	Non-credit courses

Preamble: The objective of learning Compressible and Incompressible fluid flow is to understand, the fundamental concepts of Compressible Incompressible fluid flow, various governing equations and their applications. By learning the course, one must be able to analyse various problems on compressible and incompressible flow and the various types of flow measurement techniques

Prerequisite: Fluid Mechanics and Machinery

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

CO 1	Examine and identify the fundamentals of basic conservation equations, governing equations and vorticity
CO 2	Conduct the differential analysis of fluid flow for incompressible fluids
CO 3	Understand the basics of compressible fluid flow
CO 4	Analyse the various conditions for Fanno flow and Rayleigh flow for compressible fluids
CO 5	Understand the governing equations for normal shock
CO 6	Apply the various measuring techniques learned for Compressible flow field visualization and measurement

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	-	1	1	1	1
CO 2	2	-	1	-	-	1	2	-	-	1	1	2
CO 3	2	1	3	1	-	1	2	-	-	2	1	1
CO 4	2	-	2	-	-	3	2	-	-	2	1	1
CO 5	2	-	1	-	-	1	2	-	-	2	1	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember			
Understand			
Apply	20	20	20
Analyse	20	20	30
Evaluate	10	10	40
Create			10

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. Explain the Reynolds transport theorem

Course Outcome 2 (CO2)

1. Derive Navier- Stokes equations for various conditions

Course Outcome 3(CO3):

1.State the physical difference between incompressible, subsonic, sonic and supersonic flows

2. List the basic problems on isentropic flow.

3. Describe the Isentropic duct flow of an ideal gas

Course Outcome 4 (CO4)

1. Illustrate flow in constant area duct with friction only (Fanno flow).

2. Explain the flow in constant area duct with heat transfer only (Rayleigh flow)

Course Outcome 5 (CO5):

1.Describe the governing equations prevailing normal shocks

2. Explain the property changes across shocks

Course Outcome 6 (CO6):

1.Explain the various techniques for Compressible flow field visualization and measurement

2.List the various instruments used for the compressible flow measurement

Syllabus

Module 1

Fluid Kinematics- Lagrangian and Eulerian Descriptions- Flow patterns and flow visualisations- Plots of fluid flow data- Vorticity and Rotationality- Reynolds transport theorem

Module 2

Differential Analysis of Fluid Flow- Introduction-Conservation of mass- The continuity equation- The stream function-Caushy's equation- Navier-Stokes equations- Differential analysis of fluid flow problems

Module 3

Compressible fluid flows: Introduction and review: Concept of continuum-system and control volume approach- conservation of mass, momentum and energy- stagnation state-compressibility-Entropy relations - Acoustic velocity-Mach number - physical difference between incompressible, subsonic, sonic and supersonic flows

Isentropic duct flow of an ideal gas: Governing equations - 1D compressible adiabatic duct flow, variation of properties with Mach number and critical properties; Converging nozzles, choking, converging-diverging nozzles, basic problems on isentropic flow.

Module 4

Flow in constant area duct with friction only (Fanno flow): Governing equations – Fanno line - significance of maximum entropy point on Fanno line – choking in Fanno flow – relations of properties with Mach number - basic problems.

Flow in constant area duct with heat transfer only (Rayleigh flow): Governing equations – Rayleigh line - significance of maximum entropy and maximum enthalpy points on Rayleigh line – choking in Rayleigh flow – relations of properties with Mach number – basic problems.

Module 5

Normal shocks: Governing equations - Prandtl Meyer relation - property changes across shocks, shocks in isentropic, Fanno and Rayleigh flows, problems of normal shock in those flows – introduction to oblique shock.

Measurement techniques: Compressible flow field visualization and measurement - Shadowgraph - interferometer- subsonic compressible flow field - measurement (Pressure, Velocity and Temperature) – compressibility - correction factor- hot wire anemometer-supersonic flow measurement -Rayleigh Pitot tube - wedge probe - stagnation temperature probe- temperature recovery factor –Kiel probe - Wind tunnels – closed and open type

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: MUT 292

Course Name: Incompressible and compressible Flows

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

PART A

Answer all Questions.
Each question carries 3 Marks

1. Differentiate between stream lines and stream tubes
2. What does the word kinematics mean? Explain what the study of fluid kinematics involve
3. Differentiate between Newtonian and Non- Newtonian fluids
4. Explain the significance of Navier- Stokes equations
5. What is Mach number? Explain its significance in analyzing flow.
6. Derive the governing equation for isentropic flow through duct with varying area.
7. Explain choking in Fanno flow.
8. Plot Rayleigh curve on HS diagram and explain the salient points.
9. Explain why shock is impossible in subsonic flow.
10. Compare open and closed wind tunnels

Part B

Each question carries 14 Marks

11. Derive the expression for acceleration field of a fluid particle through a nozzle

or

12. Derive and prove the Reynold Transport theorem
13. Derive continuity equation using an infinitesimal control volume

or

14. Derive the Navier- Stokes equation for incompressible, isothermal flow
15. Derive the expression to prove conservation of momentum in compressible flow.

or

16. A supersonic nozzle expands air from po = 25 bar and To = 1050 K to an exit pressure of 4.35 bar; the exit area of the nozzle is 100 cm2. Determine (a) throat area (b) pressure and temperature at the throat (c) temperature at exit (d) exit velocity as fraction of the maximum attainable velocity and (e) mass flow rate.
17. The stagnation temperature of air in a combustion chamber is increased 3.5 times its initial value. If the air at entry is at 5 bar and 105 °C and a Mach number of 0.25, determine i) Mach number, pressure and temperature at exit ii) stagnation pressure loss iii) heat supplied per kg of air.

or

18. A convergent-divergent nozzle having a throat diameter of 7.5 mm supplies air to an insulated duct of diameter 15 mm. The stagnation properties of air at entry to the nozzle are 7.5 bar and 300 K. The flow through nozzle is isentropic. The mean coefficient of friction for the duct is 0.005. Calculate the maximum length of the duct that can be provided without discontinuity in the nozzle or duct. Find the condition of air at the exit, for the duct length.
19. Derive Prandtl Meyer relation

or

20. Explain the working of (a) hot wire anemometer (b) Kiel Probe

Text Books

1. *Fluid Mechanics and Hydraulic Machines* by Dr.R.K.Bansal. Revided Ninth Edition. Modi P. N. and S. M. Seth, *Hydraulics & Fluid Mechanics*, S.B.H Publishers, New Delhi, 2002.
2. Kumar D. S., *Fluid Mechanics and Fluid Power Engineering,* S. K. Kataria & Sons, New Delhi, 1998.
3. Cengel Y. A. and J. M. Cimbala, Fluid Mechanics, Tata McGraw Hill, 2013
4. Balachandran P., Fundamentals of Compressible Fluid Dynamics, PHI Learning. 2006
5. Rathakrishnan E., Gas Dynamics, PHI Learning, 2014
6. Yahya S. M., Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion, New Age International Publishers, 2003

Data book/Gas tables:

1. Yahya S. M., Gas Tables, New Age International, 2011
2. Balachandran P., Gas Tables, Prentice-Hall of India Pvt. Limited, 2011

Reference Books

1. J. F. Douglas, "Fluid Mechanics", Pearson education.
2. Robert W. Fox and Mc Donald, "Introduction to fluid dynamics", John Wiley and sons
3. Turbulence in Fluids, 3rd edition M. Lesieur Dordrecht; Boston: Kluwer Academic Publishers, 1997
4. Anderson, Modern compressible flow, 3e McGraw Hill Education, 2012
5. Shapiro, Dynamics and Thermodynamics of Compressible Flow – Vol 1., John Wiley & Sons,1953
6. Fundamental Mechanics of Fluids, Fourth Edition I.G.Currie CRC Press (Taylor and Francis Group

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Fluid Kinematics**	
1.1	Lagrangian and Eulerian Descriptions	2
1.2	Flow patterns and flow visualisations	2
1.3	Plots of fluid flow data	2
1.4	Vorticity and Rotationality	2
1.5	Reynolds transport theorem	1
2	**Differential Analysis of Fluid Flow**	
2.1	Introduction-Conservation of mass	1
2.2	The continuity equation	1
2.3	The stream function	1
2.4	Caushy's equation	2
2..5	Navier-Stokes equations	2
2.6	Differential analysis of fluid flow problems	2
3	**Compressible fluid flows**	
3.1	Introduction and review: Concept of continuum	1
3.2	System and control volume approach	1
3.3	Conservation of mass, momentum and energy	1
3.4	Stagnation state- compressibility	2
3.5	Entropy relations	1
3.6	Acoustic velocity-Mach number	1
3.7	Physical difference between incompressible, subsonic, sonic and supersonic flows	1
4	**Flow in constant area duct with friction only (Fanno flow) & Flow in constant area duct with heat transfer only (Rayleigh flow)**	
4.1	Flow in constant area duct with friction only (Fanno flow): Governing equations	1

4.2	Fanno line - significance of maximum entropy point on Fanno line	1
4.3	Choking in Fanno flow	1
4.4	Relations of properties with Mach number - basic problems	1
4.5	Flow in constant area duct with heat transfer only (Rayleigh flow): Governing equations	1
4.6	Rayleigh line - significance of maximum entropy and maximum enthalpy points on Rayleigh line	1
4.7	Choking in Rayleigh flow – relations of properties with Mach number – basic problems.	1
5	**Normal shocks & Measurement techniques**	
5.1	Normal shocks: Governing equations - Prandtl Meyer relation	1
5.2	Property changes across shocks	1
5.3	Shocks in isentropic, Fanno and Rayleigh flows	1
5.4	Problems of normal shock in those flows	1
5.5	Introduction to oblique shock.	1
5.6	Measurement techniques: Compressible flow field visualization and measurement	1
5.7	Shadowgraph - interferometer	1
5.8	Subsonic compressible flow field - measurement (Pressure, Velocity and Temperature)	1
5.9	Compressibility - correction factor	1
5.10	Hot wire anemometer- supersonic flow measurement	1
5.11	Rayleigh Pitot tube - wedge probe - stagnation temperature probe-temperature recovery factor	1
5.12	Kiel probe - Wind tunnels – closed and open type	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.

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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.

<u>Course Level Assessment Questions</u>

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 MCN202	COURSE NAME CONSTITUTION OF INDIA	CATEGORY	L	T	P	CREDIT
			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
			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. Describebedesign 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	<u>**Module 1: Design Process**</u>	
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	<u>**Module 2: Design Thinking Approach**</u>	
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	**<u>Module 3: Design Communication</u> (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	**<u>Module 4: Design Engineering Concepts</u>**	
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)

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

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

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEMESTER V

KTU
Estd.
2014

MUT301	AUTO ELECTRICAL AND ELECTRONICS	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: This course aims at providing

1. Knowledge regarding the basic wiring of an automobile
2. Knowledge about the construction and working of batteries
3. Knowledge about the working of charging, starting systems and lighting systems
4. Knowledge about the need and working of ignition systems.
3. To know the different types, automotive sensors and actuators.
4. A basic idea on the engine management systems and vehicle management systems

Prerequisite: AUTO POWER PLANT, AUTO CHASSIS

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

CO 1	Distinguish the different types of batteries, its working principle, construction and applications
CO 2	Categorize the charging systems and starting systems in vehicles
CO 3	Identify the ignition system and lighting systems used in vehicles
CO 4	Understand the different types of sensors used in vehicles
CO 5	Illustrate and identify the engine management system and vehicle management systems

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1			1					2
CO2	2		1									
CO3	2		1									
CO4	2		1									1
CO5	3		1		2		2					1

Assessment Pattern

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

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3hours

Continuous Internal Evaluation Pattern:

Attendance :10 marks

Continuous Assessment Test(2numbers): 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 construction and working of lead acid battery?
2. What type of battery is used in electric vehicles?
3. What are the various battery tests

Course Outcome 2 (CO2)

1. Explain the working of Starter motor
2. Explain the construction and working of alternator

3. What are the components that make up the charging system in an automobile? State the purpose of each

Course Outcome 3(CO3):

1. What is the importance of ignition timing in an SI engine?
2. Explain the working of lighting system in automobiles
3. What are the various other lights used in automobiles other than head light?
4. What are the various gauges used in automobiles?

Course Outcome 4 (CO4):

1. Explain the working of Hall effect sensor?
2. Explain how the engine crankshaft position is determined using the Crankshaft Position Sensor
3. What are the different types of actuators used in automobiles? State the application

Course Outcome 5 (CO5):

1. What is the difference between GDI and MPFI?
2. What are the various sensors used in fuel injection system?
3. What are the important vehicle management systems used in automobiles?

Model Question paper

QP CODE: **PAGES: 2**

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT301

Course Name: AUTOMOTIVE ELECTRICAL AND ELECTRONICS

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

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. What is the purpose of cut-out relay in a charging system?
2. what is the purpose of specific gravity test and HRD test?
3. What are the different types of starting drives and starting switches?
4. What is the working principle of alternator?
5. Why centrifugal and vacuum advance mechanism is needed?
6. What is the purpose of flasher unit? How it works?
7. What is Lambda Sensor? Define Lambda
8. What type of actuator is used in injector? Explain
9. What is the role of Engine Management system?
10. What is the difference between cruise control system and traction control system?

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

11. What are the various battery tests conducted to access the state of charge of battery? Explain any three tests. (14)

Or

12. Explain the constructional details of Lead Acid battery with necessary sketches. (14)

Module 2

13. a) Explain the working principle of alternator with a sketch (7)

    b) Explain about half-wave and full wave rectification with neat sketch. (7)

Or

14. a)Explain construction and working of Bendix drive (7)

    b)How solenoild shift cum relay works? Explain with diagram (7)

Module 3

15. a) Explain about the spark plug and its constructional details (7)

    b) With a neat sketch Explain the working of an electric horn. (7)

Or

16. Describe a high-tension magneto ignition system with figure and state its advantages and disadvantages. (14)

Module 4

17. Explain the working of MAP sensor and Throttle position sensor used in automobile with the help of sketch. (14)

Or

18. a) Explain about the application of position and lambda sensors used in automobile with neat sketches. (7)

    b) Explain about the function of wheel speed sensors with neat sketch. (7)

Module 5

19. Explain the construction and working of CRDI system with a sketch. What is quadra jet and Multijet injection? Explain (14)

Or

20. Explain the constructional features of ABS with a sketch. State the different types of ABS What are the advantages of ABS

SYLLABUS

Module 1

Principle and construction of Lead Acid Battery, Nickel – Cadmium Battery, Lithium ion Battery, Lithium Phosphate Battery, LTO Battery, Nickel Metal , Sodium Sulphur Battery and Aluminum Air Battery.

Characteristics of Battery, Battery Rating, Capacity and Efficiency, Various Tests on Battery, Battery– Charging Techniques. Maintenance of batteries.

Module 2

Charging Systems

Charging system components, Generators and Alternators, types, construction and Characteristics, Voltage and Current Regulation, Cut –out relays and regulators, Charging circuits for D.C. Generator

Starting System

Requirements of Starter Motor, Starter Motor types, construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids.

Module 3

Ignition Systems

Conventional Type -Battery Coil and Magneto–Ignition System Circuit details and Components, Spark Plugs- Constructional details and Types, Centrifugal and Vacuum Advance Mechanisms, Non–Contact–type Ignition Triggering devices, Capacitive Discharge Ignition, Distributor–less Ignition System.

Lighting System

Head Lamp and Indicator Lamp construction and working details, Focusing of head lamps, Anti-dazzling devices, Automotive Wiring Circuits (Horn Circuit, Indicator Lamp Circuit, Electronic Fuel Gauge, oil pressure gauge, Coolant temperature indicator.)

Module 4

Sensors and Actuators:

Speed sensors, Pressure sensors: Manifold Absolute Pressure sensor, knock sensor, Temperature sensors: Coolant and Exhaust gas temperature, Exhaust Oxygen level sensor. Position sensors: Throttle position sensor, accelerator pedal position sensor and crankshaft position sensor, Air mass flow sensor. Solenoids, stepper motors and relays

Module 5

Engine Management System:

Electronic engine control :Electronic fuel control system, Typical Control for a fuel injection system, MPFi And CRDI System, EGR control

Electronic ignition systems – Spark advance correction schemes, fuel injection timing control

Vehicle Management Systems

Cruise control system, Antilock braking system, electronic suspension system, electronic steering control, traction control system, Transmission control system

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**STORAGE BATTERY**	
1.1	Principle and construction of Lead Acid Battery	1
1.2	Nickel – Cadmium Battery, Lithium-ion Battery, Lithium Phosphate Battery	2
1.3	LTO Battery, Nickel Metal, Sodium Sulphur Battery and	2
1.4	Aluminum Air Battery. Characteristics of Battery, Battery Rating, Capacity and Efficiency,	2
1.5	Various Tests on Battery, Battery– Charging Techniques. Maintenance of batteries	2
2	**CHARGING AND STARTING SYSTEM**	
2.1	Charging Systems Charging system components,	1
2.2	Generators and Alternators, types, construction and Characteristics,	2
2.3	Voltage and Current Regulation, Cut –out relays and regulators, Charging circuits for D.C. Generator	2
2.4	**Starting System** Requirements of Starter Motor, Starter Motor types, construction and characteristics,	2
2.5	Starter drive mechanisms, Starter Switches and Solenoids.	2
3	**IGNITION AND LIGHTING SYSTEM**	
3.1	Ignition Systems Conventional Type -Battery Coil and Magneto–Ignition System Circuit details and Components,	2
3.2	Spark Plugs- Constructional details and Types, Centrifugal and Vacuum Advance Mechanisms,	2

3.3	Non–Contact–type Ignition Triggering devices, Capacitive Discharge Ignition, Distributor–less Ignition System.	2
3.4	Lighting System Head Lamp and Indicator Lamp construction and working details, Focusing of head lamps, Anti-dazzling devices,	2
3.5	Automotive Wiring Circuits (Horn Circuit, Indicator Lamp Circuit, Electronic Fuel Gauge, oil pressure gauge, Coolant temperature indicator.)	2
4	**SENSORS AND ACTUATORS**	
4.1	Speed sensors, Pressure sensors: Manifold Absolute Pressure sensor, knock sensor,	3
4.2	Temperature sensors: Coolant and Exhaust gas temperature, Exhaust Oxygen level sensor. Position sensors: Throttle position sensor,	3
4.3	accelerator pedal position sensor and crankshaft position sensor, Air mass flow sensor. Solenoids, stepper motors and relays	3
5	**ENGINE AND VEHICLE MANAGEMENT SYSTEM**	
5.1	Engine Management System: Electronic engine control :Electronic fuel control system, Typical Control for a fuel injection system,	3
5.2	MPFi And CRDI System, EGR control Electronic ignition systems – Spark advance correction schemes, fuel injection timing control	3
5.3	Vehicle Management Systems Cruise control system, Antilock braking system, electronic suspension system,	2
5.4	electronic steering control, traction control system, Transmission control system	2

AUT303	MANUFACTURING PROCESS	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: The aim of this subject is to offer the students a general understanding of various manufacturing process.

- ✓ To understand the basic concept of foundry and casting, metal forming and welding.
- ✓ To know different defects formed in the manufacturing process.
- ✓ To select the proper manufacturing process for the given applications.
- ✓ To select the non-traditional machining process for the given applications.
- ✓ To understand the basics of advanced manufacturing technology.

Prerequisite: Nil

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

CO 1	Understand the basic concept of foundry and casting
CO 2	Explain the different types of Metal joining process
CO 3	Discuss the different metal forming process
CO 4	Explain the non-conventional machining process
CO 5	Explain the advanced manufacturing technology

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	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	1	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
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. Explain the basic concept of foundry and casting
2. Explain Applications of Casting.

Course Outcome 2 (CO2)

1. Explain the metal Joining processes.
2. Differentiate between the soldering & brazing

Course Outcome 3(CO3):

1. Discuss the metal forming process.
2. Explain the Forging & Rolling process
3. Explain the Extrusion process.

Course Outcome 4 (CO4):
1. Explain the non-conventional machining process
2. Explain the Laser Beam, Plasma Arc Machining Electro Chemical Machining, Ultrasonic Machining,
3. Explain Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining, Electron Discharge Machining and Plasma Arc Machining.

Course Outcome 5 (CO5):
1. Discuss the Advanced Manufacturing Techniques.
2. Explain the Micro machining
3. Explain the Rapid prototyping & Nano technology

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: AUT303

Course Name: MANUFACTURING PROCESS

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

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. Discuss shell mould casting, mention its advantages and disadvantage
2. Explain the basic steps involved in casting process.
3. What is the principle of plasma? Explain plasma arc welding
4. You are assigned to join 'Rails' by Indian railways. Explain the suitable welding process with neat sketch.
5. Explain deep drawing operation with neat sketch and mention the importance of die clearance
6. What do you understand by the term 'forging'? Explain the following (i) Open die forging (ii) Closed-die forging
7. Explain the principle and working of Electro Chemical Grinding (ECG) process with suitable diagram.

8. Explain Abrasive Jet Machining (AJM) process and its process parameters

9. What is rapid prototyping? Explain in detail (i) Selective Laser Sintering (SLS) (ii) Steriolithography (SLA)

10. What is nano Technology? Give details about its applications in various fields

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

Module 1

11. Explain the construction and working principle of cupola furnace.

Or

12. Explain the vacuum casting process with figure

Module 2

13. Explain Tungsten Inert Gas (TIG) welding in detail.

Or

14. a. Compare soldering and brazing processes
b. List the advantages and disadvantages

Module 3

15. a. What are the classifications of extrusion process?
b. Explain any two extrusion types in detail.

Or

16. Discuss the principle and mechanism of rolling with suitable figure.

Module 4

17. a. Explain with a neat sketch the principle and working of Ultrasonic Machining (USM) process.
b. List its advantages, disadvantages and applications.

Or

18. What is the principle of Electron Beam Machining (EBM)? Explain the process in details.

Module 5

19. a. What is microfabrication technology?
    b. Explain (i) Micro cutting (ii) Micro finishing

Or

20. a. State the main factors that affect the selection of a manufacturing process.
    b. Explain (i) Process Information Maps (ii) Elimination and Ranking Strategy

SYLLABUS

Module 1

CASTING: Steps involved in making a casting – Advantage of casting and its applications. Patterns and Pattern making – Types of patterns – Materials used for patterns, core and core making, casting design considerations. Casting processes - Sand, CO2 moulding; shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting. Methods of Melting: Crucible melting and cupola operation, Defects in casting.

Module 2

WELDING: Classification of welding processes. Principles of Oxy-acetylene gas welding. A.C Metal-arc welding, Resistance welding, Submerged arc welding, Tungsten inert gas welding, Metal inert gas welding, plasma arc welding, Thermit welding, Electron beam welding, Laser beam welding, defects in welding, soldering and brazing.

Module 3

FORMING AND SHAPING OF PLASTICS: Blanking and piercing – Bending and forming Rolling, Theory of Rolling, Types of Rolling mills. Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning Basic extrusion processes and its characteristics. Forging processes - Principles of forging, tools and dies - Types of forging – Open, closed, drop forging, roll forging.

Module 4

Non-Traditional Machining Processes: Need for non-traditional machining, Principle, equipment & operation of Laser Beam, Plasma Arc Machining, Electro Chemical Machining, Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining, Electron Discharge Machining and Plasma Arc Machining.

Module 5

Advanced manufacturing techniques –Material addition process: 3D Printing- stereo-lithography, selective laser sintering, fused deposition modelling, laminated object manufacturing, laser engineered net-shaping, LIGA process. Sustainable and green manufacturing Application of

Nano Technology. Manufacturing process capabilities – process selection factors process information maps – ranking strategy

Text Books

1	Manufacturing Engineering and Technology,	Kalapakjian and Schmid	Pearson, 7e, 2013
2	lntroduction to Manufacturing Processes	Schey A John	Tata McGraw Hill, Noida, 2012
3	Elements ofWorkshop Technology Vol:1	S.K Hajra Choudhury,A. K Hajra Choudhury Nirjhar Roy	Media Promoters & Publishers Pvt. Ltd.

Reference Books

4	Principles of Metal Casting	Heine, Loper and Rosenthal	Tata McGraw Hill Publishing Co, Ltd; New Delhi, 2011.
5	Foundry Engineering	Banga T.R; and Agrawal R.L	Khanna Publishers, New Delhi, 2007
6	Manufacturing Technology (materials, processes and equipments)	Helmi A Youssef, Hassan A El-Hofy and Mahmoud H Ahmed,	CRC Press, 2017

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**CASTING Module 1 (9 hours)**	
1.1	Steps involved in making a casting Advantage of casting and its applications	1
1.2	Patterns and Pattern making – Types of patterns – Materials used for patterns	2
1.3	Core and core making, casting design considerations.	2
1.4	Casting processes - Sand, CO2 moulding; shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting	2

1.5	Methods of Melting: Crucible melting and cupola operation Defects in casting.	2
2	**WELDING: Module 2 (9 hours)**	
2.1	Classification of welding processes	1
2.2	Principles of Oxy-acetylene gas welding.	1
2.3	A.C Metal-arc welding, Resistance welding, Submerged arc welding	2
2.4	Tungsten inert gas welding, Metal inert gas welding, plasma arc welding, Thermit welding	2
2.5	Electron beam welding, Laser beam welding, defects in welding,	2
2.6	Soldering and brazing.	1
3	**FORMING AND SHAPING OF PLASTICS: Module 3 (9 hours)**	
3.1	Blanking and piercing – Bending and forming – Rolling, Theory of Rolling, Types of Rolling Mills.	2
3.2	Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning – Types of presses and press tool	2
3.3	Basic extrusion processes and its characteristics	2
3.4	Forging processes - Principles of forging, tools and dies - Types of forging – Open, closed, drop forging,roll forging.	2
3.5	Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding.	1
4	**Non-Traditional Machining Processes : Module-4(9 hours)**	
4.1	Non-Traditional Machining Processes: Need for non-traditional machining,	3
4.2	Principle, equipment & operation of Laser Beam, Plasma Arc Machining,	3
4.3	Electro Chemical Machining, Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining, Electron Discharge Machining and Plasma Arc Machining	3
5	**Advanced manufacturing techniques : Module-5(10 hours)**	
5.1	Advanced manufacturing techniques –Material addition process: 3D Printing, stereo-lithography, selective laser sintering,	3
5.2	Fused deposition modelling, laminated object manufacturing, laser engineered net-shaping, LIGA process.	3
5.3	Sustainable and green manufacturing.application of nano technology	2
5.4	Manufacturing process capabilities – process selection factors process information maps – ranking strategy	2

MUT305	VEHICLE DYNAMICS	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble:

This course aims at providing

1. Understand the dynamics of the automotive systems and its performance parameters.
2. Identify the driving/ braking resistances and their influences on vehicle dynamics.
3. To analyze dynamics systems such as suspension systems, body vibrations, steering mechanisms.
4. To Understand the vehicle aerodynamics and its effects on vehicle performance
5. To identify, formulate, and solve engineering problems related to vehicle dynamics

Prerequisite:

EST100 ENGINEERING MECHANICS
MUT206 MECHANICS OF SOLIDS
MUT203 AUTO CHASSIS

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

CO 1	To understand the vehicle system dynamics
CO 2	Evaluate the driving/ braking resistances and their influences on vehicle dynamics
CO 3	Identify and analyse the dynamics systems such as suspension systems, body vibrations, steering mechanisms.
CO 4	To analyse and solve engineering problems related to vehicle dynamics
CO 5	Comparing and identifying the different types of control systems in automobiles

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	-	-	1	-	-	-	-	-	1
CO 3	2	2	1	-	1	-	-	-	-	-	-	1
CO 4	2	2	1	-	1	-	-	-	-	-	-	1
CO 5	2	1	1	-	2	-	-	-	-	1	-	1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	10	10	20
Apply	20	20	50
Analyse	10	10	20
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. Are you able to classify / understand the vehicle system dynamics?

Course Outcome 2 (CO2)

1. Can you evaluate the driving/ braking resistances and their influences on vehicle dynamics?

Course Outcome 3(CO3):

1. Can you identify and analyse the dynamics systems such as suspension systems, body vibrations, steering mechanisms?

Course Outcome 4 (CO4):

1. Are you able to analyse and solve engineering problems related to vehicle dynamics?

Course Outcome 5 (CO5):

1. Can you able to compare classify / and identify the different types of control systems in automobiles?

MODEL QUESTION PAPER

QP CODE:

PAGES:…

Reg. No: _______________ **Name :_______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT 305

Course Name: VEHICLE DYNAMICS

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

Part A

(Answer all questions. Each question carry 3 marks)

1. Discuss briefly the fundamental approaches to solve the problem related to the vehicle dynamics
2. Explain the vehicle fixed coordinate system with a neat sketch.
3. Explain the term longitudinal dynamics and its significance in vehicle stability.
4. Obtain the expressions for stopping distance and braking efficiency.
5. Why do we require a suspension system? Explain the functions of a suspension system.
6. Explain the constructional details of gas and hydraulic dampers.
7. Derive the stability condition of a vehicle on a curved track and a banked road
8. Explain the terms i) self aligning torque, ii) power consumed by tire, iii) tire stiffness
9. What is the importance of vehicle aerodynamics? Explain the working principle of air dams.
10. Explain the working principle of ABS control module?

Part B

Answer any one full question from each module.

Each question carries 14 Marks

11. Discuss the steps in involved in modelling and simulation of dynamic behaviour of the vehicles. (14)

OR

12. (a) Explain SAE coordinate system with suitable sketches (7)
    (b) Discuss the history of road and off road vehicle system dynamics. (7)

13. An engine is required to power a truck having a gross weight of 40937 N. The maximum grade which the truck will have to negotiate at 32km/hr in 2nd gear is expected to be 20% (% grade = tanθ x100). The rolling resistance coefficient is 0.017

and the air resistance coefficient is 0.0324 in the relation, Total resistance= K_f W + K_a AV^2 N. The frontal area is 5.2 m^2. The transmission efficiency in 2^{nd} gear is 80%. Calculate the minimum power which should be available from the engine and the gear ratio in 2^{nd} gear if this power is available at 2400rpm and the effective radius of the wheels is 0.419 m. Also calculate the minimum speed of the vehicle in top gear on level road at the same engine speed assuming transmission efficiency of 90% in top gear. What is the gear ration in top gear? The differential has a reduction of 3.92. (14)

OR

14. Derive an expression for engine power required to propel a vehicle considering the losses in transmission also differentiate between Traction and Tractive effort? (14)

15. Determine the load carried by wheels at the outer and inner sides and the maximum value of coefficient of adhesion if there is no side slipping when the vehicle weighing 17795 N runs at 96 km/hr round a circular path so that the centre of gravity moves in a circle of radius 122m with its wheel axes at an angle of 12^0 to the horizontal. Its CG is 1.06 m above the ground level and wheel track is 1.3 m . (14)

OR

16. (a) Explain the What do you understand by hysteresis effect in tire and how it influences the rolling resistance. (7)

(b) What are the tire cornering characteristics? Analyze the main factors that affect them, and draw a curve to show the relationship between the self-aligning torque and the slip angle. (7)

17. (a) Explain the functions of a suspension system. Define roll axis. (7)

(b) Discuss the steps in design and analysis of passive, semi-active and active suspension using quarter car, half car and full car model? (7)

OR

18. Obtain the final forces on the links of an independent suspension system under the action of the external forces. (14)

19. What are the effects of aerodynamic drag and lift coefficients on the vehicle characteristics? (14)

OR

20. Explain the salient features of various dynamic control systems used in automobiles. (14)

Syllabus: MUT 203 – VEHICLE DYNAMICS 3-1-0

Module 1: INTRODUCTION

History of road and off road vehicle system dynamics - dynamics of the motor vehicle, coordinate systems- vehicle fixed coordinates system, , details of vehicle systems, wheel angles, typical data of vehicles. Fundamental approaches to vehicle dynamics modeling lumped mass, vehicle fixed coordinate system, motion variables, earth fixed coordinate system, SAE coordinate system, Euler angles ,forces, Newton's second law. Definitions- modeling and simulation of dynamic behaviour of vehicle., motion analysis, force analysis, and energy analysis.

Module 2: LONGITUDINAL DYNAMICS

Introduction to longitudinal dynamics - Performance of road vehicles: forces and moments on vehicle, equation of motion, tire forces, rolling resistance, weight distribution, tractive effort/tractive resistance and power available from the engine/ power required for propulsion, road performance curves- acceleration, grade ability, drawbar pull and the problems related to these terms.

Calculation of maximum acceleration braking torque, braking force, brake proportioning, braking efficiency, stopping distance, load distribution (three wheeled and four wheeled vehicles), calculation of acceleration, tractive effort and reactions for different drives, Stability of a vehicle on slope, (Problems related to these).

Module 3: LATERAL DYNAMICS

Introduction to lateral dynamics - Steering geometry, types of steering systems, fundamental condition for true rolling, development of lateral forces. slip angle, cornering force, cornering stiffness, pneumatic trail, self aligning torque, power consumed by tire, tire stiffness ,hysteresis effect in tires, steady state handling characteristics. yaw velocity, lateral acceleration, curvature response & directional stability.

Stability of a vehicle on a curved track and a banked road. gyroscopic effects, weight transfer during acceleration, cornering and braking, stability of a rigid vehicle and equations of motion of a rigid vehicle, cross wind handling, the problems related to these terms.

Module 4: VERTICAL DYNAMICS

Introduction to vertical dynamics - Human response to vibrations, classification of vibration, specification and vibration , sources of vibration, suspension systems, Modal Analysis, One DOF, two DOF, free and forced vibration, damped vibration, magnification and transmissibility, vibration absorber, functions of suspension system. body vibrations: bouncing and pitching. doubly conjugate points (only basic idea). body rolling. roll center and roll axis, roll axis and the vehicle under the action of side forces, stability against body rolling.

Vehicle dynamics and suspension design for stability, choice of suspension spring rate, chassis springs and theory of chassis springs, gas & hydraulic dampers and choice of damper, damper characteristics, mechanics of an independent suspension system.. Design and analysis of passive, semi-active and active suspension using quarter car, half car and full car model.

Module 5: VEHICLE AERODYNAMIC AND DYNAMIC CONTROL SYSTEM

Road Loads: Air resistance-Mechanics of air flow around a vehicle, pressure distribution on a vehicle, factors affecting rolling resistance, aerodynamic forces – aerodynamic drag, drag components, drag coefficient, aerodynamic aids, aerodynamic side force, lift force, pitching moment, yawing moment, rolling moment, cross wind sensitivity .

Vehicle dynamic Control, modelling of actuators, sensors for automobile control, sensors for detecting vehicle environment, central tyre inflation system. Prediction of vehicle performance. ABS, stability control, traction control.

Text Books

1. Rajesh Rajamani, "Vehicle Dynamics and Control", 1st edition, Springer, 2005
2. Singiresu S. Rao, "Mechanical Vibrations", 5th Edition, Prentice Hall, 2010
3. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics", Society of Automotive Engineers Inc, 1992
4. Wong. J. Y., "Theory of Ground Vehicles", 3rd Edition, Wiley-Interscience, 2001
5. N.K. Giri, Automotive Mechanics, Kanna Publishers, 2007

Reference Books

1. Theory of Ground Vehicles - J. Y. Woung - John Willey & Sons, NY
2. Steering, Suspension & Tyres – J. G. Giles, Ilete Books Ltd., London
3. Mechanics of Road Vehicles – W. Steed, Ilete Books Ltd. London
4. Automotive Chassis – P. M. Heldt, Chilton Co. NK
5. Gillespie.T.D., "Fundamental of vehicle dynamic society of Automotive Engineers ",USA, 1992.
6. Vehicle dynamics and control by Rajesh Rajamani , Springer publication
7. Vehicle Dynamics : Theory and Application by Reza N Jazar, Springer publication.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction - Discussion on syllabus, Cos and POs**	
1.1	History of road and off road vehicle system dynamics	1
1.2	dynamics of the motor vehicle, coordinate systems- vehicle fixed coordinates system, details of vehicle systems, wheel angles, typical data of vehicles.	2
1.3	Fundamental approaches to vehicle dynamics modeling lumped mass, vehicle fixed coordinate system	2

1.4	motion variables, earth fixed coordinate system, SAE coordinate system, Euler angle, forces, Newton's second law. Definitions	2
1.5	modeling and simulation of dynamic behaviour of vehicle motion analysis, force analysis, and energy analysis	2
2	**Longitudinal dynamics**	
2.1	Introduction to longitudinal dynamics - Performance of road vehicles: forces and moments on vehicle, equation of motion, tire forces,	2
2.2	rolling resistance, weight distribution, tractive effort/tractive resistance and power available from the engine/ power required for propulsion, grade ability, drawbar pull and the problems related to these terms. road performance curves	2
2.3	Calculation of maximum acceleration braking torque, braking force,	1
2.4	brake proportioning, braking efficiency, stopping distance,load distribution (three wheeled and four wheeled vehicles),	2
2..5	calculation of acceleration, tractive effort and reactions for different drives, Stability of a vehicle on slope, (Problems related to these).	2
3	**Lateral Dynamics**	
3.1	Introduction to lateral dynamics - Steering geometry, types of steering systems, fundamental condition for true rolling,	1
3.2	development of lateral forces. slip angle, cornering force, cornering stiffness, pneumatic trail, self aligning torque, power consumed by tire, tire stiffness	2
3.3	hysteresis effect in tires, steady state handling characteristics. yaw velocity, lateral acceleration, curvature response & directional stability.	2
3.4	Stability of a vehicle on a curved track and a banked road. gyroscopic effects, weight transfer during acceleration,	2
3.5	cornering and braking, stability of a rigid vehicle and equations of motion of a rigid vehicle, cross wind handling, the problems related to these terms.	2
4	**Vertical Dynamics**	
4.1	Introduction to vertical dynamics - Human response to vibrations, classification of vibration, specification and vibration ,	2
4.2	sources of vibration, suspension systems, Modal Analysis, One DOF, two DOF, free and forced vibration, damped vibration, magnification and transmissibility,	2
4.3	vibration absorber, functions of suspension system. body	2

	vibrations: bouncing and pitching. doubly conjugate points (only basic idea).	
4.4	body rolling. roll center and roll axis, roll axis and the vehicle under the action of side forces, stability against body rolling. Vehicle dynamics and suspension design for stability, choice of suspension spring rate,	1
4.5	chassis springs and theory of chassis springs, gas & hydraulic dampers and choice of damper, damper characteristics, mechanics of an independent suspension system..	1
4.6	Design and analysis of passive, semi-active and active suspension using quarter car, half car and full car model	1
5	**Vehicle Aerodynamic and dynamic control system**	
5.1	Road Loads: Air resistance-Mechanics of air flow around a vehicle, pressure distribution on a vehicle, factors affecting rolling resistance.	2
5.2	aerodynamic forces – aerodynamic drag, drag components, drag coefficient, aerodynamic aids, aerodynamic side force, lift force, pitching moment,	2
5.3	yawing moment, rolling moment, cross wind sensitivity . Vehicle dynamic Control	1
5.4	modelling of actuators, sensors for automobile control, sensors for detecting vehicle environment,	2
5.5	central tyre inflation system. Prediction of vehicle performance. ABS, stability control, traction control	2

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT307	AUTO TRANSMISSION	PCC	3	1	0	4

Preamble: This course aims at providing the students, an insight on the various transmission systems used in different types of automobiles.

Prerequisite: MU 203 Auto chassis theory of third semester.

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

CO 1	Understand and analyse the types of clutch and gearbox used in the automobiles
CO 2	Understand the basics of epicyclical gearbox and the propeller shaft
CO 3	Illustrate the working of epicyclical and hydrodynamic transmission system
CO 4	Understand the working of a hydrostatic transmission and Continuously Varying Transmission
CO 5	Understand the components and working of automatic transmissions used in the present-day vehicles

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	-	1	1	-	-	2	-	1
CO 2	2	1	-	2	-	1	2	-	-	2	-	1
CO 3	-	1	-	1	-	1	1	-	-	2	-	1
CO 4	-	-	-	-	-	1	1	-	-	2	-	1
CO 5	-	1	-	1	-	2	2	-	-	2	-	3

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	40
Apply	20	20	50
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. How automotive clutches are classified?
2. Explain the working of single plate automotive clutch
3. Give the advantages of diaphragm spring clutch over coil spring clutch.
4. What are the various clutch adjustments?
5. How a hydraulically operated clutch works?

Course Outcome 2 (CO2)

1. Distinguish between traction and tractive effort.
2. Explain the principle of operation of synchromesh gearbox.
3. How the gear ratios can be calculated?
4. What is the function of a transfer gearbox?
5. What are the different types of gears?

Course Outcome 3(CO3):

1. What are the basic laws of epicyclical gear drives?

2. List the different types of compound epicyclical gearbox.
3. Demonstrate the working of a fluid flywheel.
4. Explain the working of a torque converter
5. Give the advantages of hydrodynamic transmission

Course Outcome 4 (CO4):

1. Illustrate the working of a typical hydrostatic transmission.
2. What are the basic components of a hydrostatic transmission?
3. Explain the working of a belt type CVT
4. Illustrate the working of toroidal CVT
5. Give the advantages and disadvantages of CVT drives.

Course Outcome 5 (CO5):

1. What are the different types of automatic transmission?
2. List down the components in an automatic transmission
3. Explain the electronic control system used in automatic transmission
4. What are the sensors used in an automatic transmission system?
5. Explain the working of electric control system used in an electric vehicle

Model Question paper

QP CODE:

PAGES:02

Reg. No: _______________ **Name :_______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT 307

Course Name: AUTO TRANSMISSION

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

Part A

(Answer all questions. Each question carry 3 marks)

1. Explain the term Tractive effort
2. List the different types of friction clutches.
3. Why do we go for CV joints in front engine front wheel vehicles?

4. Explain the principle of an epicyclic gearbox
5. What is the principle of working of a hydrodynamic transmission?
6. Compare between fluid flywheel and torque converter
7. List down the advantages and disadvantages of a CVT
8. Draw the layout of a hydrostatic transmission system
9. Explain the functions of a TCM and PCM
10. List and explain the different modes of an automatic transmission

Part B

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

11. (a) Explain theworking of single plate clutch with a neat diagram (7)

    (b) Discuss the working of centrifugal clutch with a sketch. (7)

OR

12. With a suitable sketch explain the working of a multi-plate diaphragm clutch (14)
13. Discuss the working of a five speed synchromesh gearbox (14)

OR

14. With a suitable sketch explain the working of a transfer gearbox (14)
15. Explain the working of a torque converter with a neat sketch (14)

OR

16. Explain the torque characteristics of a torque converter with graphs (14)
17. With a suitable sketch explain Janny Hydrostatic transmission with a cross sectional sketch (14)

OR

18. What are the different types of CVT? Explain the working of a typical Toroidal type CVT. (14)
19. Explain a typical control system employed for an automatic transmission (14)

OR

20. Give a brief discussion about the components and the working of an AMT system (14)

SYLLABUS

Module 1

Automotive Clutches: Requirements of clutch, principle of operation, constructional details different types of clutches- dry and wet type clutches, single plate and multi-plate coil spring clutches, diaphragm spring clutches, semi-centrifugal and centrifugal clutches, cone clutch, friction lining materials, clutch operating mechanisms – hydraulically operated clutches, factors influencing clutch wear & points of wear, clutch adjustments, clutch faults- diagnosis & remedies, torque capacity of a single plate clutch (derivation and problem).

Module 2

Automotive Gear box: Need for transmission system, forces acting on vehicle, tractive effort and traction, power-torque characteristics, performance characteristics at different speeds of gear box, construction and working principle of sliding mesh, constant mesh and synchromesh gear boxes. gear shifting mechanisms - gear shifting mechanism for sequential and extended ‘h’ shift-mechanical link and wire types, calculation of gear ratios of a vehicle, power and economy modes in gearbox, transfer gear box, transaxles, overdrives, types of gears, gear box maintenance, Gear box troubles and trouble shooting.

Module 3

Epicyclical Gearbox: Principle and fundamental laws of planetary / epicyclical gearing, construction and working of simple and compound epicyclical gearboxes- simpson, wilson, and revangnauxgearboxes.

Hydrodynamic transmission: Fluid coupling – principles, advantages, limitations, slip and performance characteristics, drag torque, reduction of drag torque. torque converter – principle, construction and working of three and four element torque converters, operational phases, performance characteristics, stall speed, lock up clutches. advantages, limitations, matching engine and torque converters.

Module 4

Hydrostatic drive: Principle of hydrostatic transmission system, Basic layout for hydrostatic vehicle transmission system, components of hydrostatic systems- types and classification based on spatial arrangement, transmission ratio and circuit construction- Pump and motor combinations for hydrostatic drives, advantages and limitations, construction and working of typical hydrostatic drives Janny Hydrostatic transmission, comparison of hydrostatic drive with hydrodynamic drive.

Continuously Varying Transmission: Components of CVT, Types of CVT- pulley-belt, toroidal and hydrostatic CVT, Application of CVT in automobile, advantages and disadvantages of CVT.

Module 5

Automatic Transmission: Components of automatic transmission- gear shift valve, vacuum and governor valve, sensors and actuators, PCM, TCM, Hydraulic and Electronically controlled systems of automatic transmission - AMT, DSG/ DCT transmission.

Text Books

1. Kirpal Singh, Automobile Engineering Volume 2, Standard Publishers and distributors,
2. Heldt.P.M., Torque converters, Chilton Book Co., 1962
3. Newton and Steeds, Motor vehicles, Illiffe Publishers, 1985.
4. N.K.Giri, Automotive Mechanics, Khanna Publishers. Edition: 8th, 2008

Reference Books

1. SAE Transactions 900550 & 930910
2. Hydrostatic transmissions for vehicle applications, I MechE Conference, 1981-88.
3. Crouse,W.H., Anglin,D.L., Automotive Transmission and Power Trains construction, McGraw Hill, 1976.
4. Heinz Heisler, Advance vehicle Technology, Butterworth-Heinemann

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**MODULE – 1: AUTOMOTIVE CLUTCHES**	
1.1	Requirements of clutch, principle of operation, constructional details different types of clutches- dry and wet type clutches.	2
1.2	Single plate and multi-plate coil spring clutches.	1
1.3	Diaphragm spring clutches, clutch operating mechanisms – hydraulically operated clutches.	1
1.4	Semi-centrifugal and centrifugal clutches, cone clutch, friction lining materials.	1
1.5	factors influencing clutch wear & points of wear, clutch adjustments	1
1.6	clutch faults- diagnosis & remedies	1
1.7	Torque capacity of a single plate clutch (derivation and problem).	2
2	**MODULE – 2: AUTOMOTIVE GEAR BOX**	
2.1	Need for transmission system, forces acting on vehicle, tractive effort and traction	1
2.2	Power-torque characteristics, performance characteristics at different speeds of gear boxes	1
2.3	Construction and working principle of sliding mesh, constant mesh gear boxes.	1
2.4	Synchromesh gear boxes.	1

2.5	Gear shifting mechanisms - gear shifting mechanism for sequential and extended ‘h’ shift- mechanical link and wire types	1
2.6	Calculation of gear ratios of a vehicle, types of gears	1
2.7	Power and economy modes in gearbox,	1
2.8	Transfer gear box, transaxles, overdrives,	1
2.9	Gear box maintenance.	1
3	**MODULE – 3: EPICYCLIC AND HYDRODYNAMIC TRANSMISSION**	
3.1	Epicyclical Gearbox: Principle and fundamental laws of planetary / epicyclical gearing.	1
3.2	Construction and working of simple and compound Epicyclical gearboxes- Simpson gearboxes.	1
3.3	Construction and working of Wilson and Revangnaux gearboxes.	1
3.4	Hydrodynamic transmission: Fluid coupling – principles, advantages, limitations	1
3.5	Fluid coupling – slip and performance characteristics, drag torque, reduction of drag torque.	1
3.6	Torque converter – principle, construction and working of element torque converters.	1
3.7	Torque converter – principle, construction and working of four element torque converters, operational phases,	1
3.8	Torque converter – performance characteristics, stall speed, advantages, limitations.	1
3.9	Torque converter – lock up clutches, matching engine and torque converters.	1
4	**MODULE – 4: HYDROSTATIC TRANSMISSION AND CVT**	
4.1	Principle of hydrostatic transmission system, Basic layout for hydrostatic vehicle transmission system, components of hydrostatic systems, advantages and limitations	1
4.2	Hydrostatic transmission system types and classification based on spatial arrangement, transmission ratio and circuit construction.	1
4.3	Pump and motor combinations for hydrostatic drives	1
4.4	Hydrostatic transmission system- construction and working of typical hydrostatic drives Janny Hydrostatic transmission, comparison of hydrostatic drive with hydrodynamic drive.	1
4.5	Introduction to CVT- working	1
4.6	Types of CVT	1
4.7	Pulley - belt type CVT with different types of Belts employed	1
4.8	Toroidal and hydrostatic CVT	1
4.9	Application of CVT, advantages and disadvantages of CVT	1

5	**MODULE – 5: AUTOMATIC TRANSMISSION**	
5.1	Introduction to types of automatic transmission	1
5.2	Components of an automatic transmission	1
5.3	Working of AMT, DSG	1
5.4	Sensors used and Control system of an automatic transmission	2
5.5	Electric drives- Requirements and working	2
5.6	Ward Leonard electric drive	2

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUL331	PRODUCTION ENGINEERING LAB	PCC	0	0	3	2

Preamble: The lab provides basic application of the following:

- Types of machining to be selected for the manufacturing of components
- Parameters and optimisation of the machining parameters for better outputs
- Understand the different joining process employed in manufacturing
- Enumerate the basics of CNC machining and its methodology

Prerequisite: Nil

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

CO 1	Identify the machining operation involved for a component
CO 2	Illustrate the manufacturing sequence for developing a component
CO 3	Apply and optimise different criteria for machining of a component
CO 4	Develop and analyse a CNC programme using simulation software
CO 5	Enhance research capabilities by carrying out different research oriented experiments

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	-	-	-	-	-	-	-	-	2	3	1	1
CO 2	-	-	-	-	-	-	-	-	2	3	1	1
CO 3	-	-	-	-	-	-	-	-	2	3	1	2
CO 4	-	1	-	-	2	-	-	-	2	3	1	2
CO 5	1	2	-	-	3	-	-	-	2	3	1	2

Course Level Assessment Questions

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Assessment : 30 marks

Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work	: 15 Marks
(b) Implementing the work/Conducting the experiment	: 10 Marks
(c) Performance, result and inference (usage of equipments and trouble shooting)	: 25 Marks
(d) Viva voce	: 20 marks
(e) Record	: 5 Marks

General instructions:

Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Reference Books

1. R. K. Jain, “Production Technology”, Khanna Publishers, 18th Edition, 2013.
2. B. S.Raghuwamshi, “A Course in Workshop Technology”, DhanpatRai& Sons, 2014.
3. Kalpakjin S, “Manufacturing Engineering and Technology”, Pearson Education, 7th edition,2014.
4. HMT, “Production Technology”, McGraw-Hill Education, 1st Edition, 2008

List of Exercises/Experiments: (Lab experiments may be given considering 12 sessions of 3 hours each.)

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on Milling machine.
5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill.
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses
11. Gas welding experiment
12. Arc welding experiment
13. Resistance welding experiment.
14. Soldering & Brazing experiment
15. CNC Programming Simulation using any software
16. CNC machining in CNC Lathe

17. CNC Milling in a VMC
18. Metal Cutting Experiments (Example: Cutting Force Measurement, Cutting Temperature Measurement etc.)

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

CODE	COURSE NAME:	CATEGORY	L	T	P	CREDIT
MEL333	THERMAL ENGINEERING LAB 1	PCC	0	0	3	2

Preamble: The course is intended to impart basic understanding on the working of internal combustion engines. This includes various performance tests on internal combustion engines as well as makes the students familiar with the evaluation of fuel properties such as viscosity, flash and fire points, calorific value etc. which are key to any performance test.

Prerequisite: Should have undergone a course on Thermal Engineering with emphasis on IC engines

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

CO 1	**Measure thermo-physical properties of solid, liquid and gaseous fuels**
CO 2	**Identify various systems and subsystems of Diesel and petrol engines**
CO 3	**Analyse the performance characteristics of internal combustion engines**
CO 4	**Investigate the emission characteristics of exhaust gases from IC Engines**
CO 5	**Interpret the performance characteristics of air compressors / blowers**

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			2		3	2		2
CO 2	3		2	3			2		3	2		2
CO 3	3		2	3			2		3	2		2
CO 4	3		2	3			2		3	2		2
CO 5	3		2	3			2		3	2		2

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks
Continuous Assessment : 30 marks
Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks
(b) Implementing the work/Conducting the experiment : 10 Marks
(c) Performance, result and inference (usage of equipments and trouble shooting) : 25 Marks
(d) Viva voce : 20 marks
(e) Record : 5 Marks

General instructions:

Practical examination is to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

List of Exercises/Experiments: (Lab experiments may be given considering 12 sessions of 3 hours each. Minimum 12 experiments to be performed.)

1. Determination of flash and fire points of petroleum fuels and oils
2. Determination of viscosity of lubricating oils and fuels and its variation with temperature
3. Determination of calorific value of solid and liquid fuels- Bomb Calorimeter
4. Determination of calorific value of gaseous fuels –Gas Calorimeter
5. Familiarisation of various systems and subsystems of petrol engine / MPFI engine
6. Familiarisation of various systems and parts of Diesel engine / Turbocharged engine
7. Performance test on petrol engines / MPFI engine
8. Performance test on Diesel engines / Turbocharged engine
9. Heat Balance test on petrol/Diesel engines
10. Determination volumetric efficiency and Air-fuel ratio of IC engines
11. Cooling curve of IC engines
12. Valve timing diagram of IC engines
13. Economic speed test on IC engines
14. Retardation test on IC engines
15. Morse test on petrol engine
16. Experiment to find flame temperature of premixed flames at different equivalence ratios and temperature of diffusion flames at different fuel flow rates.
17. Analysis of automobile exhaust gas and flue gas using exhaust gas analyser.
18. .Performance test on reciprocating compressor
19. Performance test on rotary compressor/blower

Reference Books

1. J.B.Heywood, I.C engine fundamentals, McGraw-Hill, 2017
2. V. Ganesan, Fundamentals of IC engines, Tata McGraw-Hill, 2017
3. Stephen R Turns, An Introduction to Combustion: Concepts and Applications, McGraw-Hill, 2017

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEMESTER V

MINOR

AUT 381	DYNAMICS OF AUTOMOBILES	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: This course aims at providing

1. Understand the dynamics of the automotive systems and its performance parameters.
2. Identify the driving/ braking resistances and their influences on vehicle dynamics.
3. To analyze dynamics systems such as suspension systems, body vibrations, steering mechanisms.
4. To Understand the vehicle aerodynamics and its effects on vehicle performance
5. To identify, formulate, and solve engineering problems related to vehicle dynamics.

Prerequisite: ENGINEERING MECHANICS
AUTO CHASSIS AND ENGINE COMPONENTS

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

CO 1	To understand the vehicle system dynamics
CO 2	Evaluate the driving/ braking resistances and their influences on vehicle dynamics
CO 3	Identify and analyse the dynamics systems such as suspension systems, body vibrations, steering mechanisms.
CO 4	To analyse and solve engineering problems related to vehicle dynamics
CO 5	Comparing and identifying the different types of control systems in automobiles

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	2
CO 2	2	1	1	-	-	1	-	-	-	-	-	2
CO 3	2	2	1	-	1	-	-	-	-	-	-	2
CO 4	2	2	1	-	1	-	-	-	-	-	-	2
CO 5	2	2	1	-	2	-	-	-	-	1	-	3

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	10	10	20
Apply	20	20	50
Analyse	10	10	20
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. Are you able to classify/understand the vehicle system dynamics?

Course Outcome 2 (CO2)

1. Can you evaluate the driving/ braking resistances and their influences on vehicle dynamics?

Course Outcome 3(CO3):

1. Can you identify and analyse the dynamics systems such as suspension systems, body vibrations, steering mechanisms?

Course Outcome 4 (CO4):

1. Are you able to analyse and solve engineering problems related to vehicle dynamics?

Course Outcome 5 (CO5):

1. Can you able to compare classify / and identify the different types of control systems in automobiles?

MODEL QUESTION PAPER

QP CODE:

PAGES:…

Reg. No: ______________ Name :______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT281

Course Name: DYNAMICS OF AUTOMOBILES

Max. Marks: 100 Duration: 3 Hours

Part A

(Answer all questions. Each question carry 3 marks)

1. Discuss briefly the fundamental approaches to solve the problem related to the vehicle dynamics
2. Explain the vehicle fixed coordinate system with a neat sketch.
3. Explain the term longitudinal dynamics and its significance in vehicle stability.
4. Obtain the expressions for stopping distance and braking efficiency.
5. Why do we require a suspension system? Explain the functions of a suspension system.
6. Explain the constructional details of gas and hydraulic dampers.
7. Derive the stability condition of a vehicle on a curved track and a banked road
8. Explain the terms i)self aligning torque, ii) power consumed by tire, iii) tire stiffness
9. What is the importance of vehicle aerodynamics? Explain the working principle of air dams.
10. Explain the working principle of ABS control module?

Part B

Answer any one full question from each module.

Each question carries 14 Marks

11. Discuss the steps in involved in modelling and simulation of dynamic behaviour of the vehicles. (14)

OR

12. (a) Explain SAE coordinate system with suitable sketches (7)

    (b)Discuss the history of road and off road vehicle system dynamics. (7)

13. An engine is required to power a truck having a gross weight of 40937 N. The maximum grade which the truck will have to negotiate at 32km/hr in 2nd gear is expected to be 20% (% grade = tanθx100). The rolling resistance coefficient is 0.017 and the air resistance coefficient is 0.0324 in the relation, Total resistance= $K_fW + K_aAV^2$ N. The frontal area is 5.2 m^2. The transmission efficiency in 2nd gear is 80%. Calculate the minimum power which should be available from the engine and the gear ratio in 2nd gear if this power is available at 2400rpm and the

effective radius of the wheels is 0.419 m. Also calculate the minimum speed of the vehicle in top gear on level road at the same engine speed assuming transmission efficiency of 90% in top gear. What is the gear ration in top gear? The differential has a reduction of 3.92.

(14)

OR

14. Derive an expression for engine power required to propel a vehicle considering the losses in transmission also differentiate between Traction and Tractive effort?

(14)

15. Determine the load carried by wheels at the outer and inner sides and the maximum value of coefficient of adhesion if there is no side slipping when the vehicle weighing 17795 N runs at 96 km/hr round a circular path so that the centre of gravity moves in a circle of radius 122m with its wheel axes at an angle of 12^0 to the horizontal. Its CG is 1.06 m above the ground level and wheel track is 1.3 m . (14)

OR

16. (a) What do you understand by hysteresis effect in tire and how it influences the rolling resistance. (7)

(b) What are the tire cornering characteristics? Analyze the main factors that affect them, and draw a curve to show the relationship between the self-aligning torque and the slip angle. (7)

17. (a) Explain the functions of a suspension system. Define roll axis. (7)

(b) Discuss the steps in design and analysis of passive, semi-active and active suspension using quarter car, half car and full car model? (7)

OR

18. Obtain the final forces on the links of an independent suspension system under the action of the external forces. (14)

19. What are the effects of aerodynamic drag and lift coefficients on the vehicle characteristics?

OR

20. Explain the salient features of various dynamic control systems used in automobiles.

(14)

Syllabus: AUT 381–DYNAMICS OF AUTOMOBILES 3-1-0

Module 1: INTRODUCTION

History of road and off road vehicle system dynamics - dynamics of the motor vehicle, coordinate systems- vehicle fixed coordinates system, , details of vehicle systems, wheel angles, typical data of vehicles. Fundamental approaches to vehicle dynamics modeling lumped mass, vehicle fixed coordinate system, motion variables, earth fixed coordinate system, SAE coordinate system, Euler angles, forces, Newton's second law. Definitions-modeling and simulation of dynamic behaviour of vehicle., motion analysis, force analysis, and energy analysis.

Module 2: LONGITUDINAL DYNAMICS

Introduction to longitudinal dynamics - Performance of road vehicles: forces and moments on vehicle, equation of motion, tire forces, rolling resistance, weight distribution, tractive effort/tractive resistance and power available from the engine/ power required for propulsion, road performance curves- acceleration, grade ability, drawbar pull and the problems related to these terms. Calculation of maximum acceleration braking torque, braking force, brake proportioning, braking efficiency, stopping distance, load distribution (three wheeled and four wheeled vehicles), calculation of acceleration, tractive effort and reactions for different drives, Stability of a vehicle on slope, (Problems related to these).

Module 3: TIRE MECHANICS AND LATERAL DYNAMICS

Introduction to lateral dynamics - Steering geometry, types of steering systems, fundamental condition for true rolling, development of lateral forces. slip angle, cornering force, cornering stiffness, pneumatic trail, self aligning torque, power consumed by tire, tire stiffness ,hysteresis effect in tires, steady state handling characteristics. yaw velocity, lateral acceleration, curvature response & directional stability. Elastic Band Model for longitudinal slip, Simple model for lateral slip, Combined longitudinal/lateral slip (friction ellipse), Taut string model for lateral slip, Magic Tire Formula. Stability of a vehicle on a curved track and a banked road. gyroscopic effects, weight transfer during acceleration, cornering and braking, stability of a rigid vehicle and equations of motion of a rigid vehicle, cross wind handling, the problems related to these terms.

Module 4: VERTICAL DYNAMICS

Introduction to vertical dynamics - Human response to vibrations, classification of vibration, specification and vibration , sources of vibration, suspension systems, Modal Analysis, One DOF, two DOF, free and forced vibration, damped vibration, magnification and transmissibility, vibration absorber, functions of suspension system. body vibrations: bouncing and pitching. doubly conjugate points (only basic idea). body rolling. roll center and roll axis, roll axis and the vehicle under the action of side forces, stability against body rolling.

Vehicle dynamics and suspension design for stability, choice of suspension spring rate, chassis springs and theory of chassis springs, gas & hydraulic dampers and choice of damper, damper characteristics, mechanics of an independent suspension system.. Design and analysis of passive, semi-active and active suspension using quarter car, half car and full car model.

Module 5: DYNAMIC CONTROL SYSTEM AND AERODYNAMICS

Vehicle dynamic Control, modelling of actuators, sensors for automobile control, sensors for detecting vehicle environment, central tyre inflation system. Prediction of vehicle performance. ABS, stability control, traction control.Roll over mitigation system,*Traction control system,* ·hill descent control system, Emergency braking,Structure of Vehicle Dynamics Control System (case study)

Road Loads: Air resistance-Mechanics of air flow around a vehicle, pressure distribution on a vehicle, factors affecting rolling resistance, aerodynamic forces – aerodynamic drag, drag components, drag coefficient, aerodynamic aids, aerodynamic side force, lift force, pitching moment, yawing moment, rolling moment, cross wind sensitivity.

Text Books

1. Rajesh Rajamani, "Vehicle Dynamics and Control", 1st edition, Springer, 2005
2. Singiresu S. Rao, "Mechanical Vibrations", 5th Edition, Prentice Hall, 2010
3. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics", Society of Automotive Engineers Inc, 1992
4. Wong. J. Y., "Theory of Ground Vehicles", 3rd Edition, Wiley-Interscience, 2001
5. N.K. Giri, Automotive Mechanics, Kanna Publishers, 2007

Reference Books

1. Theory of Ground Vehicles - J. Y. Woung - John Willey & Sons, NY
2. Steering, Suspension & Tyres – J. G. Giles, Ilete Books Ltd., London
3. Mechanics of Road Vehicles – W. Steed, Ilete Books Ltd. London
4. Automotive Chassis – P. M. Heldt, Chilton Co. NK
5. Gillespie.T.D., "Fundamental of vehicle dynamic society of Automotive Engineers ",USA, 1992.
6. Vehicle dynamics and control by Rajesh Rajamani , Springer publication
7. Vehicle Dynamics : Theory and Application by Reza N Jazar, Springer publication.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction - Discussion on syllabus, Cos and POs**	
1.1	History of road and off road vehicle system dynamics	1
1.2	dynamics of the motor vehicle, coordinate systems- vehicle fixed coordinates system, details of vehicle systems, wheel angles, typical data of vehicles.	2

1.3	Fundamental approaches to vehicle dynamics modeling lumped mass, vehicle fixed coordinate system	2
1.4	motion variables, earth fixed coordinate system, SAE coordinate system, Euler angle, forces, Newton's second law. Definitions	2
1.5	modeling and simulation of dynamic behaviour of vehicle motion analysis, force analysis, and energy analysis	2
2	**Longitudinal dynamics**	
2.1	Introduction to longitudinal dynamics - Performance of road vehicles: forces and moments on vehicle, equation of motion, tire forces,	2
2.2	rolling resistance, weight distribution, tractive effort/tractive resistance and power available from the engine/ power required for propulsion, grade ability, drawbar pull and the problems related to these terms. road performance curves	2
2.3	Calculation of maximum acceleration braking torque, braking force,	1
2.4	brake proportioning, braking efficiency, stopping distance,load distribution (three wheeled and four wheeled vehicles),	2
2..5	calculation of acceleration, tractive effort and reactions for different drives, Stability of a vehicle on slope, (Problems related to these).	2
3	**Lateral Dynamics**	
3.1	Introduction to lateral dynamics - Steering geometry, types of steering systems, fundamental condition for true rolling,	1
3.2	development of lateral forces. slip angle, cornering force, cornering stiffness, pneumatic trail, self aligning torque, power consumed by tire, tire stiffness	2
3.3	hysteresis effect in tires, steady state handling characteristics. yaw velocity, lateral acceleration, curvature response & directional stability.	2
3.4	Stability of a vehicle on a curved track and a banked road. gyroscopic effects, weight transfer during acceleration,	2
3.5	cornering and braking, stability of a rigid vehicle and equations of motion of a rigid vehicle, cross wind handling, the problems related to these terms. .Elastic Band Model for longitudinal slip, Simple model for lateral slip, Combined longitudinal/lateral slip (friction ellipse), Taut string model for lateral slip, Magic Tire Formula.	2
4	**Vertical Dynamics**	
4.1	Introduction to vertical dynamics - Human response to vibrations,	2

	classification of vibration, specification and vibration ,	
4.2	sources of vibration, suspension systems, Modal Analysis, One DOF, two DOF, free and forced vibration, damped vibration, magnification and transmissibility,	2
4.3	vibration absorber, functions of suspension system. body vibrations: bouncing and pitching. doubly conjugate points (only basic idea).	2
4.4	body rolling. roll center and roll axis, roll axis and the vehicle under the action of side forces, stability against body rolling. Vehicle dynamics and suspension design for stability, choice of suspension spring rate,	1
4.5	chassis springs and theory of chassis springs, gas & hydraulic dampers and choice of damper, damper characteristics, mechanics of an independent suspension system..	1
4.6	Design and analysis of passive, semi-active and active suspension using quarter car, half car and full car model	1
5	**Vehicle Aerodynamic and dynamic control system**	
5.1	Road Loads: Air resistance-Mechanics of air flow around a vehicle, pressure distribution on a vehicle, factors affecting rolling resistance.	2
5.2	aerodynamic forces – aerodynamic drag, drag components, drag coefficient, aerodynamic aids, aerodynamic side force, lift force, pitching moment,	2
5.3	Yawing moment, rolling moment, cross wind sensitivity . Vehicle dynamic Control	1
5.4	modelling of actuators, sensors for automobile control, sensors for detecting vehicle environment,	2
5.5	central tyre inflation system. Prediction of vehicle performance. ABS, stability control, traction control, stability control, traction control. Roll over mitigation system,*Traction control system,* ·hill descent control system, Emergency braking,Structure of Vehicle Dynamics Control System (case study)	2

API ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEMESTER V

HONOURS

KTU
Estd.
2014

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT393	ADVANCED THEORY OF VIBRATIONS	VAC	3	1	0	4

Preamble: This course aims at providing the student

- the theories pertaining to vibrations along with the method of evaluation and controlling of vibrations
- Understand and characterize the single and multi-degrees of freedom systems subjected to free and forced vibrations with and without damping.
- Understand the method of vibration measurements and its controlling.
- Understand the concept of dynamic vibrations of a continuous system.

Prerequisite: Mechanics of Solids

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

CO 1	Identify and evaluate systems with single degrees of freedom.
CO 2	Elaborate on systems with two degrees of freedom
CO 3	Analyse and solve vibration with multiple degrees of freedom
CO 4	Identify the methods for the measurement of vibration and apply the methods to solve it
CO 5	Enumerate on transient and non linear vibrations in a 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	2	-	-	2	-	-	-	-	-	-	-	1
CO 2	1	-	3	2	-	-	-	-	-	-	-	2
CO 3	1	-	3	2	-	2	-	-	-	-	-	2
CO 4	1	-	3	2	-	-	-	-	-	-	-	2
CO 5	1	-	3	2	-	2	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	40
Apply	20	20	50
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 3 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain one DOF system
2. Understand the basis of energy dissipation
3. Apply the basic equation of vibration for a single DOF system

Course Outcome 2 (CO2)

1. Understand the system of a two DOF system
2. Identify the modes of vibrations in a geared system

Course Outcome 3(CO3):

1. Identify the different numerical methods of evaluation of the output response of a vibratory system

Course Outcome 4 (CO4):

1. Explain the effect of whirling of shafts

2. Identify the effect related to natural frequency and method to identify the natural frequency of a system

Course Outcome 5 (CO5):

1. Illustrate on transient vibration of a system
2. Understand the non linear vibrations and approximations and methodologies to evaluate it.

Model Question paper

QP CODE: **PAGES:…**

Reg. No: _______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT 393

Course Name: ADVANCED THEORY OF VIBRATIONS

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

Part A

(Answer all questions. Each question carry 3 marks)

1. List the different parts of a vibrating system with a neat diagram
2. Derive the equation for the amplitude of a rotating unbalanced mass with forced vibration and damping.
3. Explain forced vibration of a two DoF system. Write down its equation in matrix form
4. Derive the equation in matrix form for a forced harmonic vibration 2 DoF system
5. Explain Dunkerley's method for the evaluation of natural frequency
6. List down the steps employed in the Stodola method for finding the natural frequency of a system
7. Explain the term critical speed
8. How damping can affect the critical speed?
9. List some of the examples for transient vibrations
10. List down the differences between linear and non linear vibrations

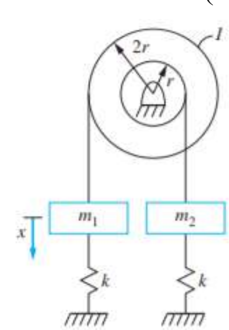
Part B

Answer any one full question from each module.

Each question carries 14 Marks

11. Derive the differential equation governing the motion of the simple pendulum using 'θ' as the counter-clockwise angular displacement of the pendulum from the system's horizontal equilibrium position and as the generalized coordinate. (14)

OR



12. Consider the system shown in the Figure. Let x describe the downward displacement of ml from the system's equilibrium position.

(a) Derive the differential equation governing x(t).

(b) Determine the reaction at the center of the disk at the pin support in terms of $x, \dot{x}, \ddot{x}$

(14)

13. In a vibratory system, the motions are expressed by the following equations.

$$x + 80\ddot{0}x + 90\theta = 0\ ;\ \ddot{\theta} + 800\theta + 90x = 0$$

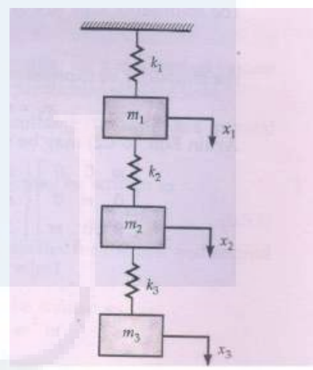
If the system is turned through 1.5 radians and released, find the frequencies and mode shapes (14)

OR

14. A machine runs at 5000rpm. Its forcing frequency is very near to its natural frequency. If the nearest frequency of the machine is to set atleast 20% from the forced frequency, design a suitable vibration absorber for the system. Assume the mass of the machine as 30kg

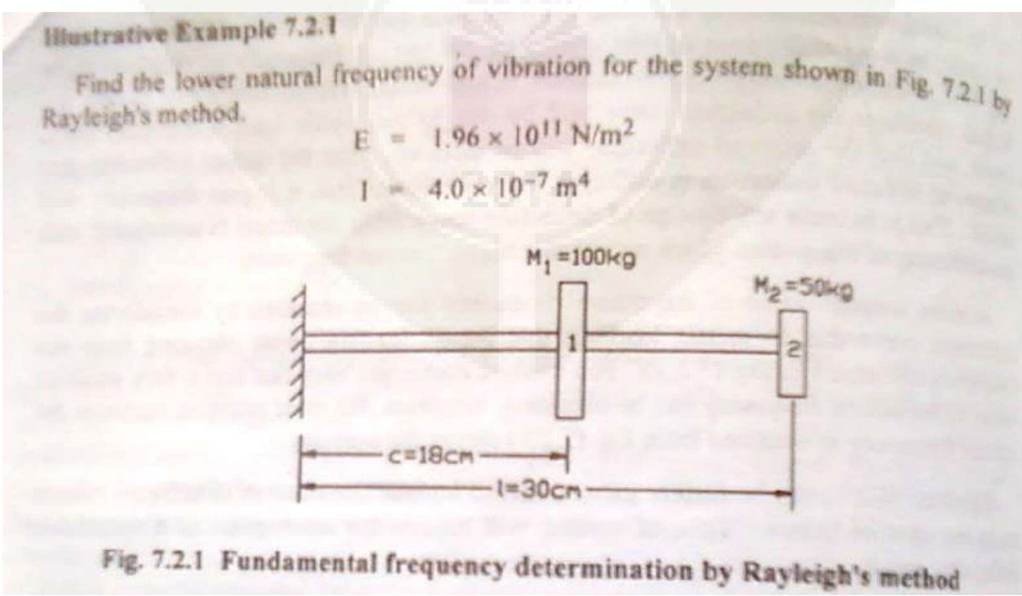
(14)

15. Using matrix method, solve the equation of motion of the system shown in the figure below



16.

OR



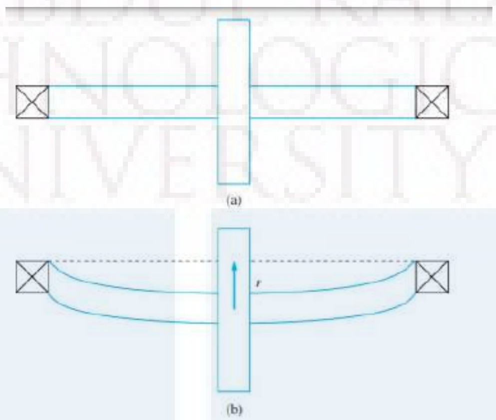
Illustrative Example 7.2.1

Find the lower natural frequency of vibration for the system shown in Fig. 7.2.1 by Rayleigh's method.

$$E = 1.96 \times 10^{11}\ N/m^2$$
$$I = 4.0 \times 10^{-7}\ m^4$$

Fig. 7.2.1 Fundamental frequency determination by Rayleigh's method

17. The rotor of figure consists of a disk mounted on a shaft. Unfortunately, the disk is unbalanced, and the center of mass is a distance e from the center of the shaft. As the disk rotates, this causes a phenomena called “whirl”, where the disk bows. Let r be the instantaneous distance from the center of the shaft to the original axis of the shaft and θ be the angle made by a given radius with the horizontal. Determine the acceleration of the mass center of the disk. (14)



OR

18. An electric motor is suspended on a spring and a dashpot. The spring has a stiffness of 6400N/m and the dashpot offers a resistance of 500N at 4m/s. The unbalanced mass 0.5kg rotates at 5cm radius and the total mass of the vibratory system is 20kg. The motor runs at 400rpm. Determine (a) Damping factor; (b) amplitude of vibration and the phase angle (c) Resonant speed and resonant amplitude (14)
19. A force F(t) is suddenly applied to a mass m which is supported by a spring with a constant stiffness k. After a short period of time T, the force is suddenly removed. During the time the force is active, it is kept constant, F. Determine the response of the system if t>T. The spring and the mass are initially in rest before the force F(t) is applied (14)

OR

20. Explain any one methodology adopted for the estimation of non linear vibrations (14)

Syllabus

Module 1: Forced vibrations (1DOF)
Introduction, analysis of forced vibration with constant harmonic excitation, MF, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, energy dissipated due to damping and numerical problems.

Module 2: Systems with 2DOF
Principal modes of vibrations, normal mode and natural frequencies of systems (Damping is not included), simple spring mass systems, masses on tightly stretched strings, double pendulum, tensional systems, combined rectilinear and angular systems, geared systems and numerical problems.

Module 3: Numerical methods for multi DOF systems
Maxwell's reciprocal theorem, influence coefficients, Rayleigh's method, Dunkerley's method, stodola method, orthogonality principle, method of matrix iteration and numerical problems.

Module 4: Vibration measuring instruments and whirling of shafts.
seismic instruments, vibrometers, accelerometer, frequency measuring instruments and numerical. Whirling of shafts with and without damping.
Vibration Control:Introduction, Vibration isolation theory, Vibration isolation and motion isolation for harmonic excitation, practical aspects of vibration analysis, vibration isolation, Dynamic vibration absorbers and Vibration dampers.

Module 5:
Transient Vibration of single Degree-of freedom systems: Impulse excitation, arbitrary excitation, Laplace transforms formulation, Pulse excitation and rise time, Shock response spectrum, Shock isolation.
Non linear Vibrations: Difference between linear and non linear vibrations, Application of super position principle, estimation and determination of non linear vibrations.

Text Books

1. S. S. Rao, "Mechanical Vibrations", Pearson Education.
2. S. Graham Kelly, "Fundamentals of Mechanical Vibration" - McGraw-Hill.
3. William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan , "Theory of Vibration with Application" , 5th edition, Pearson Education.
4. "Mechanical Vibrations", V. P. Singh, Dhanpat Rai& Company.
5. Mechanical Vibrations, W.T. Thomson- Prentice Hill India

Reference Books

1. S. Graham Kelly, "Mechanical Vibrations", Schaum's Outlines, Tata McGraw Hill.
2. C Sujatha, "Vibrations and Acoustics – Measurements and signal analysis", Tata McGraw Hill.
3. "Mechanical Vibrations", G. K. Grover, Nem Chand and Bros

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Forced vibrations (1DOF)**	
1.1	Introduction	1
1.2	Analysis of forced vibration with constant harmonic excitation	1
1.3	MF, rotating and reciprocating unbalances	2
1.4	Excitation of support (relative and absolute amplitudes)	2
1.5	Force and motion transmissibility	2
1.6	Energy dissipated due to damping and numerical problems	2
2	**Systems with 2DOF**	
2.1	Principal modes of vibrations	1
2.2	Normal mode and natural frequencies of systems	1
2.3	Simple spring mass systems	1
2.4	Masses on tightly stretched strings, double pendulum	1
2.5	Tensional systems, combined rectilinear and angular systems	2
2.6	Geared systems.	1
2.7	Numerical problems	3
3	**Numerical methods for multi DOF systems**	
3.1	Maxwell's reciprocal theorem, influence coefficients,	1
3.2	Rayleigh's method	1
3.3	Dunkerley's method	2
3.4	stodola method	2
3.5	orthogonality principle	2
3.6	method of matrix iteration	1
3.7	numerical problems.	1
4	**Vibration measuring instruments and whirling of shafts**	
4.1	Seismic instruments, vibrometers, accelerometer	1
4.2	Frequency measuring instruments	1
4.3	Numerical problems	1
4.4	Whirling of shafts with and without damping	2
4.5	Introduction to Vibration Control	1
4.6	Vibration isolation theory	1

4.7	Vibration isolation and motion isolation for harmonic excitation	1
4.8	Practical aspects of vibration analysis, vibration isolation	1
4.9	Dynamic vibration absorbers and Vibration dampers	1
5	**Transient Vibration of single Degree-of freedom systems and Non linear Vibrations:, ,**	
5.1	Impulse excitation, arbitrary excitation	1
5.2	Laplace transforms formulation	2
5.3	Pulse excitation and rise time, Shock response spectrum, Shock isolation	1
5.4	Difference between linear and non linear vibrations	1
5.5	Application of super position principle	2
5.6	Estimation and determination of non linear vibrations.	3

SEMESTER VI

AUT302	MECHANICS OF MACHINERY	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: The aim of this subject is to provide students with a general understanding of the kinematics and dynamics various mechanisms.

- ✓ Understanding of different types of mechanisms.
- ✓ Understanding of various types of clutches and brakes.
- ✓ Analyse cam-follower motions and gear train configurations.
- ✓ To impart basic concepts of Turning moment diagram and flywheels.
- ✓ To understand the balancing methods for rotating and reciprocating masses.
- ✓ To understand theory of vibration of different vibration systems.

Prerequisite: EST 100 Engineering Mechanics.

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

CO 1	**Understand** the kinematics of planar mechanisms and **describe** the principles of different types of brakes and clutches.
CO 2	**Define** cam terminologies and **apply** kinematic principles to sketch a cam profile for a specified follower motion.
CO 3	**Illustrate** different types of gears and **solve** terminologies of gears and velocity of gears in a gear train.
CO 4	**Understanding** on the Turning Moment Diagrams and use of the Flywheels in various machines and **Demonstrate** the concepts of static and dynamic balancing to rotating and reciprocating machine parts and **analyse** them for required balance.
CO 5	**Build** the basics of single degree and multi degree of freedom vibrations and their measurements.

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	3	2	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-
CO 5	3	2	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
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 anyone. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the inversion of a for bar chain.
2. Compare Davis and Ackerman's steering gear mechanisms.
3. Classify Kinematic pairs with examples.
4. Differentiate between self-locking and self-energising brakes.
5. What is a clutch? State its different types.

Course Outcome 2(CO2):

1. Explain the classification of cam followers.

2. Derive the expression for maximum velocity and acceleration for a follower moving with simple harmonic motion.

Course Outcome 3 (CO3):

1. Explain interference in involute gears. Explain any method to avoid interference.
2. Derive equation for path of contact and arc of contact of mating gears.
3. List various types of gear trains and their applications.

Course Outcome 4 (CO4):

1. Define coefficient of fluctuation of energy and coefficient fluctuation of speed
2. What is the main function of a flywheel?
3. Draw the turning moment diagram for a 4-stroke engine
4. Write a short note on primary and secondary balancing.
5. Explain hammer blow and swaying couple.
6. Derive the magnitude of unbalanced primary and secondary forces in a V-engine.

Course Outcome 5 (CO5):

1. What are the basic elements of a vibrational system? What is meat by degrees of freedom of a vibrational system?
2. What is logarithmic decrement? Derive the expression for the same.
3. What is meant by magnification factor in case of forced vibrations? On what factors does it depend?

Model Question paper

QP CODE:

PAGES: 4

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT302

Course Name: MECHANICS OF MACHINERY

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

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1) What is meant by inversion? Name the inversions of a slider crank chain.

2) Define the following terms.

a) Mechanism

b) Kinematic Pair

c) Kinematic Chain

d) Kinematic link

e) Machine.

3) Explain the working of a centrifugal clutch.

4) Derive the expression for maximum velocity and acceleration of a follower moving with cycloidal motion.

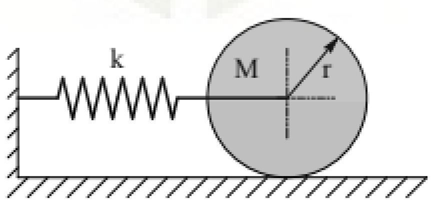
5) State and prove law of gearing.

6) Explain different types of gear trains.

7) Draw the turning moment diagram for a four-stroke engine.

8) Differentiate static balancing and dynamic balancing.

9) Find the frequency of oscillations of the system shown in figure.



10) What is meant by logarithmic decrement? Derive the expression for the same.

PART B

Answer any one full question from each module.

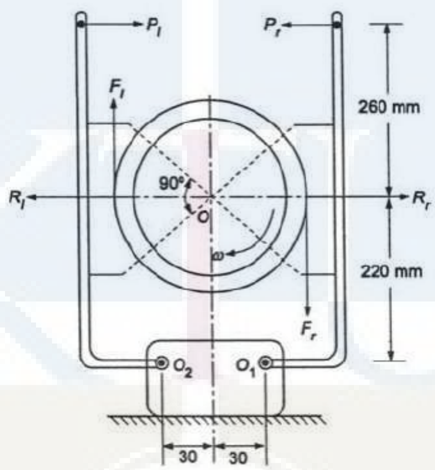
Each question carries 14 Marks

Module 1

11) With the help of neat sketches explain the classifications of kinematic pairs.

Or

12) A double-shoe (shown in figure) brake can absorb a torque of 1500 Nm. The diameter of the brake drum is 300 mm and the angle of contact for each shoe is 90°. The coefficient of friction between the brake drum and the lining is 0.35. Find (a) the spring force necessary to set the brake and (b) width of the brake shoes. The bearing pressure on the lining material is not to exceed 0.25MPa.



Module 2

13) A single-plate clutch, with both sides effective, has inner and outer diameters of friction surface 250 mm and 350 mm, respectively. The maximum intensity of pressure is not to exceed 0.15 MPa. The coefficient of friction is 0.3. Determine the power transmitted by the clutch at a speed of 2400 rpm for

a) Uniform Wear

b) Uniform Pressure.

Or

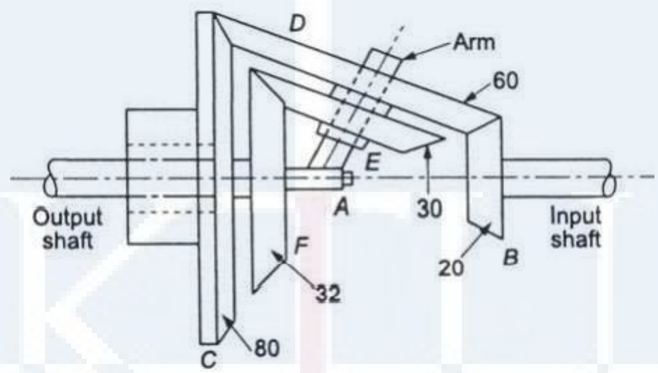
14) Design a cam to raise a valve with simple harmonic motion through 50 mm in 1/3 of a revolution, keep if fully raised through 1/12 revolution and to lower it with harmonic motion in 1/6 revolution. The valve remains closed during the rest of the revolution. The diameter of the roller is 20 mm and the minimum radius of the cam is 25 mm. The diameter of the camshaft is 25 mm. The axis of the valve rod passes through the axis of the camshaft. If the camshaft rotates at uniform speed of 100 r.p.m.; find the maximum velocity and acceleration of a valve during raising and lowering.

Module 3

15) Derive the expression for Length of path of contact, length of arc of contact and contact ratio.

Or

16) In a gear train, as shown in Fig, gear B is connected to the input shaft. The arm A carrying the compound wheels D and E, turns freely on the output shaft. If the input speed is 1200 rpm counter-clockwise, when seen from the right, determine the speed of the output shaft under the following conditions: (a) when the gear C is fixed and (b) when gear C rotates at 10 rpm counter clockwise.



Module 4

17) A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions.

Or

18) The three cranks of a three-cylinder locomotive are all on the same axle and are set at 120°. The pitch of the cylinders is 1 metre, and the stroke of each piston is 0.6 m. The reciprocating masses are 300 kg for inside cylinder and 260 kg for each outside cylinder and the planes of rotation of the balance masses are 0.8 m from the inside crank. If 40% of the reciprocating parts are to be balanced, find: 1. the magnitude and the position of the balancing masses required at a radius of 0.6 m ; and 2. the hammer blow per wheel when the axle makes 6 r.p.s.

Module 5

19) Derive the response of damped free vibration system for under damping, overdamping, and critical damping conditions.

Or

20) A body having a mass of 15kg is suspended from a spring which deflects 12mm under the weight of the mass. Determine the frequency of free vibrations. What is the viscous damping force needed to make the motion aperiodic at a speed of 1mm/s? If, when damped to this extend, a disturbing force having magnitude value of 100N and vibrating at 6Hz is made to act on the body, determine the amplitude of the ultimate motion.

SYLLABUS

Module 1

Planar Mechanisms-Terminology and definitions. Kinematic pairs, kinematic chains, and degrees of freedom of mechanisms. Kinematic Inversion of 4 bar and slider crank chains. Condition for correct steering. Davis Steering gear and Ackerman Steering gear (No numerical questions).

Brakes-Shoe brakes, Band Brakes, and Internal expanding brakes.

Module 2

Clutches-Single plate clutch, multiplate clutch, cone clutch, and centrifugal clutch.

Cams and followers- Cams - classification of cam and followers - displacement diagrams, velocity, and acceleration analysis of SHM, uniform velocity, uniform acceleration, cycloidal motion. Construction of cam profiles.

Module 3

Gears and Gear Trains- Classification of gears. Terminology and definitions of spur gears. Law of gearing, length of path of contact, arc of contact and contact ratio. Interference and minimum number of teeth to avoid interference. Simple and compound gear trains, planetary gear trains, differential, solution of planetary gear train problems.

Module 4

Flywheels-Turning moment diagrams, fluctuation of energy, flywheel, size of flywheel (No numerical problems).

Balancing of Rotating masses-static and dynamic balancing - balancing of masses rotating in several planes.

Balancing of Reciprocating masses-Balancing of reciprocating masses - balancing of multi-cylinder in line engines – V-engines.

Module 5

Mechanical Vibrations- Free vibrations of single degree freedom systems, energy Method. Undamped and damped free vibrations, viscous damping, critical damping, logarithmic decrement, harmonically excited vibrations. Response of an undamped and damped system, beat phenomenon, transmissibility. Introduction to multi-degree freedom systems (No numerical Problems). vibration measurement – accelerometer, seismometer.

Text Books

1	Theory of Machines	S S Rattan	Tata McGraw-Hill Publishing Co
2	Theory of Machines: Kinematics and Dynamics	Sadhu Singh	Pearson
3	Theory of Machines	V P Singh	Dhanpat Rai & Co
4	Mechanical Vibrations	V P Singh	Dhanpat Rai & Co

Reference Books

1	Theory of Machines and Mechanism	J E Shigley J J Unicker	Oxford University Press
2	Kinematics and Dynamics of Machinery	Robert L Norton	Tata McGraw-Hill Publishing Co
3	Theory of Machines	Thomas Bevan	Pearson
4	Theory of vibration with applications	W T Thomson	Pearson
5	Dynamics of Machinery	A R Holowenko	John Wiley & Sons

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Module 1 (9 hours)**	
1.1	Mechanism, machine, and structure. Kinematic pair, Kinematic Chain and Degrees of freedom of mechanisms.	2
1.2	Kinematic Inversions of 4 bar chain and slider crank chain. Quick return mechanisms.	3
1.3	Condition for correct steering, Davis and Ackerman Steering Gear Mechanisms	1
1.4	Shoe brakes, Band Brakes, and Internal expanding brakes.	3
2	**Module 2 (9 hours)**	
2.1	Single plate clutch, multiplate clutch, cone clutch, and centrifugal clutch.	4
2.2	Cams - classification of cam and followers - displacement diagrams, velocity, and acceleration analysis of SHM, uniform velocity, uniform acceleration, cycloidal motion. Construction of cam profiles.	5
3	**Module 3 (9 hours)**	
3.1	Classification of gears. Terminology and definitions of spur gears. Law of gearing.	1
3.2	length of path of contact, arc of contact and contact ratio. Interference and minimum number of teeth to avoid interference.	4
3.3	Simple and compound gear trains, planetary gear trains, differential, solution of planetary gear train problems	4
4	**Module 4 (9hours)**	
4.1	Turning moment diagrams.	1
4.2	Fluctuation of energy, flywheel and applications, size of flywheel	1
4.3	Balancing of rotating masses, static and dynamic balancing, balancing of rotating masses in several planes.	3
4.4	Balancing of reciprocating masses, balancing of Locomotives, effect of partial balancing in Locomotives, primary and secondary balancing and balancing of inline engines.	3
4.5	Balancing of V Engine.	1
5	**Module 5 (9 hours)**	
5.1	Vibrations- Definitions, classifications basic elements of vibrational system.	1
5.2	Undamped free vibrations, energy method.	1
5.3	Damped free vibration, equation of motion, response of damped	3

	free vibrations, over damping, under damping and critical damping. Logarithmic decrement.	
5.4	Harmonically excited vibrations, beat phenomenon, magnification factor, transmissibility.	2
5.5	Multi degree of freedom systems, Dunkerley's Method	1
5.6	Vibration measurement-Accelerometer, Seismometer.	1

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

MUT 304	COURSE NAME ADVANCED IC ENGINES	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: This course aims at providing the students, an insight on the advanced combustion systems and engine technologies.

Prerequisite: NIL

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

CO 1	Understand the modern SI and CI engine combustion technologies.
CO 2	Understand the basics of dual fuel engines and non-conventional engines
CO 3	Understand the concept and working of Lean-burn engines
CO 4	Understand the working principle and operation of stratified charge engines
CO 5	Understand the basic principles, types and operation of LTC concepts and strategies.

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	-	1	1	-	-	2	-	1
CO 2	2	1	-	2	-	1	2	-	-	2	-	1
CO 3	-	1	-	1	-	1	1	-	-	2	-	1
CO 4	-	-	-	-	-	1	1	-	-	2	-	1
CO 5	-	1	-	1	-	2	2	-	-	2	-	3

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	40
Apply	20	20	50
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.

Expected outcome:

The students will become aware of the latest developments and advancement in the field of IC engines.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the salient features of HCSI engines.
2. What are the emission control methods used in modern SI engines?
3. Discuss the working of a CRDI engine.
4. What are the different types of electronic diesel injectors?
5. List out the emission control devices in modern diesel engines

Course Outcome 2 (CO2)

1. Distinguish between a duel fuel and multi-fuel engine.
2. What are the factors affecting the performance of a duel fuel engine?
3. List the major difference between a CNG vehicle and a LNG vehicle.
4. Explain how CNG conversion is done?
5. What are the salient features of a FFV?

Course Outcome 3(CO3):

1. Explain the fundamental principle of lean combustion
2. What are the methods used to extend the lean limits?
3. Discuss about LNT technology
4. What are the major components of a gas turbine?
5. Give a comparison of gas turbine and IC engines.

Course Outcome 4 (CO4):

1. What are the methods used for charge stratification?
2. Explain the different combustion modes in a GDI engine.
3. How a TSI engines are more fuel efficient?
4. What are the approaches to auto-ignition combustion operation in gasoline engines?
5. Explain the combustion control methods used in auto-ignition combustion operation in gasoline engines.

Course Outcome 5 (CO5):

1. Explain the principle of operation of a HCCI engine
2. What are the external and internal mixture preparation techniques in LTC engines?
3. What are the combustion control methods used in HCCI engines?
4. What are the features of a RCCI engine?
5. Differentiate between HCCI engine and RCCI engine.

Model Question paper

QP CODE:

PAGES:…

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT 304

Course Name: ADVANCED IC ENGINES

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

Part A

(Answer all questions. Each question carries 3 marks)

1. List the emission control methods used in modern SI engines.
2. What are the functions of two oxygen sensors in the exhaust?
3. Give a comparison of super charger and a turbo charger.
4. What is the principle of operation of dual fuel engines?
5. List the main advantages of LNG vehicles compared to CNG vehicles.
6. Discuss the principle of Lean burn engines.
7. Why TSI engines are superior to usual GDI engines?

8. What are the advantages of LTC?
9. How the operational range of HCCI engine can be increased?
10. List down the fuel properties required for RCCI engines.

Part B

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

11. (a) Explain the working of GDI engine with a suitable lay out. (7)
    (b) Discuss the working of a Lamda sensor. (7)

OR

12. With a suitable sketch explain the working of a CRDI system and emission control strategies (14)
13. Discuss the important factors affecting the performance of a duel fuel engine. (14)

OR

14. With a suitable sketch explain the components and working of a CNG vehicle. (14)
15. Discuss the principle and working of a Lean burn engine (14)

OR

16. Explain any two techniques used for increasing the lean operation limits. (14)
17. Explain the different operational modes of a stratified charge engine? (14)

OR

18. What are the different types of gas turbine combustors? Explain their working in detail. (14)
19. Explain a typical control system employed for four stroke HCCI engine (14)

OR

20. Give a brief discussion about the concept and working of an RCCI engine. Also give a comparison between HCCI and RCCI engine. (14)

SYLLABUS

Module 1

Advanced Spark-Ignition Engines - Homogenous-Charge Spark-Ignition (HCSI) Engines, Equivalence Ratio and Engine Emissions in HCSI engines, Combustion Duration in HCSI Engines, Hydrogen in Spark-Ignited Engines, emission control devices in modern SI engines
Advanced Diesel engines- High pressure CRDI, Components of CRDI system- pump, rail, rail pressure sensor, rail pressure control valve, electronic injectors- types, pulse width, duty cycle, multiple injection diesel combustion, UPCR, turbo chargers-types, components, EGR, emission control devices in modern diesel engines.

Module 2

Dual fuel engine concepts and significance, factors affecting combustion in dual fuel engines, performance of dual fuel engines. Multifuel engines, characteristics of multi fuel engines,

performance of multi fuel engines.
CNG and LNG engines – Direct injection natural gas engines - technologies–potential applications–strength and weakness, CNG conversion – future trends
Non-conventional engines- Wankel engine, Stirling engine- free piston engine, VCR engines, flexi fuel *engines* (FFV).

Module 3

Lean burn engines–fundamentals of lean combustion–lean burn SI engines –engine combustion and emissions– lean limit operations, Extending the Lean Limit of Spark-Ignited Engine Operation- Through Increased Turbulence Generation, Through Partial Stratification, Using Microwave-Assisted Spark Ignition, LNT technology.
Gas turbines- components and working, Gasturbine as automotive engine– Limitations of gasturbine in automotive sector. Comparison of gas turbine with I.C engine.

Module 4

Stratified charge combustion in direct injection SI engines – GDI engines combustion process–Turbocharged direct injection SI engines (TSI) –problems and challenges– advantages– future trends
Direct injection gasoline engines with auto ignition combustion – principles and approaches– operation and control – development of practical engines–future trends.

Module 5

Low Temperature Combustion Strategies- Types, Principle, advantages, HCCI and CAI engines – fundamentals – external and internal mixture preparation techniques, effect of use of exhaust gas dilution – approaches to CAI/HCCI – Two stroke CAI engines – principles – control – potential applications – four stroke gasoline and diesel HCCI engines – HCCI fuel requirements – low temperature and premixed combustion with late injection – NADI concept of HCCI – CAI control and CAI/SI switching, Concept and working of dual fuel reactivity controlled compression ignition (RCCI) engine.

Text Books:

1. HZhao, Advanced Direct Injection Combustion Engine Technologies and Development, volume1-gasoline and gas engines, Wood head publishing, 2009.
2. H Zhao, Advanced Direct Injection Combustion Engine Technologies and Development, volume2-dieselengines, Wood head publishing, 2009

Reference Books

1. H Zhao , HCCIand CAI Engines for the Automotive Industry,Woodhead publishing
2. DerekDunn -Rankin,Lean Combustion:Technology and Control, Academic press, 2007
3. M.L. Mathur, R. P. Sharma-Internal Combustion Engines, Dhanpat RaiPublications.

4. VGanesan,*InternalCombustionEngine*TataMcGrawHillPublishingCompanyLtd.,New Delhi2006.
5. Rapp, V., Killingsworth, N., Therkelsen, P., & Evans, R. (2016). *Lean-Burn Internal Combustion Engines. Lean Combustion, 111–146.* doi:10.1016/b978-0-12-804557-2.00004-3, 2016 Elsevier Inc.

Course Contents and Lecture Schedule

No	Topics	No. of Lectures
1	**MODULE – 1:**	
1.1	Advanced Spark-Ignition Engines - Homogenous-Charge Spark-Ignition (HCSI) Engines	2
1.2	Equivalence Ratio and Engine Emissions in HCSI engines, Combustion Duration in HCSI Engines	1
1.3	Hydrogen in Spark-Ignited Engines,	1
1.4	emission control devices in modern SI engines	1
1.5	Advanced Dieselengines- High pressure CRDI, Components of CRDI system- pump, rail, rail pressure sensor, rail pressure control valve	1
1.6	Electronic injectors- types, pulse width, duty cycle, multiple injection diesel combustion	1
1.7	UPCR, turbo chargers-types, components, EGR	1
1.8	Emission control devices in modern diesel engines.	1
2	**MODULE – 2:**	
2.1	Dual fuel engine concepts and significance, factors affecting combustion in dual fuel engines	1
2.2	Performance of dual fuel engines.	1
2.3	Multifuel engines, characteristics of multifuel engines, performance of multifuel engines.	1
2.4	CNG and LNG engines – Direct injection natural gas engines technologies, CNG conversion	1
2.5	CNG and LNG engines –potential applications–strength and weakness– future trends	1
2.6	Non-conventional engines- Wankel engine	1
2.7	Stirling engine- free piston engine,	1
2.8	VCR engines,	1
2.9	Flexifuel*engines* (FFV).	1
3	**MODULE – 3:**	
3.1	Lean burn engines–fundamentals of lean combustion–lean burn SI engines –engine combustion and emissions–	1

3.2	Lean burn engines–lean limit operations, Extending the Lean Limit of Spark-Ignited Engine Operation- Through Increased Turbulence Generation	1
3.3	Extending the Lean Limit of Spark-Ignited Engine Operation- Through Partial Stratification, Using Microwave-Assisted Spark Ignition, LNT technology.	1
3.4	Extending the Lean Limit of Spark-Ignited Engine Operation- Through Microwave-Assisted Spark Ignition	1
3.5	LNT technology.	1
3.6	Gasturbines- components and working	1
3.7	Gasturbines- components and working - continued	1
3.8	Gasturbine as automotive engine– Limitations of gasturbine in automotive sector.	1
3.9	Comparison of gas turbine with I.C engine.	1
4	**MODULE – 4:**	
4.1	Stratified charge combustion in direct injection SI engines	1
4.2	GDI engines combustion process	1
4.3	Turbocharged direct injection SI engines (TSI)	1
4.4	Turbocharged direct injection SI engines (TSI) –problems and challenges– advantages–future trends	1
4.5	Direct injection gasoline engines with autoignition combustion	1
4.6	Direct injection gasoline engines with autoignition combustion – principles and approaches	1
4.7	Direct injection gasoline engines with autoignition combustion operation and control	1
4.8	Direct injection gasoline engines with auto ignition combustion – development of practical engines	1
4.9	Direct injection gasoline engines with auto ignition combustion – future trends.	1
5	**MODULE – 5:**	
5.1	Low Temperature Combustion Strategies- Types, Principle	1
5.2	Low Temperature Combustion Strategies-advantages,	1
5.3	HCCI and CAI engines – fundamentals – external and internal mixture preparation techniques,	1
5.4	Effect of use of exhaust gas dilution – approaches to CAI/HCCI	1
5.5	Two stroke CAI engines – principles – control – potential applications	

5.6	Four stroke gasoline and diesel HCCI engines – HCCI fuel requirements	1
5.7	Low temperature and premixed combustion with late injection – NADI concept of HCCI	1
5.8	CAI control and CAI/SI switching	1
5.9	Concept and working of dual fuel reactivity controlled compression ignition (RCCI) engine.	1

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

MUT 306	AUTO COMPONENT DESIGN	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: The aim of this subject is to offer the students a general understanding of various automotive components design.

- Explain concepts of mechanics of solids and fundamental approaches to failure prevention.
- To provide basic design methods for shafts, keys and springs.
- To provide basic design methods for clutches, brakes and bearings.
- To provide basic design methods for gear.
- To provide basic design methods for internal combustion engine parts.

Prerequisite :- MET 201: Mechanics of Solids/ MUT206: Mechanics of Solids

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

CO 1	Understand the concepts of mechanics of solids and failure prevention of components.
CO 2	Apply the basic design methods for shafts, keys and bearings.
CO 3	Apply the basic design methods for clutches, brakes and springs.
CO 4	Apply the basic design methods for gears.
CO 5	Apply the basic design methods for internal combustion engine parts.

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	-	-	-	-	-	-	-	1
CO 2	1	-	3	2	-	-	-	-	-	-	-	2
CO 3	1	-	3	2	-	2	-	-	-	-	-	2
CO 4	1	-	3	2	-	-	-	-	-	-	-	2
CO 5	1	-	3	2	-	2	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember			
Understand	10	10	20
Apply	20	20	60
Analyse	20	20	20
Evaluate			
Create			

Mark distribution

Total Marks	CIE (Continuous Internal Evaluation)	ESE (End Semester Examination)	ESE Duration
150	50	100	3 hours

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 questions, each carrying 20 marks from all the modules. The student need to attend ONE question from each module

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the concept of mechanics of solids.
2. Describe the fundamental approaches to failure prevention of components.
3. Explain theories of failure

Course Outcome 2 (CO2)

1. Illustrate the basic design procedure for shafts.
2. Interpret the basic design procedure for keys.
3. Extrapolate the basic design procedure of bearings.

Course Outcome 3(CO3):

1. Employ the basic design procedure of clutch.
2. Enumerate the basic design procedure for automotive brakes.
3. Estimate the basic design procedure of springs.

Course Outcome 4 (CO4):

1. Illustrate the basic design procedure for spur gears.
2. Illustrate the basic design procedure for helical gears.
3. Illustrate the basic design procedure for bevel gears.

Course Outcome 5 (CO5):

1. Demonstrate the basic design procedure of internal combustion engine parts.

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: AUT 306

Course Name: AUTOMOTIVE COMPONENTS DESIGN

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

Answer any FIVE

Each question carries 20 mark marks.

Module 1

1. (a) Suggest suitable materials for the following parts stating the special property which makes it more suitable for use in manufacturing: 1. Diesel engine crankshaft, 2. Automobile tyres, 3. Roller bearings 4. High pressure steam pipes 5. Stay bar of boilers 6. Worm and worm gear 7. Dies; 8. Tramway axle 9. Cam follower 10. Hydraulic brake piston. (10)

   (b) Explain in detail about,

   i. Von Mises and Hencky Theory. (5)

   ii. St. Venant's Theory (5)

OR

2. A shaft is supported on two bearings 1m apart. A 60mm diameter pulley is mounted 300mm to the right of left bearing and this drives a pulley directly below it with the help of a belt having maximum tension of 2.25kN. Another pulley 400mm diameter is driven by a motor and belt is located at a distance of 200mm to the left of right bearing. The motor is placed horizontally to the right of the system. The angle of contact of both the pulleys is 180^{o} and the co-efficient of friction is 0.24. Determine the diameter of the shaft considering that both the pulleys are operated at same torque and the shaft material has a tensile stress of 63MPa and shear stress of 42MPa. (20)

Module 2

3. A steel solid shaft transmitting 15 kW at 200 r.p.m. is supported on two bearings 750 mm apart and has two gears keyed to it. The pinion having 30 teeth of 5 mm module is located 100 mm to the left of the right hand bearing and delivers power horizontally to the right. The gear having 100 teeth of 5 mm module is located 150 mm to the right of the left hand bearing and receives power in a vertical direction from below. Using an allowable stress of 54 MPa in shear, determine the diameter of the shaft. (20)

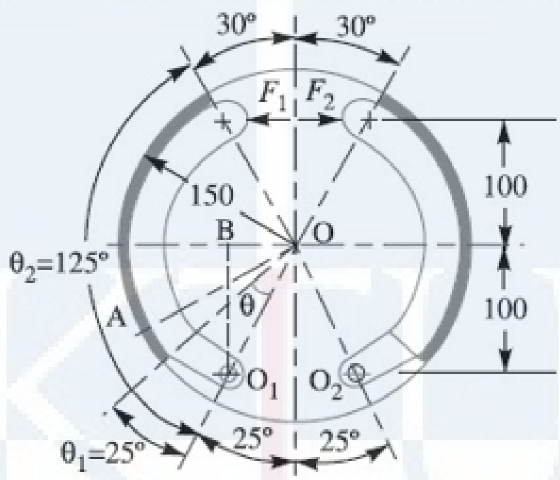
OR

4. A shaft rotating at constant speed is subjected to variable load. The bearings supporting

the shaft are subjected to stationary equivalent radial load of 3 kN for 10 per cent of time, 2 kN for 20 per cent of time, 1 kN for 30 per cent of time and no load for remaining time of cycle. If the total life expected for the bearing is 20 × 106 revolutions at 95 per cent reliability, calculate dynamic load rating of the ball bearing. (20)

Module 3

5. The figure shows an internal expanding brake system. The brake drum radius is 150mm. The intensity of pressure at any point is given by 0.4sinθN/mm2 and the co-efficient of friction is0.4. Width (b) of the brake lining is 35mm. Determine the braking torque and forces F1 and F2 and the torque capability of the brakes. Suggest a suitable type of vehicle for which this brakes can be employed (20)



All dimensions in mm.

Or

6. Design a helical spring for a spring-loaded safety valve (Ramsbottom safety valve) for the following conditions : Diameter of valve seat = 65 mm ; Operating pressure = 0.7 N/mm2; Maximum pressure when the valve blows off freely = 0.75 N/mm2; Maximum lift of the valve when the pressure rises from 0.7 to 0.75 N/mm2 = 3.5 mm ; Maximum allowable stress = 550 MPa ; Modulus of rigidity = 84 kN/mm2; Spring index = 6. Draw a neat sketch of the free spring showing the main dimensions. (20)

Module 4

7. A bronze spur pinion rotating at 600 r.p.m. drives a cast iron spur gear at a transmission ratio of 4 : 1. The allowable static stresses for the bronze pinion and cast-iron gear are 84 MPa and 105 MPa, respectively. The pinion has 16 standard 20° full depth involute teeth of module 8 mm. The face width of both the gears is 90 mm. Find the power that can be transmitted from the standpoint of strength. (20)

Or

8. A motor shaft rotating at 1500 r.p.m. has to transmit 15 kW to a low-speed shaft with a speed reduction of 3:1. The teeth are 14.5°involute with 25 teeth on the pinion. Both the pinion and gear are made of steel with a maximum safe stress of 200 MPa. A safe stress of 40 MPa may be taken for the shaft on which the gear is mounted and for the key. Design a spur gear drive to suit the above conditions. Also sketch the spur gear drive. Assume starting torque to be 25% higher than the running torque. (20)

Module 5

9. Design a cast iron piston for a single acting four stroke engine for the following data: Cylinder bore = 100 mm ; Stroke = 125 mm ; Maximum gas pressure = 5 N/mm2 ; Indicated mean effective pressure = 0.75 N/mm^2 ; Mechanical efficiency = 80% ; Fuel consumption = 0.15 kg per brake power per hour ; Higher calorific value of fuel = 42 × 103 kJ/kg ; Speed = 2000 r.p.m. Any other data required for the design may be assumed. (20)

OR

10. Design a side or overhung crankshaft for a 250 mm × 300 mm gas engine. The weight of the flywheel is 30 kN and the explosion pressure is 2.1 N/mm^2. The gas pressure at the maximum torque is 0.9 N/mm^2, when the crank angle is 35° from I. D. C. The connecting rod is 4.5 times the crank radius. (20)

SYLLABUS

Module 1

Introduction to Design- Definition, steps in design process, preferred numbers, standards and codes in design. Materials and their properties- Elastic and plastic behaviour of metals, ductile and brittle behaviour, shear, bending and torsional stresses, combined stresses, stress concentration factor.

Theories of Failure- Guest's Theory, Rankine's Theory, St. Venant's Theory, Haigh's Theory, and Von Mises and Hencky Theory. Shock and impact loads, fatigue loading, endurance limit stress, factors affecting endurance limit, factor of safety.

Module 2

Shafting- material, design considerations, causes of failure in shafts, design based on strength, rigidity and critical speed, design for static and fatigue loads, repeated loading, reversed bending. Design of woodruff key and splines

Rolling contact bearing- Design of bearings, Types, Selection of a bearing type, bearing life, static and dynamic load capacity, axial and radial loads, selection of bearings, dynamic equivalent load.

Sliding contact bearing- lubrication, lubricants, viscosity, Journal bearings, hydrodynamic theory, Sommerfield number, design considerations.

Module 3

Clutches – friction clutches, design considerations, multiple disc clutches, cone clutch, centrifugal clutch.

Brakes - Internal expanding shoe brake, Disc brakes.

Springs- classification, spring materials, stresses and deflection of helical springs, axial loading, curvature effect, resilience, static and fatigue loading, surging, critical frequency, end construction. design of leaf springs, design of torsion bar

Module 4

Gears- classification, Gear nomenclature, Tooth profiles, Materials of gears, Law of gearing (review only), virtual or formative number of teeth, gear tooth failures, Beam strength, Lewis equation, Buckingham's equation for dynamic load, wear load, endurance strength of tooth, surface durability, heat dissipation – Design of spur gear, helical gear and bevel gears

Module 5

Design of Internal combustion engine parts- Crankshaft, Piston, Cylinder, Connecting rod and Flywheel.

Textbooks

1, T Krishnarao, Design of Machine Elements Vol 1 and 2, I K International Publishing House, 2008

2 S Md Jalaludeen, Machine Design, Anuradha Publishers, 2016

3, V.B.Bhandari, Design of Machine elements, McGraw Hill, 2016

4. R. L. Norton, Machine Design – An Integrated Approach, Pearson Education, 2001

Reference Books

1, Rajendra Karwa, Machine Design, Laxmi Publications (P) LTD, New Delhi, 2006

2, J. E. Shigley, Mechanical Engineering Design, McGraw Hill book company

3, Juvinall R.C & Marshek K.M., Fundamentals of Machine Component Design, John Wiley,2011

Databook

1, Narayana Iyengar B.R & Lingaiah K, Machine Design Data Handbook,, Tata McGraw Hill, 1984

2, PSG Design Data, Design Data Handbook, DPV Printers,Coimbatore,2012

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Module 1 (9 hours)**	
1.1	Introduction to Design- Definition, steps in design process, preferred numbers, standards and codes in design.	2
1.2	Materials and their properties- Elastic and plastic behaviour of metals, ductile and brittle behaviour.	2
1.3	Shear, bending and torsional stresses, combined stresses, stress concentration factor.	2
1.4	Theories of Failure- Guest's Theory, Rankine's Theory, St. Venant's Theory, Haigh's Theory, and Von Mises and Hencky Theory.	2
1.5	Shock and impact loads, fatigue loading, endurance limit stress, factors affecting endurance limit, factor of safety.	1
2	**Module 2 (10 hours)**	
2.1	Shafting- material, design considerations, causes of failure in shafts, design based on strength, rigidity and critical speed.	2
2.2	Design for static and fatigue loads, repeated loading, reversed bending.	1
2.3	Design of woodruff key and splines.	2
2.4	Rolling contact bearing- Design of bearings, Types, Selection of a bearing type, bearing life, static and dynamic load capacity, axial and radial loads, selection of bearings, dynamic equivalent load.	3
2.5	Sliding contact bearing- lubrication, lubricants, viscosity, Journal bearings, hydrodynamic theory, Sommerfield number, design considerations.	2
3	**Module 3 (10 hours)**	
3.1	Clutches – friction clutches, design considerations.	1
3.2	Multiple disc clutches, cone clutch, centrifugal clutch.	2
3.3	Brakes - Block brakes, band brake, Internal expanding shoe brake.	2
3.4	Springs- classification, spring materials, stresses and deflection of helical springs, axial loading.	2
3.5	Curvature effect, resilience, static and fatigue loading, surging, critical frequency, end construction.	1
3.6	Design of leaf springs.	2
4	**Module 4 (10hours)**	
4.1	Gears- classification, Gear nomenclature, Tooth profiles, Materials of gears, Law of gearing (Revision)	1
4.2	Static and dynamic design of spur gears	3
4.3	Static and dynamic design of helical gears	3

4.4	Static and dynamic design of bevel gears	3
5	**Module 5 (10 hours)**	
5.1	Design of crankshaft	2
5.2	Design of Piston.	2
5.2	Design of Cylinder.	2
5.3	Design of Connecting rod.	2
5.4	Design of Flywheel.	2

MUT308	COMREHENSIVE COURSE WORK	CATEGORY	L	T	P	CREDIT
		PCC	1	0	0	1

Preamble: The aim of this subject is to evaluate the overall understanding of the students in the core areas of Mechanical Automobile Engineering Program.

- ✓ To assess the comprehensive knowledge gained in basic courses relevant to the branch of study
- ✓ To prepare the student to appear for competitive exams with questions asked in relevant field and answer them with confidence.

Prerequisite:
MUT203 Auto Chassis
MET202 Engineering Thermodynamics
MUT301 Auto Electrical And Electronics
MUT307 Auto Transmission
MUT305 Vehicle Dynamics

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

CO 1	Learn to prepare for a competitive examination
CO 2	Comprehend the questions in Automobile & Mechanical Engineering field and answer them with confidence
CO 3	Communicate effectively with faculty in scholarly environments
CO 4	Analyse the comprehensive knowledge gained in basic courses in the field of Mechanical Engineering

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									
CO2	3	2										
CO3	3	2										
CO4	3	2										

Assessment Pattern

Bloom's Category	End Semester Examination
	MCQ
Remember	25
Understand	15
Apply	5
Analyse	5
Evaluate	
Create	

Mark distribution

Total Marks	ESE	ESE Duration
50	50	1 hour

End Semester Examination Pattern: A written examination will be conducted by the University at the end of the sixth semester for 50 marks. The written examination will be of objective type. Syllabus for the comprehensive examination is based on following five Mechanical (Automobile) Engineering core courses from semester 3 to semester 5.

MUT203 Auto Chassis
MET202 Engineering Thermodynamics
MUT301 Auto Electrical and Electronics
MUT307 Auto Transmission
MUT305 Vehicle Dynamics

The written test will be of 50 marks with 50 multiple choice questions (10 questions from each core course) with 4 choices of 1 mark each covering all the five core courses. There will be no negative marking. The pass minimum for this course is 25. The course should be mapped with a faculty and classes shall be arranged for practicing questions based on the core courses listed above.

SYLLABUS

SUBJECT WILLL BE COVERING THE SYLLABUS OF FOLLLOWING SUBJECTS

MUT203 AUTO CHASSIS
MET202 ENGINEERING THERMODYNAMICS
MUT301 AUTO ELECTRICAL AND ELECTRONICS
MUT307 AUTO TRANSMISSION
MUT305 VEHICLE DYNAMICS

Model Question paper

Course Code: MUT 308		
Course name: COMPREHENSIVE EXAM – MECHANICAL (AUTO) ENGG (MU)		
Max. Marks: 50		Duration: 1 Hour

Instructions:
(1) Each question carries one mark. No negative marks for wrong answers
(2) Total number of questions: 50
(3) All questions are to be answered. Each question will be followed by 4 possible answers of which only ONE is correct.
(4) If more than one option is chosen, it will not be considered for valuation.
(5) Calculators are not permitted

	PART B- CORE COURSES						
1.	Transaxles used in .... drive type vehicle layout						
a)	Front wheel	b)	Rear wheel	c)	Four wheel	d)	Multi-axle
2.	The entry of air bubbles in the hydraulic brake lines lead to						
a)	Brake drag	b)	Brake fade	c)	Spongy brake	d)	None of these
3.	Modern coaches uses .... type of body construction						
a)	Conventional	b)	Integral	c)	Lift back	d)	Tandem axle
4.	Transaxles used in .... drive type vehicle layout.						
a)	Front wheel	b)	Rear wheel	c)	Four wheel	d)	Multi-axle
5.	The entry of air bubbles in the hydraulic brake lines lead to						
a)	Brake drag	b)	Brake fade	c)	Spongy brake	d)	None of these
6.	The relative motions between sun gear and planetary gear will occur in a differential only during						
a)	Braking	b)	Taking a turn	c)	Accelerating	d)	Straight ahead
7.	The distance between the point at which the steering axis meet the ground and the centre of the same wheel tread is referred as....						
a)	Wheel radius	b)	Steering angle	c)	Scrub radius	d)	Wheel track
8.	The change in .... between front axle and rear axle lead to under steer and over steer.						
a)	Wheel base	b)	Wheel track	c)	Slip angle	d)	None of these
9.	The change in .... between front axle and rear axle lead to under steer and over						

	steer.							
	a)	Wheel base	b)	Wheel track	c)	Slip angle	d)	None of these
10.	The amount of front wheel tilt measured in degrees from the vertical, is called							
	a)	camber angle	b)	caster angle	c)	toe-in	d)	toe-out
11.	In which thermodynamic process is there no flow of heat between the system and surroundings.							
	a)	Isobaric	b)	Isochoric	c)	Adiabatic	d)	Isothermal
12.	A definite area or space where some thermodynamic process takes place is known as							
	a)	thermodynamic system	b)	thermodynamic cycle	c)	thermodynamic process	d)	thermodynamic law
13.	The temperature at which the volume of a gas becomes zero is called							
	a)	absolute scale of temperature	b)	absolute zero temperature	c)	absolute temperature	d)	none of the above
14.	A series of operations, which take place in a certain order & restore the initial condition is known as							
	a)	reversible cycle	b)	irreversible cycle	c)	thermodynamic cycle	d)	none of the above
15.	According to kinetic theory of heat							
	a)	temperature should rise during boiling	b)	temperature should fall during freezing	c)	at low temperature all bodies are in solid state	d)	at absolute zero there is absolutely no vibration of molecules
16.	A system comprising a single phase is called a							
	a)	closed system	b)	open system	c)	isolated system	d)	homogeneous system
17.	Internal energy of a perfect gas depends on							
	a)	temperature, specific heats & pressure	b)	temperature, specific heats & enthalpy	c)	temperature, specific heats& entropy	d)	temperature only
18.	Which of the following is not a property of the system							
	a)	temperature	b)	pressure	c)	specific volume	d)	heat
19.	The process or systems that do not involve heat are called							

	a)	isothermal processes	b)	equilibrium processes	c)	adiabatic processes	d)	steady processes
20.	The condition for the reversibility of a cycle is							
	a)	the pressure & temperature of the working substance must not differ, appreciably	b)	all the processes, taking place in the cycle of operation, must be extremely slow	c)	the working parts of the engine must be friction free	d)	all of the above
21.	Which of the following is the advantage of alkaline battery?							
	a)	High energy density	b)	Good discharge characteristics over a wide range of temperature	c)	The specific gravity of electrolyte remains the same	d)	Cheap raw materials are used
22.	What is a maintenance-free battery?							
	a)	A battery having lead-antimony plate grid	b)	A battery having lead-calcium plate grid	c)	A battery does not contain acid	d)	A battery does not contain water
23.	The basic purpose of the overrunning clutch in the starter drive is to:							
	a)	assist the solenoid during cranking.	b)	pull the starter pinion gear out of mesh.	c)	disengage the armature when the engine starts	d)	keep the hold-in winding energized during cranking
24.	A solenoid uses two coils. Their windings are called							
	a)	push-in and pull-out.	b)	pull-in and push-out.	c)	push-in and hold-out.	d)	pull-in and hold-in
25.	The drive shaft in distributor is rotated at ___ the engine speed in four stroke engine							
	a)	half	b)	equal to	c)	one and half times	d)	double
26.	The sensor used to measure the oxygen content in exhaust is							
	a)	MAP Sensor	b)	Throttle Position Sensor	c)	Knock Sensor	d)	Lambda Sensor
27.	The rpm of the engine is given by							

	a)	Speedometer	b)	Odometer	c)	tachometer	d)	monometer
28.	The system which provides the direction in which the vehicle is taking a curve is							
	a)	Head Light	b)	Rear Light	c)	Directional Indicator	d)	Side Light
29.	Single point of injection in SI Engine is							
	a)	MPFI	b)	TBI	c)	GDI	d)	CRDI
30	The pressure in which fuel is injected in CRDI engine is							
	a)	100 bar	b)	200 bar	c)	500 bar	d)	Above 1000 bar
31	Cushioning springs in clutch plate are meant to reduce							
	a)	Noisy operation	b)	Jerky starts	c)	Vehicle speed	d)	none of the above
32	The clutch is located between the transmission and the							
	a)	Engine	b)	Rear axle	c)	Differentia	d)	Propeller Shaft
33	Clutch facings are attached to plates by							
	a)	Steel screws	b)	Aluminium screws	c)	Brass trivets	d)	None of these
34	The purpose of transmission in an automobile is							
	a)	To vary speed of engine	b)	To vary power of engine	c)	To vary the power of automobile	d)	To vary the torque at road wheels
35	The central gear of an epicyclic gear set is called							
	a)	Ring gear	b)	Planet gear	c)	Sun gear	d)	None of the above
36	The component of torque converter that drives the oil is							
	a)	Turbine	b)	Impeller	c)	Stator	d)	None of these
37	The blades in a torque converter have a shape which is							
	a)	Square	b)	Round	c)	Flat	d)	Curved
38	Why are the helical gears used commonly in transmission over spur gears?							
	a)	Low cost and high strength	b)	Low noise level and high strength	c)	Low noise level and economy	d)	Low noise level and low cost
39	In which of the configuration of epicyclic gearbox output will be forward and fast output speed?							
	a)	Sun gear stationary, ring gear driven,	b)	Sun gear driving, ring gear driven,	c)	Sun gear driven, ring gear stationary,	d)	Sun gear stationary, ring gear stationary,

		planet carrier driving		planet carrier stationary		planet carrier driving		planet carrier driving
40	Automatic transmission does not have the following component							
	a)	Epicyclic Gear Train	b)	Torque Converter	c)	TCC Solenoid	d)	Synchromesh Gear Box
41.	What is the relation between overturning couple and balancing couple for the stability of vehicle?							
	a)	Independent of each other	b)	Overturning couple is greater	c)	Balancing couple is greater	d)	Equal to each other
42.	A traction control system (TCS) in automobiles controls the							
	a)	Vibrations on the steering wheel	b)	Engine power during acceleration	c)	Torque that is transmitted by the tyres to the road surface	d)	Stopping distance in case of emergency
43.	The stopping sight distances(S) of a vehicle for Indian highways is given by: (Here V is the speed of the vehicle, t is the brake reaction time and η is the efficiency of brakes)							
	a)	$S = 0.28V.\ t + \frac{0.01V^2}{\eta}$	b)	$S = 0.28V\ .t + \frac{0.01\eta}{V^2}$	c)	$S = 0.01V\ .t + \frac{0.28V^2}{\eta}$	d)	$S = 0.01V\ .t + \frac{0.28\eta}{}V^2$
44.	For a car traveling with speed v around a curve of radius r, determine a formula for the angle at θ which a road should be banked so that no friction is required							
	a)	tanθ = V2/rg	b)	sin θ = V/rg	c)	tanθ = V/rg	d)	cosθ = V2/rg
45.	Rolling resistance of wheels depends uponi) vehicle load ii) Grade iii) Ground conditions. Of these statement							
	a)	only i) is correct	b)	i) and ii) are correct	c)	i) and iii) are correct	d)	) ii) and iii) are correct
46.	What is called the cornering force over the slip angle?							
	a)	Castor trail	b)	Cornering power	c)	Self-righting torque	d)	Pneumatic trail
47.	A combination of roll and pitch is called							
	a)	Circular pitch	b)	Lateral pitch	c)	Transverse pitch	d)	Diagonal pitch
48.	What happens when air struggles to fill the void left behind a car that's moving forward?							
	a)	The low-pressure area behind the car	b)	The air rushes into the void and pushes the	c)	The low-pressure area creates lift that	d)	All of the above

		"pulls" on the car, creating drag.		car forward.		reduces the traction of the rear tires.		
49.	A portion of the underbody of a car which is shaped to create a location of increasingly larger air volume below the rear is called:							
	a)	Air dams	b)	Splitter	c)	Diffuser	d)	Spoiler
50.	When is the positive sign used for the expression of gyroscopic couple?							
	a)	Centre of gravity is lower than the centre of vehicle	b)	When the engine is rotating in the opposite direction as that of wheels	c)	When the engine is rotating in the same direction as that of wheels	d)	Centre of gravity is higher than vehicle centre

MEL332	COMPUTER AIDED DESIGN AND ANALYSIS LAB	CATEGORY	L	T	P	CREDITS
		PCC	0	0	3	2

Preamble:

- To introduce students to the basics and standards of engineering design and analysis related to machine components.
- To make students familiarize with different solid modelling and analysis soft wares
- To convey the principles and requirements ofmodelling and analysis of machine elements.
- To introduce the preparation of part modelling and assembly modelling of machineries
- To introduce standard CAD packages to perform Finite Element Analysis of machine parts

Prerequisite:

EST 110 - Engineering Graphics
MEL 201 - Computer Aided Machine Drawing

Course Outcomes - At the end of the course students will be able to

CO1	Gain working knowledge in Computer Aided Design and modelling procedures.
CO2	Gain knowledge in creating solid machinery parts.
CO3	Gain knowledge in assembling machine elements.
CO4	Gain working knowledge in Finite Element Analysis.
CO5	Solve simple structural, heat and fluid flow problems using standard software

Mapping of course outcomes with program outcomes (Minimum requirements)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	2	-	-
CO2	3	-	1	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	2	2	-	-
CO4	3	1	3	-	-	-	-	1	2	3	-	-
CO5	3	3	2	-	-	-	-	2	3	3	-	-

Mark Distribution

Total Marks	CIE Marks	ESE marks	ESE duration
150	75	75	2.5 hours

Continuous Internal Evaluation (CIE) Pattern:

Attendance	15 marks
Regular class work/Modelling and Analysis/Lab Record and Class Performance	30 marks
Continuous Assessment Test (minimum two tests)	30 marks

Continuous Assessment test pattern

Bloom's Taxonomy	Continuous Assessment Tests	
	Test 1 - PART A MODELLING (marks)	Test 2 - PART B ANALYSIS (marks)
Remember	10	10
Understand	10	10
Apply	20	20
Analyse	15	15
Evaluate	20	20
Create	25	25

End semester examination pattern

End semester examination shall be conducted on modelling and analysis and based on complete syllabus. The following general guidelines should be maintained for the award of marks

Part A Assembly Modelling – 35 marks
Part B Analysis – 30 marks
Viva Voce – 10 marks.

Conduct of University Practical Examinations

The Principals of the concerned Engineering Colleges with the help of the Chairmen/Chairperson will conduct the practical examination with the approval from the University and bonafide work / laboratory record, hall ticket, identity card issued by college are mandatory for appearing practical University examinations. No practical examination should be conducted without the presence of an external examiner appointed by the University.

References Books:

1. Daryl Logan, A First course in Finite Element Method, Thomson Learning, 2007
2. David V Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill,2003
3. Ibrahim Zeid, CAD/ CAM Theory and Practice, McGraw Hill, 2007
4. Mikell P. Groover and Emory W. Zimmer, CAD/ CAM – Computer aided design and manufacturing, Pearson Education,1987
5. T. R. Chandrupatla and A. D. Belagundu, Introduction to Finite Elements in Engineering, Pearson Education, 2012

Experiment List (Minimum 12 exercises)

SL.NO	PART - A (Minimum 6 models)	COURSE OUTCOMES	HOURS
1	Creation of high end part models (minimum 2 models, Questions for examinations must not be taken from this portions)	CO1, CO2	6
2	Creating assembly models of Socket and spigot joint, Knuckle Joint, Rigid flange couplings, Bushed Pin flexible coupling, Plummer block, Single plate clutch and Cone friction clutch. Pipe joints, Screw jack, Tail stock etc. (minimum 4 models)	CO1, CO2, CO3	12
	PART – B (Minimum 6 problems)		
3	Structural analysis. (minimum 3 problems)	CO4, CO5	6
4	Thermal analysis. (minimum 2 problems)	CO4, CO5	3
5	Fluid flow analysis. (minimum 1 problem)	CO4, CO5	3

END SEMSTER EXAMINATION

MODEL QUESTION PAPER

MEL332: COMPUTER AIDED DESIGN AND ANALYSIS LAB

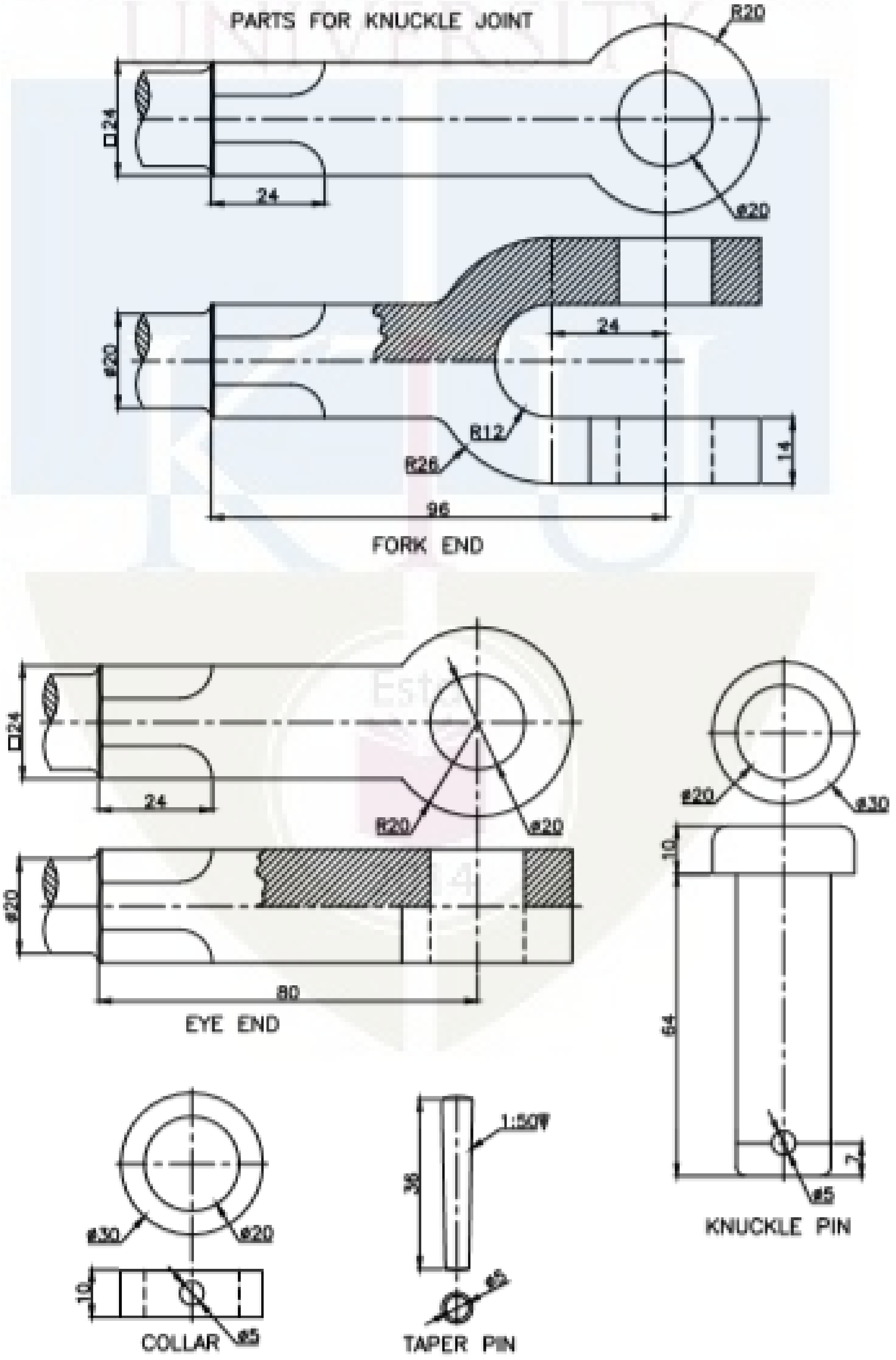
Duration : 2.5 hours Marks : 75

Note :

1. All dimensions in mm
2. Assume missing dimensions appropriately
3. A4 size answer booklet shall be supplied
4. Viva Voce shall be conducted for 10 marks

PART A (ASSEMBLY MODELLING) – 35 marks

1. Create an assembly model using the part details given below



PART B (FINITE ELEMENT ANALYSIS) – 30 marks

2. Air flows over a long cylinder of 150mm diameter at a velocity of 3m/sec at a temperature of 105º F. Using this data and applying finite element technique find
   a. Max velocity
   b. Plot flow trajectories
   c. Cut plot of velocity

CODE MUL332	ELECTRICAL SYSTEMS LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble: This lab is intended to impart training to auto mobile engineering students on the working of various types of electrical machines. It is also intended that students will be able to acquire some knowledge on the working of speed control of dc motors.

Prerequisite: Nil

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

CO 1	To understand the working of a single phase transformer
CO 2	To understand the working of dc generators
CO 3	To understand the load characteristics of dc series motor
CO 4	To understand the load characteristics of 3-phase squirrel cage induction motor
CO 5	To understand the load characteristics of 3-phase slip ring induction motor
CO 6	To understand operation of four quandrant chopper dc motor drive

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		2
CO 2	2							2	2	2		2
CO 3	2							2	2	2		2
CO 4	2							2	2	2		2
CO 5	2							2	2	2		2
CO 6	2	1			2			2	2	2		2

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Assessment : 30 marks

Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work	: 15 Marks
(b) Implementing the work/Conducting the experiment	: 10 Marks
(c) Performance, result and inference (usage of equipments and trouble shooting)	: 25 Marks
(d) Viva voce	: 20 marks
(e) Record	: 5 Marks

General instructions:

Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Reference Books

1.Fitzgerald, A. E., Kingsley, C., Umans, S. D., & James, B. (2003). *Electric machinery* (Vol. 5, pp. 178-179). New York: McGraw-Hill.

2.Guru, B. S., & Hiziroglu, H. R. (2001). *Electric machinery and transformers* (Vol. 726). New York: Oxford university press.

3.DW, N., & Sen, P. K. (1999). *Electric drives*. PHI Learning Pvt. Ltd..

List of Exercises/Experiments:

(Lab experiments may be given considering 12 sessions of 3 hours each.)

1. Load test on single phase transformer
2. OC and SC test on single phase transformer
3. Open circuit characteristics of dc shunt generators.
4. Load test on dc shunt generator.
5. Load test on cumulatively compounded dc generator.
6. Load test on differentially compounded dc generator.
7. Load test on dc series motor.
8. Load test on three phase squirrel cage induction motor
9. Load test on three phase slip ring induction motor.
10. Starting of three phase induction motor using star-delta/autotransformer methods.
11. No-load and Blocked rotor tests on three phase squirrel cage induction motor
12. Study of four quadrant chopper dc drive.

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEMESTER VI

PROGRAM ELECTIVE I

KTU Estd. 2014

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT312	VEHICLE MAINTENANCE	PEC	2	1	0	3

Preamble: This course aims at providing the students, an insight on the various service and maintenance, trouble shoots and diagnostic tools used in automobiles.

Prerequisite: Nil

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

CO 1	Understand the need for vehicle maintenance and its importance
CO 2	Familiarize the maintenance procedure for various components of an automobile
CO 3	Identify various troubles and troubleshooting related to the automobile components.
CO 4	Familiar with Diagnostic tools used in Automobiles for detection of problems
CO 5	Rectify the problems occurring in various components an automobile

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	-	1	1	-	-	2	-	1
CO 2	2	1	-	2	-	1	2	-	-	2	-	1
CO 3	-	1	-	1	-	1	1	-	-	2	-	1
CO 4	-	-	-	-	-	1	1	-	-	2	-	1
CO 5	-	1	-	1	-	2	3	-	-	2	-	2

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyze			
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. State the importance of maintenance.
2. List the requirements of a service station.
3. Define about maintenance schedule for different types of automobiles.

Course Outcome 2 (CO2)

1. State the importance of engine overhauling
2. List the troubles and troubleshooting related to engines.
3. Define the use of different engine fault diagnosing instruments

Course Outcome 3(CO3):

1. Demonstrate the importance of fuel pump calibration and testing
2. List different methods for fault diagnosis in fuel injection system.
3. Describe about maintenance of cooling systems.

Course Outcome 4 (CO4):

1. Define in detail about servicing of transmission system.
2. Discuss in detail about servicing of braking system.
3. Describe the importance of wheel alignment in an automobile.

Course Outcome 5 (CO5):

1. Discuss about different methods for servicing of electrical accessories.
2. Describe in detail about maintenance of battery.

3. Demonstrate the importance of ignition system in engines.

Model Question paper

QP CODE: **PAGES:………**

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR
COURSE CODE: MUT 312
COURSE NAME: VEHICLE MAINTENANCE

Max. Marks: 100 Duration: 3 Hours

PART A

I. Answer all questions. Each question carries 3 marks

1. Why a regular service is important for a vehicle?
2. Explain the Importance of Job Card with the help of a sample job card.
3. List the causes for "engine cranks slowly, but does not start"
4. List down the corrective actions if the engine lacks power, acceleration or high-speed performance
5. Explain the importance of Wheel alignment in a car
6. List the reasons for clutch slipping while engaging
7. Differentiate between OBD 1 and OBD II scanners used for electronic fault diagnosis
8. Discuss any one method for testing of an automobile battery
9. List down the procedure for setting the idle speed of a carburettor engine
10. Why do we require to add anticorrosion and antifreeze additives in cooling system of a vehicle?

(10 x 3 =30 marks)

PART B

II. Answer all questions. Each question carries 14 marks

11 (a) What are the different types of maintenances carried out for a vehicle? Explain each

OR

12 (a) With the help of a chart explain about PDI.

13 (a) What are the steps involved in dismantling of an engine? List the precautions to be observed while dismantling

OR

14 (a) Discuss about the use of OBD for trouble shooting in automobiles.

15 (a) List any five major complaints in a fuel injection system and prepare a chart showing the possible causes and corrective actions.

OR

16 (a) Discuss in detail about the maintenance of cooling system.

17 (a) Discuss about common complaints observed in the steering and suspension system of a vehicle. List down its causes and remedial measures

OR

18 (a) List the complaints in the power brake system. List its possible causes and remedies

19 (a) Explain in detail about the servicing of charging system used in automobiles

OR

20(a) Discuss about various starting system troubles observed in a vehicle. Explain the method for trouble shooting of these complaints.

(5 x 14=60 marks)

Syllabus

Module 1

Maintenance, Records and Schedules: Importance of maintenance, types of maintenance, Inspection, scheduled maintenance, Job card, PDI chart, requirement of service station, service station records (stores & maintenance), layout and personnel for service station, Typical maintenance schedule for two-wheeler, LMV and HMV.

Module 2

Engine trouble diagnosis and tune-up: Overhauling of engine - types of overhauling (Top overhauling and major overhauling), specific tools used for overhauling, de-carbonizing and degreasing, engine time up, Engine fault diagnosing instruments, use of automobile stethoscope, computerized engine analyzers/scanners, OBD II usage for troubleshooting, troubles and troubleshooting related to engines.

Module 3

Maintenance and repair of fuel supply, Lubrication and cooling system: Fuel pump testing, Carburetor servicing and tuning, servicing of gasoline injection system, FIP calibration and

phase setting, injector testing, Electronic fuel injection and engine management. service - fault diagnosis- servicing emission controls.
Lubrication maintenance, lubricating oil changing, greasing of parts, engine oil change intervals.
Maintenance of Cooling systems, water pump and radiator, thermostat, anti-corrosion and antifreeze additives.

Module 4
Maintenance and Repair of chassis components: Servicing of clutch assembly, gear box, propeller shaft, troubles and troubleshooting chart on transmission, differential maintenance and repair, backlash adjustment, servicing of braking system, identification and rectification of brake faults, brake testing, steering system maintenance and repair, tyre rotation, tyre re-treading, checking and adjusting of suspension system, wheel balancing, wheel alignment.

Module 5
Maintenance of Auxiliaries: Maintenance of starter motor, dynamo and alternator, regulator unit, battery maintenance, methods of testing & servicing various electrical accessories like horn, headlight (aiming and focusing), gauges, Testing the spark plug and ignition coil with special equipment, checking and setting the ignition timing in conventional engines.

Text Book:
1. Ed May, "Automotive Mechanics Volume 1 & 2", Mc Graw Hill Publications, 2003
2. Boyce Dwiggins, Automobile Repair guide, Theodor Audel and Co., Indiana, 1978.
3. A-W Judge- Maintenance of High-speed Diesel Engine, Chapman Hall Ltd

References:
1. G.B.S. Narang - Automobile Engineering, Khanna Publishers
2. Knott and Phil Knott, “An Introductory Guide to Motor Vehicle Maintenance: Light Vehicles”, EMS publishing, 2010
3. Antony.E. Schwaller - Motor Automotive Technology, Delmar Publishers
4. A.W Judge - Motor Vehicle Engine Servicing, 3rd Edition, Pitman paper mark, London
5. Bosch Automotive Handbook, Sixth Edition, 2004
6. Vehicle Service Manuals and reputed manufacturers.
7. Tim Giles, “Automotive service: Inspection, maintenance and repair”, 3rd edition, 2007

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Maintenance, Records and Schedules**	
1.1	Importance of maintenance, types of maintenance	1
1.2	Inspection, scheduled maintenance	1
1.3	Job card, PDI chart, requirement of service station	1
1.4	service station records (stores & maintenance)	1
1.5	layout and personnel for service station	1
1.6	Typical maintenance schedule for two-wheeler	1
1.7	Typical maintenance schedule for LMV, HMV	1
2	**Maintenance of Engine**	
2.1	Engine trouble diagnosis and tune-up: Overhauling of engine - types of overhauling (Top overhauling and major overhauling)	1
2.2	Specific tools used for overhauling, de-carbonizing and degreasing	1
2.3	Engine tuning	1
2.4	Engine fault diagnosing instruments, Use of automobile stethoscope	1
2.5	Computerized engine analyzers/scanners	1
2.6	OBD II usage for troubleshooting	1
2.7	Troubles and troubleshooting related to engines	1
3	**Maintenance and repair of fuel supply, Lubrication and cooling system**	
3.1	Fuel pump testing, Carburetor servicing and tuning	1
3.2	Servicing of gasoline injection system, FIP calibration and phase setting, injector testing	1
3.3	Electronic fuel injection and engine management	1
3.4	Service - fault diagnosis- servicing emission controls.	1
3.5	Lubrication maintenance, lubricating oil changing, greasing of parts, engine oil change intervals.	1
3.6	Maintenance of Cooling systems, water pump and radiator, thermostat.	1
3.7	Anti-corrosion and antifreeze additives	1
4	**Maintenance and Repair of chassis components**	
4.1	Servicing of clutch assembly, gear box, propeller shaft	1
4.2	Troubles and troubleshooting on transmission	1
4.3	Differential maintenance and repair, backlash adjustment	1
4.4	Servicing of braking system	1
4.5	Identification and rectification of brake faults, brake testing	1

4.6	steering system maintenance and repair, Tyre rotation, tyre re-treading	1
4.7	Checking and adjusting of suspension system, wheel balancing, wheel alignment	1
5	**Maintenance of Auxiliaries**	
5.1	Maintenance of starter motor	1
5.2	Maintenance of dynamo and alternator, regulator unit	1
5.3	Battery maintenance	1
5.4	Methods of testing & servicing various electrical accessories like horn, headlight (aiming and focusing)	1
5.5	Methods of testing & servicing various electrical accessories like gauges	1
5.6	Testing the spark plug, Testing of Ignition coil with special equipment	1
5.7	Checking and setting the ignition timing in conventional engines	1

CODE MET 312	COURSE NAME NON-DESTRUCTIVE TESTING	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble:

Nondestructive Testing (NDT) plays an extremely important role in quality control, flaw detection and structural health monitoring covering a wide range of industries. There are varieties of NDT techniques in use. This course will first cover the fundamental science behind the commonly used NDT methods to build the basic understanding on the underlying principles. It will then go on to cover the process details of each of these NDT methods.

Prerequisite: NIL

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

CO 1	Have a basic knowledge of surface NDT which enables to carry out various inspections in accordance with the established procedures.
CO 2	The students will be able to differentiate various defect types and select the appropriate NDT methods for the specimen.
CO 3	Calibrate the instrument and evaluate the component for imperfections.
CO 4	Have a basic knowledge of ultrasonic testing which enables them to perform inspection of samples.
CO 5	Have a complete theoretical and practical understanding of the radiographic testing, interpretation and evaluation.

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	2									1
CO 2	**3**	3	2									1
CO 3	**3**	3	1									2
CO 4	**3**	3	2									2
CO 5	**3**	3	1									1

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	25	25	25
Understand	25	25	25

Apply	30	30	30
Analyse	10	10	10
Evaluate	10	10	10
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. Explain why NDT methods were initially developed

2. Describe the uses of NDT

3. Define the functionality of Destructive method

Course Outcome 2 (CO2)

1. Name the various nondestructive test methods

2. Recognize the NDT method abbreviations

3. Briefly explain each NDT method

Course Outcome 3(CO3):

1. Explain the discontinuities inherent in various manufacturing processes

2. Define the causes, prevention, and repair of those welding discontinuities

3. Explain the discontinuities inherent in various welding processes

Course Outcome 4 (CO4):

1. Explain basic principle of Radiographic examination.
2. Discuss principle of radiographic testing and give its application and limitation
3. Explain the principle, application and disadvantages of Radiographic Testing.

Course Outcome 5 (CO5):

1. Describe the various types of RT equipment
2. Describe the basic principles of gamma and X-ray generation
3. Name the three means of protection to help reduce exposure to radiation

MODEL QUESTION PAPER

SIXTH SEMESTER MECHANICAL ENGINEERING

NON DESTRUCTIVE TESTING - MET 312

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

Part – A

Answer all questions, each question carries 3 marks

1. Define Non-destructive testing?
2. Explain the basic principle of Visual testing?
3. Explain the sequence of operation of Liquid penetrant testing?
4. Explain the basic principle of Liquid penetrant testing?
5. How are the materials classified based on their interaction with a magnetic field?
6. Explain the Hysteresis Loop and Magnetic Properties of a material?
7. Compare X-rays and Gamma rays?
8. What is Snell's Law and it's significance in Ultrasonic Testing?
9. Define the terms (a) Radiation Energy, (b) Intensity
10. What are the physical aspects of E.C.T?

PART -B

Answer one full question from each module.

MODULE – 1

11. a) With the help of suitable examples, differentiate between destructive and nondestructive testing techniques. **(8 Mark)**
  b) With the help of a neat diagram, explain computer enhanced visual inspection system. **(6 Mark)**

OR

12. a) Explain visual inspection process. Also explain about the different types of optical aids used in the process. **(8 Mark)**
  b) List the applications and Limitations of Visual inspection technique in ND **(6Mark)**

MODULE – 2

13. a) How are the penetrants classified based on **(8 Mark)**
    a. Physical properties
    b. Removal techniques
    c. Strength of indication
  b) What are the methods used to remove excess penetrants during LPI **(6 Mark)**

OR

14. a) Explain the working principle of liquid penetrant inspection (LPI). With neat sketches explain the various steps involved in performing LPI. **(8 Mark)**
  b) Explain different types of developers and how it is being applied **(6 Mark)**

MODULE – 3

15. a) With the help of neat sketches explain about any four types of magnetization techniques used in magnetic particle inspection (MPI). **(8 Mark)**
  b) What are the differences between dry and wet continuous MPI? **(6 Mark)**

OR

16. a) Differentiate between direct and indirect method of magnetization. Write the advantages and disadvantages of both methods. **(8 Mark)**
  b) What is continuous testing and residual technique of MPI **(6 Mark)**

MODULE – 4

17. a) With the help of neat figures, differentiate between through transmission technique and pulse echo testing techniques used in ultrasonic testing. **(8 mark)**
  b) What are the different types of probes used in ultrasonic testing? **(6 mark)**

OR

18. a) What are the different wave forms used in ultrasonic testing? **(8 Mark)**
  b) With neat sketches explain the following: **(6 mark)**
    i) A-Scan ii) B-Scan iii) C-Scan

MODULE – 5

19. a) With neat sketches explain about the different inspection techniques in radiography testing (RT). **(8 Mark)**

b) Explain about various steps involved in film processing in RT. **(6 mark)**

OR

20. a) Explain the following terms associated with ECT: **(8 Mark)**

i) Lift off effect ii) Edge effect iii) End effect

b) Explain about eddy current testing (ECT) technique in detail. **(6 mark)**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SYLLABUS

Module 1

NDT Versus Mechanical testing-Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation-Relative merits and limitations-various physical characteristics of materials and their applications in NDT.

Visual Inspection: Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, Boroscopes and fibro scopes– light sources and special lighting–calibration- computer enhanced system

Module 2

Liquid Penetrant Inspection: Principles – types and properties of liquid penetrants – developers – advantages and limitations of various methods - Preparation of test materials – Application of penetrants to parts, removal of excess penetrants, post cleaning – Control and measurement of penetrant process variables –selection of penetrant method – solvent removable, water washable, post emulsifiable – Units and lighting for penetrant testing – calibration- Interpretation and evaluation of test results - dye penetrant process applicable codes and standards.

Module 3

Magnetic Particle Inspection (MPI): Important terminologies related to magnetic properties of material, principle-magnetizing technique, procedure, and equipment, fluorescent magnetic particle testing method, sensitivity-application and limitation-Methods of magnetization, magnetization techniques such as head shot technique, cold shot technique- central conductor testing, and magnetization using products using yokes-direct and indirect method of magnetization - continuous testing of MPI, residual technique of MPI- checking devices in MPI, Interpretation of MPI, indications, advantage and limitation of MPI.

Module 4

Ultrasonic Testing: Basic principles of sound propagation, types of sound waves, Principle of UT-methods of UT, their advantages and limitations-Piezoelectric Material, Various types of transducers/probe-Calibration methods, contact testing and immersion testing, normal beam and straight beam testing, angle beam testing, dual crystal probe, ultrasonic testing techniques resonance testing, through transmission technique, pulse echo testing technique, instruments used UT, accessories such as transducers, types, frequencies, and sizes commonly used. Reference of standard blocks-technique for normal beam inspection-flaw characterization technique, defects in welded products by UT-Thickness determination by ultrasonic method;- Study of A, B and C scan presentations-Time of Flight Diffraction (TOFD).

Module 5

Radiography: X-rays and Gamma rays, Properties of X-rays relevant to NDE - Absorption of rays - scattering. Characteristics of films- graininess, Density, Speed, Contrast. Characteristic curves. Inspection techniques like SWSI, DWSI, DWDI, panoramic exposure, real time radiography, films used in industrial radiography

Eddy Current Testing: Generation of eddy currents – effect of change of impedance on instrumentation – properties of eddy currents – eddy current sensing elements, probes, type of coil arrangement – absolute, differential, lift off, operation, applications, advantages, limitations Field factor and lift of effect, edge effect, end effect, impedance plane diagram in brief, depth of penetration of ECT, relation between frequency and depth of penetration in ECT.

Text Books

1. Baldev Raj, Practical Non – Destructive Testing, Narosa Publishing House, 1997

2. J.Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition (2011).

3. B.Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3 rd edition (2007).

4. T. Rangachari, J. Prasad and B.N.S. Murthy, Treatise on Non-destructive Testing and Evaluation, Navbharath Enterprises, Vol.3, (1983).

5. Ed. Peter.J. Shull, Non-destructive Evaluation: Theory, Techniques, and Applications, Marcel Dekker (2002). 2.

Reference Books

1. C. Hellier, Handbook of Non-Destructive Evaluation, McGraw-Hill Professional, 1st edition (2001).

2. J. Thomas Schmidt, K. Skeie and P. Maclntire, ASNT Non Destructive Testing Handbook: Magnetic Particle Testing, American Society for Non-destructive Testing, American Society for Metals, 2nd edition (1989).

3. Krautkramer, Josef and Hebert Krautkramer, Ultrasonic Testing of Materials, Springer Verlag, 1990

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
	MODULE 1	
1.1	NDT Versus Mechanical testing-Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation	2
1.2	Relative merits and limitations-various physical characteristics of materials and their applications in NDT	1
1.3	Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods	1
1.4	Mirrors, magnifiers, Boroscopes and fibro scopes	1
1.5	light sources and special lighting, calibration- computer enhanced system	2
	MODULE 2	
2.1	**Liquid Penetrant Inspection:** Principles – types and properties of liquid penetrants – developers	1
2.2	Advantages and limitations of various methods - Preparation of test materials	1
2.3	Application of penetrants to parts, removal of excess penetrants, post cleaning	1
2.4	Control and measurement of penetrant process variables –selection of penetrant method	1
2.5	solvent removable, water washable, post emulsifiable – Units and lighting for penetrant testing	1
2.6	calibration- Interpretation and evaluation of test results - dye penetrant process applicable codes and standards	2
	MODULE 3	
3.1	**Magnetic Particle Inspection (MPI):** Important terminologies related to magnetic properties of material	1
3.2	Principle-magnetizing technique, procedure, and equipment, fluorescent magnetic particle testing method, Sensitivity	1
3.3	Methods of magnetization, magnetization techniques such as head shot technique, cold shot technique- central conductor testing,	1
3.4	magnetization using products using yokes-direct and indirect method of magnetization - continuous testing of MPI	1
3.5	residual technique of MPI- checking devices in MPI	1
3.6	Indications, advantage and limitation of MPI.	1
	MODULE 4	
4.1	Ultrasonic Testing: Basic principles of sound propagation, types of	

	sound waves, Principle of UT-methods of UT	1
4.2	Piezoelectric Material, Various types of transducers/probe Calibration methods, contact testing and immersion testing, normal beam and straight beam testing,	1
4.3	Angle beam testing, dual crystal probe, ultrasonic testing techniques resonance testing, through transmission technique, pulse echo testing technique	1
4.4	Accessories such as transducers, types, frequencies, and sizes commonly used. Reference of standard blocks	1
4.5	Technique for normal beam inspection Thickness determination by ultrasonic method	1
4.6	Study of A, B and C scan presentations, Instruments used UT	1
4.7	Time of Flight Diffraction (TOFD).	1
	MODULE 5	
5.1	**Radiography:** X-rays and Gamma rays, Properties of X-rays relevant to NDE - Absorption of rays - scattering	1
5.2	Characteristics of films- graininess, Density, Speed, Contrast. Characteristic curves. Inspection techniques like SWSI, DWSI, DWDI	1
5.3	Panoramic exposure, real time radiography, films used in industrial radiography	1
5.4	**Eddy Current Testing:** Generation of eddy currents – effect of change of impedance on instrumentation – properties of eddy currents	1
5.5	Eddy current sensing elements, probes, type of coil arrangement – absolute, differential, lift off, operation, applications, advantages, limitations	1
5.6	Field factor and lift of effect, edge effect, end effect, impedance plane diagram in brief, depth of penetration of ECT	1
5.7	Relation between frequency and depth of penetration in ECT.	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT322	VEHICLE BODY ENGINEERING	PEC	2	1	0	3

Preamble: At the end of the course, the students will be able to have a sound knowledge for the design of the vehicles body to give maximum comfort for the passengers and exposed to the methods of stream lining the vehicles body to minimize drag.

Prerequisite: Nil

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

CO 1	Understand the need for vehicle ergonomics and its importance
CO 2	Familiarize the various styling forms of car body
CO 3	Understand various commercial vehicle body styles and its dimensions
CO 4	Understand the various aspects of vehicle aerodynamics
CO 5	Illustrate comfort and safety considerations that have to be taken into account while designing a vehicle

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	-	-	-	-	-	-	-	2
CO 2	-	1	3	-	-	-	-	-	-	-	-	-
CO 3	2	-	3	-	-	-	-	-	-	-	-	2
CO 4	3	2	3	-	3	-	2	-	-	-	-	-
CO 5	1	1	2	2	2	1	-	-	-	-	1	3

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyze			
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. State the importance of cabin ergonomics.
2. Explain the concepts of suspension seats
3. Describe and sketch the structure of split frame seating

Course Outcome 2 (CO2)

1. Illustrate and explain various car body styling forms
2. Explain the considerations for better visibility
3. Explain the methods to improve visibility

Course Outcome 3(CO3):

1. Illustrate and explain double skin body construction
2. Explain various commercial vehicle body styling
3. Explain the structure of fifth wheel

Course Outcome 4 (CO4):

1. Define in detail about vehicle aerodynamics and its factors
2. Discuss in detail about Aerodynamic drag and its types
3. Describe the methods used to reduce drag

Course Outcome 5 (CO5):

1. Explain the purpose of crash tests and criteria considered for crash test
2. Describe in detail about vehicle vibrations
3. Demonstrate the importance of secondary safety systems in vehicles

Model Question paper

QP CODE:

PAGES:

Reg. No: _______________ **Name :_______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT322

Course Name: VEHICLE BODY ENGINEERING

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

Part A

Answer all questions, each question carries 3 marks

1. Explain the term ergonomics
2. Describe split frame seating
3. What is meant by blind spot in automobiles?
4. Illustrate and explain a 4 door saloon car
5. Explain double skin body construction
6. Briefly explain body styling of forward control pick up
7. Define in detail about vehicle aerodynamics and its factors
8. List and explain any 3 methods to reduce drag
9. What is the purpose of using silicon rubber in body construction?
10. What is meant by Secondary Restraint System? (10*3=30 marks)

Part B

Answer any five questions, each one carries 14 marks

11. Explain with the help of neat sketch about commercial vehicle cabin ergonomics

OR

12. List and explain various dashboard instruments used in automobiles
13. Explain any 5 types of car body styling forms

OR

14. Describe various factors affecting visibility and methods to improve visibility

OR

15. Illustrate and explain articulated bus body construction

OR

16. Explain in detail about double Decker buses

17. Describe and illustrate wind tunnel testing

OR

18. List and explain various flow visualization techniques used in automobile body design

19. Explain various automotive safety systems used and its classifications

OR

20. Define and categorize various sources of vibration and methods to suppress the same.

(5*14=70 marks)

Syllabus

Module 1

ERGONOMICS: Introduction, seating dimensions, interior ergonomics, ergonomics system design, seat comfort, suspension seats, split frame seating, back pain reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout.

Module 2

CAR BODY DETAILS: Types: saloon, convertibles, limousine, estate car, racing and sports car. Visibility - Regulations, driver's visibility, tests for visibility, methods of improving visibility and space in cars. Car body construction - Design criteria and initial tests.

Module 3

TRUCK AND SPECIALITY PASSENGER VEHICLES: Commercial vehicle body technology, trends, special goods vehicle, special haulage vehicles cab body. Buses and coaches, bus body layout, floor height, engine location, entrance and exit locations, seating dimensions, constructional details, frame construction, double skin construction, types of metal sections used, regulations, conventional and integral type construction.

PSV (Passenger Specialty Vehicle) structural design, low floor and articulated buses, three wheelers and light weight trailers.

Module 4

VEHICLE AERODYNAMICS- Objectives, Vehicle drag and types. Various type of forces and moments. Effect of forces and moments. Side wind effects on forces and moments. Various body optimization techniques for minimum drag. Wind tunnels, Principle of operation, Types. Wind tunnel testing such as: Flow visualization techniques, Airflow management test, measurement of various forces and moments by using wind tunnel.

Module 5

DESIGN, SAFETY AND FATIGUE ASPECTS: Design for press working, design for spot welding, adhesives and sealants, goods vehicle structure design, chassis frame configuration, structural properties of chassis frame members. Crash tests, forces in roll over, head on impact, plastic collapse and analysis, fatigue and vibration, structural vibration.
(8)

TEXT BOOKS:

1. John Fenton, “Handbook of Automotive Body and Systems Design”, John Wiley & Sons, 2013
2. John Fenton, “Handbook of Automotive Construction and Design Analysis”, John Wiley & Sons, 2014
3. Powloski, J., "Vehicle Body Engineering", Business Books Ltd., 1998.

REFERENCES:

1. Braithwaite.J.B., Vehicle Body building and drawing, Heinemann Educational Books Ltd., London.
2. Heinz Heisler, Advanced Vehicle Technology‖, 2nd edition, Butterworth –Heinemann, 2002.
3. Wolf-Heinrich Hucho, ―Aerodynamics of road vehicles, 4th edition, 2000.
4. Julian Happian Smith, “Introduction to Modern Vehicle Design”, Butterworth Publisher, 2001.

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Module 1 (8 hours)**	
1.1	Introduction, seating dimensions, interior ergonomics, ergonomics system design	2
1.2	Seat comfort, suspension seats, split frame seating, back pain reducers	2
1.3	Dash board instruments, electronic displays	1
1.4	Commercial vehicle cabin ergonomics	1
1.5	Mechanical package layout, goods vehicle layout.	1
2	**Module 2 (7 hours)**	
2.1	Car body types: saloon, convertibles, limousine, estate car, racing and sports car	2
2.2	Regulations for visibility, driver’s visibility	1
2.3	Tests for visibility, methods of improving visibility and space in cars.	2
2.4	Car body construction - Design criteria and initial tests.	2

3	**Module 3 (9 hours)**	
3.1	Commercial vehicle body technology	1
3.2	trends, special goods vehicle, special haulage vehicles cab body	1
3.3	Buses and coaches, bus body layout, floor height, engine location, entrance and exit locations, seating dimensions, constructional details, frame construction, double skin construction	2
3.4	Types of metal sections used, regulations, conventional and integral type construction.	1
3.5	PSV (Passenger Specialty Vehicle) structural design, low floor and articulated buses, three wheelers and light weight trailers.	2
4	**Module 4 (8 hours)**	
4.1	Objectives, Vehicle drag and types. Various type of forces and moments. Effect of forces and moments	2
4.2	Side wind effects on forces and moments. Various body optimization techniques for minimum drag	1
4.3	Wind tunnels, Principle of operation, Types. Wind tunnel testing such as: Flow visualization techniques	2
4.4	Airflow management test, measurement of various forces and moments by using wind tunnel.	2
5	**Module 5 (8 hours)**	
5.1	Design for press working, design for spot welding, adhesives and sealants	2
5.2	Goods vehicle structure design, chassis frame configuration, structural properties of chassis frame members	2
5.3	Crash tests, forces in roll over, head on impact, plastic collapse and analysis	2
5.4	Fatigue and vibration, structural vibration.	1

CODE MUT332	HEATING VENTILATION AND AIR CONDITIONING	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble:
This course is designed to equip the students with the fundamentals of HVAC systems used in automobiles, their operation and maintenance practices.

Prerequisite: UG course on Thermodynamics.

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

CO 1	esignation of refrigerants and their selection for common applications.
CO 2	Determine performance of vapour compression refrigeration systems
CO 3	Understand basic principles of wet and dry sorption cooling/heating systems
CO 4	Design supply condition of air for different air conditioning processes.
CO 5	Understand components of auto air conditioning systems, their testing and maintenance.

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					2					
CO 2	3	2			2				2			
CO 3	3	2					2					
CO 4	3	2										
CO 5	3	2										

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	30
Apply	20	20	60
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. Designate the following refrigerants

   a)CH_4 b)CCl_2H_2 c)NH_3
2. Write the name of the chemical compound for the following refrigerants

   a)R-50 b)R-12 c)R-717
3. Select suitable refrigerants for the following applications and justify the answer

   a)Ice plants b)Computer centre c)Super market

Course Outcome 2 (CO2)

1. A R-12 vapour compression refrigeration system has a condensing temperature of 40^{o}C. The refrigeration capacity is 7 TR. The liquid leaving the condenser is saturated liquid and compression is isentropic. Determine i. Refrigerant flow rate ii. Power required to run the compressor iii. COP of the system

2. Discuss the effect of evaporator temperature and condenser temperature on performance of vapour compression refrigeration system with p-h plot.

3. Discuss the effect of sub cooling and suction vapour superheat on the performance of vapour compression refrigeration system with suitable plots.

Course Outcome 3(CO3):

1. Discuss the characteristics of ideal binary mixture.
2. Explain the working principle of vapour absorption refrigeration system with PTX plot.
3. In a vapour absorption refrigeration system generator temperature is 210^{o}C, evaporator temperature is 10^{o}C and the condenser temperature is 35^{o}C. Determine the COP of the system.

Course Outcome 4 (CO4):

1. Prove that $\varphi = \frac{\mu}{1-(1-\mu)(p_s/p)}$ where φ is relative humidity and μ is degree of saturation
2. For the room air at 28^{o}C DBT and 20^{o}C WBT, Calculate a) Dew point temperature b) Relative humidity c) Specific humidity d) Degree of saturation e) Enthalpy of air (Use relevant correlations only. Psychrometric chart should not be used for solution)
3. An office building needs to be air conditioned.

The ambient air conditions are 35°C DB, 25°C WB and the indoor design conditions are 24°C DB, 50% RH.

RSH – 60 000 W & RLH – 15 000 W

Ventilation – 1000 L/s OA. Assume suitable BPF.

Find:

1. Outdoor air load (OATH)
2. Grand total heat (GTH)
3. Effective sensible heat factor (ESHF)
4. Apparatus dewpoint temperature (t_{ADP})
5. Dehumidified air quantity
6. Entering and leaving conditions at the plant (t_{EDB}, t_{EWB}, t_{LDB}, t_{LWB})

Represent the process and states in psychrometric chart.

Course Outcome 5 (CO5):

1. Discuss the case and duct system for air distribution.
2. How is a system charged with refrigerant?
3. How auto AC malfunctions are diagnosed using gauge reading?

Model Question Paper

Reg. No:_______________ Name:__________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH &YEAR
Course Code: MUT332
Course Name: HEATING VENTILATION AND AIR CONDITIONING

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

Part A
(Answer all questions. Each question carries 3 marks)

1. What do you mean by GWP and ODP of refrigerants?
2. Designate the following refrigerants:
   a. NH_3 b. CCl_2F_2 c.CF_3Br
3. Represent vapour compression refrigeration cycle in T-s and p-h plots.
   (*Assume dry compression with no suction vapour superheat and no subcooling of liquid refrigerant in condenser*.)
4. Define Tons of Refrigeration (TR). 5000 kg of water at 0^oC is converted to ice at the same temperature in 12 hrs. Calculate the refrigeration capacity in TR.
5. What is Raoults Law? What do you mean by positive and negative deviation from Raoults Law?
6. In a vapour absorption refrigeration system generator temperature is 210^oC, evaporator temperature is 10^oC and the condenser temperature is 35^oC. Determine the max COP of the system.
7. Represent the following processes on a psychrometric chart.
   a. Cooling and dehumidification
   b. Adiabatic saturation
8. Define the following
   a) Relative Humidity b) Specific Humidity c)Degree of saturation
9. List some auto AC malfunctions are diagnosed using gauge reading.
10. What are the effects of moisture ingress in refrigerant circuit?

PART-B
Answer any one full question from each module. Each question carries 14 Marks
Module-1

11. a) Discuss the milestones in the history of automobile air conditioning.
    b) Discuss the working principle of evaporative coolers.
12. a) Discuss important thermodynamic requirements of refrigerants.
    b) Explain eco friendly refrigerants.

Module-2

13. An ammonia vapour compression refrigeration system has a condensing temperature of 40^{o}C. The refrigeration capacity is 20 TR. The liquid leaving the condenser is saturated liquid and compression is isentropic. Determine i. Refrigerant flow rate ii. Power required to run the compressor iii. COP of the system

14. Sketch a neat schematic of multi-compression refrigeration system with flash gas removal and flash intercooling Also depict this using the corresponding T-s and P-h plots.

Module-3

15. a) What are the advantages of vapour absorption refrigeration system over vapour compression refrigeration system? Discuss the working principle.

    b) Discuss the characteristics of ideal binary mixture. How actual mixture deviates from ideal behaviour?
16. Discuss the working principle of a solid sorption system with a neat schematic and p-T-X diagram

Module-4

17. For the room air at 30^{o}C DBT and 22^{o}C WBT, Calculate a) Dew point temperature b) Relative humidity c) Specific humidity d) Degree of saturation e) Enthalpy of air (Use relevant correlations only. Psychrometric chart should not be used for solution)
18. Air at 35^{o}C DBT and 75% relative humidity enters a cooling coil at the rate of 200 m3/min. The coil dew point temperature is 15^{o}C and the bypass factor of the coil is 0.1. Determine the following:
    a) Temperature of air leaving the cooling coil.
    b) Capacity of cooling coil in TR
    c) Amount of water vapour removed per minute
    d) Sensible Heat Factor for the process.

Module-5

19. Discuss the case and duct system for air distribution in automobiles with a neat schematic.

20. Prepare a writeup on sensors and actuators used for climate control of passenger compartment in automobiles.

Syllabus

Module 1

Introduction to auto HVAC systems

History of auto air conditioning, Overview of technologies, development of refrigerants and compressors. Applications. Refrigerants: Primary and secondary refrigerants, Nomenclature of refrigerants, Thermo-physical properties and Selection of refrigerants, Mixed refrigerants.

(7 hours)

Module 2

Vapour Compression Refrigeration System (VCRS)

Units of refrigeration, COP, EER and SEER, Carnot refrigeration cycle, Standard vapour compression refrigeration system, Effect of condenser and evaporator temperature on performance, Effect of sub cooling and superheating, Actual VCRS system, Multistage VCRS, Flash gas removal and flash intercooling, Multi evaporator and cascade systems.

(8 hours)

Module 3

Vapour Absorption Refrigeration System (VARS)

Relevance of VARS, Basic principle of operation of VARS, Max. COP, Refrigerant absorbent mixtures and their properties, Raoults law, Ideal and real mixtures, Ammonia-water VARS. PTX and h-X diagrams. Solid-gas absorption systems: Working pairs, Basic cycle and principle of operation.

(7 hours)

Module 4

Psychrometry: Properties of moist air and their estimation, Psyschrometric chart, Psychrometric Processes (Sensible cooling/heating, cooling and dehumidification, heating and humidification, Mixing of air streams, Adiabatic saturation)

Psychrometry of air conditioning systems: Summer air conditioning (Systems with full recirculation and ventilated air) and fixing supply condition, Determination of RSHF, GSHF, ADP and BPF, Year round air conditioning system

(7 hours)

Module 5

Automotive Air Conditioning Systems

Distribution ducting and their sizing, type of grills, diffusers, ventilation, filtration, layout of duct systems for automobiles. Common controls such as thermostats, humidistat, control dampers, pressure cut-outs, relays. Dashboard re-circulating unit, Temperature/flow control in auto air conditioning systems. Refrigerant charging, Testing, Diagnosis & trouble shooting of air conditioning system.

(7 hours)

Text Books

1. C P Arora, Refrigeration and Air Conditioning by, McGraw-Hill India Publishing Ltd.
2. Manohar Prasad, Refrigeration and Air Conditioning by, New Age International Publisher

Reference Books

1. Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.
2. Roy. J Dossat, Principles of Refrigeration, Pearson Education
3. W.F. Stocker and J. W. Jones, Refrigeration and Air Conditioning, McGraw-Hill
4. Crouse and Anglin, Automobile Air conditioning McGraw Hill Publications
5. Paul Weisler, "Automotive Air Conditioing", Reston Publishing Co. Inc., 1990.
6. McDonald,K.L., "Automotive Air Conditioning", Theodore Audel series, 1978.
7. Mark Schnubel, Automotive engineering-Heating and Air conditioning, Cengage Learning, 2009

NPTEL Resources:

Refrigeration and Air Conditioning, Prof. M. Ramgopal, IIT Kharagpur

Course Contents and Lecture Plan

No.	Topic	No. of Lectures
1	**Introduction to auto HVAC systems:**	
1.1	History of auto air conditioning,	1
1.2	Overview of technologies	1
1.3	Development of refrigerants and compressors, Applications.	1
1.4	Refrigerants: Primary and secondary refrigerants	1
1.5	Nomenclature of refrigerants	1
1.6	Thermo-physical properties and Selection of refrigerants	1
1.7	Mixed refrigerants	1
2	**Vapour Compression Refrigeration System (VCRS)**	
2.1	Units of refrigeration COP, EER and SEER	1
2.2	Carnot refrigeration cycle	1
2.3	Standard vapour compression refrigeration system	1
2.4	Effect of condenser and evaporator temperature on performance	1
2.5	Effect of sub cooling and superheating	1
2.6	Actual VCRS system, Multistage VCRS	1
2.7	Flash gas removal and flash intercooling	1
2.8	Multi evaporator and cascade systems	1
3	**Vapour Absorption Refrigeration System (VARS)**	

3.1	Relevance of VARS, basic principle of operation of VARS, Max. COP	1
3.2	Refrigerant absorbent mixtures and their properties	1
3.3	Raoults law, Ideal and real mixtures	1
3.4	Ammonia-water VARS. PTX and h-X diagrams	1
3.5	Solid-gas absorption systems	1
3.6	Working pairs	1
3.7	Basic cycle and principle of operation	1
4	**Psychrometry**	
4.1	Properties of moist air and their estimation, Psyschrometric chart	1
4.2	Psychrometric Processes (Sensible cooling/heating, cooling and dehumidification)	1
4.3	(heating and humidification, Mixing of air streams, Adiabatic saturation)	1
4.4	Psychrometry of air conditioning systems: Summer air conditioning (Systems with full recirculation and ventilated air)	1
4.5	Fixing supply condition	1
4.6	Determination of RSHF, GSHF, ADP and BPF	1
4.7	Year round air conditioning system	1
5	**Automotive Air-Conditioning systems**	
5.1	Distribution ducting and their sizing, type of grills, Diffusers, ventilation, filtration	1
5.2	Layout of duct systems for automobiles	1
5.3	Common controls such as thermostats, humidistat	1
5.4	Control dampers, pressure cutouts, relays	1
5.5	Dashboard re-circulating unit, Temperature/flow control in auto air conditioning systems	1
5.6	Refrigerant charging, Testing	1
5.7	Diagnosis & trouble shooting of air conditioning system.	1

MUT342	ELECTRIC VEHICLE TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: This course aims at providing

1. Understand the basic concept of Electric Vehicle Technology.
2. To understand about drives and controls used in Electric Vehicles
3. To know about Select battery, battery indication system for EV applications
4. To understand the energy drives used in EV applications
5. To know about Connected Mobility and Autonomous Mobility

Prerequisite:

MUT 203 AUTO CHASSIS
MUT 307 AUTO TRANSMISSION
MUT 301 AUTO ELECTRICAL/ ELECTRONICS

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

CO 1	To understand the basics of electric vehicle technology
CO 2	To familiarize with drives and controls used in Electric Vehicle Technology
CO 3	Identify and analyse the dynamics systems such as suspension systems, body vibrations, steering mechanisms.
CO 4	To analyse and solve engineering problems related to vehicle dynamics
CO 5	Comparing and identifying the different types of control systems in automobiles

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	-	-	1	-	-	-	-	-	1
CO 3	2	2	1	-	1	-	-	-	-	-	-	1
CO 4	2	2	1	-	1	-	-	-	-	-	-	1
CO 5	2	1	1	-	2	-	-	-	-	1	-	1

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	10	10	20
Apply	20	20	50
Analyse	10	10	20
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. Are you able to understand the concept of Electric Vehicle Technology?

Course Outcome 2 (CO2)

1. Did you understand different configuration of Electric vehicles based on drive?
2. Did you get the basic concept of various hybrid vehicles?

Course Outcome 3(CO3):

1. Did you get the idea about various storage batteries used in Electric vehicles?
2. Did you get the concept of various range extending technologies used in electric vehicles?

Course Outcome 4 (CO4):

1. Are you able to know the various types of energy drives or electric motors used for electric vehicles?

Course Outcome 5 (CO5):

1. Did you understand the challenges in charging the electric vehicles and the various types used?

MODEL QUESTION PAPER
QP CODE:
PAGES:…
Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR
Course Code: MUT 342
Course Name: Electric Vehicle Technology

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

Part A
(Answer all questions. Each question carry 3 marks)

1. Why electric vehicles are gaining the attention of automotive industry?
2. State the disadvantages of electric vehicles over IC engine vehicles?
3. How the drive motor is controlled in electric vehicle? Describe briefly.
4. What are the advantages of hybrid vehicles over electric vehicles?
5. What is the chemical reaction involved in a lead acid battery? Explain briefly
6. What is regenerative braking? How it helps in extending the range of EV?
7. What is the torque characteristics needed from a electric motor?
8. State the advantages of BLDC motor
9. What are the challenges in implementing Emobility with respect charging infrastructure in India?
10. What is the charging time required in conventional charging methods? How it can be resolved?

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

11. a) Explain how electric vehicles are evolved in India and World (7)
    b) Explain the concept of Formula e Cars (7)

OR

12. (a) Describe the scope of autonomous electric vehicles. (7)
    (b) How energy saving and emission reduction is achieved by electric vehicles? (7)

13. (a) Explain the types of electric drive arrangements used in EVs (9)
    (b) Differentiate between series and parallel hybrid vehicles (5)

OR

14. Explain the salient features of electric bus. What are the challenges faced in using the electric bus for mass transportation? (14)

15. a) Explain the constructional features of Lithium ion batteries with chemical reaction involved (7)

b) How Nickel Metal hydride batteries works? Explain (7)

OR

16. (a) How flywheel based energy system works? Explain with sketch (7)
    (b) Explain the concept of regenerative braking with a neat sketch (7)

17. Explain the constructional features of a basic DC Motor and explain its torque characteristics (14)

OR

18. (a) Explain the constructional features of BLDC motor with a neat sketch (7)
    (b) What are the various strategies for improving the cooling and efficiency of electric motors used in EVs (7)

19. What are the various EV charging standards? Explain the challenges in Emobility and electrification challenges in India. (14)

OR

20. Explain the concepts of V2G, G2V, V2B and V2H and their importance in EVs (14)

Syllabus: MUT 342 - ELECTRIC VEHICLE TECHNOLOGY 2-1-0

MODULE I – Introduction to Electric Vehicle Review of Conventional Vehicle: Introduction to Electric Vehicles: History and development of Electric Vehicles, Types of EVs, Electric vehicles and environment, Energy Saving and Overall Reduction of Carbon Emission, Costs and emissions, introduction to autonomous/ self driving cars, Formula e cars, Tractive effort in normal driving Mode.

MODULE II – Electric drive train: Electric vehicle drive layout, types of electric drive arrangements, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains, Electric Propulsion unit, Constructional Features of Electric Bus.

MODULE III– Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles: - Battery based energy storage and its analysis, Lead Acid Battery Basics, Special Characteristics of Lead Acid Batteries, Nickel-Based Batteries - Nickel Cadmium and Nickel Metal Hydride Batteries, Lithium Batteries - Lithium Polymer Battery, The Lithium Ion Battery Metal–Air Batteries, Range extending with regenerative braking, flywheel based energy storage system, Super capacitors

MODULE IV- Energy drives: ‘Brushed’ DC Electric Motor, Operation of the Basic DC Motor, Torque Speed Characteristics, Controlling the Brushed DC Motor, Electric Motors as Brakes, Switching Devices, Step-Down or ‘Buck’ Regulators, Step-Up or ‘Boost’ Switching

Regulator , Brushless DC Motor, Switched Reluctance Motors, The Induction Motor, Motor Cooling, Efficiency, Size and Mass, Improving Motor Efficiency,

MODULE V –

Energy Management Strategies, Automotive networking and communication, EV charging standards, V2G, G2V, V2B, V2H. Business: E-mobility business, electrification challenges, Business- E-mobility business, electrification challenges.

Emobility Indian Roadmap Perspective. Policy: EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs. Connectors- Types of EV charging connector, North American EV Plug Standards, DC Fast Charge EV Plug Standards in North America, CCS (Combined Charging System), CHAdeMO, Tesla, European EV Plug Standards,

Text Books

1. James, and John Lowry, "Electric Vehicle Technology Explained" John Wiley and Sons, 2012
2. Singiresu S. Rao, "Mechanical Vibrations", 5th Edition, Prentice Hall, 2010
3. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics", Society of Automotive Engineers Inc, 1992
4. Wong. J. Y., "Theory of Ground Vehicles", 3rd Edition, Wiley-Interscience, 2001
5. N.K. Giri, Automotive Mechanics, Kanna Publishers, 2007

Reference Books

1. Emadi, A. (Ed.), Miller, J., Ehsani, M., "Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003
2. Husain, I. "Electric and Hybrid Vehicles" Boca Raton, CRC Press, 2010.
3. Tariq Muneer and Irene IllescasGarcía, "The automobile, In Electric Vehicles: Prospects and Challenges", Elsevier, 2017
4. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
Introduction - Discussion on syllabus, Cos and POs		
1	**Introduction to Electric Vehicle**	
1.1	Review of Conventional Vehicle	1
1.2	Introduction to Electric Vehicles: History and development of Electric Vehicles	1
1.3	Types of EVs, Electric vehicles and environment	1

1.4	Energy Saving and Overall Reduction of Carbon Emission	1
1.5	Costs and emissions	1
1.6	Introduction to autonomous/ self driving cars	1
1.7	Formula e cars, Tractive effort in normal driving Mode	1
2	**Electric drive train**	
2.1	Electric vehicle drive layout	1
2.2	Types of electric drive arrangements	2
2.3	Energy consumption Concept of Hybrid Electric Drive Trains	1
2.4	Architecture of Hybrid Electric Drive Trains	1
2.5	Series Hybrid Electric Drive Trains	1
2.6	Parallel hybrid electric drive trains	1
2.7	Electric Propulsion unit, Constructional features of Electric Bus	1
3	**Energy Storage**	
3.1	Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles	1
3.2	Battery based energy storage and its analysis	1
3.3	Lead Acid Battery Basics, Special Characteristics of Lead Acid Batteries	1
3.4	Nickel-Based Batteries - Nickel Cadmium and Nickel Metal Hydride Batteries	1
3.5	Lithium Batteries - Lithium Polymer Battery	1
3.6	The Lithium-Ion Battery Metal–Air Batteries	1
3.7	Regenerative braking, Flywheel based energy storage system	1
4	**Energy drives**	
4.1	‘Brushed’ DC Electric Motor, Operation of the Basic DC Motor	1
4.2	Torque Speed Characteristics, Controlling the Brushed DC Motor	1
4.3	Motors as Brakes, Switching Devices	1
4.4	Step-Down or ‘Buck’ Regulators, Step-Up or ‘Boost’ Switching Regulator	1
4.5	Brushless DC Motor, Switched Reluctance Motors	1
4.6	The Induction Motor, Motor Cooling, Efficiency	1
4.7	Size and Mass, Improving Motor Efficiency, Super Capacitors	1
5	**Energy Management Strategies and E-Mobility Indian Roadmap Perspective**	
5.1	Energy Management Strategies, Automotive networking and communication	1
5.2	EV charging standards, V2G, G2V, V2B, V2H	1
5.3	Business- E-mobility business, electrification challenges.	1
5.4	Emobility Indian Roadmap Perspective. Policy: EVs in	1

	infrastructure system	
5.5	Integration of EVs in smart grid, social dimensions of EVs	1
5.6	Connectors- Types of EV charging connector, North American EV Plug Standards	1
5.7	DC Fast Charge EV Plug Standards in North America, CCS (Combined Charging System), CHAdeMO, Tesla, European EV Plug Standards	1

MUT362	PRODUCT LIFE CYCLE MANAGEMENT	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: This course aims at providing

1. Understand product life cycle management, its scope and opportunities.
2. Identify the drivers and enablers of product life cycle management
3. To Understand the environmental aspects of product life cycle management
4. To familiarise with PLM software and to discuss the case studies of PLM implementation in various industries.

Prerequisite: HUT300 INDUSTRIAL ECONOMICS & FOREIGN TRADE

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

CO 1	To familiarise with product life cycle management, its scope and opportunities.
CO 2	To identify the components of product life cycle management
CO 3	Identify and analyse the product life cycle management & its drivers
CO 4	To understand product data management its integration of environmental aspects in product design
CO 5	To understand and familiarise with PLM software and to discuss and classify the case studies of PLM implementation in various industries

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
CO 2	2	1	1	-	-	1	2	-	-	-	-	2
CO 3	2	1	1	-	-	1	2	-	-	-	-	2
CO 4	2	1	1	-	-	1	2	-	-	-	-	2
CO 5	2	2	1	2	3	1	2	-	-	-	-	3

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	50
Apply	10	10	20
Analyse	10	10	20
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.Can you able to make acquainted with product life cycle management, its scope and opportunities.?

Course Outcome 2 (CO2)

1. Can you evaluate and identify the components of product life cycle management?

Course Outcome 3(CO3):

1. Can you identify and analyse the product life cycle management & its drivers

Course Outcome 4 (CO4):

1. Are you able to understand product data management its integration of environmental aspects in product design?

Course Outcome 5 (CO5):

1. Can you able to understand and familiarise with PLM software and to discuss and classify the case studies of PLM implementation in various industries?

MODEL QUESTION PAPER

QP CODE:

PAGES:…

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT362

Course Name: PRODUCT LIFE CYCLE MANAGEMENT

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

Part A

(Answer all questions. Each question carry 3 marks)

1. Discuss briefly the basic principle definitions of product life cycle management.
2. Explain the term PLM grid.
3. What are the different phases of product lifecycle management.
4. What do you understand by PLM model.
5. Discuss the importance of PDM systems.
6. Explain the terms traceability and reflectiveness.
7. Define cycle cost analysis.
8. What do you understand by the term 'Design for Environment' , explain in detail.
9. Discuss the importance of PDM systems.
10. What is meant by PLM visioning, explain with an example?

Part B

Answer any one full question from each module.

Each question carries 10 Marks

11. Discuss the various stages of product life cycle, and explain how PLM strategies are used in the various stages using a case example. (14)

OR

12. (a) Explain the role of customer in PLM. (7)
    (b) Discuss the history and emergence of PLM. (7)

13. . a) Define engineering data management (EDM). (7)
    b) Explain the foundation technologies and standards of PLM. (7)

OR

14. With the help of a case example explain the role of human resources in product lifecycle management? (14)
15. a) Discuss the importance of PDM systems and its components . (7)
    b) Differentiate between PLM and ERP. (7)

OR

16. (a) Explain information mirroring model. (7)

(b) What are the external drivers of PLM explain with examples. (7)

OR

17. Discuss the different strategies in Product Design for Sustainable Development and its importance in PLM. (14)

OR

18. What do you understand by LCA discuss the fields of Application and Limitations of Life Cycle Assessment. (14)

19. With the help of a case example explain the steps involved in PLM implementation. (14)

OR

20. Explain the salient features of any two commercial PLM/PDM software. (14)

Syllabus: MUT362– PRODUCT LIFE CYCLE MANAGEMENT 2-1-0

Module 1: INTRODUCTION

Introduction to product life cycle management– Introduction, growth, maturity & decline, Product Lifecycle Management- Definition & Overview, benefits of PLM, PLM scope and the PLM grid, Background for PLM-corporate challenges, Need of PLM, Components/Elements of PLM, steps and activities of PLM initiative (case study). Emergence of PLM, Significance of PLM - life cycle problems to be resolved, product development problems to be resolved, Customer Involvement.Reasons for the deployment of PLM systems.

Module 2: COMPONENTS OF PRODUCT LIFE CYCLE MANAGEMENT

Different phases of product lifecycle and corresponding technologies, Foundation technologies and standards e.g. visualization, collaboration and enterprise application integration, Core functions e.g., data vaults, document and content management, workflow and program management, Functional applications e.g., configuration management. Human resources in product lifecycle. PLM Case Study. PLM model- plan, design, build, support & dispose. Product life cycle management system- system architecture, Information models and product structure, Threads of PLM computer aided design (CAD), engineering data management (EDM),

Module 3: PRODUCT LIFE CYCLE MANAGEMENT & ITS DRIVERS

Product data management (PDM),Product Data Management (PDM) ,PDM systems and importance, Components of PDM, Reason for implementing a PDM system, Financial justification of PDM, Barriers to PDM implementation. computer integrated manufacturing (CIM). Weaving the threads into PLM, comparison of PLM to Engineering resource planning (ERP).PLM characteristics - singularity, cohesion, traceability, reflectiveness, Information mirroring model. External drivers- scale, complexity, cycle times, globalization & regulation.

Internal drivers - productivity, innovation, collaboration & quality. Board room drivers – income, revenues & costs.

Module 4: PRODUCT DATA MANAGEMENT AND INTEGRATION OF ENVIRONMENTAL ASPECTS IN PRODUCT DESIGN

Product and Product Data Product Importance, Range, Parts, Ingredients, Components, Assemblies, Identifier, Requirements From Customer, Requirement to Product Specification, Identification Standards, Unique Identifier, Unique Key, Traceability.Collaborative Product Development. Integration of Environmental Aspects in Product Design Sustainable Development, , Design for X System and tools, Design for Disassembly, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design. Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis, Case Studies in LCA and LCCA

Module 5: ROLE OF PLM IN INDUSTRIES

PDM systems and importance, reason for implementing a PDM system, financial justification of PDM implementation. Case studies on PLM selection and implementation (like auto, aero and other manufacturing industries)-other possible sectors, Components and Phases of PLM, PLM feasibility study, PLM visioning, PLM strategy, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organisation, users, product or service, process performance. Case studies based on top few commercial PLM/PDM softwares.

Text Books

1. **Grieves Michael**, Product Lifecycle Management- Driving the Next Generation of Lean Thinking, McGraw-Hill, 2006. ISBN 0071452303
2. **Antti Saaksvuori**, **Anselmi Immonen**, Product Life Cycle Management - Springer, 1st Edition (Nov.5, 2003)
3. **Stark, John**. Product Lifecycle Management: 21st Century Paradigm for Product Realization, Springer-Verlag, 2004. ISBN 1852338105.

Reference Books

1. **Fabio Giudice, Guido La Rosa, Antonino Risitano**, “Product Design for the environment-A life cycle approach”, Taylor & Francis 2006, ISBN: 0849327229

2. **Karl Ulrich, Steven** Eppinger, “Product Design and Development”, McGraw HillEducation, 2008, ISBN- 9780070146792
3. **Jack R. Meredith and Samuel J. Mantel**, “Technology Forecasting”, 1995, John Wileyand Sons

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction - Discussion on syllabus, Cos and POs**	
1.1	Introduction to product life cycle management– Introduction, growth, maturity & decline	1
1.2	, Product Lifecycle Management- Definition & Overview, benefits of PLM, PLM scope and the PLM grid	2
1.3	, Background for PLM-corporate challenges, Need of PLM, Components/Elements of PLM, steps and activities of PLM initiative (case study).	1
1.4	Emergence of PLM, Significance of PLM - life cycle problems to be resolved,	2
1.5	product development problems to be resolved, Customer Involvement.Reasons for the deployment of PLM systems.	1
2	**COMPONENTS OF PRODUCT LIFE CYCLE MANAGEMENT**	
2.1	Different phases of product lifecycle and corresponding technologies, Foundation technologies and standards e.g. visualization, collaboration and enterprise application integration,	2
2.2	Core functions e.g., data vaults, document and content management, workflow and program management, Functional applications e.g., configuration management.	2
2.3	Human resources in product lifecycle. PLM Case Study. PLM model- plan, design, build, support & dispose.	1
2.4	Product life cycle management system- system architecture, Information models and product structure	1
2..5	, Threads of PLM computer aided design (CAD), engineering data management (EDM),	1
3	**PRODUCT LIFE CYCLE MANAGEMENT & ITS DRIVERS**	
3.1	Product data management (PDM),Product Data Management (PDM) ,PDM systems and importance,	1
3.2	Components of PDM, Reason for implementing a PDM system, Financial justification of PDM, Barriers to PDM implementation. computer integrated manufacturing (CIM).	1
3.3	Weaving the threads into PLM, comparison of PLM to	2

	Engineering resource planning (ERP).	
3.4	PLM characteristics - singularity, cohesion, traceability, reflectiveness, Information mirroring model.	1
3.5	External drivers- scale, complexity, cycle times, globalization & regulation. Internal drivers - productivity, innovation, collaboration & quality. Board room drivers – income, revenues & costs.	2
4	**PRODUCT DATA MANAGEMENT AND INTEGRATION OF ENVIRONMENTAL ASPECTS IN PRODUCT DESIGN**	
4.1	Product and Product Data Product Importance, Range, Parts, Ingredients, Components, Assemblies, Identifier, Requirements From Customer, Requirement to Product Specification, Identification Standards, Unique Identifier, Unique Key, Traceability.	2
4.2	Collaborative Product Development. Integration of Environmental Aspects in Product Design Sustainable Development, , Design for X System and tools, Design for Disassembly, Design for Environment, Need for Life Cycle Environmental Strategies.	2
4.3	Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design.	1
4.4	Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment,	1
4.5	Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis, Case Studies in LCA and LCCA	1
5	**ROLE OF PLM IN INDUSTRIES**	
5.1	PDM systems and importance, reason for implementing a PDM system, financial justification of PDM implementation.	2
5.2	Case studies on PLM selection and implementation (like auto, aero and other manufacturing industries)-other possible sectors,	1
5.3	Components and Phases of PLM, PLM feasibility study, PLM visioning, PLM strategy, change management for PLM, financial justification of PLM,	2
5.4	barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organisation, users, product or service, process performance.	1
5.5	Case studies based on top few commercial PLM/PDM softwares.	1

MUT 372	NUCLEAR ENGINEERING	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: The aim of this subject is to provide students with a general understanding of the fundamentals and applications of nuclear engineering. So the purpose of this course is to expose the student.

- ✓ To introduce the various basic concepts in nuclear engineering
- ✓ Understanding the theory of nuclear reactors.
- ✓ Analyse the performance comparison of various types of reactors configurations.
- ✓ Understanding the importance of computer codes and modelling
- ✓ To impart basic knowledge on materials used in reactors.
- ✓ To understand health effects of radiation.
- ✓ to introduce the concepts of radiation hazards and shielding

Prerequisite: NIL

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

CO 1	**Understand** the important nuclear engineering concepts and radioactivity
CO 2	**Understanding** the neutron production and its reaction with nuclei
CO 3	**Illustrate** the different types of reactors and their performance comparison. Examine the role of computers in modern reactor modelling.
CO 4	**Understanding** on the application of isotopes and materials in nuclear reactor
CO 5	**Understand** the health effects of low and high doses of ionizing radiation **Build a** conceptual design of nuclear propulsion systems

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	3	2	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-
CO 5	3	2	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	

Remember	25	25	50
Understand	25	25	50
Apply			
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 anyone. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the term mass defect and binding energy.
2. Compare the fundamental properties of rays and elementary particles from radioactive materials-mass, charge, shape, spin, magnetic moment.
3. What do you mean by nuclear stability?
4. State and explain the Laws of radioactive decay
5. Write down the various decay schemes of radioactive nuclei
6. With the help of neat sketches explain the operation of any two particle accelerators

Course Outcome 2(CO2):

1. Explain the liquid drop model of nuclear fission.
2. Explain the terms- neutron flux, cross-section and mean free path
3. Describe in details about the absorption type of neutron reactions with nuclei

4. Discuss the variations of cross – section with neutron energy
5. Write short notes on the amounts and activities of fission products during operation and shut down
6. Discuss about the heat generation after shut down of a nuclear reactor.

Course Outcome 3 (CO3):

1. List five advantages and five disadvantage of a pressurised water reactor.
2. List five advantages and five disadvantage of a Boiling water reactor.
3. List five advantages and five disadvantage of a Sodium Graphite reactor.
4. List five advantages and five disadvantage of a Fast Breeder reactor.
5. List five advantages and five disadvantage of a Homogeneous reactor.
6. Explain the role of computers and coding in the mathematical modelling of nuclear weapon reactors

Course Outcome 4 (CO4):

1. What are the uses of radioactive isotopes in chemistry and biology?
2. What are the uses of radioactive isotopes in medicine and agriculture?
3. What are process tracers?
4. What is the Industrial application of isotopes in activation analysis?
5. Discuss the isotope application in Wear studies and thickness gages.
6. Describe the essential requirements of Moderator and Reflector materials.

Course Outcome 5 (CO5):

1. Define the term REM
2. What is meant by Radiation shielding?
3. What are the various shielding materials.?
4. Explain the propulsion system in Nuclear submarines and Nuclear ships.

Model Question paper

QP CODE:

PAGES: 2

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT372

Course Name: NUCLEAR ENGINEERING

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

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1) Determine the binding energy per nucleon of an isotopic mass of ${}_{92}U^{235}$.

2) Calculate the activity in curies of 1 mg of tritium (${}_{1}H^{3}$)

3) Explain the liquid drop model of nuclear fission.

4) Write the expression for Briet-Wigner formula. what is its use?

5) How are nuclear fission reactors are classified?

6) List two advantages and one disadvantage of a pressurised water reactor.

7) Mention the uses of radioactive isotopes in medicine and agriculture

8) Find out the most common fuel material in commercial power reactors, mention its two advantages.

9) What are the three main aspects in the problem of shielding the reactor?

10) What is meant by dose rate and radioactive source strength?

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

11) With the help of neat sketches explain the operation of any two particle accelerators.

Or

12) (a) Calculate the decay constant for U-235, half-life is $8.5\text{x}10^{8}$ years. (7 marks)

(b) How many disintegrations per second are there in 1-gram sample of U-235? What number of curies is this? (7 marks)

Module 2

13) (a) The average energy of neutrons released in the fission process is 1.935Mev. calculate the neutron speed that corresponds to this energy. (7 marks)

(b) What will be the temperature of a graphite block containing neutrons in thermal equilibrium, with most probable speed 2600 m/s ? (7 marks)

Or

14) Describe in details about the absorption type of neutron reactions with nuclei

Module 3

15) Make a detailed comparison between boiling water and sodium graphite reactor.

Or

16) Explain the role of computers and coding in the mathematical modelling of nuclear weapon reactors.

Module 4

17) Explain any three industrial application of isotopes, in detail

Or

18) Describe the various instrumental techniques for detection and measurement of radioactivity.

Module 5

19) Discuss the Somatic and genetic effects of Radiation.

Or

20) What is the main advantage of using a nuclear fuel in longer space voyage missions? Explain with a schematic diagram, the construction and features of a Nuclear iconic spaceship.

SYLLABUS

Module 1

Nuclear Engineering Basic Concepts- Nuclear structure of matter, Fundamental properties of rays and elementary particles from radioactive materials-mass, charge, shape, spin, magnetic moment, size of nucleus, binding energy, packing fraction and nuclear stability.

Radioactivity – Laws of radioactive decay, half-life, mean life, specific activity, radioactive decay calculations, Nuclear reactions and artificial radioactivity, decay schemes of radioactive nuclei, particle accelerators.

Module 2

Neutrons, Fission and chain reactions- General properties and production of neutrons, Neutron temperature, neutron reactions-absorption and scattering, the Maxwell-Boltzmann distribution, neutron flux, cross-section and mean free path, variations of cross – section with neutron energy, Briet-Wigner formula, Doppler effect, thermal neutron cross sections

Fission and chain reactions- Uranium fission, critical mass, mechanism of nuclear fission, Fission cross section, rate and Reaction Power, Fission, Prompt and Delayed Neutrons, Amounts and activities of fission products during operation and shut down, heat generation after shut down.

Module 3

Nuclear reactor principles and Types-History of reactor development,Classification of nuclear fission reactors, pressurised water reactor(PWR), Boiling water reactor (BWR), Sodium Graphite reactor, Fast breeder reactor (FBR), Gas cooled reactors, Homogeneous and other reactor concepts. General principles of evaluating power reactors, Role of computers in the mathematical modelling of nuclear reactor.

Module 4

Isotopes – Relative advantages of stable and radioactive isotopes, uses in chemistry, biology, medicine and agriculture. Industrial application of isotopes- process tracers, X-rays, Activation analysis, Wear studies, flow and level measurements, thickness gages, Uses of fission product wastes. Instrumental techniques for detection and measurement of radioactivity.

Fuel Materials - uranium dioxide fuel, Plutonium fuels, Thorium Fuel materials, coated particle fuels for gas cooled reactors,

Moderator and Reflector materials - essential requirements of these materials, Graphite, Ordinary water, Heavy water, radiation decomposition of water, Zirconium Hydride.

Module 5

Radiation Hazards and shielding – health effects of different types of radiation, maximum permissible external dosage, internal exposure, calculation of maximum permissible concentrations, photon flux, dose rate and radioactive source strength, Rem, Biological effects of Radiation-Somatic and genetic effects. Radiation shielding – sources of radiation, Heat generation in shields, Thermal and Biological shields, reactor shielding requirements, shielding materials.

Nuclear Propulsion – submarines, Nuclear ships, Nuclear aircraft, Nuclear ionic spaceship.

Text Books

1	Nuclear Reactor Engineering	Samuel Glasstone & Alexander Sesonske	CBS Publishers & distributors Pvt.Ltd
2	Introduction to Nuclear Engineering	Raymond L. Murray	Prentice- Hall, Inc.
3	Nuclear Engineering	Charles F. Bonilla	McGraw - Hill book company, Inc.

Reference Books

1	Nuclear Physics	D.C. Tayal	Himalayan Publication house, Bombay ,1980.
2	Nuclear Physics	Irving Kaplan	Narosa Book Distributors, 2002.
3	Radiation detection and measurement	G.F. Knoll	John Wiley &Sons, 3ed, London, 2000.
4	Introduction to Nuclear Engineering	J. R. Lamarsh, A. J. Baratta	Prentice-Hall, 2001.
5	Medical Physics, Volume I, II, III	Glasser O.	The year book publishers Inc., Chicago 1980.

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Module 1 (7 hours)**	
1.1	Nuclear structure of matter, Fundamental properties of rays and elementary particles from radioactive materials-mass, charge, shape, spin, magnetic moment, size of nucleus,	2
1.2	Binding energy, packing fraction and nuclear stability.	1
1.3	Laws of radioactive decay, half-life, mean life, specific activity,	1

	radioactive decay calculations	
1.4	Nuclear reactions and artificial radioactivity, decay schemes of radioactive nuclei	2
1.5	Particle accelerators.	1
2	**Module 2 (7 hours)**	
2.1	General properties and production of neutrons, Neutron temperature	1
2.2	Neutron reactions-absorption and scattering, the Maxwell-Boltzmann distribution, neutron flux, cross-section and mean free path, variations of cross – section with neutron energy, Briet-Wigner formula, Doppler effect, thermal neutron cross sections	3
2.3	Uranium fission, critical mass, mechanism of nuclear fission	1
2.4	Fission cross section, rate and Reaction Power, Fission, Prompt and Delayed Neutrons, Amounts and activities of fission products during operation and shut down, heat generation after shut down.	2
3	**Module 3 (7 hours)**	
3.1	History of reactor development, Classification of nuclear fission reactors.	1
3.2	pressurized water reactor(PWR), Boiling water reactor (BWR), Sodium Graphite reactor.	2
3.3	Fast breeder reactor (FBR), Gas cooled reactors, Homogeneous and other reactor concepts.	2
3.4	General principles of evaluating power reactors,	1
3.5	Role of computers in the mathematical modelling of nuclear reactor.	1
4	**Module 4 (7 hours)**	
4.1	Relative advantages of stable and radioactive isotopes, uses in chemistry, biology, medicine and agriculture.	1
4.2	Industrial application of isotopes- process tracers, X-rays, Activation analysis, Wear studies, flow and level measurements, thickness gages, Uses of fission product wastes.	2
4.3	Instrumental techniques for detection and measurement of radioactivity.	2
4.4	uranium dioxide fuel, Plutonium fuels, Thorium Fuel materials, coated particle fuels for gas cooled reactors.	1
4.5	Essential requirements of Moderator and Reflector materials - Graphite, Ordinary water, Heavy water, radiation decomposition of water, Zirconium Hydride.	1

5	**Module 5 (7 hours)**	
5.1	Health effects of different types of radiation, maximum permissible external dosage, internal exposure, calculation of maximum permissible concentrations	1
5.2	photon flux, dose rate and radioactive source strength, Rem.	1
5.3	Biological effects of Radiation-Somatic and genetic effects.	1
5.4	Radiation shielding – sources of radiation, Heat generation in shields, Thermal and Biological shields.	2
5.5	Reactor shielding requirements, shielding materials.	1
5.6	Nuclear Propulsion – Submarines, Nuclear ships, Nuclear aircraft, Nuclear ionic spaceship.	1

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEMESTER VI

MINOR

AUT 382	COURSE NAME: MODERN AUTOMOTIVE TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		VAC	4	0	0	4

Preamble: The aim of this subject is to provide students with a general understanding of the advanced developments in modern Automobile engineering.

Pre-requisite: Auto chassis, power plant, Auto electrical and electronics.

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

CO 1	Understand the construction and working of different electric and Hybrid Vehicle technology.
CO 2	Exemplify the significance of alternate power plants for automobiles and different modes of operation for optimum use.
CO 3	Understand the navigation and driver assistance systems used in modern vehicles.
CO 4	Understand the application of electronic and microcontroller systems incorporated in modern automobiles.
CO 5	Understand the construction and working of different types of fuel cells and auxiliary systems.

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	-	1	1	-	-	2	-	1
CO 2	2	1	-	2	-	1	2	-	-	2	-	1
CO 3	2	1	-	1	-	1	1	-	-	2	-	1
CO 4	2	-	-	-	-	1	1	-	-	2	-	1
CO 5	2	1	-	1	-	2	2	-	-	2	-	3

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	40
Apply	20	20	50
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 components and the working of battery electric vehicles
2. Distinguish between BEVs and PBEVs
3. Explain the different layouts of Hybrid vehicles
4. With an example explain the Control system for hybrid vehicles.

Course Outcome 2 (CO2)

1. Explain the principle of operation of a stratified charge engine
2. What are the methods used for charge stratification?
3. Illustrate the operation of an RCCI engine.
4. Distinguish between open loop and closed loop systems.

Course Outcome 3(CO3):

1. What are the modern navigation systems used in automobiles?
2. What is GPS? How it works?
3. List the different driver assistance systems used in modern automobiles.
4. Explain the method of object recognition and lane detection.

Course Outcome 4 (CO4):

1. List the modern micro-processor control devices used in modern vehicles.
2. What is adaptive head light? How it works?
3. Distinguish between car A/C and climate control system.
4. Explain the working of an ESP with a layout sketch.

Course Outcome 5 (CO5):

1. Explain the principle of operation of a PEM fuel cell
2. What are the characteristics of a high temperature fuel cell?
3. Explain integrated Air supply and humidification concepts for fuel cell systems.
4. Write a note on fuel cell stacks.

Model Question paper

QP CODE: **PAGES:02**

Reg. No: _______________ **Name :_______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT 382

Course Name: MODERN AUTOMOTIVE TECHNOLOGY

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

Part A

(Answer all questions. Each question carry 3 marks)

1. Distinguish between BEVs and PBEVs
2. What are the advantages and disadvantages of a parallel HEV?
3. Explain the direct injection method used for charge stratification.
4. Discuss the principle of operation of a RCCI engine.
5. List the different driver assistance systems used in modern automobiles.
6. What is the principle of object recognition?
7. Distinguish between regular car A/C and a climate control system.
8. Discuss the principle of operation of a wheel speed sensor.
9. What are the advantages of a fuel cell electric vehicle?
10. Give a comparison between PEM and Alkaline Electrolyte fuel cells

(3 x 10 = 30 Marks)

Part B

Answer any one full question from each module.

Each question carries 14 Marks

11. a. What are the basic factors to be considered for converting automobiles to an electric vehicle? (7)

    b. Distinguish between HEVs and PHEVs with examples. (7)

OR

12. a. Discuss the operating modes and Control Strategy for BEVs and HEVs (7)

    b. Distinguish between parallel and series HEVs. (7)

13. (b) a. Explain the terms Swrill, squish and tumble. What is their significance in stratified charge engines? (7)

    b. Explain the different methods used for charge stratification. (7)

OR

14. a. Discuss the different combustion modes in a GDI engine. (7)

    b. Explain the concept and working of a Lean burn engine. (7)

15. Explain the capabilities of various navigation systems in modern automobiles (14)

OR

16. Explain how the lane recognition and traffic light recognition is done. (14)

17. a. Explain the working a adaptive head light (7)

    b. With the help of a layout sketch, explain the working of a anti-theft system (7)

OR

18. What is GPS and how it works? Discuss the importance of GPS in modern navigation systems. (14)
19. Explain the working of Alkaline Electrolyte fuel cell with a neat sketch (14)

OR

20. Write a brief note on the following:
    a. Fuel cell Auxiliary systems. (7)
    b. Medium and high temperature fuel cells (7)

(5 x 14 = 70 Marks)

SYLLABUS

Module 1

Electric and Hybrid Vehicle technology: Introduction, LEV, TLEV, ULV & ZEV, Basic components of Electric vehicles- Inverters, Battery packs and battery management system, motors, electronic power control unit, Electric wiring harness – CAN Bus, Multiplex wiring. regenerative braking, basic factors to be considered for converting automobiles to electric vehicle, hybrid electric vehicle, types - series and parallel hybrid, layouts, comparison, Power systems and control systems, Different modes of operation of hybrid vehicles for best performance.

Module 2

Recent Trends in Automotive Power Plants: Stratified charged / lean burn engines – TSI engines, RCCI engines, Hydrogen Engines, Flex fuel vehicles.
Vehicle Operation and engine Control: Application of sensors and actuators and microprocessors for operation of the vehicle to achieve best fuel economy, reduced emission and optimum road performance, Closed loop and open loop operation, electronic engine management systems, Electronic cruise control, chassis control system, Integrated systems.

Module 3

Principle of automobile navigation and controls in the new generation cars- capabilities of navigation and control of modern cars.
Driver Assistance Systems in Automobiles: Vision in cars, A comprehensive driver assistance approach – Lane recognition, Traffic sign recognition, road recognition, Object recognition – Traffic lights and signals

Module 4

Modem electronic and micro control systems in automobiles: Electronically controlled concealed headlight systems, Electro chromic mirrors, automatic review mirrors, Day time running lamps (DRL), Head up display, Travel information systems, On board navigation system, Electronic climate control, Electronically controlled sunroof, Anti-theft systems, Automatic door locks (ADL), tyre pressure sensing, automated wiper, Antilock braking system and, electronic traction and stability control (ESP).

Module 5

Fuel Cells and Alternative energy systems: Introduction to fuel cells, Operational fuel cell voltages, Proton Exchange membrane fuel cells, Alkaline Electrolyte fuel cells, Medium and high temperature fuel cells, fuel and fuel chose, fuel processing, fuel cell stacks, Delivering fuel cell power, Integrated Air supply and humidification concepts for fuel cell systems, Fuel cell Auxiliary systems.

Text Books

1. Barry Hollembeak, Automotive Electricity, Electronics and Computer Controls, Delmer Publishers. 8. Tom Denton, Automotive Electronics, SAE
2. Beranek. L. L., Noise Reduction, McGraw-Hill Book Co., Inc, New York, 1993.
3. Bosch Hand Book, 3rd Edition, SAE, 1993.
4. Bob Brant, Build Your Own Electric Vehicle,McGraw-Hill, 2013.

References

1. SAE, Electric and Hybrid Electric Vehicles and Fuel Cell Technology, SAE.
2. Andrew Dicks and James Laminine, Fuel Cell Systems Explained, SAE.
3. SAE, Fuel cells and alternative fuels / Energy systems
4. SAE, Fuel Cell Power for Transportation, 2001.
5. Rickard Stobart, Fuel Cell Technology for Vehicles, SAE.

Course Contents and Lecture Plan

No.	Topic	No. of Lectures
1	**Electric and Hybrid Vehicle technology**	
1.1	Introduction, LEV, TLEV, ULV & ZEV, Basic components of Electric vehicles- Inverters	1
1.2	Battery packs and battery management system, motors, electronic power control unit	1
1.3	Electric wiring harness – CAN Bus	1
1.4	Multiplex wiring. regenerative braking	1
1.5	Basic factors to be considered for converting automobiles to electric vehicle	1
1.6	Hybrid electric vehicle	1
1.7	Types - series and parallel hybrid, layouts, comparison	1
1.8	Power systems and control systems	1
1.9	Different modes of operation of hybrid vehicles for best performance.	1
2	**Recent Trends in Automotive Power Plants**	
2.1	Stratified charged / lean burn engines – TSI engines	1
2.2	RCCI engines, Hydrogen Engines, Flex fuel vehicles	1
2.3	Vehicle Operation and engine Control	1
2.4	Application of sensors and actuators and microprocessors for operation of the vehicle to achieve best fuel economy	1
2.5	Reduced emission and optimum road performance	1
2.6	Closed loop and open loop operation	1
2.7	Electronic engine management systems	1

2.8	Electronic cruise control	
2.9	Chassis control system, Integrated systems.	1
3	**Principle of automobile navigation and controls in the new generation cars**	
3.1	Capabilities of navigation and control of modern cars.	1
3.2	Application and working of GPS	1
3.3	Driver Assistance Systems in Automobiles	1
3.4	Vision in cars	1
3.5	A comprehensive driver assistance approach	1
3.6	Lane recognition,	1
3.7	Traffic sign recognition,	1
3.8	Road recognition methods	1
3.9	Object recognition – Traffic lights and signals	1
4	**Modem electronic and micro control systems in automobiles**	
4.1	Electronically controlled concealed headlight systems	1
4.2	Electro chromic mirrors, automatic review mirrors	1
4.3	Day time running lamps (DRL)	1
4.4	Head up display, Travel information systems	1
4.5	On board navigation system, Electronic climate control	1
4.6	Electronically controlled sunroof, Anti-theft systems	1
4.7	Automatic door locks (ADL), tyre pressure sensing	1
4.8	Automated wiper, Antilock braking system	1
4.9	Electronic traction and stability control (ESP)	1
5	**Fuel Cells and Alternative energy systems**	
5.1	Introduction to fuel cells, Operational fuel cell voltages	1
5.2	Proton Exchange membrane fuel cells,	1
5.3	Alkaline Electrolyte fuel cells	1
5.4	Medium and high temperature fuel cells	1
5.5	Fuel and fuel chose	1
5.6	fuel processing,	1
5.7	fuel cell stacks, Delivering fuel cell power	1
5.8	Integrated Air supply and humidification concepts for fuel cell systems	1
5.9	Fuel cell Auxiliary systems	1

SEMESTER VI

HONOURS

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT 394	IC ENGINES AND ADVANCED COMBUSTION STRATEGIES	VAC	4	0	0	4

Preamble: This course aims at providing the students, an insight on the advanced combustion systems and engine technologies.

Prerequisite: NIL

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

CO 1	Understand the chemistry of combustion and classification of Engines
CO 2	Understand the differences of combustion in SI and CI Engines
CO 3	Understand the modern SI engine combustion and emission control technologies.
CO 4	Understand the modern CI engine combustion and emission control technologies.
CO 5	Understand the basic principles, types and operation of LTC concepts and strategies.

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	-	1	1	-	-	2	-	1
CO 2	2	1	-	2	-	1	2	-	-	2	-	1
CO 3	-	1	-	1	-	1	1	-	-	2	-	1
CO 4	-	-	-	-	-	1	1	-	-	2	-	1
CO 5	-	1	-	1	-	2	2	-	-	2	-	3

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	40
Apply	20	20	50
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.

Expected outcome:

The students will become aware of the latest developments and advancement in the field of IC engines.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What are the thermodynamic principles of Engines?
2. What are the sub parts/systems of the basic Automotive Engines?
3. Discuss the different types of Automotive Engine materials.
4. What is well to wheel efficiency?
5. What are the classifications of Heat Engines?

Course Outcome 2 (CO2)

1. Explain the factors affecting the SI engine combustion

2. Explain the phases of SI Engine combustion graphically.
3. Discuss about CI Engine combustion and important factors.
4. What is the fuel spray structure in CI Engine combustion?
5. Give a comparison of SI and CI engine in terms of ignition delay.

Course Outcome 3(CO3):

1. Explain the salient features of HCSI engines.
2. Explain the different combustion modes in a GDI engine
3. What is the concept of Hydrogen in Spark-Ignited Engines
4. What are the different factors affecting the HCSI combustion?
5. List out the emission control devices in modern gasoline engines

Course Outcome 4 (CO4):

1. Discuss the working of a CRDI engine.
2. What are the approaches to auto-ignition combustion operation in gasoline engines?
3. Explain the combustion control methods used in auto-ignition combustion operation in gasoline engines.
4. What are the different types of electronic diesel injectors ?
5. Explain the various types of turbochargers and its applications.

Course Outcome 5 (CO5):

1. Explain the principle of operation of a HCCI engine
2. What are the external and internal mixture preparation techniques in LTC engines?
3. What are the combustion control methods used in HCCI engines?
4. What are the features of a RCCI engine?
5. Differentiate between HCCI engine and RCCI engine.

Model Question paper

QP CODE: **PAGES:…**

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT 394

Course Name: IC ENGINES AND ADVANCED COMBUSTION STRATEGIES

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

Part A

(Answer all questions. Each question carries 3 marks)

1. List the emission control methods used in modern SI engines.
2. What are the functions of two oxygen sensors in the exhaust?
3. Give a comparison of super charger and a turbo charger.
4. What is the principle of operation of dual fuel engines?
5. List the main advantages of LNG vehicles compared to CNG vehicles.
6. Discuss the principle of Lean burn engines.
7. Why TSI engines are superior to usual GDI engines?
8. List the advantages of LTC strategies.
9. What are the methods used to increase the operational range of HCCI engine?
10. List down the fuel properties required for RCCI engines.

Part B

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

11. (a) Explain theworking of GDI engine with a suitable lay out. (7)
    (b) Discuss the working of a Lamda sensor. (7)

OR

12. With a suitable sketch explain the working of a CRDI system and emission control strategies (14)

13. Discuss the important factors affecting the performance of a duel fuel engine. (14)

OR

14. With a suitable sketch explain the components and working of a CNG vehicle. (14)

15. Discuss the principle and working of a Lean burn engine (14)

OR

16. Explain any two techniques used for increasing the lean operation limits. (14)
17. Explain the different operational modes of a stratified charge engine? (14)

OR

18. What are the different types of gas turbine combustors? Explain their working in detail. (14)
19. Explain a typical control system employed for four stroke HCCI engines. (14)

OR

20. Give a brief discussion about the concept and working of an RCCI engine. Also give a comparison between HCCI and RCCI engines. (14)

SYLLABUS

MUT 394 IC ENGINES AND ADVANCED COMBUSTION STRATEGIES

Module 1

IC engine Combustion – IC Engine Classifications, Combustion equations, heat of combustion, Theoretical flame temperature, Chemical equilibrium and dissociation, Theories of Combustion, Pre-flame Reactions- Reaction rates - Laminar and Turbulent Flame Propagation in Engines. Construction and working, Engine operating Cycles – Ideal and Fuel Air Cycles, Well to wheel efficiency.

Module 2

SI Engine Combustion – Phases of Ignition, Flame Propagation – Factors, Flame Structure, Burning Velocity, Cycle to Cycle Variations , CI Engine Combustion – Stages of Combustion, Heat Release Rate analysis, Ignition Delay - Factors, Diesel fuel Spray structure, Spray Penetration, Spray Angle, Droplet distribution and Evaporation.

Module 3

Advanced Spark-Ignition Engines – GDI Engines combustion – Homogenous-Charge Spark-Ignition (HCSI) Engines, Equivalence Ratio and Engine Emissions in HCSI engines, Combustion Duration in HCSI Engines, Hydrogen in Spark-Ignited Engines, TSI engines-working, advantages, Emission control devices in modern SI engines

Module 4

Advanced Diesel engines- High pressure CRDI, Components of CRDI system- pump, rail, rail pressure sensor, rail pressure control valve, electronic injectors- types, pulse width, duty cycle, multiple injection diesel combustion, UPCR, super chargers and turbo chargers-types, components, EGR, emission control devices in modern diesel engines.

Module 5

Low Temperature Combustion Strategies- Types, Principle, advantages, HCCI and CAI engines – fundamentals – external and internal mixture preparation techniques, effect of use of exhaust gas dilution – approaches to CAI/HCCI – Two stroke CAI engines – principles – control – potential applications – four stroke gasoline and diesel HCCI engines – HCCI fuel requirements – low temperature and premixed combustion with late injection – NADI concept of HCCI –CAI control and CAI/SI switching, Concept and working of dual fuel reactivity controlled compression ignition (RCCI) engine.

TextBooks:

1. John B Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill Education, 2011.
2. VGanesan,*InternalCombustionEngine*TataMcGrawHillPublishingCompanyLtd.,New Delhi2006.
3. HZhao, AdvancedDirect InjectionCombustionEngineTechnologies andDevelopment, volume1-gasoline andgas engines, Wood head publishing, 2009.
4. H Zhao, Advanced Direct Injection Combustion Engine Technologies and Development, volume2-dieselengines, Wood head publishing, 2009

Reference Books

1. H Zhao , HCCIand CAIEngines forthe Automotive Industry,Woodhead publishing
2. DerekDunn -Rankin,Lean Combustion:Technologyand Control, Academic press, 2007
3. M.L. Mathur, R. P. Sharma-Internal Combustion Engines, Dhanpat RaiPublications.
4. Richard Stone, Introduction to internal combustion engines, The Macmillan press Ltd.
5. H.N.Guptha, Fundamentals of Internal combustion engines, PHI learning Pvt Ltd

Course Contents and Lecture Schedule

No	Topics	No. of Lectures
1	**MODULE – 1: (9 hours)**	
1.1	Combustion - Combustion equations, heat of combustion	2
1.2	Theoretical flame temperature, Chemical equilibrium and dissociation, Theories of Combustion	2
1.3	Pre-flame Reactions- Reaction rates - Laminar and Turbulent Flame Propagation in Engines.	3

1.4	Construction and working, Engine operating Cycles – Ideal and Fuel Air Cycles, Engine Classifications, Well to wheel efficiency	2
2	**MODULE – 2: (9 hours)**	
2.1	SI Engine Combustion – Phases of Ignition, Flame Propagation – Factors, Flame Structure, Burning Velocity, Cycle to Cycle Variations	3
2.2	CI Engine Combustion – Stages of Combustion, Heat Release Rate analysis, Ignition Delay - Factors	3
2.3	Fuel Spray structure, Spray Penetration, Spray Angle, Droplet distribution and Evaporation	3
3	**MODULE – 3: (9 hours)**	
3.1	Advanced Spark-Ignition Engines – GDI Engines combustion	2
3.2	Homogenous-Charge Spark-Ignition (HCSI) Engines, Equivalence Ratio and Engine Emissions in HCSI engines, Combustion Duration in HCSI Engines	3
3.3	Hydrogen in Spark-Ignited Engines Through Partial	2
3.4	Emission control devices in modern SI engines	2
4	**MODULE – 4: (9 hours)**	
4.1	Advanced Diesel engines- High pressure CRDI, Components of CRDI system- pump, rail, rail pressure sensor, rail pressure control valve	2
4.2	Electronic injectors- types, pulse width, duty cycle, multiple injection diesel combustion	2
4.3	UPCR, turbo chargers-types, components, EGR	3
4.4	Emission control devices in modern diesel engines.	2
5	**MODULE – 5: (9 hours)**	
5.1	Low Temperature Combustion Strategies- Types, Principle	1
5.2	Low Temperature Combustion Strategies- advantages,	1
5.3	HCCI and CAI engines – fundamentals – external and internal mixture preparation techniques,	1
5.4	Effect of use of exhaust gas dilution – approaches to CAI/HCCI	1
5.5	Two stroke CAI engines – principles – control – potential applications	
5.6	Four stroke gasoline and diesel HCCI engines – HCCI fuel requirements	1
5.7	Low temperature and premixed combustion with late injection – NADI concept of HCCI	1
5.8	CAI control and CAI/SI switching	1
5.9	Concept and working of dual fuel reactivity controlled compression ignition (RCCI) engine.	1

COMMON COURSES

(S5 & S6)

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
KTU
Estd.
2014

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.
4. M. Y. Khan, and P. K. Jain, Financial Management, Tata-McGraw Hill, 2008.
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

MUT401	HEAT AND MASS TRANSFER	CATEGORY	L	T	P	CREDIT
		PCC	2	1	0	3

Preamble: The aim of this subject is to provide students with a general understanding of the fundamentals and applications of Heat and mass transfer. So the purpose of this course is to expose the student to

- ✓ Understand various modes of heat transfer and to develop methodologies for solving a wide variety of practical heat transfer problems
- ✓ Conceive the energy balance in any thermal practical situation involving heat transfer mechanisms
- ✓ Provide useful information concerning the performance and design of simple heat transfer systems
- ✓ Introduce mass transfer

Prerequisite: MUT201 Fluids Mechanics and Machinery, MET202 Engineering Thermodynamics

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

CO 1	Apply principles of steady state and transient conductive heat transfer to engineering problems.
CO 2	Analyse and obtain solutions to problems involving natural and forced convection for internal and external flows.
CO 3	Design heat transfer systems such as heat exchangers, fins etc. Determine the effectiveness of heat exchanger using LMTD and NTU methods.
CO 4	Apply principles of radiative heat transfer to engineering problems. Illustrate radiation shape factors for various geometries.
CO 5	Understand the phenomenon of diffusion and convective mass transfer.

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	3	2	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-
CO 5	3	2	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
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 anyone. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. A furnace wall is made up of three layers of thicknesses 250 mm, 100 mm and 150 mm with thermal conductivities of 1.65 W/m.K and 9.2 W/m.K respectively. The inside is exposed to gases at 1250 ^oC with a convection coefficient of 25 W/m^2 K. and the inside surface is at 1100 ^oC, the outside surface is exposed to air at 25 ^oC with convection coefficient of 12 W/m^2 K. Determine (a) the unknown thermal conductivity K (b) the overall heat transfer coefficient (c) all the intermediate temperatures?

2. Derive an expression for steady state temperature distribution in a slab with internal heat generation.

3. Dry air at 300 ^{0} C and 1 atm flows over a wet flat plate 600 mm. long at a velocity of 50 m/s. Calculate the mass transfer co-efficient of water vapour in air at the end of the plate. Take the diffusion co-efficient of water vapour in air, D = 0.26 x 10 $^{-4}$ m^{2} /s.

Course Outcome 2(CO2):

1.Discuss the importance of non-dimensional numbers in heat transfer problems

2. A hollow sphere (k = 65 W/m.K) of 120 mm inner diameter and 350 mm outer diameter is covered 10 mm layer of insulation (k =10 W/m.K). The inside and outside temperatures are 500 °C and 50 °C respectively. Calculate the rate of heat flow through this sphere.

3. A steel ball (specific heat =0.46 kJ/kg.K, and thermal conductivity 35W/m.K) having 5 cm diameter and initially at a uniform temperature of 450 ^{o}C is suddenly placed in a control environment in which the temperature is maintained at 100 ^{o}C. Calculate the time required for the ball to attain a temperature of150 ^{o}C.

Course Outcome 3 (CO3):

1. Water at the rate of 4 kg/s is heated from 40 ^{o}C to 55^{o}C in a shell and tube heat exchanger. On the shell side one pass is used with water as the heating fluid and at a mass flow rate of 2 kg/s, and entering the heat exchanger at 95 ^{o}C. The overall heat transfer coefficient is 1500 W/m^{2} K. and the average water velocity in the 2 cm diameter tubes is 0.5 m/s. Because of space limitations, the tube length must not exceed 3 m. Calculate the number of tube passes, the number of tubes per pass and the length of the tubes, keeping in mind the design constraints.

2. Steam condenses at atmospheric pressure on the external surface of the tubes of a steam condenser. The tubes are 12 in number and each is 30 mm in diameter and 10 m long. The inlet and outlet temperatures of cooling water flowing inside the tubes are 25°C and 60°C respectively. If the flow rate is 1.1 kg/s, calculate (i) The rate of condensation of steam (ii) The number of transfer units (iii) The effectiveness of the condenser.

3. Water enters a cross flow Heat exchanger (both fluids unmixed) at 5°C and flows at the rate of 4600 kg/h to cool 4000 kg/h of air that is initially at 40°C. Assume the overall heat transfer coefficient value to be 150 W/m2K . For an exchanger surface area of 25m^{2} Calculate the exit temperature of air and water.

Course Outcome 4 (CO4):

1. Two large plates, one at 800 K and other at 600 K have emissivities 0.5 and 0.8 respectively. A radiation shield having an emissivity 0.1 on one side and emissivity 0.05 on the other side is placed between the plates. Calculate the heat transfer by radiation per square meter with and without the radiation shield

2. Define emissivity, absorptivity and reflectivity. Describe the phenomenon of radiation from real surfaces

3. Liquid Helium at 4.2 K is stored in a dewar flask of inner diameter = 0.48 m and outer diameter = 0.5 m. The Dewar flask can be treated as a spherical vessel. The outer surface of the inner vessel and the inner surface of the outer vessel are well polished and the emissivity of these surfaces is 0.05. The space between the two vessels is thoroughly evacuated. The inner surface of the dewar flask is at 4.2 K while the outer surface is at 300 K. Estimate the rate of heat transfer between the surfaces.

Course Outcome 5 (CO5):

1. Explain the phenomenon of equimolar counter diffusion. Derive an expression for equimolar counter diffusion between two gases or liquids

2. Discuss the analogy between heat and mass transfer.

3. The tire tube of a vehicle has a surface area 0.62 m^2 and wall thickness 12 mm. The tube has air filled in it at a pressure 2.4 x 10^5 N/m^2. The air pressure drops to 2.3 x 10^5 N/m^2 in 10 days. The volume of air in the tube is 0.034 m^3 . Calculate the diffusion coefficient of air in rubber at the temperature of 315K. Gas constant value = 287. Solubility of air in rubber tube = 0.075m^3 of air/m^3 of rubber tube at one atmosphere

SYLLABUS

Module 1

Conductive heat transfer- thermodynamics and heat transfer, typical heat transfer situations, modes of heat transfer, mechanism of heat transfer- basic laws of heat transfer, thermal conductivity, effect of temperature on thermal conductivity, combined heat transfer mechanism, real life situations of combined heat transfer. General Differential Conduction equation in Cartesian and Cylindrical Coordinate systems , boundary conditions and initial conditions, one dimensional steady state situations – plane wall, cylinder, sphere, composite systems , concept of thermal resistance, critical radius, conduction with heat generation- Extended surfaces, Two-dimensional steady state situations. Transient conduction, lumped capacitance model, Infinite and semi Infinite solids using Heislers Chart. Schmidt Plot- Conduction shape factor.

Module 2

Convective heat transfer- convective heat transfer coefficient, order of magnitude analysis of momentum and energy equations; hydrodynamic and thermal boundary Layers-Relation between fluid friction and heat transfer-Concepts of fluid mechanics, Differential equation of heat convection, Laminar flow heat transfer in circular pipe – constant heat flux and constant wall temperature, thermal entrance region, Turbulent flow heat transfer in circular pipe, pipes of other cross sections, Heat transfer in laminar flow and turbulent flow over a flat plate, Reynolds analogy, Flow across a cylinder and sphere- Natural convection- basics free convection heat transfer on a vertical flat plate, empirical relations for free convection heat transfer.

Module 3

Condensation heat transfer phenomena- Nusselts theory of condensation, the condensation Number, boiling heat transfer Phenomena, Regimes in boiling, Correlations in condensation and boiling

Heat exchangers-types of heat exchangers-the overall heat transfer coefficient-Fouling factor, LMTD analysis of heat exchangers effectiveness-NTU method, Analysis of variable properties, compact heat exchangers-heat exchanger design considerations.

Module 4

Radiation heat Transfer, Physical mechanism-Radiation properties, Black body radiation, Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law, Gray body Radiation shape factors-heat exchange between non -black bodies-Infinite parallel planes-Radiation combined with conduction and convection.

Module 5

Mass transfer- Molecular diffusion in fluids- Steady state molecular diffusion in fluids under stagnant and laminar flow conditions , Fick's law of diffusion, Types of solid diffusion- mass transfer coefficients in laminar and turbulent flows, Introduction to mass transfer coefficient Equimolar counter-diffusion, Correlation for convective mass transfer coefficient, Correlation of mass transfer coefficients for single cylinder, Theories of mass transfer, Overall mass transfer coefficients.

Text Books

1	Fundamentals of Engineering Heat and Mass Transfer,	Sachdeva R.C	New Age Science Limited, 2009
2	Heat and mass transfer	R.K. Rajput	S. Chand &Co., 2015
3	Heat and Mass Transfer	Nag P.K	McGraw Hill, 2011
4	Fundamentals of Heat and Mass Transfer	Kothandaraman C.P	New Age International, New Delhi,2006

Reference Books

1	Heat transfer	Holman J.P	Mc Graw-Hill, 10th. Ed.,2009
2	Heat and Mass Transfer:	Yunus A.	McGraw-Hill Higher Education; 6th

	Fundamentals and Applications	Cengel	edition,2019
3	Heat and Mass Transfer	Frank P. Incropera and David P. Dewitt	John Wiley and sons,2011

Data Book (may be permitted in the examination hall)

Heat and Mass Transfer data book: C.P. Kothandaraman, S. Subramanya, New age International Publishers,2014

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Module 1 (7 hours)**	
1.1	Conductive heat transfer- thermodynamics and heat transfer, typical heat transfer situations, modes of heat transfer, mechanism of heat transfer- basic laws of heat transfer, thermal conductivity, effect of temperature on thermal conductivity, combined heat transfer mechanism, real life situations of combined heat transfer.	2
1.2	General Differential Conduction equation in Cartesian and Cylindrical Coordinate systems, boundary conditions and initial conditions, one dimensional steady state situations – plane wall, cylinder, sphere, composite systems , concept of thermal resistance, critical radius, conduction with heat generation- Extended surfaces, Two-dimensional steady state situations.	3
1.3	Transient conduction, lumped capacitance model, Infinite and semi Infinite solids using Heislers Chart. Schmidt Plot- Conduction shape factor.	2
2	**Module 2 (7 hours)**	
2.1	Convective heat transfer- convective heat transfer coefficient, order of magnitude analysis of momentum and energy equations; hydrodynamic and thermal boundary Layers-Relation between fluid friction and heat transfer-Concepts of fluid mechanics,	2
2.2	Differential equation of heat convection, Laminar flow heat transfer in circular pipe – constant heat flux and constant wall temperature, thermal entrance region. Turbulent flow heat transfer in circular pipe, pipes of other cross sections, Heat transfer in laminar flow and turbulent flow over a flat plate, Reynolds analogy, Flow across a cylinder and sphere	4

2.3	Natural convection- basics free convection heat transfers on a vertical flat plate, empirical relations for free convection heat transfer.	1
3	**Module 3 (7 hours)**	
3.1	Condensation heat transfer phenomena- Nusselts theory of condensation, the condensation Number, boiling heat transfer Phenomena, Regimes in boiling, Correlations in condensation and boiling	2
3.2	**Heat exchangers**-types of heat exchangers-the overall heat transfer Coefficient-Fouling factor, LMTD analysis of heat exchangers effectiveness-NTU method, Analysis of variable properties,	4
3.3	Compact heat exchangers-heat exchanger design considerations	1
4	**Module 4 (7 hours)**	
4.1	Radiation heat Transfer,Physical mechanism-Radiation properties, Black body radiation, Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law, Gray body	3
4.2	Radiation shape factors-heat exchange between non -black bodies-Infinite parallel planes	2
4.3	Radiation combined with conduction and convection	2
5	**Module 5 (7 hours)**	
5.1	Mass transfer- Molecular diffusion in fluids- Steady state molecular diffusion in fluids under stagnant and laminar flow conditions , Fick's law of diffusion	2
5.2	Types of solid diffusion- mass transfer coefficients in laminar and turbulent flows, Introduction to mass transfer coefficient Equimolar counter-diffusion,	3
5.3	Correlation for convective mass transfer coefficient, Correlation of mass transfer coefficients for single cylinder, Theories of mass transfer, Overall mass transfer coefficients.	2

Model Question Paper

QP CODE:

PAGES: 2

Reg. No: ______________ Name :______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT401

Course Name: HEAT AND MASS TRANSFER

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1) Discuss about the application of Heisler chart and Schmidt plot in heat transfer analysis.

2) Give some examples of heat transfer in engineering.

3) Sketch formation of boundary layer and show laminar, transition & turbulent flow

4) Differentiate between Natural & Forced convection

5) What is meant by condensation heat transfer? How it differs from drop wise heat transfer?

6) What are the main factors to be considered for a heat exchanger design?

7) Explain about radiation shape factor.

8) What are the properties of blackbody?

9) Explain Fick's law of diffusion with suitable assumptions.

10) Give two examples of mass transfer in day-to-day life. (10 x 3 = 30 Marks)

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

11) a) Derive 3-dimensional unsteady state heat conduction equation with heat generation, in Cartesian co-ordinate system for anisotropic material. (7 marks)

b) A 3 mm diameter and 5m long electric wire is tightly wrapped with a 2 mm thick plastic cover whose thermal conductivity is k = 0.15 W/m-K. Electrical measurements indicate that a current of 10 A passes through the wire and there is a voltage drop of 8 V along the wire. If the insulated wire is exposed to a medium at T_∞ = 30°C with a heat transfer coefficient of h = 12 W/m²-K, determine the temperature at the interface of the wire and the plastic cover in steady operation. Also state with reason, whether doubling the thickness of the plastic cover will increase or decrease heat transfer. (7 marks)

Or

12) a) Derive an expression for temperature distribution for 1-dimensional slab with varying thermal conductivity. Assume the variation of thermal conductivity of slab as $k = k_0 (1+\beta t)$.

(7 marks)

b)A square plate heater 15 cm x 15 cm is inserted between two slabs. Slab A is 2 cm thick (k = 50W/m-K) and Slab B is 1cm thick (k = 0.2W/m-K). The outside heat transfer coefficients on side A and side B are 200W/m²-K and 50W/m²-K respectively. The temperature of surrounding air is 25 °C. If rating of heater is 1 KW, find (a) Maximum temperature in the system, and (b) outer surface temperature of the two slabs.

(7 marks)

Module 2

13) a)Saturated propane at 300 K with a velocity of 25 cm/s flows over a flat plate of length L=2 m. and width w=1 m. maintained at uniform temperature of 400 K. Calculate the local heat transfer coefficient at 1 m. length and the average heat transfer coefficient from L=0 m. to L=2 m. Also find the heat transfer. (7 marks)

b) Hot air at atmospheric pressure and 80°C enters an 8 m. long uninsulated square duct of cross section 0.2 m. x 0.2 m. that passes through the attic of a house at a rate of 0.15m³/s. The duct is observed to be nearly isothermal at 60°C. Determine the exit temperature of the air. (7 marks)

Or

14) a)Air at 15° C, 35 m/s, flows through a hollow cylinder of 4 cm. inner diameter and 6 cm. outer diameter and leaves at 45° C. The tube passes through a room where the room temperature is 65°C and tube wall is maintained at 60° C. Calculate the heat transfer coefficient between the air and the inner tube. (7 marks)

b) Consider a 0.6 m. x 0.6 m. thin square plate in a room at 30°C. One side of the plate is maintained at a temperature of 90°C, while the other side is insulated. Determine the rate of heat transfer from the plate by natural convection. If the emissivity of the surface is

1.0, calculate the heat loss by radiation. Also calculate the percentage of heat loss by convection. (7 marks)

Module 3

15) a) A counter flow double pipe heat exchanger is to heat water from 20°C to 80°C at a rate of 1.2kg/s. The heating is to be accomplished by geothermal water available at 170°C at a mass flow rate of 2 kg/s. The inner tube is thin walled and has a diameter of 1.5 cm. If the overall heat transfer coefficient of the heat exchanger is 640 W/m²-K, determine the length of the heat exchanger required to achieve the desired heating. Use ε-NTU method. (8 marks)

b) Derive an expression for LMTD of double pipe, parallel flow heat exchanger(6 marks)

Or

16) a) Steam in the condenser of a power plant is to be condensed at a temperature of 30°C with cooling water from a nearby lake, which enters the tubes of the condenser at 14°C and leaves at 22°C. The surface area of the tubes is 45 m^2 and the overall heat transfer coefficient is 2100 W/m2 °C. Determine the mass flow rate of the cooling water needed and the rate of condensation of the steam in the condenser. (7 marks)

b) In a double pipe heat exchanger, hot fluid with a specific heat of 2300 J/kg enters at 380^o C and leaves at 300^o C. Cold fluid enters at 25^o C and leaves at 210^o C. Calculate the heat exchanger area required for (i) Counter flow and (ii) Parallel flow. Take overall heat transfer coefficient as 750 W/m^2 K and mass flow rate of hot fluid is 1 kg/s.

(7 marks)

Module 4

17) a)A 70 mm. thick metal plate with a circular hole of 35 mm. diameter along the thickness is maintained at a uniform temperature 250 ^oC. Find the loss of energy to the surroundings at 27 ^oC, assuming the two ends of the hole to be as parallel discs and the metallic surfaces and surroundings have blackbody characteristics. (6 marks)

b) Two large parallel planes with emissivities of 0.3 and 0.5 are maintained at temperatures of 527 ^0C and 127 ^0C respectively. A radiation shield having emissivities of 0.05 on both sides is placed between them. Calculate, (i) Heat transfer rate between them without shield. (ii) Heat transfer rate between them with shield. (8 marks)

Or

18) a) Two parallel plates of size 1.0 m. by 1.0 m. spaced 0.5 m apart are located in a very large room, the walls of which are maintained at a temperature of 27^0 C. One plate is maintained at a temperature of 900 ^0C and other at 400 ^0C. their emissivity's are 0.2and 0.5 respectively. If the plates exchange heat between themselves and the surroundings, find the net heat transfer to each plate and to the room. Consider only the plate surface facing each other (8 marks)

b) Two rectangular surfaces are perpendicular to each other with a common edge of 2 m. The horizontal plane is 2 m. long and vertical plane is 3 m long. Vertical plane is at 1200 K and has an emissivity of 0.4. the horizontal plane is 18 ^{0}C and has an emissivity of 0.3. Determine the net heat exchange between the planes. (6 marks)

Module 5

19) Dry air at 30^0 C and 1 atm flows over a wet flat plate 600 mm. long at a velocity of 50 m/s. Calculate the mass transfer co-efficient of water vapour in air at the end of the plate. Take the diffusion co-efficient of water vapour in air, D = 0.26 x 10 $^{-4}$ m^2 /s (14 marks)

Or

20) a) Explain the analogy between heat and mass transfer. (8 marks)

b) Explain the phenomenon of equimolar counter diffusion. Derive an expression for equimolar counter diffusion between two gases or liquids. (6 marks)

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

MUL411	AUTOTRONICS AND VEHICLE TESTING LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble: The aim of this course is to make the students gain practical knowledge about the fault detection technique and to familiar with the operations of sensors and actuators used in automobile. After this course, the student will be able to identify the issue in a vehicle from the output of the advanced testing equipment.

Prerequisite: NIL

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

CO 1	To classify the advanced testing equipment used for fault detection in automobile.
CO 2	To identify the sensors, and actuators used automobile systems
CO 3	To make use of advanced testing equipment for identifying the malfunctioning of the automotive components.
CO 4	To make use of advanced testing equipment for identifying the malfunctioning of the sensors and actuators in automobile.
CO 4	Utilize one's ability as an individual or in a team for the effective communication, practical skill and document design.

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	-	-	2	2	-	3
CO 2	3	2	2	2	1	2	-	-	2	2	-	3
CO 3	3	2	2	2	1	2	-	-	3	3	-	3
CO 4	3									3		3
CO 5	3									3		3

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	:	15 marks
Continuous Assessment	:	30 marks
Internal Test (Immediately before the second series test)	:	30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work	: 15 Marks
(b) Implementing the work/Conducting the experiment	: 10 Marks
(c) Performance, result and inference (usage of equipment and trouble shooting)	: 25 Marks
(d) Viva voce	: 20 marks
(e) Record	: 5 Marks

General instructions: Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. To study about hand tools, special purpose tools, advanced testing equipment and simulation software.

Course Outcome 2 (CO2)

1. To recognize the sensors used in automobiles in the ignition systems, braking system, , HVAC systems and traction control.

Course Outcome 3 (CO3):

1. To gain proficiency in using the engine scan tool and familiarise with DTC
2. To gain proficiency in checking the camber, caster, kingpin inclination, toe in & out with optical aligner or computerized wheel aligner
3. To gain proficiency in balancing of wheels by using computerized wheel balancing machine
4. To check and measure the condition of the exhaust emissions using gas analyser and smoke meter
5. To asses the performance of an automobile using chassis dynamometer
6. To gain proficiency in fault diagnostics in headlight, braking system and auto electric components

Course Outcome 3 (CO4):

1. To simulate and testing the air-conditioning system/braking system using the simulation trainer
2. To analyse/asses and get the idea of the control application using simulation software

Course Outcome 3 (CO4):

1. To build the ability to work as a team
2. To develop the skill in report preparation and documentation

LIST OF EXPERIMENTS

List of Exercises/Experiments (Minimum 12 exercises/experiments are mandatory)

1. Checking the exhaust of gasoline vehicle with infrared gas analyzer.
2. Checking the emission of diesel vehicle with smoke meter.
3. Checking the emission using Multigas analyzer for the given vehicle.
4. Wheel alignment: Checking the camber, caster, kingpin inclination, toe in & out with optical aligner or computerized wheel aligner.
5. Removal of tyre, inspection of tyre and tube, carryout the necessary repair and reassemble with automatic or semiautomatic tire changer.
6. Wheel balancing: Balancing of wheels by using computerized wheel balancing machine.
7. Vehicle testing - Performance Testing of vehicle with chassis dynamometers (2 / 4 wheelers)
8. Checking the engine with Scan tool and familiar with DTC.
9. Brake testers: Testing of brakes using brake testers
10. Fault diagnostic of Air Conditioning System.
11. Head Light Aiming and Focusing with Head light aligners.
12. Testing auto electrical components: a) Battery testing - Specific gravity test, open volt test, HRD test. b) Testing generator and regulator - testing the generator for short circuit, open circuit, testing the regulator unit c) Testing and checking of spark plugs - Cleaning and testing the spark plug with spark plug cleaner & testing machine. d) Testing of ignition coil e) Checking of dwell angle and rpm.
13. Computerised data logging from sensors - like pressure, temperature, vibration
14. Interfacing LabVIEW software with sensors and actuators
15. PLC- ladder programming using PLC trainer kit to control different Actuators

16. Testing the characteristics and operation of various sensors and actuators used in automobiles using CANbus autotronic training system.
17. Testing the car air-conditioning system using automotive air conditioning and heating simulation trainer
18. Test the working of anti-lock braking system using four-wheel ABS and traction control trainer in different road conditions (ice, wet and dry).

Note: 12 experiments are mandatory

Reference/Text Books:

1. Boyce Dwiggins – Automobile Repair guide, Theodor Audel and Co., Indiana – 1978.
2. A. W. Judge – Maintenance of high speed diesel engine, Chapmann Hall Ltd.
3. A. W. Judge – Motor vehicle engine servicing 3rd edition, Pitman paper mark, London, 1969.
4. Vehicle service manuals and reputed manufacturers

MUQ413	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.).

MUD415	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
PO6	The Engineer and Society	PO12	Lifelong learning

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 find a 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 plan wasn'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 show 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/desig n/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**			

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

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

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT413	FINITE ELEMENT METHODS	PEC	2	1	0	3

Preamble: The course aims at providing the student an in-sight on the mathematical formulation behind the finite element problems and evaluate the simulated solutions using analytical methods

Prerequisite: NIL

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

CO 1	Identify the underlying principles of Finite Element Methods
CO 2	Solve simple problem using FEA
CO 3	Solve higher order problems using FEA
CO 4	Enumerate the different software that uses Finite Element methods and its process
CO 5	Apply the methods to real time problems in automobile

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	-	2	-	-	-	-	-	1
CO 2	3	-	3	2	-	2	-	-	-	-	-	2
CO 3	3	-	3	2	-	2	-	-	-	-	-	2
CO 4	2	-	3	2	-	2	-	-	-	-	-	2
CO 5	2	1	3	2	-	2	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember			
Understand	20	20	20
Apply	20	20	70
Analyse	10	10	10
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):

1Explain different approximation techniques used in FEA

Course Outcome 2 (CO2)

1. Derive the equation for rod, bar, beam and truss

Course Outcome 3(CO3):

1. Identify isoparametric elements and jacobian matrix

Course Outcome 4 (CO4):

1. Create a database for the FEA software calculation

Course Outcome 5 (CO5):

1.Develop different structural and thermal analysis using softwares and compare using experimental methods

Model Question Paper

QP CODE:

PAGES:…

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT413

Course Name: FINITE ELEMENT ANALYSIS

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

Part A

(Answer all questions. Each question carry 3 marks)

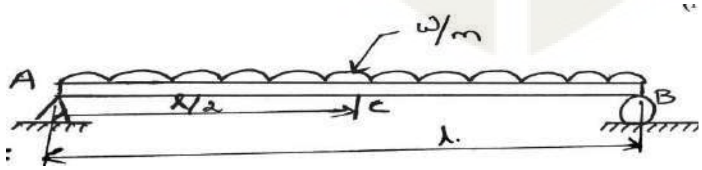
1. What do you mean by elements and nodes?
2. What is Ritz method?
3. Explain the three different co-ordinate systems used? Why do we require it?
4. What is shape function? State its characteristics
5. List down the different LST and CST elements used in an analysis
6. Define plane stress and plane strain analysis. List down its applications
7. What are the advantages of post processing?
8. What are the desirable properties of an FEA software?
9. How do we convert piston to a 2D element?
10. Can we convert crankshaft to a 2D body for torsional analysis? If not,Why? If yes, how?

PART B

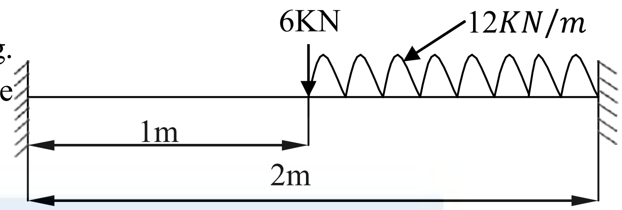
11. The following differential equation is available for a physical phenomenon. $\boldsymbol{AE} = \frac{\boldsymbol{d^2u}}{\boldsymbol{dx^2}} + \text{ax} = 0$ with the boundary condition as u(0) =0 and $\left.\frac{du}{dx}\right|_{x=L} = 0$. Using Galerkin's method, solve the above equation

OR

12. Find the deflection at the centre of a simply supported beam of span length "l" subjected to uniformly distributed load throughout its length as shown in figure using (a) point collocation method, (b) sub-domain method, (c) Least squares method, and (d) Galerkin's method.

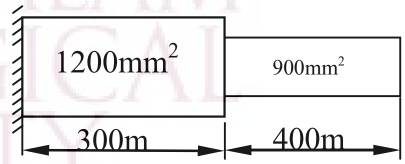


13. For the beam and loading shown in fig. calculate the nodal displacements. Take [E] =210 GPa, [I] = 6×10^{-6} m^4

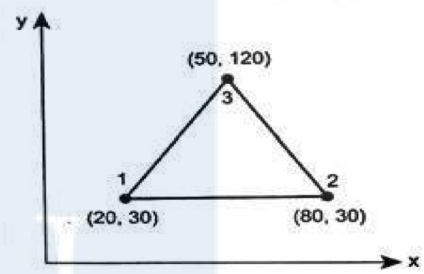


OR

14. Determine the axial vibration of a steel bar shown in fig. Take [E] =$2.1\times10^5 N/mm^2$, ρ= $7800kg/m^3$

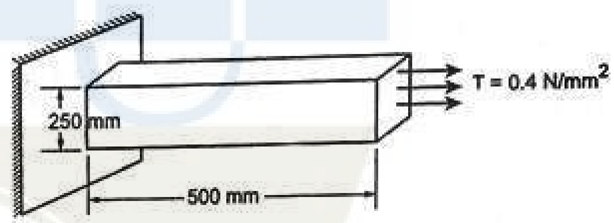


15. For the plane stress element shown in fig, the nodal points areU1=2.0mm;v1=1.0mm;U2=0.5mm;v2=0.0mm;U3=3.0mm; v3=1.0mm.Determine the element stresses σx, σy, σ1, and σ2 and the principal angle θp, let E=210 GPA, ν= 0.25 and t=10 mm. All coordinates are in millimetre.



OR

16. A thin plate is subjected to surface traction as shown in figure. Calculate the global stiffness matrix.Take Young's modulus E = 2 X $10^5 N/mm^2$, possion ratio ν=0.30, Thickness t=25mm.Assume plane stress condition.



17. Derive the shape function derivation for the Eight Noded Rectangular Element

OR

18. Explain the basic structure of an FEA programme and how do we determine the solution obtained is upto the requirement?
19. Explain the methodology adopted for torsional analysis of a crankshaft

OR

20. Explain how the thermal analysis of the fins of an air cooled engine is carried out

SYLLABUS

Module 1: BASIC CONCEPTS

Introduction, Evolution of FEA, General procedures of FEA, Discretization, Advantages and disadvantages of using FEA, applications of FEA, Different approaches in FEA- Variational method, Raileigh Ritz method, Weighted residual method, Least square, Galerkin's method, Solution of algebraic problems, Gaussian Elimination method

Module 2: SIMPLE SOLUTIONS

Co-ordinate system: Global. Local and natural, Shape function, Energy approach, generation of stiffness matrix, force vector and stiffness matrix assembly, applying boundary conditions, generating equations for spring, bar, beam and truss elements

Module 3: HIGHER ORDER SOLUTIONS

Plane stress and plane strain, CST and LST elements, basics of axisymmetric elements, Jacobian matrices and transformations, Iso parametric elements, numerical integration, Gaussian quadrature, identification of different elements and its properties.

Module 4: INTRODUCTION TO FEA SOFTWARES

Introduction to different commercial software available, basic structure of a Finite Element analysis programme, Pre processing and post processing, desirable features of FEA packages,

Module 5: APPLICATION OF FEA SOFTWARES

Analysis of different automobile components using FEA- Torsional analysis of crankshaft, analysis of piston converting it to a 2D plate element, thermal analysis of fin, modal analysis of frame. Vibration analysis of suspension system. Thermal analysis of brake disc.

Text Books

1. C S Krishnamoorthyr, "Finite Element Analysis: Theory and Programming", Tata McGraw Hill, 2nd edition, 2017.
2.J N Reddy, Introduction to Finite Element Methods, Tata McGraw Hill, 4th edition, 2020.

Reference Books

1. Saeed Moaveni, Finite Element Analysis Theory And Application With ANSYS, Pearson, 3rd edition, 2011
2. P Seshu, Textbook of Finite Element Analysis, Prentice Hall India Learning Private Limited, 1st edition,2012
3. S S Bhavikatti, Finite Element Analysis, 3rd edition, New Age International Publishers, 2015
4.Erdogan Madenci, Finite Elements Method and Applications in Engineering Using Ansys, Springer,2015

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**BASIC CONCEPTS**	
1.1	Introduction,Evolution of FEA	1
1.2	General procedures of FEA, Discretization	1
1.3	Advantages and disadvantages of using FEA, applications of FEA,	1
1.4	Variational method	1
1.5	Raileigh Ritz method	1
1.6	Weighted residual method, Least square	1
1.7	Galerkin’s method, Solution of algebraic problems, Gaussian Elimination method	1
2	**SIMPLE SOLUTIONS**	
2.1	Co-ordinate system: Global. Local and natural	1
2.2	Shape function	1
2.3	Energy approach	1
2.4	Generation of stiffness matrix	1
2.5	Force vector and stiffness matrix assembly	1
2.6	Applying boundary conditions	1
2.7	Generating equations for spring, bar, beam and truss elements	1
3	**HIGHER ORDER SOLUTIONS**	
3.1	Plane stress and plane strain	1
3.2	CST and LST elements	1
3.3	Basics of axisymmetric elements	1
3.4	Jacobian matrices and transformations	1
3.5	Iso parametric elements	1
3.6	Numerical integration, Gaussian quadrature	1
3.7	Identification of different elements and its properties	1
4	**INTRODUCTION TO FEA SOFTWARES**	
4.1	Introduction to different commercial software available	2
4.2	basic structure of a Finite Element analysis programme	2
4.3	Pre processing and post processing	2
4.4	desirable features of FEA packages	1
5	**APPLICATION OF FEA SOFTWARES**	
5.1	Torsional analysis of crankshaft	1
5.2	analysis of piston converting it to a 2D plate element	1
5.3	thermal analysis of fin	1

5.4	modal analysis of frame	1
5.5	Vibration analysis of suspension system.	1
5.6	Thermal analysis of brake disc.	2

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
KTU
Estd.
2014

MUT423	VEHICLE PERFORMANCE AND TESTING	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: The aim of this subject is to make students familiarize with the various tests performed on a vehicle, to study and analyse its performance Characteristics.

- Explain about various laboratory testing procedures of the engine on dynamometer to study about basic engine parameters.
- To impart basic knowledge about engine exhaust analysers for petrol and diesel engine.
- To impart basic concepts of Collision Testing and Wind Tunnel Testing of vehicles
- To study about the role of Noise Vibration and Harshness in automobile and to know about various Ride vibration and body test procedure.
- To understand about Wheels and braking performance test procedure.

Prerequisite: Auto Chassis, Vehicle Body Engineering

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

CO 1	Understand the basic engine parameters and various laboratory testing procedures.
CO 2	Knowledge about engine exhaust analysers for petrol and diesel engine.
CO 3	Explain the basic concepts of Collision testing and Wind Tunnel testing of vehicles.
CO 4	Explain the role of Noise Vibration and Harshness in automobile and to know about various Ride vibration and body test procedure.
CO 5	Understand about Wheels and Braking performance test procedure.

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	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
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 3 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain about the basic engine parameters.
2. Discuss about different laboratory testing procedures of the engine on dynamometer.

Course Outcome 2 (CO2)

1. Explain about various exhaust gas analysers used for petrol engine.
2. Discuss about Energy consumption tests performed on engine.
3. Briefly explain about Fuel Consumption Test performed on a vehicle.

Course Outcome 3(CO3):

1. Explain about various Collision and Crash Testing procedure performed on a vehicle.
2. Discuss about Wind Tunnel Testing procedure of vehicles.

Course Outcome 4 (CO4):

1. Identify and explain the different sources of noise in a vehicle.
2. Discuss about Standard noise measurement methods and noise control methods.
3. Briefly explain about Vibration measurement tests performed on a vehicle.

Course Outcome 5 (CO5):

1. Discuss about different type of Wheels and braking performance test performed on a vehicle.
2. Explain about various test conducted to check the performance of Air and hydraulic brake.

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: MUT423
Course Name: VEHICLE PERFORMANCE AND TESTING

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

Part A
Answer all questions
Each question carry 3 marks (2 questions from each module)

1. Define IP, BP and FP. Explain why engines are tested on dynamometers?
2. Differentiate between two wheel& four wheel dynamometers.
3. Explain about different types of exhaust gas analysers used for petrol and diesel engines.
4. What are the factors to be considered while conducting fuel consumption test?
5. List importance of collision and crash testing. What is meant by crashworthiness of a vehicle?
6. Discuss the factors to be considered while conducting wind tunnel testing of vehicles.
7. What is meant by NVH? Mention the importance of NVH in vehicle design.
8. What are the different types of noises originating from a vehicle?
9. Differentiate between Dynamic cornering fatigue test and dynamic radial fatigue tests.
10. Explain about the factors to be considered while designing a front bumper of a vehicle?

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

Module 1

11. Explain the principle of following dynamometers.
    a. Hydraulic dynamometer (7)
    b. Eddy current dynamometer (7)

OR

12. Explain the procedure of testing vehicle on chassis dynamometers. (14)

Module 2

13. Explain different types exhaust gas analysers used for petrol and diesel engines. (14)

OR

14. Briefly explain the procedure of conducting fuel consumption tests. (14)

Module 3

15. Explain the procedure of collision and crash testing conducted on vehicles. (14)

OR

16. (a) Explain in detail about wind tunnel testing of vehicle. (7)
    (b) What are the factors that affect the aerodynamic efficiency of the vehicle? (7)

Module 4

17. (a) Explain about different types of standard noise measurement methods. (7)
    (b) Discuss how sound insulation is achieved in vehicles. (7)

OR

18. (a) Discuss about different sources of noise in a vehicle. How they are originated. (7)
    (b) Discuss about the process of ride vibration isolation in vehicles. (7)

Module 5

19. Explain the road hazard impact test for wheel and tyre assemblies. (14)

OR

20. (a) Differentiate between drawbar pull test and grade holding test for testing parking brake. (7)
    (b) Explain the procedure of dynamic cornering fatigue test. (7)

SYLLABUS

Module 1

Laboratory testing: Basic engine parameters, Measurement of BHP, IHP- Engine testing on dynamometers, different types of dynamometers- hydraulic, eddy current etc. Vehicle testing on chassis dynamometers: two wheel& four wheel dynamometers, vehicle testing lanes - side slip testers, brake testers, head light alignment testing.

Module 2

Engine analysers- for petrol and diesel engines, exhaust gas analysers - various types- Orsat apparatus, infrared gas analysers, smoke meter .Energy consumption tests-Engine Cooling fan, air conditioning and brake compressors. Fuel Consumption Test, test root selection, Vehicle test speeds.

Module 3

Collision And Crash Testing :Human Testing, Dummies, Crash worthiness, pole crash testing, near crash testing, vehicle to vehicle impact, side impact testing, crash test sensor, sensor mounting positions, crash test data acquisition, braking distance test.

Wind Tunnel Test: Test requirements – ground boundary simulation-wind tunnel selection and Reynolds number capability, model requirements, model details, model mounting, test procedure.

Module 4

Noise vibration and Harshness: Automotive noise criteria, Standard noise measurement methods, Noise inside and outside the vehicle, sources of vehicle noise- intake and exhaust noise, combustion noise, mechanical noise, noise from auxiliaries, wind noises, transmission noises, brake squeal, structure noise, noise control methods.

Ride vibration and body test:Vibration measurement instrument - accelerometer and signal conditioning.

Module 5

Wheels and braking performance test: Dynamic cornering fatigue, dynamic radial fatigue tests - procedure. Impact test - road hazard impact test for wheel and tyre assemblies, test procedures, failure criteria and performance criteria.Bumpers - types of tests, pendulum test, fixed collision barrier test procedure, performance criteria. Air and hydraulic brake test, air brake actuator, valves test, performance requirements. Parking brake - drawbar pull test,grade holding test.

Text Books

1. “Automotive Mechanics”, Crouse W.H and Anglin D.L, Tata McGraw-Hill Publishing Co
2. “Vehicle operation and performance”, J. G. Giles, Wildlife Publications- London, 1969
3. “Mechanical Measurements”, Beckwith T.G. and Buck. N.L, Addition Wesley publishing company Limited, 1995.

Reference Books

1. ARAI Standards https://www.araiindia.com/downloads
2. SAE Hand book, Vol. 3, SAE, Publications, 2000
3. Automotive Handbook, Bosch.Website:www.mainindia.com/Draft, AIS standards.
4. SAE Transaction papers – 831814, 820346, 8203820371, 820375
5. “Automotive technology”, Dr. N.K Giri, Khanna publishers, 2009
6. “Motor vehicle inspection”, W. H. Crouse and L. Anglin McGraw, Hill Book Co. 1978.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Laboratory testing Module 1 (7 hours)**	
1.1	Definition of basic engine parameters. BHP, IHP, FHP	1
1.2	Different types of dynamometers- hydraulic, eddy current	1
1.3	Engine testing on dynamometers -Measurement of BHP, IHP	1
1.4	Vehicle testing on chassis dynamometers: two wheel& four wheel	2

	dynamometers	
1.5	Vehicle testing lanes - side slip testers, brake testers, head light alignment testing.	2
2	**Engine analysers Module 2 (7 hours)**	
2.1	Engine analyzers- for petrol and diesel engines	1
2.2	Exhaust gas analyzers - Orsat apparatus, infrared gas analyzers, smoke meter	1
2.3	Energy consumption tests-Engine Cooling fan, air conditioning	1
2.4	Energy consumption tests - brake compressors	2
2.5	Fuel Consumption Test, test root selection, Vehicle test speeds.	2
3	**Collision and Crash Testing,Wind Tunnel Test Module 3 (7 hours)**	
3.1	Collision And Crash Testing of vehicles. Human Testing, Dummies, Crash worthiness of the vehicle.	1
3.2	Pole crash testing, near crash testing, vehicle to vehicle impact, side impact testing.	1
3.3	Crash test sensor, sensor mounting positions, braking distance test.	1
3.4	Wind Tunnel Test: Test requirements – ground boundary simulation wind tunnel selection	2
3.5	Reynolds number capability, model requirements, model details, model mounting, test procedure.	2
4	**Noise vibration and Harshness Module 4 (7 hours)**	
4.1	Automotive noise criteria, Standard noise measurement methods, Noise inside and outside the vehicle	1
4.2	Sources of vehicle noise- intake and exhaust noise, combustion noise, mechanical noise	1
4.3	Noise from auxiliaries, wind noises, transmission noises, brake squeal, structure noise, noise control methods.	2
4.4	Ride vibration and body test:Vibration measurement instrument – accelerometer and signal conditioning.	3
5	**Performance Testing Module 5 (7 hours)**	
5.1	Wheels and braking performance test: Dynamic cornering fatigue, dynamic radial fatigue tests – procedure.	1
5.2	Impact test – road hazard impact test for wheel and tyre assemblies, test procedures, failure criteria and performance criteria.	2
5.3	Bumpers - types of tests, pendulum test, fixed collision barrier test procedure, performance criteria.	2
5.4	Air and hydraulic brake test, air brake actuator, valves test, performance requirements. Parking brake – drawbar pull test,grade holding test.	2

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT433	TRACTORS AND FARM EQUIPMENTS	PEC	2	1	0	3

Preamble: This course aims at providing the students, an insight about tractors and various farm machineries, working of various components of tractors, various farming processes and equipment used in farming.

Prerequisite: Nil

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

CO 1	Understand about classification and applications of tractors, method of selection of equipment's and machines.
CO 2	Familiarize about the power plant used in tractors.
CO 3	Understand about the control system of tractors, preventive maintenance of various systems of a tractor.
CO 4	Familiar with tillage equipment's and ploughing methods.
CO 5	Familiar with harvesting and cultivation machinery.

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	-	1	1	-	-	2	-	1
CO 2	2	1	-	2	-	1	2	-	-	2	-	1
CO 3	-	1	-	1	-	1	1	-	-	2	-	1
CO 4	-	-	-	-	-	1	1	-	-	2	-	1
CO 5	-	1	-	1	-	2	3	-	-	2	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyze			
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. State the importance of maintenance.
2. List out the applications of tractors.
3. Define about wheeled and crawler tractors, also explain about the selection of equipment's and machines.

Course Outcome 2 (CO2):

1. Define in detail about the power plant used in tractors.
2. Describe about general engine performance characteristics.
3. List the lubricating system servicing and troubles for a tractor.

Course Outcome 3 (CO3):

1. Demonstrate the importance of control system for a tractor.
2. Discuss in detail about accessories for wheeled tractors.
3. Describe about preventive maintenance of engine components and various systems of a tractor.

Course Outcome 4 (CO4):

1. Demonstrate the importance of cage wheel in tractors.

2. Discuss in detail about various tillage equipment's.

3. Describe in detail about various ploughing methods.

Course Outcome 5 (CO5):

1. Discuss about construction of different harvesters.

2. Describe in detail about various cultivation machineries.

3. Discuss about machineries used for different crops.

SYLLABUS

Module 1

Introduction to Tractors and tractors units, General description of tractors: classification of tractors, Components of tractor. Applications of tractors, rating of tractors, wheeled and crawler tractor. Layout of wheeled and crawler tractors, crawler details, selection of machines, basic rules for matching machines, selection of equipment's including the nature of operating selection based on the type of soil, selection based on haul distance, selection based on weather conditions.

Module 2

Power plant in Tractors, Engine cycles, Operation of multi-cylinder engines, General engine performance characteristics, cooling system - classification, Liquid cooling system - components, lubricating system servicing and troubles, Air cleaner and turbo charger , fuel tanks and filters, fuel pumps.

Module 3

Power transmission, steering system, brakes and braking system, wheels, rims, tyres and accessories of wheeled tractors. Power transmission, steering, clutch and braking system in crawler tractors, hydraulic control system, power take off, tractor stability and ride characteristics. Preventive maintenance of engine components and various systems of a tractor.

Module 4

Primary and Secondary Tillage equipment's - DISC Plough, Mould Board Plough, furrow mounted plough. Tiller and Harrows - Construction and maintenance, plough controls, Mounting the plough, ploughing methods - systematic ploughing, round ploughing and one way ploughing, hitching - Three point linkage - cage wheel and its uses.

Module 5

Harvesting - conventional and Modern Harvesters, Threshing - Principle of paddy threshers, construction and maintenance, safety precautions. Cultivation machinery, cultivators - effects and uses of cultivator , disc harrows, seed harrows, chain harrows, spring tine cultivator , rotary cultivator - uses. Corn drills, seed metering mechanisms, combine harvester, potato crop machinery, hand feed and automatic sugar beet crop machinery.

Text Book:

1. Nakra C.P., "Farm machines and Equipments" Dhanparai Publishing company Pvt. Ltd.
2. Rodichev and G. Rodicheva, *Tractor and Automobiles*, MIR Publishers, Moscow, 1987

References:

1. Geleman and M. Maskovin, *Farm Tractors*, MIR. Publishers, Moscow, 1975.
2. Guruvech A. and B. Sorekin, *Tractors*, MIR Publishers Moscow, 1975.
3. Kolchin A. and V. Demidov, *Design of Automotive Engines for Tractor*, MIR P ublishers,Moscow, 1972.
4. Smith H. P. and L. H. Wilkes, *Farm Machinery and Equipment*, TATA McGraw Hill Publications, 1977

Model Question Paper

QP CODE: **PAGES:………**

Reg. No: ______________ **Name :_____________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

COURSE CODE: MUT 433

COURSE NAME: TRACTORS AND FARM EQUIPMENTS

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

PART A

I. Answer all questions. Each question carries 3 marks

1. Mention different implements that can be connected to a tractor?
2. Explain how a wheeled tractor or a crawler is selected based on application?
3. Explain the term PTO with respect to a tractor.
4. Explain how machines and equipment's are selected for farm machinery.
5. Mention general engine performance characteristics for a tractor.
6. Explain about the basic requirements of a power plant that can be used for a tractor.
7. Discuss different tillage equipment's for a tractor.
8. Briefly explain cage wheel and its uses.
9. Explain about different cultivators.
10. Write short note on seed metering mechanisms.

(10 x 3 =30 marks)

PART B

11 (a) What are the different types of final drives used in a tractor? Discuss them in detail with sketches.

OR

12 (a) Explain the advantages of crawler over a wheeled tractor for agricultural applications, also explain the selection criteria for a farm machine based on soil, haulage and weather

13 (a) Explain about different power plants used in tractors.

OR

14 (a) Discuss about the lubricating system troubles and servicing of a tractor.

15 (a) Explain in detail about the control systems used in tractors. Also explain hydraulic control system.

OR

16 (a) Explain in detail about the preventive maintenance schedule of engine components and various systems for a farm tractor.

17 (a) With neat sketches explain different tillage equipment's used for a tractor.

OR

18 (a) Explain different ploughing methods with the help of neat sketches.

19 (a) With neat diagrams, explain in detail about different harvesters used in agricultural purpose.

OR

20(a) Explain in detail about different cultivation machinery used in agricultural purpose with the help of suitable sketches.

(5 x 14=70 marks)

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Tractors, classification, Applications, Selection of machines**	
1.1	Introduction to tractors and tractors units	1
1.2	General Description of Tractors: Classification of tractors, Components of tractor	1
1.3	Applications of tractors	1
1.4	Rating of tractors	1
1.5	Wheeled and Crawler tractor, Layout of wheeled and crawler tractors	1
1.6	Crawler details, Selection of machines, basic rules for matching machines	1
1.7	Selection of equipment's including the nature of operating selection based on the type of soil, haul distance and weather conditions	1
2	**Different systems in Tractors**	
2.1	Power plant in Tractors	1
2.2	Engine cycles, operation of multi-cylinder engines	1
2.3	General engine performance characteristics	1
2.4	Cooling system - classification, liquid cooling system - components	1
2.5	Lubricating system servicing and troubles	1
2.6	Air cleaner and turbo charger	1
2.7	Fuel tanks and filters, fuel pumps	1
3	**Control system of Tractors**	
3.1	Power transmission, steering system of wheeled tractors	1
3.2	Clutch and braking system of wheeled tractors	1
3.3	Wheels, rims, tyres and accessories of wheeled tractors	1
3.4	Power transmission, steering system of crawler tractors	1
3.5	Clutch and braking system of crawler tractors	1
3.6	Hydraulic control system, power take off, Tractor stability and ride characteristics	1
3.7	Preventive maintenance of engine components and various systems of a tractor.	1
4	**Tillage Equipment's**	
4.1	Primary and Secondary Tillage equipment's	1
4.2	DISC Plough, Mould Board Plough, furrow mounted plough	1
4.3	Tiller and Harrows - construction and maintenance	1
4.4	Plough controls, mounting the plough	1
4.5	Ploughing methods - systematic ploughing	1

4.6	Round ploughing and one way ploughing	1
4.7	Hitching - Three point linkage, Cage wheel and its uses	1
5	**Harvesters and Cultivators**	
5.1	Harvesting - conventional and modern Harvesters	1
5.2	Threshing - Principle of paddy threshers	1
5.3	Construction and maintenance, safety precautions	1
5.4	Cultivation machinery, cultivators - effects and uses of cultivator	1
5.5	Disc harrows, seed harrows, chain harrows, spring tine cultivator , rotary cultivator – uses	1
5.6	Corn drills, seed metering mechanisms	1
5.7	Combine harvester, potato crop machinery , Hand feed and automatic sugar beet crop machinery	1

MUT443	TOTAL QUALITY MANAGEMENT	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: Total Quality Management concept and principles are used to achieve Total Quality Management, and to enhance the statistical approach for quality control. This subject will give an understanding about the need for quality and the application of TQM to achieve total quality control. It will also create awareness about the ISO and QS certification process and its need in the industries

- ✓ To impart knowledge about quality management principles, techniques and philosophies.
- ✓ To study the application of SQC and SPC techniques to improve the quality.
- ✓ To have better understanding about various TQM techniques used for quality improvement in industries
- ✓ To understand and create awareness about Quality Management System and its certification.
- ✓ To have basic understanding of Reliability Engineering and its techniques.

Prerequisite: Nil

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

CO 1	Demonstrate knowledge of quality management principles, techniques and philosophies
CO 2	Understand and apply SQC and SPC techniques to improve the quality.
CO 3	Demonstrate knowledge of TQM tools for industries and its application.
CO 4	Understand the Quality Management System and Environmental Management system in industries.
CO 5	Demonstrate basic knowledge about reliability engineering and its techniques.

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	3	-	-	1	1	-	-	-	-	-	-	-
CO 3	3	-	-	-	1	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	1	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
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. Define quality. Explain the need of quality.

2. Discuss about principle of TQM.

Course Outcome 2 (CO2)

1. Discuss about the seven quality control tools.

2. Explain about six sigma process.

3. Discuss the benefits of statistical quality control.

Course Outcome 3(CO3):

1. Discuss the features of Design FMEA and Process FMEA.

2. Explain the process of QFD.

Course Outcome 4 (CO4):

1. Elaborate on the benefits Quality Management System.

2. Discuss about ISO 9001 series of standards and its requirements.

Course Outcome 5 (CO5):

1. Discuss the importance of Reliability Engineering.

2. Explain about Bath Tub Concept used in Reliability Engineering.

SYLLABUS

Module 1

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM- Basic concepts of TQM, Principles of TQM- Leadership Concepts, Role of Senior Management, Quality Council, Strategic Planning, Customer Satisfaction –Customer Perception of Quality, Deming Philosophy, Continuous Process Improvement, Juran Trilogy, PDSA Cycle, 5S, Kaizen.

Module 2

The seven traditional tools of quality -Statistical Fundamentals, Population and Sample, Normal Curve, Control Charts for Variables and Attributes, New management tools - Six-sigma Process Capability-Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking

Module 3

FMEA - Intent, Documentation, Stages: Design FMEA and Process FMEA. Quality Function Deployment (QFD) House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) Concept, Improvement Needs-– Performance measures- Cost of Quality - BPR.

Module 4

Quality Management System-Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards – AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation- Internal Audits-Registration- Environmental Management System: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.

Module 5

Introduction to Reliability- Importance of Reliability, Performance Cost and Reliability, Quality and Safety, System Configuration with Examples, Stochastic Processes, Bathtub Concept, MTBF, MTTR, Hazard Rate, Failure Rate, Probability and Sampling, Cumulative Probability Distribution Function, Data and Distributions.

Text Books

1	Total Quality Management	Dale H. Besterfiled, Carol B. Michna, Glen H. Bester field, Mary B. Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe	Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.
2	Total Quality Management	Joel E. Rose,	3rd Edition, Kogan Page Ltd., USA 1999
3	Reliability Engineering	Srinath, L. S	Affiliated East West Press, New Delhi 2005

Reference Books

1	Total Quality Management	Feigenbaum A V	McGraw Hill, 1991
2	Total Quality Management: Key concepts and case studies	Kiran D R	Butterworth – Heinemann Ltd, 2016.
3	Introduction to Reliability Engineering	E E Lewis	John Wiley and Sons
4	Reliability Engineering	S S Rao	Pearson Education India; First edition (3 March 2016)

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Introduction to TQM Module 1 (7 hours)**	
1.1	Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality	1
1.2	Definition of TQM- Basic concepts of TQM, Principles of TQM	1
1.3	Leadership Concepts, Role of Senior Management, Quality Council, Strategic Planning	1
1.4	Customer Satisfaction–Customer Perception of Quality, Deming Philosophy, Continuous Process Improvement	2
1.5	Juran Trilogy, PDSA Cycle, 5S, Kaizen.	2
2	**SQC and SPC Module 2 (7 hours)**	
2.1	The seven traditional tools of quality - Statistical Fundamentals	1
2.2	Population and Sample, Normal Curve, Control Charts for Variables and Attributes	1
2.3	New management tools - Six-sigma Process Capability	2
2.4	Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark	1
2.5	Understanding Current Performance, Planning, Studying Others, learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking	2
3	**TQM tools and techniques Module 3 (7 hours)**	
3.1	FMEA - Intent, Documentation, Stages: Design FMEA and Process FMEA	2
3.2	Quality Function Deployment (QFD) House of Quality, QFD Process, Benefits	2
3.3	Taguchi Quality Loss Function, Total Productive Maintenance (TPM) Concept	2
3.4	Improvement Needs- – Performance measures- Cost of Quality - BPR.	1
4	**Quality Management System and EMS 4 (7 hours)**	

4.1	Quality Management System-Introduction-Benefits of ISO Registration	1
4.2	ISO 9000 Series of Standards, Sector-Specific Standards – AS 9100, TS16949 and TL 9000	2
4.3	ISO 9001 Requirements-Implementation-Documentation- Internal Audits-Registration	2
4.4	Environmental Management System: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.	2
5	**Performance Testing Module 5 (7 hours)**	
5.1	Introduction to Reliability- Importance of Reliability, Performance Cost and Reliability	2
5.2	Quality and Safety, System Configuration with Examples, Stochastic Processes	2
5.3	Bathtub Concept, MTBF, MTTR, Hazard Rate, Failure Rate	1
5.4	Probability and Sampling, Cumulative Probability Distribution Function, Data and Distributions.	2

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: MUT443

Course Name: Total Quality Management

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

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. Define quality. Explain the need of quality.

2. List out the basic principles of TQM.

3. List out seven traditional tools of quality.

4. Discuss the benefits of statistical quality control.

5. Differentiate between Design FMEA and Process FMEA.

6. What is meant by QFD?

7. What are the benefits of ISO Registration?

8. List the benefits of EMS?

9. Discuss the importance of Reliability.

10. Explain Bath tub concept?

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

11. List and explain the principles of TQM. (14)

Or

12. Explain briefly the 14 points of Deming's Philosophy. (14)

Module 2

13. What is meant by process capability? Briefly explain about six sigma process. (14)

Or

14. Define SQC and SPC. Write down the process of preparing control chart. (14)

Module 3

15. Explain the process of FMEA. Differentiate between Design FMEA and Process FMEA. (14)

Or

16. a. Explain QFD process. (7)

b. What is meant by Total Quality Maintenance? (7)

Module 4

17 a. What is meant by QMS? Write down its benefits. (7)

b. Explain about EMS. What are the requirements of ISO 14001 standard? **(7)**

Or

18. Discuss in detail about any ISO 9000 series standards. (14)

Module 5

19.Explain about Bath Tub concept. How it is related to the life of products. (14)

Or

20.Define Reliability. Discuss its significance in relation to product life cycle and customer satisfaction. (14)

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MET423	OPTIMIZATION TECHNIQUES AND APPLICATIONS	PEC	2	1	0	3

Preamble: This course introduces the students to the concept of solving engineering problems by developing linear and non-linear mathematical models. The models involve objectives and constraints in terms of the relevant design variables. The student learns to apply a suitable mathematical programming technique to solve the developed model. The course includes Linear Programming, Integer Programing, Dynamic Programming, Classical Optimization and Metaheuristic techniques.

Prerequisite: Basic concepts of linear algebra.

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

CO 1	Formulate engineering problems as mathematical programming problems.
CO 2	Apply Simplex and dual Simplex methods to solve linear programming problems.
CO 3	Analyse the sensitivity of the model parameters
CO 4	Solve integer programming problems.
CO 5	Apply Dynamic Programming techniques to solve sequential optimization problems
CO 6	Apply classical optimization techniques and algorithms to solve nonlinear optimization problems.

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	1							
CO 2	3	3	2	2	2							
CO 3	3	3	3	3	2							
CO 4	3	3	2	2	2							
CO 5	3	3	2	2								
CO 6	3	3	3	3								

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember			5
Understand			5
Apply	30	30	40
Analyse	10	10	20
Evaluate	10	10	20
Create			10

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. Consider a chocolate manufacturing company that produces only two types of chocolate – A and B. Both the chocolates require Milk and Choco only. Each unit of A requires 1 unit of Milk and 3 units of Choco, and each unit of B requires 1 unit of Milk and 2 units of Choco. The company kitchen has a total of 5 units of Milk and 12 units of Choco. On each sale, the company makes a profit of Rs 6 per unit A sold, and Rs 5 per unit B sold. Now, the company wishes to maximize its profit. Formulate the problem as a LPP and determine how many units of A and B should it produce respectively?

2. A person wishes to invest Rs.14,000. He has identified four investment opportunities. Investment 1 requires an investment of $5,000 and has a present value (a time-discounted value) of $8,000; Investment 2 requires $7,000 and has a value of $11,000; Investment 3 requires $4,000 and has a value of $6,000; and Investment 4 requires $3,000 and has a value of $4,000. Into which investments should he place his money so as to maximize the total present value?

3. Find the dimensions of a box of largest volume that can be inscribed in a sphere of unit radius.

Course Outcome 2 (CO2)

1. Solve the following LPP using simplex method.

Minimize $Z = 4x_1 + x_2$

Subject to:

$3x_1 + x_2 = 3;$

$4x_1 + 3x_2 \geq 6;$

$x_1 + 2x_2 \leq 4;$
$x_1, x_2 \geq 0;$

2. Show that the Big-M method will conclude that the following LPP has no feasible solution.
   Maximize Z = $2x_1 + 5x_2$
   Subject to:
   $3x_1 + 2x_2 \geq 6;$
   $2x_1 + x_2 \leq 2;$
   $x_1, x_2 \geq 0;$

3. Generate the dual simplex iterations for the LPP given below and find the solution.
   Minimize Z = $5x_1 + 6x_2$
   Subject to :
   $x_1 + x_2 \geq 2;$
   $4x_1 + x_2 \geq 4;$
   $x_1, x_2 \geq 0;$

Course Outcome 3(CO3):

1. The following LPP has an optimal solution of $x_1 = 320$; $x_2 = 360$ and Objective function value = 4360.

   Maximize Z = $8x_1 + 5x_2$
   Subject to:
   $2x_1 + 1x_2 \leq 1000;$
   $3x_1 + 4x_2 \leq 2400;$
   $x_1 + x_2 \leq 700;$
   $x_1 - x_2 \leq 350;$
   $x_1, x_2 \geq 0.$

   Carry out sensitivity analysis to determine the range in which the objective function coefficients can vary keeping the current solution as optimal.
2. Determine the shadow price corresponding to the first constraint for the LPP given in the previous question.

3. Describe the concept of shadow price and reduced cost.

Course Outcome 4 (CO4):

1. Solve the following integer programming problem using Branch and Bound algorithm.
   Maximize Z = $5x_1 + 4x_2;$
   Subject to:
   $x_1 + x_2 \leq 5;$
   $10x_1 + 6x_2 \leq 45;$
   $x_1, x_2 \geq 0$, and integers.

2. Solve the following integer programming problem using the cutting plane algorithm.
   Maximize Z = $7x_1 + 10x_2$
   Subject to:
   $-x_1 + 3x_2 \leq 6;$

$7x_1 + x_2 \leq 35;$

$x_1, x_2 \geq 0$, and integers.

3. Solve the following integer programming problem.

Maximize $Z = 2x_1 + 3x_2$

Subject to:

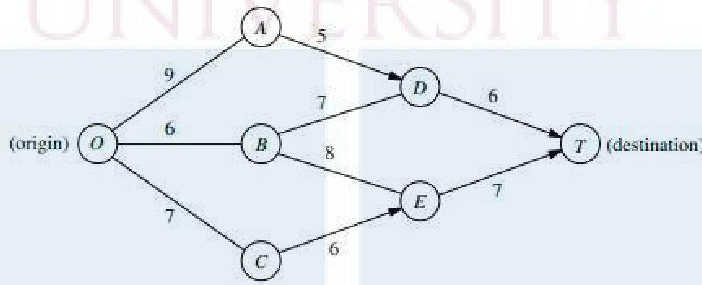
$5x_1 + 7x_2 \leq 35;$

$4x_1 + 9x_2 \leq 36;$

$x_1, x_2 \geq 0$, and integers.

Course Outcome 5 (CO5):

1. Find the shortest distance between the origin and destination for the network given below using dynamic programming.



2. What is Bellman's principle of optimality?

3. A college student has 7 days remaining before the final examinations for four courses, and she wants to allocate this study time as effectively as possible. She needs at least 1 day on each course, and likes to concentrate on just one course each day. So she wants to allocate 1, 2, 3, or 4 days to each course. She decides to use dynamic programming to make these allocations to maximize the total grade points to be obtained from the four courses. She estimates that the alternative allocations for each course would yield the number of grade points shown in the table given below. Solve this problem using dynamic programming.

Study Days	Estimated grade points			
	Course 1	Course 2	Course 3	Course 4
1	3	5	2	6
2	5	5	4	7
3	6	6	7	9
4	7	9	8	9

Course Outcome 6 (CO6):

1. Maximize the function $f(x_1, x_2, x_3) = x_1 + 2x_2 + x_2x_3 - x_1^2 - x_2^2 - x_3^2$

2. Find the solution for the following problem using the Lagrange multiplier method.

Minimize $f(x, y) = 5x^{-1}y^{-2}$

subject to : $g(x,y) = x^2 + y^2 - 9 = 0$

3. Use the Fibonacci search method to minimize the function

Model Question Paper

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
VII SEMESTER BTECH DEGREE EXAMINATION
MET423: OPTIMIZATION TECHNIQUES AND APPLICATIONS

Maximum : 100 Marks Duration : 3 hrs.

PART A

Answer all questions. Each question carries 3 marks.

1. How is degeneracy identified in the simplex procedure?

2. What is the role of artificial variables in simplex method?

3. Write the dual for the following LPP.

   Maximize $Z = 5x_1 + 4x_2$;
   Subject to:
   $x_1 + x_2 \leq 5$;
   $10x_1 + 6x_2 \leq 45$;
   $x_1, x_2 \geq 0$.

4. What is meant by shadow price?

5. Explain the importance of integer programming models and their applications.

6. What is Bellman's principle of optimality?

7. Find the extreme points of the function

$$f(x) = 12x^5 - 45x^4 + 40x^3 + 5$$

8. State the necessary and sufficient conditions for the maximum of a multivariable function $f(X)$.

9. Find the Hessian matrix of the function $f(x) = 3x_1^2x_2^2 - x_2^2x_3^3$

10. Describe the procedure of Golden Section search method.

PART B

Answer one full question from each module

Module 1

11. a) Consider a chocolate manufacturing company that produces only two types of chocolate – A and B. Both the chocolates require Milk and Choco only. Each unit of A requires 1 unit of Milk and 3 units of Choco, and each unit of B requires 1 unit of Milk and 2 units of Choco. The company kitchen has a total of 5 units of Milk and 12 units of Choco. On each sale, the company makes a profit of Rs 6 per unit A sold, and Rs 5 per unit B sold. Now, the company wishes to maximize its profit. Formulate the problem as a

LPP and graphically determine how many units of A and B should it produce respectively?

(5 Marks)

b) Use Simplex method to solve the following LPP.

Minimize $Z = 4x_1 + x_2$
Subject to:

$$3x_1 + x_2 = 3;$$
$$4x_1 + 3x_2 \geq 6;$$
$$x_1 + 2x_2 \leq 4;$$
$$x_1, x_2 \geq 0;$$

(9 Marks)

12. Solve the following LPP using Simplex method and carry out sensitivity analysis to determine the range in which the objective function coefficients can vary keeping the current solution as optimal.

Maximize $Z = 8x_1 + 5x_2$
Subject to:

$$2x_1 + 1x_2 \leq 1000;$$
$$3x_1 + 4x_2 \leq 2400;$$
$$x_1 + x_2 \leq 700;$$
$$x_1 - x_2 \leq 350;$$
$$x_1, x_2 \geq 0.$$

(14 Marks)

Module 2

13. Generate the dual simplex iterations for the LPP given below and find the solution.

Minimize $Z = 5x_1 + 6x_2$
Subject to :

$$x_1 + x_2 \geq 2;$$
$$4x_1 + x_2 \geq 4;$$
$$x_1, x_2 \geq 0;$$

(14 Marks)

14. Solve the following integer programming problem using Branch and Bound algorithm.

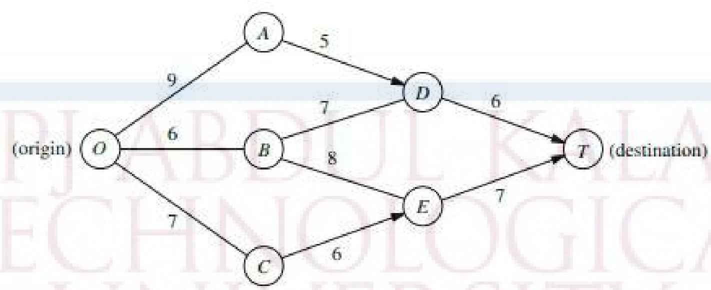
Maximize $Z = 2x_1 + 3x_2$
Subject to:

$$5x_1 + 7x_2 \leq 35;$$
$$4x_1 + 9x_2 \leq 36;$$
$$x_1, x_2 \geq 0, \text{ and integers}$$

(14 Marks)

Module 3

15. Find the shortest distance between the origin and destination for the network given below using dynamic programming.



(14 Marks)

16. A candidate in an election wants to purchase TV time for a total of four commercials on TV stations located in four areas. Based on polling information, an estimate is made of the number of votes that can be won in the different areas depending upon the number of commercials run. These estimates are given in the table in thousands of votes. Use dynamic programming to find how the four commercials should be distributed among the four areas to maximize the estimated number of votes won.

Commercials	Area			
	1	2	3	4
0	0	0	0	0
1	4	6	5	3
2	7	8	9	7
3	9	10	10	12
4	12	11	12	14

(14 Marks)

Module 4

17. a) Find the extreme points of the function $f(X) = x_1^3 + x_2^3 + 2x_1^2 + 4x_2^2 + 6$

(6 Marks)

b) Find the maximum of the function $f(X) = 2x_1 + x_2 + 10$; subject to $g(X) = x_1 + 2x_2^2 = 3$ using the Lagrange multiplier method.

(8 Marks)

18. a) Find the dimensions of a box of largest volume that can be inscribed in a sphere of unit radius. (6 Marks)

b) Maximize the function $f(x_1, x_2, x_3) = x_1 + 2x_2 + x_2x_3 - x_1^2 - x_2^2 - x_3^2$ (8 Marks)

Module 5

19. a) Minimize the function $f(x) = 0.65 - [0.75/(1+x^2)] - 0.65x \tan^{-1}(1/x)$ in the interval [0,3] using the Fibonacci method with n = 6. (7 Marks)

b) Use the steepest descent method to search for the minimum for the function $f(x, y) = 25x^2 + y^2$. Start at (1, 3) with a step size of 0.5 (7 Marks)

20. a) Use the golden section search method to minimize the function

$f(x) = x^4 - 14x^3 + 60x^2 - 70x$ in the range [0,2]. (7 Marks)

b) Solve $\cos x = 2x$ using Newton Raphson method. Carry out 4 iterations.

(7 Marks)

Syllabus

Module 1

Formulation of engineering problems as mathematical programming models: Linear Programming formulations.

Solutions to Linear Programming Problems: Simplex method – Big-M and 2-phase methods – Sensitivity Analysis for the objective function coefficients and right hand side coefficients of constraints - Exceptional cases in LPP.

Module 2

Duality concept in LPP - Dual Simplex method.

Integer Programming problem: Applications of Integer Programming problems - Integer Programming algorithms - Cutting Plane method - Branch and Bound method.

Module 3

Dynamic Programming: Bellman’s principle of optimality - Forward recursion and backward recursion - Application problems- Shortest route and Knapsack problems.

Module 4

Classical optimization techniques: Single variable optimization - Multivariable optimization with no constraints - Optimization with equality constraints - Method of Lagrange Multipliers - Optimization with inequality constraints - Kuhn-Tucker conditions.

Module 5

Algorithms for unconstrained optimization: Fibonacci search method - Golden section search method -Hooke and Jeeve’s method - Newton-Raphson method - Cauchy's (Steepest descent) method.

Text Books

1. Hamdy A. Taha, "Operations Research, An Introduction", Pearson Education, 10^{th} edition, 2019.
2. S. S. Rao, "Engineering Optimization, Theory and Practice", New Age International, 3^{rd} edition, 2013

Reference Books

1. N. V. S. Raju, " Optimization Methods for Engineers", Prentice-Hall of India, 1^{st} edition, 2014
2. Ravindran, Philips and Solberg, "Operations Research, Principles and Practice", Wiley, 2^{nd} edition, 2007

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1**	
1.1	Formulation of engineering problems as mathematical programming models.	1
1.2	Linear Programming models, Examples	1
1.3	Graphical method to solve LPP	1
1.4	Simplex method, Introduction	1
1.5	Example problems using Simplex method	2
1.6	Big-M method and 2-phase method	2
1.7	Sensitivity analysis	2
1.8	Exceptional cases	1
2	**Module 2**	
2.1	Duality concept in LPP	1
2.2	Dual Simplex method	2
2.3	Integer Programming problem – Introduction and applications.	1
2.4	Branch and Bound method	2
2.5	Cutting Plane method	2
3	**Module 3**	
3.1	Dynamic Programming- Introduction and Bellman's principle of optimality	1
3.2	Forward recursion and backward recursion	1
3.3	Application problems -Shortest route problem	2
3.4	Knapsack problem	2
4	**Module 4**	
4.1	Classical optimization – Introduction- Single variable optimization	1
4.2	Multivariable optimization with no constraints	2
4.3	Optimization with equality constraints - Method of Lagrange	2

	Multipliers	
4.4	Optimization with inequality constraints - Kuhn-Tucker conditions.	2
5	**Module 5**	
5.1	Algorithms for unconstrained optimization- Introduction	1
5.2	Fibonacci search method	1
5.3	Golden section search method	1
5.4	Hooke and Jeeve’s method	1
5.5	Newton-Raphson method.	1
5.6	Cauchy's (Steepest descent) method	1

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

CODE MUT463	COURSE NAME AUTOMOTIVE TESTING EQUIPMENTS	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: This course aims at providing the students, an insight on the advanced combustion systems and engine technologies.

Prerequisite: NIL

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

CO 1	Understand the working principle of various measurement devices.
CO 2	Understand the basics of engine in-cylinder measurement equipment
CO 3	Understand the methods of measurement of air, fuel and oil
CO 4	Understand the working principle and operation of dynamometers
CO 5	Understand the basic principles and types equipment used in vehicle testing

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	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	40
Apply	20	20	50
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.

Expected outcome: The students will become aware of the latest developments and advancement in the field of IC engines.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the working principle of angle encoders.
2. With neat sketch explain the working of mass flow meters
3. What are the various equipment used in emission test bench ?
4. What is constant volume sampling ?
5. With neat sketch explain the working of volume flowmeters

Course Outcome 2 (CO2)

1. Explain the advantages of in-cylinder measurements
2. What are the spectroscopic techniques used in in-cylinder measurements?
3. Explain the working of a phase Doppler analyser.
4. Differentiate Fast FID and CLD.
5. Why particle image velocimeter is used ?

Course Outcome 3(CO3):

1. On what criteria a fuel flow meter is selected for engine testing?
2. What are the various air flow measurement devices?
3. Discuss the importance of sensitivity of measuring instrument
4. What are the equipment used for crankcase blow by measurement?
5. How liquid fuel consumption is measured?

Course Outcome 4 (CO4):

1. What is a dynamometer? Classify and explain
2. Explain the selection criteria of dynamometer.
3. How dynamometer is calibrated? Explain with example
4. How is engine coupled to a dynamometer?
5. Explain the advantages and disadvantages of eddy current dynamometer.

Course Outcome 5 (CO5):

1. Explain the principle of operation of an anemometer
2. What are the types of weighing instruments used in vehicle testing?
3. What are the torque and angle measuring instruments used?
4. How is the sound pressure level measured?
5. Briefly explain the tyre tread measurement.

Model Question Paper

QP CODE:
PAGES:…

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT 463

Course Name: AUTOMOTIVE TESTING EQUIPMENTS

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

Part A
(Answer all questions. Each question carries 3 marks)

1. Discuss the working principle of a pressure transducer.
2. What are the various temperature sensors?
3. How is the air consumption calculated?
4. Explain the measurement of BSFC in an engine?
5. What are the types of dynamometers?
6. Mention the various factors that influence dynamometer selection.
7. What are the advantages of in-cylinder measurements?
8. Broadly classify in-cylinder measurements.
9. Explain the basic testing equipment for vehicle testing
10. Briefly describe the application of anemometer in vehicle testing

Part B
(Answer any one full question from each module. Each question carries 14 Marks)

11. (a) Explain the constant volume sampling method. (7)

(b) Differentiate mass and volume flow meter with neat sketches (7)

OR

12. Explain the various emission measuring instruments in detail (14)

13. Explain the optical methods of engine in cylinder measurement (14)

OR

14. With a suitable sketch explain the soot measurement instrument. (14)

15. Explain the various air flow measuring devices with neat sketches (14)

OR

16. Explain the various liquid fuel consumption measurement devices with neat sketches (14)

17. With neat sketches, explain the measurement using dynamometers? (14)

OR

18. Explain in detail the various types of dynamometers with neat sketches (14)

19. Explain the various weighing equipment used in the vehicle testing (14)

OR

20. What is tyre tread depth measuring equipment? Explain in detail (14)

SYLLABUS

Module 1

Working principles of measurement devices – Pressure Transducer – Angle Encoders – Temperature Sensors – Mass Flow Meter – Volume Flow Meter – Emission Test Bench – Constant Volume Sampling – Emission Measurement Instruments

Module 2

Engine In-cylinder measurements–Pressure measurement – Fast FID and CLD – Sampling Valve – Optical Access – Combustion Visualization – Spectroscopic Techniques –Flame Temperature and Soot Measurement – Phase Doppler Analyser – Particle Image Velocimeter

Module 3

Introduction to measurement of air, fuel and oil consumption–Air flow measuring devices– Measurement of liquid fuel consumption –Selection of fuel flow meter– Brake Specific Fuel Consumption –– Oil Consumption Measurement– Measurement of Crankcase Blow-by –Sensitivity of the measuring instrument.

Module 4

Introduction to Dynamometer – Function and Basic Working Principle – Types of Dynamometer– Dynamometer Selection Criteria–Dynamometer Measurement – Calibration – Advantages and Disadvantages – Coupling Engine to Dynamometer

Module 5

Introduction to vehicle testing equipment – Marker – Camera – Barometer – Microphone – Speed Sensor – Thermocouples – Measuring Tape – Weighing system – Tyre pressure gauge – Tyre depth gauge – Fuel flow measurement – Torque/angle measuring instrument – Tachometer – Anemometer.

Text/Reference Books

1. Martyr, Anthony J., and Michael Alexander Plint. Engine testing: theory and practice. Elsevier, 2011..

Course Contents and Lecture Schedule

No	Topics	No. of Lectures
1	**MODULE – 1:**	
1.1	Working principles of measurement devices	1
1.2	Pressure Transducer	1
1.3	Angle Encoders	1
1.4	Temperature Sensors	1
1.5	Mass Flow Meter	1
1.6	Volume Flow Meter, Emission Test Bench	1
1.7	Constant Volume Sampling, Emission Measurement Instruments	1
2	**MODULE – 2:**	
2.1	Engine In-cylinder measurements–Pressure measurement	1
2.2	Fast FID , CLD and Sampling Valve	1
2.3	Optical Access and Combustion Visualization	1
2.4	Spectroscopic Techniques	1
2.5	Flame Temperature and Soot Measurement	1
2.6	Phase Doppler Analyser	1
2.7	Particle Image Velocimeter	1
3	**MODULE – 3:**	
3.1	Introduction to measurement of air, fuel and oil consumption	1
3.2	Air flow measuring devices	1
3.3	Measurement of liquid fuel consumption	1
3.4	Selection of fuel flow meter &Brake Specific Fuel Consumption	1
3.5	Oil Consumption Measurement	1
3.6	Measurement of Crankcase Blow-by	1
3.7	Sensitivity of the measuring instrument	1
4	**MODULE – 4:**	
4.1	Introduction to Dynamometer – Function and Basic Working Principle	1
4.2	Types of Dynamometer	1
4.3	Dynamometer Selection Criteria	1
4.4	Dynamometer Measurement & Calibration	2

4.5	Advantages and Disadvantages of Dynamometer	1
4.6	Coupling Engine to Dynamometer	1
5	**MODULE – 5:**	
5.1	Introduction to vehicle testing equipment	1
5.2	Marker, Camera, Barometer and Microphone	1
5.3	Weighing system	1
5.4	Tyre pressure gauge and Tyre depth gauge	1
5.5	Fuel flow measurement – Torque/angle measuring instrument –	2
5.6	Tachometer – Anemometer	1

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

MUT473	AUTOMOTIVE AERODYNAMICS	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: This course aims at providing

1. Understand vehicle aerodynamics, its scope and opportunities.
2. Identifying the sources of drag and to acquire the knowledge of its mitigation strategies using various methods.
3. Analyse the road vehicle stability from an aerodynamic viewpoint.

Prerequisite: MUT203 AUTO CHASSIS, MUT305 VEHICLE DYNAMICS

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

CO 1	To familiarise with road vehicle aerodynamics and to understand how the aerodynamic is related to the fuel consumption and performance
CO 2	To identify the sources of drag and to familiarise with the methods to mitigate the negative consequences of the drag
CO 3	To familiarise with the wind tunnel experiments and software tools for examining vehicle aerodynamics
CO 4	Identify and analyse the aerodynamic stability and behaviours of the road vehicles using numerical methods with the help of software tools
CO 5	To understand and familiarise with various aerodynamic forces and its impact on the road vehicles

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	-	-	-	-	1
CO 2	1	2	-	-	-	-	-	-	-	-	-	1
CO 3	1	2	-	2	2	-	-	-	-	-	-	2
CO 4	1	2	-	-	-	-	-	-	-	-	-	1
CO 5	1	2	-	2	2	-	-	-	-	-	-	1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	50
Apply	10	10	20
Analyse	10	10	20
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. Can you able to make familiar with vehicle aerodynamics, its scope and opportunities and how the aerodynamic study helps in increasing the fuel efficiency.

Course Outcome 2 (CO2)
1. Can you able to evaluate and identify the sources of drag and the methods to mitigate the drag?

Course Outcome 3(CO3):
1. Can you able to explain the wind tunnel experiments and software tools for examining vehicle aerodynamics.

Course Outcome 4 (CO4):
1. Are you able to explain the procedure to identify and analyse the aerodynamic stability?

Course Outcome 5 (CO5):
1. Can you able to understand and familiarise with various aerodynamic forces and its impact on the road vehicles?

Model Question Paper

QP CODE:
PAGES:…

Reg. No: _______________ **Name :_______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT473

Course Name: AUTOMOTIVE AERODYNAMICS

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

Part A
(Answer all questions. Each question carry 3 marks)

1. Discuss briefly the history and development of vehicle aerodynamics.
2. Explain the term drag.
3. What is the effect of aerodynamic drag on fuel consumption?
4. What do you understand by ascending ability.
5. Discuss the importance of aerodynamic forces and their influence on passenger
6. Explain the basic features of CFD Package.
7. Define the term trailing vortices.
8. How the aerodynamic axle loads relief settings helps in aerodynamic performance of the vehicle.
9. Discuss the history of commercial vehicle aerodynamics.
10. How do you calculate the CD value of a commercial vehicle during test drives?

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

11. Discuss the principle of wind tunnel technology and explain the various flow visualization techniques. (14)

OR

12. a) Explain the various body optimization techniques for minimising the drag. (7)
    b) Discuss the characteristics of forces and moments influencing drag. (7)

13. a) Define theory of driving resistance. (7)
    b) Explain the terms acceleration and elasticity. (7)

OR

14. What do you understand by worldwide-harmonized light vehicles test procedure and explain the various possible measures for reducing fuel consumption. (14)

15. a) Discuss the influence of basic shape modifications for drag reduction in passenger cars. (14)

OR

16. (a) Explain the basic steps of computational aerodynamics for ground vehicles (7)
    (b) Define yaw and pitching moments. (7)

17. Discuss in details the effect side wind on the stability of the road vehicle. (14)

OR

18. a). Discuss the effect of the environment on aerodynamic drag. (7)
    b).Discuss the aerodynamic characteristics of truck-car Passing interaction (7)

19. With the help of a case example, explain the steps involved in commercial vehicle aerodynamic study using software packages. (14)

OR

20. Explain the salient features of commercial vehicle drag reduction components. (14)

SYLLABUS

Module 1: Introduction to automobile aerodynamics, The Role of Aerodynamics in Vehicle Design,The Character of Vehicle Aerodynamics,Flow of air around the vehicle; Flow of air through the vehicle's body; Flow processes within the vehicle's machinery, Historical Development of Vehicle Aerodynamics, Systematic development of car aerodynamics, Fundamentals of fluid mechanics – Flow phenomenon related to vehicles, Types of aerodynamic drag. Forces and moments influencing drag. Effects of forces and moments. Various body optimization techniques for minimum drag. – External & Internal flow problems. Various body optimization techniques for minimum drag.Principle of wind tunnel technology. Flow visualization techniques. Testing with wind tunnel balance (scale models), full scale wind tunnels - measurement techniques - equipment and transducers - road testing methods – numerical

Module 2: Consumption and Performance,Resistance to vehicle motion – Performance – Fuel consumption and performance – Potential of vehicle aerodynamics, The Significance of Aerodynamic Drag, Effect of Aerodynamic Drag on Fuel Consumption, Theory of Driving Resistance, Rolling Resistance, Aerodynamic Drag, Grade Resistance, acceleration, Overall Driving Resistance, Acceleration and Elasticity,Ascending Ability, Calculating Fuel Consumption,Different Cycles, Consumption Measurement and CO2 and Energy Equivalents, Worldwide Harmonized Light Vehicles Test Procedure, Possibilities for Reducing Fuel Consumption. Introduction to simulation exercise,

Module 3: Aerodynamic Forces and Their Influence on Passenger, Vehicles Flow Field Around Cars,Analysis of Aerodynamic Drag Components, Other Components of Aerodynamic Force and Aerodynamic Moment such as Lift and Pitching Moment ,Side Force and Yaw Moment, Roll Moment. Influence on Aerodynamic Forces.The Influence of Basic Shape:Vehicle Front,Position of the Stagnation Point, Hood Inclination, Windshield, A-Pillar,side window inclination, rear end shapes, wheel house shape etc... Shape optimization of cars front end modification - front and rear windshield angle - boat tailing - hatch back, fast back and square back -dust flow patterns at the rear - effects of gap configuration - effect of fasteners.Basics of Computational Aerodynamics for Ground Vehicles, Modeling, Methods of Modeling, introduction to CFD Packages.

Module 4: Aerodynamics and Driving Stability : Introduction to driving dynamics of the vehicle, Unsteady Aerodynamic Forces and Moments: Overtaking Maneuvers, Side Wind , Dynamic Driving Effects, Single-Track Model , Reaction to Lift Force, Aerodynamic Axle Load Relief Settings,Reaction to Crosswinds, Traction,Power Requirement,Tire Contribution, Sideslip and Turning , Trailing Vortices, Control Surfaces,Car Underbody Flow, Cross Wind, Truck-Car Passing Interaction,Effect of the Environment on Aerodynamic Drag.

Module 5: Commercial vehicle aerodynamics: History of Commercial Vehicle Aerodynamics, Principles of Commercial Vehicle Aerodynamics:Straight/Oblique Flow, Tools for Optimizing Commercial Vehicle Aerodynamics: Model wind tunnel, Wind tunnel measurements with scale ,CFD simulation , Calculation of the CD value during test drives, Full-Scale Wind Tunnel, CFD Simulation, Constant-speed driving and Coasting test. Optimizing Aerodynamic Drag on Trucks, buses and coaches, Effects of rounding sharp front body edges. Effects of various cabs on trailer body. Fore body pressure distribution. Effects of a cab to trailer body roof height. Commercial vehicles drag reduction devices. Characteristic Airflow and Pressure Conditions, Airflow Through the Engine Compartment, Cab. Mirrors and other Attachments, Semitrailers and Bodies, Rear View Mirrors, Windscreen Wipers, Underbody, Wheels and Wheel Covers, Tipping and Susceptibility to Side Winds.

Text Books

1. Thomas Schuetz– Aerodynamic of Road Vehicles – 2016 SAE International.
2. T. Yomi Obidi,-Theory and Applications of Aerodynamics for Ground Vehicles- 2014 SAE International

Reference Books

1. Hucho.W.H. – Aerodynamic of Road Vehicles – Butterworths Co., Ltd., – 1997.
2. A. Pope – Wind Tunnel Testing- John Wiley & Sons – 2nd Edition, New York – 1974.
3. Automotive Aerodynamic: Update SP-706 – SAE – 1987
4. Vehicle Aerodynamics – SP-1145 – SAE – 1996

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction - Discussion on syllabus, Cos and POs**	
1.1	Introduction to automobile aerodynamics, The Role of Aerodynamics in Vehicle Design,The Character of Vehicle Aerodynamics,	1
1.2	Flow of air around the vehicle; Flow of air through the vehicle's body; Flow processes within the vehicle's machinery, Historical Development of Vehicle Aerodynamics, Systematic development of car aerodynamics,	2
1.3	Fundamentals of fluid mechanics – Flow phenomenon related to vehicles, Types of aerodynamic drag. Forces and moments influencing drag. Effects of forces and moments. Various body optimization techniques for minimum drag. – External & Internal	1

	flow problems.	
1.4	Various body optimization techniques for minimum drag.Principle of wind tunnel technology. Flow visualization techniques.	2
1.5	Testing with wind tunnel balance (scale models), full scale wind tunnels - measurement techniques - equipment and transducers - road testing methods – numerical	1
2	**Consumption and Performance**	
2.1	Consumption and Performance, Resistance to vehicle motion – Performance – Fuel consumption and performance – Potential of vehicle aerodynamics,	2
2.2	The Significance of Aerodynamic Drag, Effect of Aerodynamic Drag on Fuel Consumption, Theory of Driving Resistance, Rolling Resistance.	2
2.3	Aerodynamic Drag, Grade Resistance, acceleration,Overall Driving Resistance, Acceleration and Elasticity, Ascending Ability,	1
2.4	Calculating Fuel Consumption,Different Cycles, Consumption Measurement and CO2 and Energy Equivalents,	1
2..5	Worldwide Harmonized Light Vehicles Test Procedure, Possibilities for Reducing Fuel Consumption. Introduction to simulation exercise,	1
3	**Aerodynamic Forces and Their Influence on Passenger**	
3.1	Aerodynamic Forces and Their Influence on Passenger, Vehicles Flow Field Around Cars,Analysis of Aerodynamic Drag Components, Other Components of Aerodynamic Force and Aerodynamic Moment such as Lift and Pitching Moment ,	1
3.2	Side Force and Yaw Moment, Roll Moment. Influence on Aerodynamic Forces.The Influence of Basic Shape:Vehicle Front,Position of the Stagnation Point, Hood Inclination, Windshield,	1
3.3	A-Pillar,side window inclination, rear end shapes, wheel house shape etc... Shape optimization of cars front end modification - front and rear windshield angle	2
3.4	Boat tailing - hatch back, fast back and square back -dust flow patterns at the rear - effects of gap configuration - effect of fasteners.Basics of	1
3.5	Computational Aerodynamics for Ground Vehicles, Modeling, Methods of Modeling, introduction to CFD Packages	2
4	**Aerodynamics and Driving Stability**	
4.1	Aerodynamics and Driving Stability : Introduction to driving dynamics of the vehicle, Unsteady Aerodynamic Forces and Moments: Overtaking Maneuvers, Side Wind , Dynamic Driving Effects, Single-Track Model	2
4.2	,Reaction to Lift Force, Aerodynamic Axle Load Relief Settings,	2

	Reaction to Crosswinds, Traction, Power Requirement,Tire Contribution, Sideslip and Turning ,.	
4.3	Trailing Vortices, Control Surfaces, Car Underbody Flow, Cross Wind,	1
4.4	Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment,	1
4.5	Truck-Car Passing Interaction,Effect of the Environment on Aerodynamic Drag.	1
5	**Commercial vehicle aerodynamics:**	
5.1	Commercial vehicle aerodynamics: History of Commercial Vehicle Aerodynamics, Principles of Commercial Vehicle Aerodynamics:Straight/Oblique Flow,	1
5.2	Tools for Optimizing Commercial Vehicle Aerodynamics: Model wind tunnel, Wind tunnel measurements with scale ,CFD simulation , Calculation of the CD value during test drives, Full-Scale Wind Tunnel,	2
5.3	CFD Simulation, Constant-speed driving and Coasting test. Optimizing Aerodynamic Drag on Trucks, buses and coaches, Effects of rounding sharp front body edges. Effects of various cabs on trailer body. Fore body pressure distribution.	1
5.4	Effects of a cab to trailer body roof height.Commercial vehicles drag reduction devices. Characteristic Airflow and Pressure Conditions, Airflow Through the Engine Compartment, Cab.	1
5.5	Mirrors and other Attachments, Semitrailers and Bodies, Rear View Mirrors, Windscreen Wipers, Under body, Wheels and Wheel Covers ,Tipping and Susceptibility to Side Winds	2

SEMESTER VII

OPEN ELECTIVE

CODE MUT415	COURSE NAME: MODERN AUTOMOTIVE TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		OEC	2	1	0	3

Preamble: This course aims to provide the students the various aspects related to current technology trends in Automobile engineering like electric, hybrid and fuel cell vehicles, advanced vehicle control and auxiliary systems etc.

Prerequisite: NIL.

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

CO 1	Understanding various aspects of electric and hybrid vehicles.
CO 2	To know the latest technological advancements in vehicle power plant and control systems
CO 3	Understanding the working principles of advanced navigation and driver assistance systems
CO 4	To give an in-depth knowledge of microprocessor controlled engine management systems
CO 5	Get exposed to research and development challenges involved in various types of fuel cells.

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	-	1	1	-	-	2	-	1
CO 2	2	1	-	2	-	1	2	-	-	2	-	1
CO 3	1	1	-	1	-	1	1	-	-	2	-	1
CO 4	1	-	-	-	-	1	1	-	-	2	-	1
CO 5	1	1	-	1	-	2	2	-	-	2	-	3

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	40
Apply	20	20	50
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.

SYLLABUS

Module 1

Introduction to Electric and Hybrid Vehicle technology- LEV, TLEV, ULV & ZEV, Basic components of Electric vehicles-Inverters, Battery packs and battery management system, motors, electronic power control unit, Electric wiring harness – CAN Bus, Multiplex wiring. regenerative braking, basic factors to be considered for converting automobiles to electric vehicle, hybrid electric vehicle, types - series and parallel hybrid, layouts, comparison, Power systems and control systems, Different modes of operation of hybrid vehicles for best performance.

Module 2

Recent Trends in Automotive Power Plants: Stratified charged– TSI engines, lean burn engines, RCCI engines-concept and working, Hydrogen Engines- working and fuel feed systems, Flex fuel vehicles.
Vehicle Operation and engine Control: Electronic engine management systems, Application of sensors and actuators and microprocessors for operation of the vehicle to achieve best fuel economy, reduced emission and optimum road performance, Closed loop and open loop operation, Electronic cruise control, chassis control system, Integrated systems.

Module 3

Principle of automobile navigation and controls in the new generation cars-capabilities of navigation and control of modern cars- Advanced Driver Assistance Systems (ADAS)- LiDAR, RADAR, application and working of GPS, On-board Navigation Vs Mobile Navigation, Introduction to Autonomous vehicles.
Driver Assistance Systems in Automobiles: Vision in cars - Automotive night vision devices (NVD)- active and passive systems, A comprehensive driver assistance approach – Lane recognition, Traffic sign recognition, road recognition, Object recognition – Traffic lights and signals

Module 4

Modem electronic and micro control systems in automobiles: Electronically controlled concealed headlight systems, Electro chromic mirrors, automatic review mirrors, Day time running lamps (DRL), Head up display, Travel information systems, On board navigation system, Electronic climate control, Electronically controlled sun-roof, Anti-theft systems, Automatic door locks (ADL), tyre pressure sensing, automated wiper, Antilock braking system and, electronic traction and stability control (ESP).

Module 5

Introduction to Fuel Cells: Fuel cells-classification, Operational fuel cell voltages, Proton Exchange membrane fuel cells, Alkaline Electrolyte fuel cells, Medium and high temperature fuel cells, fuel and fuel chose, fuel processing, fuel cell stacks, Delivering fuel cell power, Integrated Air supply and humidification concepts for fuel cell systems, Fuel cell Auxiliary systems.
Modern Developments in Automobiles: Air compression systems, Air powered vehicles,

Text Books

1. Barry Hollembeak, Automotive Electricity, Electronics and Computer Controls, Delmer Publishers. 8. Tom Denton, Automotive Electronics, SAE
2. Beranek. L. L., Noise Reduction, McGraw-Hill Book Co., Inc, New York, 1993.
3. Bosch Hand Book, 3rd Edition, SAE, 1993.
4. Bob Brant, Build Your Own Electric Vehicle.

References

1. SAE, Electric and Hybrid Electric Vehicles and Fuel Cell Technology, SAE.
2. Andrew Dicks and James Laminine, Fuel Cell Systems Explained, SAE.
3. SAE, Fuel cells and alternative fuels / Energy systems
4. SAE, Fuel Cell Power for Transportation, 2001.
5. Rickard Stobart, Fuel Cell Technology for Vehicles, SAE.

Course Contents and Lecture Plan

No.	Topic	No. of Lectures
1	**Electric and Hybrid Vehicle technology**	
1.1	Introduction, LEV, TLEV, ULV & ZEV, Basic components of Electric vehicles-Inverters	1
1.2	Battery packs and battery management system, motors, electronic power control unit	1
1.3	Electric wiring harness – CAN Bus	1
1.4	Multiplex wiring. regenerative braking	1
1.5	Basic factors to be considered for converting automobiles to electric vehicle , Hybrid electric vehicle	1
1.6	Types - series and parallel hybrid, layouts, comparison ,Power	1

	systems and control systems	
1.7	Different modes of operation of hybrid vehicles for best performance.	1
2	**Recent Trends in Automotive Power Plants**	
2.1	Stratified charged / lean burn engines – TSI engines	1
2.2	RCCI engines, Hydrogen Engines, Flex fuel vehicles	1
2.3	Vehicle Operation and engine Control	1
2.4	Application of sensors and actuators and microprocessors for operation of the vehicle to achieve best fuel economy	1
2.5	Reduced emission and optimum road performance	1
2.6	Closed loop and open loop operation , Electronic engine management systems	1
2.7	Electronic cruise control, Chassis control system, Integrated systems.	1
3	**Principle of automobile navigation and controls in the new generation cars**	
3.1	Capabilities of navigation and control of modern cars.	1
3.2	Application and working of GPS	1
3.3	Driver Assistance Systems in Automobiles	1
3.4	Vision in cars-LiDAR, RADAR	1
3.5	A comprehensive driver assistance approach, Lane recognition,	1
3.6	Traffic sign recognition, Road recognition methods	1
3.7	Object recognition – Traffic lights and signals	1
4	**Modem electronic and micro control systems in automobiles**	
4.1	Electronically controlled concealed headlight systems	1
4.2	Electro chromic mirrors, automatic review mirrors	1
4.3	Day time running lamps (DRL)	1
4.4	Head up display, Travel information systems	1
4.5	On board navigation system, Electronic climate control	1
4.6	Electronically controlled sunroof, Anti-theft systems, Automatic door locks (ADL), tyre pressure sensing	1
4.7	Automated wiper, Antilock braking system, Electronic traction and stability control (ESP)	1
5	**Fuel Cells and Alternative energy systems**	
5.1	Introduction to fuel cells, Operational fuel cell voltages	1
5.2	Proton Exchange membrane fuel cells,	1
5.3	Alkaline Electrolyte fuel cells	1
5.4	Medium and high temperature fuel cells	1
5.5	Fuel and fuel chose, fuel processing,	1
5.6	fuel cell stacks, Delivering fuel cell power, Integrated Air supply and humidification concepts for fuel cell systems	1
5.7	Fuel cell Auxiliary systems, Air compression systems, Air powered vehicles	1

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What are the major components in an Electric vehicle?
2. Distinguish between hybrid and plug-in electric vehicles.
3. Give the advantages of parallel hybrid vehicles.
4. What is the function of a battery management system in a hybrid vehicle?
5. Discuss the various operating modes of a hybrid vehicle for best performance.

Course Outcome 2 (CO2)

1. What are the basic characteristics of a lean burn engine?
2. Explain the different methods used for charge stratification?
3. Discuss about the different fuel feed systems used in a hydrogen vehicle.
4. Explain the working of a Lamda sensor.
5. Give a comparison of On-board Navigation Vs Mobile Navigation.

Course Outcome 3(CO3):

1. List the various Advanced Driver Assistance Systems (ADAS).
2. Explain the difference between active and passive night vision systems.
3. Discuss about the scope of application of LiDAR and RADAR for vehicle navigation.
4. Explain the working of a GPS system.
5. Give the advantages of piezo-electric fuel injectors.

Course Outcome 4 (CO4):

1. Illustrate the working of an ESP.
2. What are the basic components of a ABS?
3. Explain the working of an adaptive head light.
4. Illustrate the working of a modern climate control system.
5. Give the features of an on- board navigation system.

Course Outcome 5 (CO5):

1. What are the different types of fuel cells?
2. List down the different fuels used for the fuel cells and state their characteristics.
3. Explain the working of a PEM fuel cell.
4. What are the characteristics of an air powered vehicle?
5. Explain the working of Integrated Air supply and humidification for fuel cell systems.

Model Question Paper

QP CODE:

PAGES:02

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AUT415

Course Name: MODERN AUTOMOTIVE TECHNOLOGY

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

Part A

(Answer all questions. Each question carry 3 marks)

1. Explain the terms LEV, TLEV, ULV & ZEV.
2. Give the advantages of parallel hybrid vehicles.
3. What are the basic characteristics of a lean burn engine?
4. Why two Lamda sensors are used in the exhaust system of Euro VI vehicles?
5. Give the salient features of an autonomous vehicle.
6. Distinguish between active and passive night vision systems.
7. Explain the working of an adaptive head light.
8. What all sensors are used in a modern climate control system?
9. Give a comparison between a PEM and Alkaline fuel cell.
10. List the advantages and disadvantages of Air powered vehicles.

Part B

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

11. (a) Explain thelayout and working of a parallel hybrid vehicle. (7)
    (b) Discuss the Basic factors to be considered for converting conventional automobiles to electric vehicle. (7)

OR

12. Explain the various components of a hybrid –electric vehicle. (14)
13. Discuss the construction and working of a Lamda sensor. (14)

OR

14. With a suitable layout sketch explain the working of a Hydrogen engine. (14)
15. Explain the application and working of GPS for fleet management. (14)

OR

16. Give a brief explanation about the working of:
    i) LiDAR ii) RADAR (14)
17. With a suitable sketch Illustrate the working of a climate control system used in modern passenger cars. (14)

OR

18. What is the difference between ABS and ESP? Explain the working of an ESP. (14)

19. Explain the working of a PEM fuel cell with a suitable sketch. (14)

OR

20. a) List the different fuels used for the fuel cells and state their characteristics. (7)

b) What are the characteristics of an air powered vehicle? Explain its working. (7)

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

MUT425	HYBRID AND ELECTRIC VEHICLES	CATEGORY	L	T	P	CREDIT
		OEC	2	1	0	3

Preamble: The aim of this subject is to offer the students a general understanding of hybrid (internal combustion and electric motor) propulsion system and an overview of fuel cell vehicles.

- ✓ Explain about hybrid electric vehicles.
- ✓ Describe the construction and working of hybrid electric drive trains
- ✓ Explain the importance of energy storage in hybrid vehicles.
- ✓ Discuss the important steps in sizing the drive system.
- ✓ Explain the different types of fuel cells.

Prerequisite: Basic Electrical Engineering

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

CO 1	Understand the construction and working of various hybrid electric topologies.
CO 2	Discuss the construction and working of various electric motors
CO 3	Explain the various energy storage systems available.
CO 4	Explain the procedure to match electric motor and ic engine.
CO 5	Understand the construction and working of various types of fuel cells.

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	3	-	1	-	-	-	-	-	-	-	-	-
CO 3	3	-	1	-	-	-	-	-	-	-	-	-
CO 4	3	-	1	-	-	-	-	-	-	-	-	-
CO 5	3	-	1	-	-	-	-	-	-	-	-	-

1.Slight (Low) 2. Moderate (Medium) 3. Substantial (High) No Correlation '-'

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	25	25	50
Understand	25	25	50
Apply			
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. What are the various components of a hybrid vehicle?

2. What are various drive train topologies used in electric vehicles?

Course Outcome 2 (CO2)

1. Explain the construction and working of PMDC motor?

2.Explain BLDC motor drive configuration?

Course Outcome 3(CO3):

1. What is the importance of energy storage in a hybrid electric vehicle?

2. How does Flywheel based energy storage work?

Course Outcome 4 (CO4):

1.How matching of IC engine is done with electric machine in a hybrid vehicle?

2.What are the factors affecting selection and sizing of storage systems in hybrid vehicles?

Course Outcome 5 (CO5):

1. Explain the working of alkaline fuel cell?

2. Explain how the construction and working of solid oxide fuel cell?

SYLLABUS

Module 1

Introduction to hybrid electric vehicles: components, advantages and disadvantages, application, social and environmental impacts. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies (Series, Parallel, Series – Parallel), power flow control in hybrid drive-train topologies.

Module 2

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, DC motors: Series wound, shunt wound, compound wound and separately excited, AC motors: Induction, synchronous, brushless DC motor, switched reluctance motors.

Module 3

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage, Fuel Cell based energy storage, Super Capacitor based energy storage, Flywheel based energy storage, Hybridization of different energy storage devices

Short Term Storage Systems: Flywheel Accumulators, Ultra capacitors, Superconducting magnetic energy storage; Hydraulic Accumulators; Hydraulic Pumps/Motors - Pneumatic Hybrid Engine Systems.

Module 4

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Module 5

Fuel cell characteristics, fuel cell types: alkaline fuel cell. Proton exchange Membrane; direct methanol fuel cell. Phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, hydrogen storage systems - reformers; Fuel cell vehicles.

Text Books

1. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.

References

1. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2004.

2. Mike Westbrook, “The Electric Car: Development & Future of Battery- Hybrid & Fuel Cell Cars”, British library Cataloguing in Publication Data.

3. John M. Miller, “Propulsion System for Hybrid Vehicle”, The Institution of Engineers, London, UK, 2004.

4. James Larminie, John Lowry – Electric vehicle technology explained – John Wiley

<u>MOOC</u>

NPTEL Course on “FUNDAMENTALS OF ELECTRIC VEHICLES, TECHNOLOGY AND

ECONOMICS”

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Module 1 (7 hours)**	
1.1	Introduction to hybrid electric vehicles: components, advantages and disadvantages, application, social and environmental impacts.	2
1.2	Hybrid Electric Drive-trains: Basic concept of hybrid traction	2
1.3	Introduction to various hybrid drive-train topologies	2
1.4	Power flow control in hybrid drive-train topologies	1
2	**Module 2 (7 hours)**	
2.1	Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles	1
2.2	DC motors: Series woundand shunt wound	1
2.3	DC motors: Compound wound and separately excited	1
2.4	AC motors: Induction, synchronous	2
2.5	AC motors: brushless DC motor, switched reluctance motors	2
3	**Module 3 (7 hours)**	
3.1	Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles	1
3.2	Battery based energy storage	1
3.3	Fuel Cell based energy storage	1
3.4	Super Capacitor based energy storage, Flywheel based energy storage	1
3.5	Hybridization of different energy storage devices, Short Term Storage Systems	1
3.6	Flywheel Accumulators Ultra-capacitors, Superconducting magnetic energy storage	1
3.7	: Hydraulic Accumulators; Hydraulic Pumps/Motors; Pneumatic Hybrid Engine Systems	1
4	**Module 4 (7 hours)**	
4.1	Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE)	2
4.2	Sizing the propulsion motor	2
4.3	Sizing the power electronics	2
4.4	Selecting the energy storage technology, Communications, supporting	1

	subsystems	
5	**Module 5 (7 hours)**	
5.1	Fuel cell characteristics, fuel cell types: alkaline fuel cell	1
5.2	Proton exchange Membrane	1
5.3	Direct methanol fuel cell	1
5.4	Phosphoric acid fuel cell	1
5.5	Molten carbonate fuel cell,	1
5.6	Solid oxide fuel cell	1
5.7	Hydrogen storage systems – reformers, Fuel cell vehicles	1

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: AUT 425

Course Name: HYBRID AND ELECTRIC VEHICLES

(OPEN ELECTIVE)

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

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. How traction is achieved in Hybrid Electric vehicles?
2. What are the advantages and disadvantages of hybrid electric vehicle?
3. What is the construction of PMDC motors?
4. What is the construction of BLDC motors?
5. What are the requirements for energy storage systems in HEV and pure electric vehicle?
6. Describe the analysis of a fuel cell-based energy storage device.
7. How is power electronics sized for a hybrid electric vehicle?
8. How is the motor sized for a hybrid electric vehicle?
9. Explain the operating principle of a fuel cell.
10. List the different types of fuel cell systems available for HEVs.

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

11. Explain the power flow and control modes of series hybrid electric vehicles with the help of suitable sketches. (14)

Or

12. What are various drive train topologies used in electric hybrid vehicles? Explain (14)

Module 2

13. List out and explain various electric components used in hybrid vehicles. (14)

Or

14. With the help of a neat sketch, explain the construction, working and application of Brushless DC motor. (14)

Module 3

15. Explain fuel cell-based energy storage and its analysis? (14)

Or

16. Write short note on ultra-capacitor energy storage system and super conducting magnetic energy storage. (14)

Module 4

17. How the sizing of propulsion motor and other drive system components done in hybrid vehicles? (14)

Or

18. Design a hybrid electric vehicle including the selection of batteries and electric motor (EM) with Parallel hybrid as base /core. (14)

Module 5

19. Explain the construction and working of the following fuel cells:(i) phosphoric acid fuel cell (ii) Photon exchange membrane fuel cell (14)

Or

20. Explain the construction and working of Molten Carbonate fuel cell (MCFC) with the help of a suitable sketch (14)

MUT435	AUTOMOTIVE ERGONMICS AND SAFETY	CATEGORY	L	T	P	CREDIT
		OEC	2	1	0	3

Preamble: The aim of this subject is to offer the students a general understanding of Automotive ergonomics and safety

- ✓ To gain essential and basic knowledge of Automotive ergonomics
- ✓ To familiarize with the procedures of Ergonomics
- ✓ To gain essential knowledge about Automotive safety and safety tests

Prerequisite: Nil

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

CO 1	Fundamentals of ergonomics and its measurement
CO 2	Introduction to features used to improve ergonomics
CO 3	Improve the knowledge about driver's visibility and methods to improve the visibility
CO 4	Introduction to Automotive safety, Active and passive safety
CO 5	Increase the knowledge about Safety equipments

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	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
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. Explain the need of anthropometry?
2. Explain the different postural conditions?

Course Outcome 2 (CO2)
1. Explain the arrangement of dash board equipment's
2. Explain the positioning of operational controls

Course Outcome 3(CO3):
1. Explain the major factors considered Mirror design
2. Explain the logical formations of cockpit

Course Outcome 4 (CO4):
1. Explain the design concept of crumple zone
2. Explain the characteristics of passenger compartment on impact

Course Outcome 5 (CO5):
1. Discuss the function of Airbag and electronic system for activating air bags
2. Explain the working of collision warning system

SYLLABUS

MODULE 1

INTRODUCTION TO ERGONOMICS: Anthropometry – Need, Data Collection Methodology, Different postural Considerations

MEASUREMENT: Measuring Procedures, Subject and sampling size selection, Measurement of feet/hands/full posture, Applying anthropometry data

MODULE 2

VEHICLE ERGONOMICS: Passenger Compartment, Floor Pan, technical requirements, Dash board equipment arrangement, Positioning of operational controls, Force Analysis, Seating and position - ECE Regulations, Human Factors, Navigation systems, pedal positioning.

MODULE 3

VISIBILITY: Sight – All round visibility, View of Instruments, Mirror design, Logical formation of cockpit.

VEHICLE PACKAGING:R-Point, AHP, Manikin positioning of 2-D pattern, car entry/exit, Boot lid packaging

MODULE 4

INTRODUCTION TO SAFETY: Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone. Active and Passive safety

MODULE 5

VEHICLE SAFETY EQUIPMENT: Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags

Text Books

1	An introduction to modern vehicle design	Julian Happian-Smith	Butterworth Heinmenn, 2001
2	Automotive Handbook	Bosch	9th edition - SAE publication – 2014

Reference Books

1	Automotive ergonomics	J. Brian Peacock, WaldemarKarwowski, Taylor & Francis ltd, 1993
2	Handbook of automotive body and system design	Fenton John, Wiley-Blackwell, 1998
3	Automotive Electronics Handbook	Ronald.K.Jurgen Second edition- McGrawHill Inc., - 1999.
4	Vehicle Body Engineering	J.Powloski - Business books limited, London - 1969.

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Module 1 (7 hours)**	
1.1	**Introduction To Ergonomics**: Anthropometry – Need	1
1.2	Data Collection Methodology, Different postural Considerations	2
1.3	**Measurement:** Measuring Procedures, Subject and sampling size selection,	2
1.4	Measurement of feet/hands/full posture	1
1.5	Applying anthropometry data.	1
2	**Module 2 (7 hours)**	
2.1	**Vehicle Ergonomics:** Passenger Compartment,	1
2.2	Floor Pan, technical requirements, Dash board equipment arrangement, Positioning of operational controls,	3
2.4	Force Analysis, Seating and position - ECE Regulations,	2
2.5	Human Factors, Navigation systems, pedal positioning.	1
3	**Module 3 (7 hours)**	
3.1	**Visibility:** Sight – All round visibility	1
3.2	View of Instruments, Mirror design, Logical formation of cockpit.	1
3.3	**Vehicle packaging:**R-Point, AHP,	1
3.4	Manikin positioning of 2-D pattern,	2
3.5	car entry/exit, Boot lid packaging	2
4	**Module 4 (7 hours)**	
4.1	**Introduction To Safety:** Design of the body for safety	2
4.2	energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle,	3
4.3	concept of crumble zone, Active and Passive safety	2
5	**Module 5 (7 hours)**	
5.1	**Vehicle safety Equipment:** Seat belt, regulations,	1
5.2	automatic seat belt tightener system,	1
5.3	collapsible steering column,	2
5.4	tiltablesteering wheel, air bags, electronic system for activating air bags	3

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: MUT435

Course Name: AUTOMOTIVE ERGONOMICS & SAFETY

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

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. Explain the term – Anthropometry?
2. Explain the methods to measure the hands?
3. Write a short note on ECE regulations
4. Explain the various human factors affects vehicle ergonomics
5. Explain the Logical formation of cockpit
6. Write a short note on driver visibility
7. write a short note on concept of crumble zone
8. Explain the methods to locate engine in a vehicle
9. Write a short note on automatic seat belt tightener system
10. Explain the working of collapsible steering column

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

11. Explain the various data collection methodology

Or

12. Explain the methods to select the subject and sample size

Module 2

13. Explain the Dash board equipment arrangement

Or

14. Briefly explain the Positioning of operational controls.

Module 3

15. Describe the types of Manikin positioning of 2-D pattern

Or

16. Explain the process car entry/exit, Boot lid packaging

Module 4

17 Briefly explain the deceleration on impact with stationary and movable obstacle

Or

18. Explain the various safety system used in Active and passive safety

Module 5

19. Explain the regulations of seat belt and locations of seat belt

Or

20. Explain the working of electronic system for activating air bags

MUT445	AGV AND AUTONOMOUS VEHICLES	CATEGORY	L	T	P	CREDIT
		OEC	2	1	0	3

Preamble: The aim of this subject is to offer the students a general understanding of the working of autonomous guided vehicles (AGV's).

- ✓ Explain about the evolution of autonomous vehicles.
- ✓ Describe the construction and working of imaging devices (LIDAR, RADAR etc.)
- ✓ Explain the importance of understanding vehicle positioning through GPS.
- ✓ Explain the different methods to control vehicle motion.
- ✓ Describe the working of various intelligent transportation system technologies.

Prerequisite: Nil

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

CO 1	Understand the construction and working of autonomous guided vehicles (AGV's).
CO 2	Understand the working of various imaging devices like LIDAR, RADAR etc.
CO 3	Explain the working of vehicle positioning systems.
CO 4	Explain how vehicle motion can be controlled.
CO 5	Understand the working of intelligent transportation system technologies.

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	3	-	1	-	-	-	-	-	-	-	-	-
CO 3	3	-	1	-	-	-	-	-	-	-	-	-
CO 4	3	-	1	-	-	-	-	-	-	-	-	-
CO 5	3	-	1	-	-	-	-	-	-	-	-	-

1.Slight (Low) 2. Moderate (Medium) 3. Substantial (High) No Correlation '-'

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	25	25	50
Understand	25	25	50
Apply			
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. What is an AGV?

2. What are the barriers to the implementation of autonomous vehicle technology?

Course Outcome 2 (CO2)

1.How does LIDAR work?

2.How does RADAR work?

Course Outcome 3(CO3):

1. What is DGPS?

2. What is IMU?

Course Outcome 4 (CO4):

1.What are the goals of an intelligent transportation system?

2.What is the goal of longitudinal control of a vehicle?

Course Outcome 5 (CO5):

1. What is Adaptive Cruise Control (ACC)?

2. What is Vehicle ad hoc network?

SYLLABUS

Module 1

Evolution of Autonomous cars: Rapid growth in Automotive production, Traffic congestions and accidents; Driver assistance and safety warning systems, fully autonomous vehicles, Reluctant consumer acceptance and misconceptions about safety, Basic framework of Autonomous vehicles.

Module 2

Environment perception and modelling –surrounding environment sensing using LIDAR, RADAR, ultrasonic, infrared, radio and visual camera. Vision based road detection and tracking, Vehicle detection and tracking, Object detection and tracking.

Module 3

Vehicle localization and Navigation – Absolute positioning: GPS/DGPS, GLONASS; Inertial Measurement Unit (IMU) and encoders. Electronic map services: Google earth, Microsoft virtual earth, On-board database. Map matching techniques

Path planning and decision making - global path planning, local path planning, Decision making: Mission planning and behavioural reasoning, trolley problem, Utilitarian analysis

Module 4

Advanced vehicle motion control – Lateral motion control: road curvature calculation, steering control, determining look-ahead distance, Error calculation and correction. Longitudinal motion control: PID, backing up control, fuzzy control, neural control.

Module 5

Intelligent transportation system technologies: Adaptive cruise control (ACC), Vehicle ad hoc networking, Route guidance, Collision avoidance, Automated highway system, Freight management, En route trip planning.

Text Books

1. Hong Cheng, "Autonomous intelligent vehicles, Theory, Algorithms and Implementation", Springer.
2. Ronald K. Jurgen, "Autonomous vehicles for safer driving", SAE international.

Reference

1. Markus Maurer, Autonomous Driving: Technical, Legal and Social Aspects, ISBN-13: 978-3662488454, Springer 2012
2. Ljubo Vlacic, Michel Parent, Fumio Harashima, "Intelligent Vehicle Technologies", Butterworth- Heinemann publications, Oxford, 2001

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Module 1 (7 hours)**	
1.1	Evolution of Autonomous cars: Rapid growth in Automotive production, Traffic congestions and accidents	1
1.2	Driver assistance and safety warning systems	2
1.3	Fully autonomous vehicles	1
1.4	Reluctant consumer acceptance and misconceptions about safety	1
1.5	Basic framework of Autonomous vehicles	2
2	**Module 2 (7 hours)**	
2.1	Environment perception and modeling –surrounding environment sensing using LIDAR	2
2.2	Ultrasonic, infrared, radio and visual camera.	2
2.3	Vision based road detection and tracking	1
2.4	Vehicle detection and tracking	1
2.5	Object detection and tracking	1
3	**Module 3 (7 hours)**	
3.1	Vehicle localization and Navigation – Absolute positioning	1
3.2	GPS/DGPS, GLONASS;	1
3.3	Measurement Unit (IMU) and encoders.	1
3.4	Electronic map services: Google earth, Microsoft virtual earth,On-board database. Map matching techniques	1
3.5	Path planning and decision making - global path planning, local path planning	1
3.6	Decision making: Mission planning and behavioural reasoning	1
3.7	Trolley problem ,Utilitarian analysis	1
4	**Module 4 (7 hours)**	
4.1	Advanced vehicle motion control – Lateral motion control:	1
4.2	Road curvature calculation	1
4.3	Steering control	1
4.4	Determining look-ahead distance	1
4.5	Error calculation and correction	1
4.6	Longitudinal motion control: PID	1

4.7	Backing up control, fuzzy control, neural control.	1
5	**Module 5 (7 hours)**	
5.1	Intelligent transportation system technologies: Adaptive cruise control (ACC)	1
5.2	Vehicle ad hoc networking	2
5.3	Route guidance	1
5.4	Collision avoidance, Automated highway system	2
5.5	Freight management, En route trip planning.	1

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: MUT445

Course Name: AGV AND AUTONOMOUS VEHICLES

(OPEN ELECTIVE)

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

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. What is an AGV?
2. What are the barriers to the implementation of autonomous vehicle technology?
3. How does LIDAR work?
4. How does RADAR work?
5. What is DGPS?
6. What is IMU?
7. What are the goals of an intelligent transportation system?
8. What is the goal of longitudinal control of a vehicle?
9. What is the function of Adaptive Cruise Control?
10. What is vehicle ad – hoc network?

PART B

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

Module 1

11. Elaborate the basic framework used in the development of autonomous vehicles. (14)

Or

12. Explain the construction and working of any two-driver assistance and safety warning systems. (14)

Module 2

13. Elaborate the main advantages of video-based road detection and tracking. (14)

Or

14. Explain how ultrasonic, infrared and radio waves are used in vision sensors. (14)

Module 3

15. Discuss the application of trolley problem in path planning and decision making. (14)

Or

16. Elaborate the steps involved in combining panoramic images with electronic maps. (14)

Module 4

17. Explain any two longitudinal approaches for vehicle control. (14)

Or

18. Explain the different control strategies used to control the steering system for linear and curvilinear roads. (14)

Module 5

19. Explain the construction and working of collision avoidance system. (14)

Or

20. Explain the construction and working of automated highway system. (14)

CODE MUT455	COURSE NAME COMPUTER SIMULATION AND ANALYSIS OF AUTOMOTIVE SYSTEMS	CATEGORY	L	T	P	CREDIT
		OEC	2	1	0	3

Preamble: The course aims at providing the student an understanding on analysis of different automotive systems using design and analysis softwares.

Prerequisite: MUT306: AUTO COMPONENT DESIGN

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

CO 1	Design and analyse chassis and suspension system of a vehicle
CO 2	Design and analyse clutch system
CO 3	Design and analyse Driveline and rear axle
CO 4	Design and analyse steering and front axle
CO 5	Design and analyse the suspension system

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	-	2	-	-	-	-	-	-	-	1
CO 2	1	-	3	2	-	-	-	-	-	-	-	2
CO 3	1	-	3	2	-	2	-	-	-	-	-	2
CO 4	1	-	3	2	-	-	-	-	-	-	-	2
CO 5	1	-	3	2	-	2	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember			
Understand	20	20	20
Apply	20	20	70
Analyse	10	10	10
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.Explain different approximation techniques used in FEA

Course Outcome 2 (CO2)
1. Derive the equation for rod, bar, beam and truss

Course Outcome 3(CO3):
1. Identify isoparametric elements and jacobian matrix

Course Outcome 4 (CO4):
1. Create a database for the FEA software calculation

Course Outcome 5 (CO5):
1.Develop different structural and thermal analysis using softwares and compare using experimental methods

Model Question Paper

QP CODE:

PAGES:…

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT 455

Course Name: COMPUTER SIMULATION AND ANALYSIS OF AUTOMOTIVE SYSTEMS

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

Part A

(Answer all questions. Each question carry 3 marks)

1. Draw the free body diagram for the forces acting on a vehicle frame
2. List the difference between the frame analysis for passenger and commercial vehicles
3. Why do we consider torque as the base for the analysis of clutch in place of power?
4. What is the type of progression preferred for the identification of intermediate gear ratios? Why do we prefer it?
5. List the types of loads acting on the rear axle
6. Explain with a free body diagram, the loads acting on a dead and fully floating live rear axle
7. Explain the term steering error. How do we minimize it?
8. Why do we prefer taper roller bearing in the front axle in place of needle or ball bearing?
9. Explain the load distribution in a leaf spring
10. How do we analyse a torsion bar?

PART B

(ANSWER ANY ONE QUESTION FROM EACH MODULE. EACHFULL QUESTION CARRY 14 MARKS)

11. Explain the step-by-step methodology for the analysis of a vehicle frame

OR

12.
    a. Which are the stresses and moments that act on a frame? (7 marks)
    b. What are the inputs required for the design of a frame? (7 marks)
13. Derive the equation for the torque capacity of a single plate clutch

OR

14. Explain the methodology for the finalisation of gear ratio of a vehicle. Explain the inputs required for the same
15. Explain the methodology adopted for finalising the size of axle and axle housing of a semi floating drive axle

OR

16. Why is propeller shaft made as a hollow shaft in place of solid shaft? How do we finalise the size of the propeller shaft
17. How do we optimise the dimensions of the steering linkages?

OR

18. Explain the moments and stresses acting at different sections of the front axle
19. I would like to convert my leaf spring to single leaf composite spring. How should I go about finalising the size and dimensions of the leaf spring?

OR

20. Explain the methodology of CFD analysis of the hydraulic damping system

SYLLABUS

Module 1: VEHICLE FRAME

Vehicle frame: Study of loads - moments and stresses on frame members. computer aided design and analysis of frame for passenger and commercial vehicle

Module 2: CLUTCH& GEARBOX

Clutch torque capacity of clutch. computer aided design of clutch components, design details of roller and sprag type of clutches. Gearbox –Finalisation of gear ratios, computer aided design of three speed and four speed gear boxes.

Module 3: DRIVELINE AND REAR AXLE

Drive line and rear axle computer aided design of propeller shaft. design details of final drive gearing. design details of full floating and semi-floating rear shafts and rear axle housings.

Module 4: FRONT AXLE AND STEERING SYSTEM

Analysis of loads, moments and stresses at different sections of front axle. determination of bearing loads at kingpin bearings. wheel spindle bearings. choice of bearings. determination of optimum dimensions and proportions for steering linkages ensuring minimum error in steering.

Module 5: SUSPENSION

Computer aided design and analysis of leaf springs, coil springs and torsion bar, analysis of hydraulic damper using any CFD software

Text Books

1. Ganesan.V. " Computer Simulation of spark ignition engine process ", Universities Press (I) Ltd, Hyderbad, 1996.
2. Giri.N.K. " Automobile Mechanics ", Khanna Publisher, New Delhi, 1996
3. Newton, Steeds & Garret, " Motor vehicle ", llliffe Books Ltd., London, 1982.

Reference Books

4. Dean Averns, " Automobile Chassis Design ", llliffe Books Ltd, 1992.
5. Giles.J.G., "Steering, Suspension and tyres ", llliffe Books
6. Heldt.P.M., " Automotive Chassis ", Chilton Co., New York, 1992.
7. Ramoss.A.L., " Modelling of Internal Combustion Engines Processes ", McGraw Hill Publishing Co., 1992
8. Steeds.W., " Mechanics of Road vehicles ", llliffe Books Ltd., London, 1990.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**VEHICLE FRAME**	
1.1	Study of loads - moments and stresses on frame members.	3
1.2	computer aided design and analysis of frame for passenger and commercial vehicle	4
2	**CLUTCH & GEARBOX**	
2.1	Torque capacity of clutch	1
2.2	Computer aided design of clutch components	1
2.3	design details of roller and sprag type of clutches.	1
2.4	Gearbox –Finalisation of gear ratios,	2
2.5	Computer aided design of three speed and four speed gear boxes.	2
3	**DRIVELINE AND REAR AXLE**	
3.1	Computer aided design of propeller shaft.	2
3.2	Design details of final drive gearing	2
3.3	Design details of full floating and semi-floating rear shafts and rear axle housings	3
4	**FRONT AXLE AND STEERING SYSTEM**	
4.1	Analysis of loads, moments and stresses at different sections of front axle.	3
4.2	Determination of bearing loads at kingpin bearings. wheel spindle bearings.	3
4.3	Choice of bearings.	1
4.4	Determination of optimum dimensions and proportions for steering linkages ensuring minimum error in steering.	1
5	**SUSPENSION**	
5.1	computer aided design and analysis of leaf springs,	3
5.2	coil springs and torsion bar,	2
5.3	analysis of hydraulic damper using any CFD software	2

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEMESTER VII

MINOR

Estd. 2014

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUD481	MINIPROJECT	PWS	0	0	3	4

Preamble: This course is designed for enabling the students to apply the knowledge to address the real-world situations/problems and find solutions. The course is also intended to estimate the ability of the students in transforming theoretical knowledge studied as part of the curriculum so far in to a working model of a software system. The students are expected to design and develop a software/hardware project to innovatively solve a real-world problem.

Prerequisites: Subjects studied up to sixth semester.

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

CO No.	Course Outcome (CO)	Bloom's Category Level
CO 1	Make use of acquired knowledge within the selected area of technology for project development.	Level 3: Apply
CO 2	Identify, discuss and justify the technical aspects and design aspects of the project with a systematic approach.	Level 3: Apply
CO 3	Interpret, improve and refine technical aspects for engineering projects.	Level 3: Apply
CO 4	Associate with a team as an effective team player for the development of technical projects.	Level 3: Apply
CO 5	Report effectively the project related activities and findings.	Level 2: Understand

Mapping of course outcomes with program outcomes

POs / COs	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	3	3	3	3	-	-	-	3
CO 2	3	3	3	3	3	-	2	3	-	3	2	3
CO 3	3	3	3	3	3	2	3	3	-	2	3	3
CO 4	3	3	2	2	-	-	-	3	3	3	3	3
CO 5	3	-	-	-	2	-	-	3	2	3	2	3

3/2/1: high/medium/low

Assessment Pattern

The End Semester Evaluation (ESE) will be conducted as an internal evaluation based on the product, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, academic coordinator for that program and project guide/coordinator. The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, working knowledge and involvement.

The Continuous Internal Evaluation (CIE) is conducted by evaluating the progress of the mini project through minimum of TWO reviews. At the time of the 1st review, students are supposed to propose a new system/design/idea, after completing a thorough literature study of the existing systms under their chosen area. In the 2nd review students are expected to highlight the implementation details of the proposed solution. The review committee should assess the extent to which the implementation reflects the proposed design. A well coded, assembled and completely functional product is the expected output at this stage. The final CIE mark is the average of 1st and 2nd review marks.

A zeroth review may be conducted before the beginning of the project to give a chance for the students to present their area of interest or problem domain or conduct open brain storming sessions for innovative ideas. Zeroth review will not be a part of the CIE evaluation process.

Marks Distribution

Total Marks	CIE	ESE
150	75	75

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Marks awarded by Guide : 15 marks
Project Report : 10 marks
Evaluation by the Committee : 40 Marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks.

(a) Demonstration : 50 Marks
(b) Project report : 10 Marks
(d) Viva voce : 15marks

Course Plan

In this course, each group consisting of three/four members is expected to design and develop a moderately complex software/hardware system with practical applications. This should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty-in-charge of miniproject/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. Demonstrate the novelty of the project through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews**.**

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEMESTER VII

HONOURS

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT495	SIMULATION AND ANALYSIS OF IC ENGINE PROCESS	VAC	3	1	0	4

Preamble: The course aims at providing the student an understanding on analysis of IC engines

Prerequisite: NIL

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

CO 1	Analyse the combustion energy generated for different fuels
CO 2	Simulate the combustion in S I Engines
CO 3	Simulate the combustion in C I Engines
CO 4	Understand the gas exchange processes
CO 5	Analyse the heat transfer and friction in engines

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	-	2	-	-	-	-	-	-	-	1
CO 2	1	-	3	2	-	-	-	-	-	-	-	2
CO 3	1	-	3	2	-	2	-	-	-	-	-	2
CO 4	1	-	3	2	-	-	-	-	-	-	-	2
CO 5	1	-	3	2	-	2	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember			
Understand	20	20	20
Apply	20	20	70
Analyse	10	10	10
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):
Can you analyse the combustion energy of the given fuel?

Course Outcome 2 (CO2)
Can you simulate the combustion in SI engines?

Course Outcome 3(CO3):
Can you simulate the combustion in CI engines?

Course Outcome 4 (CO4):
Can you explain the methods that could improve the efficiency of an engine?

Course Outcome 5 (CO5):
Can you elaborate the loss of energy due to friction and methods to reduce it?

Model Question Paper

QP CODE: **PAGES:**

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT 495

Course Name: SIMULATION AND ANALYSIS OF IC ENGINE PROCESS

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

Part A

(Answer all questions. Each question carry 3 marks)

1. What is meant by adiabatic flame temperature?
2. List at least five assumptions needed for ideal cycle SI engine simulation with air as the working medium.
3. List the power developing components of a basic S.I engine
4. Define displacement volume, clearance volume and compression ratio
5. Elaborate on the influence of swirl in the combustion process
6. Explain the term ‘squish’
7. Why do we prefer taper roller bearing in the front axle in place of needle or ball bearing?
8. Define Mach index
9. List out the methods used to determine engine friction.
10. Define Pumping work and rubbing friction work

PART B

(ANSWER ANY ONE QUESTION FROM EACH MODULE. EACHFULL QUESTION CARRY 14 MARKS)

11. Explain the procedure for measurement of U_{rp} with neat sketches.

OR

12. Derive an equation for calculation of adiabatic temperature
13. Differentiate ideal and actual cycle simulation.

OR

14. Analyse the full throttle and part throttle simulation of SI engine with sketch.
15. Discuss about CI engine simulation with adiabatic combustion under naturally aspirated conditions.

OR

16. Derive the efficiency of an ideal diesel cycle.
17. Explain about the flow patterns through valves.

OR

18. Discuss the In cylinder fluid motion in a combustion chamber.
19. Explain in detail about the effect of load on mechanical efficiency

OR

20. Explain the gas temperature variations for a 4 stroke cycle engine

SYLLABUS

Module 1: Combustion Calculations

Heat of reaction at constant volume and constant pressure, Calculation of properties of the working medium in an engine, Constant volume and constant pressure adiabatic combustion, Calculation of Adiabatic flame temperature.

Module 2: Simulation of SI Engine Combustion

Engine kinematics, Ideal Otto cycle, SI engine simulation with adiabatic combustion with air as the working substance under full and part throttle conditions. Actual SI engine heat release rate curves.

Module 3: Simulation of CI Engine Combustion

CI engine simulation with adiabatic combustion with air as the working substance under naturally aspirated, supercharged and turbocharged conditions. Zero dimensional combustion models for CI engines

Module 4: Gas Exchange Processes

Flow through valves their characteristics, compressible and incompressible flow through valves, volumetric efficiency and Mach index, Effect of valve timing on volumetric efficiency, Swirl and squish, SI engine simulation with gas exchange, influence of valve timing and area.

Module 5: Heat Transfer and Friction in Engines

Engine friction variation, models for engine friction, Heat transfer mechanisms in engines, Models for heat transfer in engines.

Text Books

1. Ganesan.V. ,Computer Simulation of spark ignition engine process , Universities Press (I) Ltd, Hyderbad, 1996.
2. V.Ganesan, Computer simulation of compression ignition engine processes,Universities Press (I) Ltd, Hyderbad, 1996.

Reference Books

1. Richard Stone, Introduction to Internal Combustion Engines, SAE Inc., 1999
2. 4. Colin R Ferguson , Internal Combustion Engines – Applied Thermo Sciences, John Wiley and Sons.
3. 5. John B Heywood , Internal Combustion Engine Fundamentals, , McGraw Hill

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Combustion Calculation**	
1.1	Heat of reaction at constant volume and constant pressure	2
1.2	Calculation of properties of the working medium in an engine	3
1.3	Constant volume and constant pressure adiabatic combustion	3
1.4	Calculation of Adiabatic flame temperature	1
2	**Simulation of SI Engine Combustion**	
2.1	Engine kinematics	2
2.2	Ideal Otto cycle	2
2.3	SI engine simulation with adiabatic combustion with air as the working substance under full and part throttle conditions	3
2.4	Actual SI engine heat release rate curves	2
3	**Simulation of CI Engine Combustion**	
3.1	CI engine simulation with adiabatic combustion with air as the working substance under naturally aspirated, supercharged and turbocharged conditions	5
3.2	Zero dimensional combustion models for CI engines	4
4	**Gas Exchange Processes**	
4.1	Flow through valves their characteristics, compressible and incompressible flow through valves	2
4.2	volumetric efficiency and Mach index	2
4.3	Effect of valve timing on volumetric efficiency	2
4.4	Swirl and squish	1
4.5	SI engine simulation with gas exchange	1
4.6	Influence of valve timing and area	1
5	**Heat Transfer and Friction in Engines**	
5.1	Engine friction variation	2
5.2	Models for engine friction	2
5.3	Heat transfer mechanisms in engines	2
5.4	Models for heat transfer in engines	3

SEMESTER VIII

MUT402	HYBRID AND ELECTRIC VEHICLES	CATEGORY	L	T	P	CREDIT
		PCC	2	1	0	3

Preamble: The aim of this subject is to offer the students a general understanding of hybrid (internal combustion and electric motor) propulsion system and an overview of fuel cell vehicles.

- ✓ Explain about hybrid electric vehicles.
- ✓ Describe the construction and working of hybrid electric drive trains
- ✓ Explain the importance of energy storage in hybrid vehicles.
- ✓ Discuss the important steps in sizing the drive system.
- ✓ Explain the different types of fuel cells.

Prerequisite: Basic Electrical Engineering

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

CO 1	Understand the construction and working of various hybrid electric topologies.
CO 2	Discuss the construction and working of various electric motors
CO 3	Explain the various energy storage systems available.
CO 4	Explain the procedure to match electric motor and ic engine.
CO 5	Understand the construction and working of various types of fuel cells.

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	3	-	1	-	-	-	-	-	-	-	-	-
CO 3	3	-	1	-	-	-	-	-	-	-	-	-
CO 4	3	-	1	-	-	-	-	-	-	-	-	-
CO 5	3	-	1	-	-	-	-	-	-	-	-	-

1.Slight (Low) 2. Moderate (Medium) 3. Substantial (High) No Correlation '-'

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			

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. What are the various components of a hybrid vehicle?
2. What are various drive train topologies used in electric vehicles?

Course Outcome 2 (CO2)
1. Explain the construction and working of PMDC motor?
2.Explain BLDC motor drive configuration?

Course Outcome 3(CO3):
1. What is the importance of energy storage in a hybrid electric vehicle?
2. How does Flywheel based energy storage work?

Course Outcome 4 (CO4):
1.How matching of IC engine is done with electric machine in a hybrid vehicle?
2.What are the factors affecting selection and sizing of storage systems in hybrid vehicles?

Course Outcome 5 (CO5):
1. Explain the working of alkaline fuel cell?
2. Explain how the construction and working of solid oxide fuel cell?

SYLLABUS

Module 1

Introduction to hybrid electric vehicles: components, advantages and disadvantages, application, social and environmental impacts. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies (Series, Parallel, Series – Parallel), power flow control in hybrid drive-train topologies.

Module 2

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, DC motors: Series wound, shunt wound, compound wound and separately excited, AC motors: Induction, synchronous, brushless DC motor, switched reluctance motors.

Module 3

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage, Fuel Cell based energy storage, Super Capacitor based energy storage, Flywheel based energy storage, Hybridization of different energy storage devices

Short Term Storage Systems: Flywheel Accumulators, Ultra capacitors, Superconducting magnetic energy storage; Hydraulic Accumulators; Hydraulic Pumps/Motors - Pneumatic Hybrid Engine Systems.

Module 4

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Module 5

Fuel cell characteristics, fuel cell types: alkaline fuel cell. Proton exchange Membrane; direct methanol fuel cell. Phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, hydrogen storage systems - reformers; Fuel cell vehicles.

Text Books

1. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.

References

1. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2004.

2. Mike Westbrook, “The Electric Car: Development & Future of Battery- Hybrid & Fuel Cell Cars”, British library Cataloguing in Publication Data.

3. John M. Miller, “Propulsion System for Hybrid Vehicle”, The Institution of Engineers, London, UK, 2004.

4. James Larminie, John Lowry – Electric vehicle technology explained – John Wiley

MOOC

NPTEL Course on "FUNDAMENTALS OF ELECTRIC VEHICLES, TECHNOLOGY AND ECONOMICS"

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Module 1 (7 hours)**	
1.1	Introduction to hybrid electric vehicles: components, advantages and disadvantages, application, social and environmental impacts.	3
1.2	Hybrid Electric Drive-trains: Basic concept of hybrid traction	2
1.3	Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies	2
2	**Module 2 (7 hours)**	
2.1	Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles	1
2.2	DC motors: Series wound and shunt wound	2
2.3	DC motors: Compound wound and separately excited	2
2.4	AC motors: Induction, synchronous ,AC motors: brushless DC motor, switched reluctance motors	2
3	**Module 3 (7 hours)**	
3.1	Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles	1
3.2	Battery based energy storage , Fuel Cell based energy storage	1
3.3	Super Capacitor based energy storage	1
3.4	Flywheel based energy storage	1
3.5	Hybridization of different energy storage devices, Short Term Storage Systems: Flywheel Accumulators	1
3.6	Ultra-capacitors, Superconducting magnetic energy storage	1
3.7	Hydraulic Accumulators; Hydraulic Pumps/Motors; Pneumatic Hybrid Engine Systems	1
4	**Module 4 (7 hours)**	
4.1	Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE)	2
4.2	Sizing the propulsion motor	2
4.3	Sizing the power electronics	2
4.4	Selecting the energy storage technology, Communications, supporting	1

	subsystems	
5	**Module 5 (7 hours)**	
5.1	Fuel cell characteristics, fuel cell types: alkaline fuel cell	1
5.2	Proton exchange Membrane	1
5.3	Direct methanol fuel cell	1
5.4	Phosphoric acid fuel cell	1
5.5	Molten carbonate fuel cell,	1
5.6	Solid oxide fuel cell	1
5.7	Hydrogen storage systems - reformers; , Fuel cell vehicles	1

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: MUT402

Course Name: HYBRID AND ELECTRIC VEHICLES

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

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. How traction is achieved in Hybrid Electric vehicles?
2. What are the advantages and disadvantages of hybrid electric vehicle?
3. What is the construction of PMDC motors?
4. What is the construction of BLDC motors?
5. What are the requirements for energy storage systems in HEV and pure electric vehicle?
6. Describe the analysis of a fuel cell-based energy storage device.
7. How is power electronics sized for a hybrid electric vehicle?
8. How is the motor sized for a hybrid electric vehicle?
9. Explain the operating principle of a fuel cell.
10. List the different types of fuel cell systems available for HEVs.

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

11. Explain the power flow and control modes of series hybrid electric vehicles with the help of suitable sketches.

Or

12. What are various drive train topologies used in electric hybrid vehicles? Explain

Module 2

13. List out and explain various electric components used in hybrid vehicles.

Or

14. With the help of a neat sketch, explain the construction, working and application of Brushless DC motor.

Module 3

15. Explain fuel cell-based energy storage and its analysis?

Or

16. Write short note on ultra-capacitor energy storage system and super conducting magnetic energy storage.

Module 4

17. How the sizing of propulsion motor and other drive system components done in hybrid vehicles?

Or

18. Design a hybrid electric vehicle including the selection of batteries and electric motor (EM) with Parallel hybrid as base /core.

Module 5

19. Explain the construction and working of the following fuel cells:(i) phosphoric acid fuel cell
(ii) Photon exchange membrane fuel cell

Or

20. Explain the construction and working of Molten Carbonate fuel cell (MCFC) with the help of a suitable sketch

MUT404	COMPREHENSIVE COURSE VIVA	CATEGORY	L	T	P	CREDIT
		PCC	1	0	0	1

Preamble: 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 Marks

MUD416	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 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.	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 track the 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						

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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/or industrial 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

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT414	EMBEDDED SYSTEM IN AUTOMOBILES	PEC	2	1	0	3

Preamble: To make the student understand about the fundamentals of embedded system and give them insight to the various components related to embedded systems used in Automobiles and their application

Prerequisite: MUT301: Auto Electrical and Electronics

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

CO 1	Elaborate on the different embedded systems to be applied in an automobile
CO 2	Identify the different communication protocols
CO 3	Identify the assembly languages required for the embedded systems
CO 4	Understand the serial communication protocol
CO 5	Understand on the data acquisition systems and its applications

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	-	2	-	-	-	-	-	-	-	1
CO 2	1	-	-	2	-	-	-	-	-	-	-	2
CO 3	1	-	-	2	-	2	-	-	-	-	-	2
CO 4	1	-	-	2	-	-	-	-	-	-	-	2
CO 5	1	-	-	2	-	2	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	30
Understand	30	30	50
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):
Explain the applications of different embedded systems in automobile

Course Outcome 2 (CO2)
Elaborate about the different communication protocols

Course Outcome 3(CO3):
Identify the different assembly programming methods in embedded systems

Course Outcome 4 (CO4):
Learn on the ADC serial communication protocol and its applications

Course Outcome 5 (CO5):
Understand the different data acquisition systems and its applications

Model Question paper

QP CODE:
PAGES:…

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT414

Course Name: EMBEDDED SYSTEM IN AUTOMOBILE ENGINEERING

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

Part A
(Answer all questions. Each question carry 3 marks)

1. What are the various sensors used in the ESP system?
2. Explain Head up Display
3. What are the challenges in drive by wire technology?
4. Explain power by wire?
5. Mention the task of the following instructions
   a. MOV B, A
   b. CMA
6. What are subroutines?
7. Explain tristate buffers?
8. Explain DMA data transfer?
9. Explain stepper motor control
10. What are the advantages of temperature control in automobiles?

PART B
(ANSWER ANY ONE QUESTION FROM EACH MODULE. EACHFULL QUESTION CARRY 14 MARKS)

11	a)	What is Anti-Lock Braking System? Explain its working with neat block diagram	(10)
	b)	Explain the working of wheel speed sensor	(4)
		OR	
12	a)	Explain traffic telematics with examples	(7)
	b)	Explain GPS Navigation	(7)
13		Compare between CAN and Flex ray protocols	(14)
		OR	
14		Explain the system and design requirements of any two of the x by wire technology.	(14)

15a) Convert the following BCD to Decimal (6)

(i) 00101001
(ii) 101100111
(iii)10011

b) Convert the following Binary to BCD (8)

(i) 00101001
(ii) 101100111
(iii)10011
(iv)10110

OR

16 Explain the steps to multiply two 8 bit numbers stored at address 2050 and 2051. Result should be stored at address 3050 and 3051. (14)

17 Compare SPI and SCI protocols(14)

OR

18 Explain the interfacing of 8251 with 8085 (14)

19 Explain with neat diagram the Advanced Driver Assistance Systems (ADAS) (14)

OR

20 Explain CRDI engine control with neat block diagram (14)

SYLLABUS

Module 1:

Introduction – Vehicle body and convenience electronics, vehicle power supply controllers and lighting systems, Active and passive safety systems like ABS, ASR & ESP, restrained systems and their associated sensors, Infotainment electronics-Instrument cluster, navigation systems, telematics and multimedia systems, Cross application technologies: 42 volt vehicle power supply system

Module 2:

Embedded Communications-Review of Embedded Automotive Protocols, Dependable Automotive CAN Networks, Flex Ray Protocol, Drive by Wire - Challenges and opportunities of X by Wire: System and Design requirements steer by wire, Brake by wire, Suspension by wire, Gas by wire, Power by wire, and shift by wire.

Module 3:

Assembly language programming: construction of the language programming - assembly format of 8085 - assembly directive - multiple precision addition and subtraction - bcd to binary and binary to bcd, multiplication, division, code conversion using look up tables - stack and subroutines.

Module 4:

On chip ADC serial communication protocol: SCI, SPI, IIC, CAN, Data transfer schemes interrupt structure - programmed i/o - interrupt driven i/o, dma - serial i/o. Interfacing devices types of interfacing devices - input / output ports 8212, 8255, 8251, 8279. octal latches and tristate buffers - a/d and d/a converters - switches, led's rom and ram interfacing.

Module 5:

Applications data acquisitions - temperature control - stepper motor control - automotive applications-engine control, suspension system control, driver information systems, Advanced Driver Assistance Systems (ADAS), control systems for the GDI and CRDI engine control

Text Books

1. Rajkamal,'EmbeddedSystem-Architecture,Programming,Design',TataMcGrawHill,2003.
2. Ramesh, Goankar.S., " Microprocessor Architecture Programming and Applications ", Wiley Eastern Ltd., New Delhi, 1986.
3. Ahson.S.I. " Microprocessors with Applications in Process Control ", Tata McGraw-Hill, New Delhi, 1986.
4. Jabez Dhinagar.S., " Microprocessor Application in Automoblies ".

Reference Books

1. L.Bianco and A.Labella., " Automotive Micro Electronics ", Elsevier science publishers.
2. Daniel W. Lewis 'Fundamentals of Embedded Software', Prentice Hall of India, 2004.
3. Aditya.P.Mathur, " Introduction to Microprocessors ", III Edition, Tata McGraw-Hill Publishing Co Ltd., New Delhi, 1989.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**INTRODUCTION**	
1.1	Vehicle body and convenience electronics, vehicle power supply controllers and lighting systems	2
1.2	Active and passive safety systems like ABS, ASR & ESP, restrained systems and their associated sensors	2
1.3	Infotainment electronics-Instrument cluster, navigation systems, telematics and multimedia systems, Cross application technologies :42 volt vehicle power supply system	3
2	**COMMUNICATION SYSTEMS**	
2.1	Embedded Communications-Review of Embedded Automotive Protocols, Dependable Automotive CAN Networks, Flex Ray Protocol	3

2.2	Drive by Wire - Challenges and opportunities of X by Wire: System and Design requirements steer by wire, Brake by wire, Suspension by wire, Gas by wire, Power by wire, and shift by wire	4
3	**ASSEMBLY LANGUAGE PROGRAMMING**	
3.1	Construction of the language programming	1
3.2	Assembly format of 8085	2
3.3	Assembly directive - multiple precision addition and subtraction	2
3.4	Bcd to binary and binary to bcd, multiplication, division, code conversion using look up tables - stack and subroutines.	2
4	**SERIAL COMMUNICATION PROTOCOL**	
4.1	On chip ADC serial communication protocol: SCI, SPI, IIC, CAN.	2
4.2	Data transfer schemes interrupt structure - programmed i/o - interrupt driven i/o, dma - serial i/o.	2
4.3	Interfacing devices types of interfacing devices - input / output ports 8212, 8255, 8251, 8279	1
4.4	Octal latches and tristate buffers - a/d and d/a converters - switches, led's rom and ram interfacing.	2
5	**DATA ACQUISITION**	
5.1	Temperature control - stepper motor control	1
5.2	Automotive applications-engine control, suspension system control, driver information systems	2
5.3	Advanced Driver Assistance Systems (ADAS)	2
5.4	Control systems for the GDI and CRDI engine control	2

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MET434	PRESSURE VESSEL AND PIPING DESIGN	PEC	2	1	0	3

Preamble: To gain knowledge of pressure vessel design, designing of piping and piping systems, and familiarize with codes and practices in design.

Prerequisite: Solid mechanics/ Strength of materials

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

CO Nos	Course Outcomes	Level of learning domain
CO 1	Explain the design considerations of various shell type pressure vessels	2
CO 2	Explain the design considerations of thick cylinders under various kind of loadings	2
CO 3	Apply design concepts in the design of shell and supports of vertical and horizontal pressure vessels	3
CO 4	Solve problems involving the thickness and stiffener support requirements of cylinders under buckling loads	3
CO 5	Solve problems involving pipe stress and flexibility analysis and also understand the fracture based design concepts of pressure vessels	3

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	3											1
CO 3	3	3	3									1
CO 4	3	3	3									1
CO 5	3	3	3									1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember			
Understand	20	20	30
Apply	30	30	70
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. Derive the expression for membrane stresses in axisymmetric shell structure under internal pressure
2. Derive the expression for dilation in cylindrical and spherical pressure vessels under internal pressure
3. Explain the conditions for buckling in ellipsoidal shells and discuss the remedies

Course Outcome 2 (CO2)
1. Derive the Lame's equations of stresses in thick cylinder under internal pressure
2. Find out the stress pattern developed in case of built up cylinders under a given interference

after assembly

3. What are thermal stresses in a pressure vessel and how they are evaluated

Course Outcome 3(CO3):

1. Explain the design steps in the design of tall cylindrical vessel under wind load
2. Explain with neat sketches the supports used in the case of vertical tall self-supported cylindrical vessels
3. Explain with sketches, various stresses developed in a saddle supported horizontal pressure vessel

Course Outcome 4 (CO4):

1. Derive the expression for critical buckling pressure for cylinder under external pressure
2. Explain with sketches the support design for pipes under external pressure
3. Explain the design curves for design of cylinders under both external pressure and compressive axial loading

Course Outcome 5 (CO5):

1. Explain the flexibility analysis of piping system
2. what is meant by modes of fracture? What is stress intensity factor
3. Explain failure assessment diagram and its usage

Model Question Paper

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
EIGHTH SEMESTER B. TECH DEGREE EXAMINATION
Course Code: MET 434
Course Name: PRESSURE VESSEL AND PIPING DESIGN

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

PART – A

(ANSWER ALL QUESTIONS, EACH QUESTION CARRIES 3 MARKS)

Part-A

1. Explain the stresses developed in a conical cylinder under internal pressure?
2. Derive the expression for dilation of a spherical shell under internal pressure?
3. Explain with sketches the stress pattern in a built-up cylinder after assembly?
4. Derive the expression for internal pressure for the full cross section yielding of a cylinder?
5. Explain with sketches, any two types of supports used for tall cylindrical vessels?
6. What are the different sections of ASME pressure vessel code?
7. Explain with sketches, stiffener support for pipe under external pressure?
8. Explain the design curves for pipe under both external and axial compressive loading?

9. What is meant by flexibility analysis?
10. What is meant by modes of fracture?

(10X3=30)

PART – B

(ANSWER ONE FULL QUESTION FROM EACH MODULE)

MODULE – 1

11. (a) Derive the general expression for stress equilibrium in an axisymmetric shell under internal pressure (6 marks)

(b) Derive the expression for membrane stresses in an elliptical shell and bring out the condition for local buckling (8 marks)

OR

12. (a) Derive the expression for stresses developed in a thin cylinder under internal pressure (6 marks)

(b) Derive the expression for membrane stresses developed in a torus under internal pressure (8 marks)

MODULE – 2

13. (a) A short Thick cylinder with 1000 mm internal diameter and 1300mm outside diameter subjected to an internal pressure of 40 MPa. Determine the location and magnitude of maximum tangential, radial, shear stresses induced. Find also the dilation of its inner and outer radii. (10 marks)

(b) Sketch the variation of stresses across the thickness of thick cylinder under internal pressure (4 marks)

OR

14. (a) A steel tube of 240 mm external diameter is shrunk on another steel tube of 80 mm internal diameter. Diameter of junction is 160mm. The interference before shrinking is 0.08 mm. Find the tangential stress at outer surface of inner tube (ii) the tangential stress at the inner surface of the outer tube and (iii) radial stress at the junction after assembly. E=200 GPa (6 marks)

(b) Derive the expression for the internal pressure for intermittent yielding of cylindrical pressure vessels? (8 marks)

MODULE – 3

15. (a) Explain the design procedure of a tall vessel under wind load as per ASME code? (8 marks)

(b) Explain with sketches, various supports used in case of tall vessel? (6 marks)

OR

16. (a) Explain the procedure followed in the case of tall vessel under seismic load? (8 marks)

(b) Explain with sketches, various supports used in case of horizontal pressure vessels under internal pressure? (6 marks)

MODULE – 4

17. (a) Derive the critical buckling pressure for a circular ring under external pressure? (8 marks)

(b) Explain the procedure for pipe sizing under external pressure? (6 marks)

OR

18. (a) Discuss the classification of cylinders for design for buckling as per ASME code. (6 marks)

(b) Explain the following terms (i) factors A & B for vacuum design (ii) Buckling coefficients (iii) effect of imperfections on buckling strength ? (8 marks)

MODULE – 5

19. (a) Discuss various methods to increase flexibility in a piping system. (6 marks)

(b) A thick walled cylinder with 300 MPa internal pressure, internal diameter 300mm external diameter 600 mm is having a semi elliptical defect 10mm deep on the inside surface. The aspect ratio of the flaw is 0.1. Check whether vessel is satisfactory from fracture point of view. K_{IC} =180 MPa$\sqrt{m}$. (8 marks)

OR

20.(a) Explain the following (i) Displacement stress range (ii) stress range reduction factor (ii) Sustained and occasional loads. (7 marks)

(b) Explain (i) fracture toughness (ii) leak before break (iii) through thickness/surface flaws. (7 marks)

Syllabus

Module 1

Pressure vessel – Terminology – Types of loads – Types of pressure- Stresses in pressure vessels – Dilation of pressure vessels – Membrane stress analysis of vessel shell components Cylindrical shells, spherical shells, torus, conical head, elliptical head

Bending of circular plates under uniform pressure load with simply supported and clamped edges (no derivation)

Module 2

Stresses in thick walled cylinders – Lame's equation for internal and external pressure Shrink-fit stresses in Built up cylinders, autofrettage of thick cylinders, Thermal stresses and their significance

Module 3

Design of pressure vessels- shell and support design of tall vessel under wind and seismic load

Shell and support design of horizontal vessels

Familiarization with relevant ASME codes and standard practices in pressure vessel design

Module 4

Buckling -Elastic buckling of cylinders or pipes under external pressure- Pipe sizing under external pressure- Design of Stiffeners

Buckling under combined compressive pressure and axial load

Module 5

Pipe stress Analysis -allowable displacement stress range for expected cyclic life-stress intensification factor and flexibility factor-Flexibility Analysis (Analysis as per clause 119.7.1 in Code ASME B31.1/clause 319.4.1 in ASME B31.3 only)

Fracture based design of pressure vessels- modes of fracture-stress intensity factor -through thickness and surface cracks in pressure vessels (mode-I only)-fracture toughness-leak before break-failure assessment diagram

Text Books

1. John F. Harvey, "Theory and Design of Pressure Vessels" CBS Publisher and Distributors
2. Brownell, L. E., and Young, E. H., "Process Equipment Design", John Wiley and Sons
3. Somnath Chathopadhyay, "Pressure Vessels Design and practice", C. R. C Press
4. Prashant Kumar, "Elements of fracture mechanics", McGraw Hill Education India

Reference Books

1. Henry H. Bender, "Pressure Vessels Design hand book"
2. ASME Pressure Vessel Codes Section VIII, 2006
3. Dennis Moss,"Pressure Vessel Design Manual" Gulf publishing, 2003

4. J. Phillip Ellenberger, “Pressure Vessels: ASME Code Simplified”, ASME
5. “American standard code for pressure piping, B 31.1”, ASME.
6. Smith P, “Fundamentals of Piping Design”, Elsevier
7. ASME Pressure Vessel and Boiler code, Section VIII Div. 1, 2, and 3”, ASME
8. T. L Anderson “Fracture Mechanics: Fundamentals and applications” Taylor &Francis
9. D. Broek, “Elementary Engineering Fracture Mechanics”, Kluwer Academic Publications

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Design of thin pressure vessels	
1.1	Membrane stresses in general axisymmetric shell under internal pressure	3
1.2	Stresses and dilation in various kinds of components	2
1.3	Bending plates	2
2	**Design of thick pressure vessels**	
2.1	Stresses in thick walled cylinders – Lame’s equation - Shrink fit stresses in built up cylinders in Built up cylinders	3
2.2	Autofrettage in cylinders	2
2.3	Thermal stresses and significance	2
3	**Vertical and horizontal vessel design**	
3.1	Design of tall vertical shell structure and its supports	3
3.2	Design of shell and supports for horizontal vessels	3
3.3	Familiarization with standards and codes	2
4	**Buckling Analysis**	
4.1	Derivation of critical buckling pressure under external pressure	2
4.2	Pipe sizing and stiffener support design	3
4.3	Combined circumferential and axial buckling design	2
5	**Flexibility analysis and fracture design**	
5.1	Pipe stress and flexibility analysis	2
5.2	Fracture fundamentals	2
5.3	SIFs, leak before break and failure assessment diagram	3

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT434	AVG AND AUTONOMOUS VEHICLES	PEC	2	1	0	3

Preamble: This course aims at providing the students, an insight on the advanced combustion systems and engine technologies.

Prerequisite: NIL

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

CO 1	Understand the evolution, types and safety concerns of autonomous vehicles
CO 2	Understand the fundamental technologies in autonomous vehicle
CO 3	Understand the autonomous vehicle perception for detection and tracking
CO 4	Understand the advanced driver assistance system used in autonomous vehicles
CO 5	Understand the path planning and decision making in autonomous vehicles

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	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	40
Apply	20	20	50
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.

Expected outcome: The students will become aware of the latest developments and advancement in the field of IC engines.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the evolution of autonomous vehicle.
2. Differentiate a fully autonomous and semi-autonomous vehicle
3. What are the major safety concerns of an autonomous vehicle ?
4. Mention real-time application of autonomous vehicles
5. Explain the concept of a network of autonomous vehicles.

Course Outcome 2 (CO2)

1. Explain the autonomous vehicle concept from a hardware perspective.
2. Explain the autonomous vehicle concept from a software perspective
3. What is a Kalman filter? Briefly explain how Kalman filter is used for non-linear systems
4. What are the types of control in an autonomous vehicle?
5. Why localization is required in an autonomous vehicle?

Course Outcome 3(CO3):

1. Briefly explain about the types of perception techniques in an autonomous vehicle?
2. With a neat diagram, explain about computer vision in autonomous vehicle?
3. Discuss the recognition methods used in an autonomous vehicle
4. What are the types of vision used for general navigation in an autonomous vehicle?
5. Why “optical flow” is used in autonomous vehicles?

Course Outcome 4 (CO4):

1. Why ADAS systems are used in an autonomous vehicle?
2. Elaborate information based assistance systems.
3. How manipulation based assistance system is used in an autonomous vehicle?
4. Explain the multi-vehicle systems used in autonomous vehicles
5. Explain the V2V ,V2R & V2I communication systems used in autonomous vehicles.

Course Outcome 5 (CO5):

1. Explain the significance of planning in an autonomous vehicle.
2. What are the layers of planning used in an autonomous vehicle?
3. What are the types of traffic? Explain its advantages and disadvantages.
4. How is the motion planned in the case of special scenarios?
5. Briefly explain the motion planning primitives in an autonomous vehicle.

Model Question paper

QP CODE:

PAGES:…

Reg. No: _______________ **Name :_______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT434

Course Name: AVG AND AUTONOMOUS VEHICLES

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

Part A

(Answer all questions. Each question carries 3 marks)

1. Briefly explain the evolution of autonomous vehicle.
2. What are the major safety concerns of an autonomous vehicle?
3. Differentiate between a Kalman filter and Particle filter?
4. Why localization is required in an autonomous vehicle?
5. Why “optical flow” is used in autonomous vehicles?
6. Mention the vision systems used in an autonomous vehicle.
7. Explain the working of ADAS system?
8. Briefly explain the multi-vehicle systems in autonomous vehicles.
9. Explain the layers of planning in an autonomous vehicle
10. Briefly explain the types of traffic as per the autonomous vehicle.

Part B

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

11 (a) Mention real-time application of autonomous vehicles (7)
(b) Differentiate a fully autonomous and semi-autonomous vehicle (7)

OR

12 Explain the need for adoption of autonomous vehicle in detail for future (14)

13 Explain the autonomous vehicle concept from a hardware perspective (14)

OR

14 Explain the autonomous vehicle concept from a software perspective (14)

15 Explain the recognition methods used in an autonomous vehicle (14)

OR

16 Explain the vision systems in autonomous vehicle with neat diagrams (14)

17 Explain V2V, V2I AND V2R communication systems (14)

OR

18 Explain in detail assistance systems used in autonomous vehicle (14)

19 Explain the significance of planning in autonomous vehicles (14)

OR

20 What are the motion planning primitives used in an autonomous vehicle (14)

SYLLABUS

Module 1

Evolution of Autonomous Vehicles – Advantages & Disadvantages – Concept of Intelligent Vehicles – Artificial Intelligence and Planning – Fully Autonomous and Semi-Autonomous Vehicles – Network of Autonomous Vehicles – Autonomous Vehicles in Action – Other Types of Robots – Future technologies

Module 2

Basics of Autonomous Vehicles–Hardware – External Sensors – Stereovision and 3D Sensing – Motion and Internal Sensors – Actuators and Drive by Wire – Processing and Networking – Power – Software – Vision – Mapping – Localization – Motion Planning – Control – Humane Machine Interface Issues – Kalman Filter – Particle Filtering – Control

Module 3

Perception in Autonomous Vehicles – Sensor Choices and Placement – Sensor Calibration – Stereovision and 3D Techniques – Multisensors and Information Fusion –– Computer Vision – Image Preprocessing –Feature Extraction – Segmentation and Localization – Recognition – Neural Networks – Support Vector Machines – Decision Trees – Adaptive Boosting – Tracking and Optical Flow – Vision for General Navigation – Vehicle and Obstacle Detection and Tracking – Road and Lane Detection and Tracking – Pedestrian Detection – Understanding Traffic Signs

Module 4

Advanced Driver Assistance Systems – Information-Based Assistance Systems – Advanced Traveller Information Systems – Inattention Alert Systems – Measuring Driver Performance – Manipulation-Based Assistance Systems – Safety Alert and Emergency Stopping – Adaptive Cruise Control – Overtaking Assessment and Assist –Automated Parking Systems – Feedback Modalities to Driver – Multi-Vehicle Systems – Communication

Module 5

Introduction to Planning – Layers of Planning– Types of Traffic – Motion Planning Primitives – Multirobot Motion Planning – Motion Planning for Autonomous Vehicles – Planning for Special Scenarios.

Text/Reference Books:

1. Kala, Rahul. On-road intelligent vehicles: Motion planning for intelligent transportation systems. Butterworth-Heinemann, 2016.
2. Cheng, Hong. Autonomous intelligent vehicles: theory, algorithms, and implementation. Springer Science & Business Media, 2011.
3. Ronald K. Jurgen, "Autonomous vehicles for safer driving", SAE international.

Course Contents and Lecture Schedule

No	Topics	No. of Lectures
1	**MODULE – 1:**	
1.1	Introduction to Autonomous Vehicles, Advantages & Disadvantages	1
1.2	Concept of Intelligent Vehicles	1
1.3	Artificial Intelligence and Planning	1
1.4	Fully Autonomous and Semi-Autonomous Vehicles	1
1.5	Network of Autonomous Vehicles	1
1.6	Autonomous Vehicles in Action	1
1.7	Other Types of Robots, Future technologies	1

No	Topics	No. of Lectures
2	**MODULE – 2**	
2.1	Basics of Autonomous Vehicles–Hardware	1
2.2	External Sensors – Stereovision and 3D SensingProcessing and Networking –Power	2
2.3	Motion and Internal Sensors – Actuators and Drive by Wire, Processing and Networking	1
2.4	Software – Vision – Mapping ,Humane Machine Interface Issues, Control Motion Planning	1
2.5	Localization – Kalman Filter – Particle Filtering	2
3	**MODULE – 3**	
3.1	Perception in Autonomous Vehicles Sensor Choices and Placement – Sensor Calibration Stereovision and 3D Techniques – Multisensors and Information Fusion	2
3.2	Computer Vision – Image Pre-processing –Feature Extraction – Segmentation and Localization	1
3.3	Recognition – Neural Networks – Support Vector Machines – Decision Trees – Adaptive Boosting	2
3.4	Tracking and Optical Flow – Vision for General Navigation – Vehicle and Obstacle Detection and Tracking – Road and Lane Detection and Tracking – Pedestrian Detection – Understanding Traffic Signs	2
4	**MODULE – 4**	
4.1	Advanced Driver Assistance Systems	1
4.2	Information-Based Assistance Systems – Advanced Traveller Information Systems	1
4.3	Inattention Alert Systems – Measuring Driver Performance	1
4.4	Manipulation-Based Assistance Systems – Safety Alert and Emergency Stopping	1
4.5	Adaptive Cruise Control – Overtaking Assessment and Assist – Automated Parking Systems	2
4.6	Feedback Modalities to Driver – Multi-Vehicle Systems – Communication	1
5	**MODULE – 5**	
5.1	Introduction to Planning – Layers of Planning	1
5.2	Types of Traffic	1
5.3	Motion Planning Primitives	2
5.4	Multi Robot Motion Planning	1
5.5	Motion Planning for Autonomous Vehicles	1
5.6	Planning for Special Scenarios	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT444	HUMAN RELATIONS MANAGEMENT	PEC	2	1	0	3

Preamble: Goal of this course is to expose the students to the fundamental concepts about human behaviour in individual and group levels. It introduces students to manage the human relations in organizations and collective bargaining. After this course students will be able to recognize and manage employer-employee relations and conflicts.

Prerequisite: Nil

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

CO 1	Understanding the basics of Human Behaviour and relations in Groups
CO 2	Understand the management of human relations in Organizations
CO 3	Understand the management of labour laws, appraisal process and collective bargaining
CO 4	Understand the management of training and employer-employee relations
CO 5	Understand the management of human conflicts, customer relations, Union and Global Relations

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	×	×	×	×	×	✓	×	×	✓	✓	✓	✓
CO 2	×	×	×	×	×	✓	×	✓	×	✓	✓	✓
CO 3	×	×	×	×	×	✓	×	×	×	✓	✓	✓
CO 4	×	×	×	×	×	✓	×	×	×	✓	✓	✓
CO 5	×	×	×	×	×	✓	×	×	✓	✓	✓	✓

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
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. What are the types and importance of value?

2. Explain the importance of diversity and potential threats to diversity.

3. Define Leadership. What are various ingredients a leader should possess?

Course Outcome 2(CO2):

1. How ethics, fair treatment & justice be fostered in an organization

2. Briefly explain about guidelines for grievance handling

3. Explain in detail on how to discipline an employee

Course Outcome 3 (CO3):

1. Briefly explain about guidelines for grievance handling

2. What is the role of employee in the appraisal process? Explain

3. Define misconduct. What are its repercussions?

Course Outcome 4 (CO4):

1. What are the various training strategies used?

2. Mention requirement employee relations department in an industry

3. Explain the industrial relations implications of personal policies

Course Outcome 5 (CO5):

1. Explain the importance of customer relationship management.

2. What are the precautionary measures taken for employee health and safety?

3. How can the personnel management change in the future scenario?

Model Question paper

QP CODE:
PAGES:…

Reg. No: _______________ **Name :_______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT444

Course Name: HUMAN RELATIONS MANAGEMENT

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

Part A
(Answer all questions. Each question carries 3 marks)

1. Explain about the various personality traits.
2. Differentiate between leadership and management?
3. Define Ethics. What is meant by ethical behaviour?
4. Why employee privacy is important? Explain
5. What are the categories of bargaining items?
6. Explain about Gross misconduct of employees.
7. Describe any two on-the-job training methods for employees
8. Why Employee relations are essential?
9. State the importance of IHRM
10. What are the types of conflicts in organizations?

Part B

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

MODULE 1

11 Explain the link between perception and decision making. What are common biases and errors in decision making (14)

OR

12 What do you think of universalistic theories of leadership? Critically examine Likert's four system of leadership. Which of the systems, you feel is ideal. Give reasons.(14)

MODULE 2

13 How HR managers can create more ethical environments. (14)

OR

14 Explain in detail on how to discipline an employee (14)

MODULE 3

15 What is grievance? Explain about grievance sources, procedure and handling. (14)

OR

16 Explain the procedure of layoff and plant closing with its aftereffects (14)

MODULE 4

17 Explain in detail the process of designing a training programme for employees (14)

OR

18 Explain the approach of handling problems of employees (14)

MODULE 5

19 Describe the place and role of Labour Unions in Organisations. (14)

OR

20 What is meant by Customer Relationship Management? Explain the need and importance of CRM. (14)

SYLLABUS

Module 1

Human Behaviour: Learning, theories of learning. Attitude and Values, importance and types, workforce diversity. Personality determinants and traits, emotion dimensions. Perception, factors influencing perception, making judgement about others, link between perception and individual decision making.

Relations in Groups: Theories of Leadership, Leadership styles based on authority, Managerial Grid, Approaches to Leadership. Groups, Definition and classification, Stages of group development, five stage model. Group structure roles, norms, status and size. Group decision making, group versus the individual. Types of teams, self-managed work teams, problem solving teams. Creating effective teams.

Module 2

Management of Human Relations in Organisations: Ethics and fair treatment at work, ethics and the law, ethics fair treatment and justice. Ethical behaviour at work, individual factors, organizational factors, the boss's influence, ethics policies and codes, the organization's culture, role of HR in fostering ethics and fair treatment. Disciplining an employee, formal disciplinary appeal process, discipline without punishment, employee privacy.

Module 3

Management of Labour Laws and Collective Bargaining: Employment law, gross misconduct, personal supervisory liability, layoffs and plant closing law. Appraisal Process, Collective bargaining, good faith, negotiating team, bargaining items, bargaining stages, bargaining hints, impasses, mediation, and strikes, the contract agreement. Grievances, sources of grievances, the grievances procedure, guidelines for handling grievances.

Module 4

Management of Training and Employer-Employee Relations: Training and Development, objectives, strategies, methods and techniques. Design and organisation of training and evaluation of training. Employee relations, management-employee relations, managing discipline, grievance and stress, counselling, handling problem employees. Industrial relations implications of personal policies, nature of employment relationship.

Module 5

Management of Human Conflicts, Customer Relations, Unions and Global Relations: Industrial and Organisational conflicts, managing for good industrial relations and managing the moment of conflict. Customer relationship management, what if customer is the problem. Place of union in organizations. The future scenario, the changing personnel management scenario. Managing global human relations. HRD the development role of personnel to the force. Employee safety and health

Text Books

1. Gary Dessler, Human Resource Management, Pearson Education, 2017

2. Seema Sanghi, Stephen P.Robbins, Timoti A Judge : Organizational Behaviour, Pearson Education, 2009

Reference Books

1. Sherman, Arthur W., and George W. Bohlander. *Managing human resources*. South western educational publishing, 1998.

2. Aubrey C Sanford, Human Relations: Theory & Practice, Merrill, 1973

3. C S Venkata Ratnam and B K Srivastava, Personnel Management and Human Resources, TMH,1996

4. Uma Sekharan, Organizational Behaviour- Text and Cases, Tata Mc Graw Hill, 1989

5. V.Kumar, Customer Relationship Management, Wiley India Edition, 2013

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1**	
1.1	Learning, theories of learning. Values, importance of values, types	1
1.2	Attitudes, types, attitudes and consistency, workforce diversity	1
1.3	Personality determinants and traits, emotion dimensions	1
1.4	Perception factors influencing perception, making judgement about others, link between perception and individual decision making	1
1.5	Theories of Leadership, Leadership styles based on authority, Managerial Grid, Approaches to Leadership.	1
1.6	Defining and classifying different groups. Stages of group development, five stage model	1
1.7	Group structure roles, norms, status and size Group decision making, group versus the individual.	1
1.8	Types of teams, self-managed work teams, problem solving teams. Creating effective teams	1
2	**Module 2**	
2.1	Ethics and fair treatment at work, ethics and the law, ethics fair treatment and justice.	2
2.2	Ethical behaviour at work, individual factors, organizational factors, the boss's influence, ethics policies and codes, the	2

	organization's culture, role of HR in fostering ethics and fair treatment.	
2.3	Disciplining an employee, formal disciplinary appeal process, discipline without punishment, employee privacy.	2
3	**Module 3**	
3.1	Employment law, gross misconduct, personal supervisory liability, layoffs and plant closing law.	2
3.2	Appraisal Process, Collective bargaining, good faith, negotiating team, bargaining items, bargaining stages, bargaining hints, impasses, mediation, and strikes, the contract agreement.	3
3.3	Grievances, sources of grievances, the grievances procedure, guidelines for handling grievances.	2
4	Module 4	
4.1	Training and Development, objectives, strategies, methods and techniques.	1
4.2	Design and organisation of training and evaluation of training	2
4.3	Employee relations, management-employee relations, managing discipline, grievance and stress, counselling, handling problem employees	2
4.4	Industrial relations implications of personal policies, nature of employment relationship.	2
5	**Module 5**	
5.1	Industrial and Organisational conflicts, managing for good industrial relations and managing the moment of conflict.	1
5.2	Customer relationship management, what if customer is the problem. Place of union in organizations.	2
5.3	The future scenario, the changing personnel management scenario. Managing global human relations	2
5.4	HRD the development role of personnel to the force. Employee safety and health.	2

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MET464	MICRO AND NANO MANUFACTURING	PEC	2	1	0	3

Preamble: This course serves to enable the learners to understand the underlying principles, processes and applications with regard to broader areas of micro manufacturing and nanotechnology. It also covers dimensional metrology aspects and tools for micro and nanoscale manufacturing.

Prerequisite: Nil

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

CO 1	Explain different techniques used in micro and nano manufacturing
CO 2	Describe conventional techniques used in micro manufacturing.
CO 3	Describe non-conventional micro-nano manufacturing approaches.
CO 4	Outline the working principle and applications of micro and nano finishing processes
CO 5	Explain the basics of micro and nano fabrication techniques.
CO 6	Apply and select metrology systems in micro and nano manufacturing.

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	1	1	-
CO 2	2	-	-	-	-	-	1	-	2	1	1	-
CO 3	2	-	-	2	-	-	1	-	2	1	1	-
CO 4	3	-	-	-	-	-	1	-	2	1	1	-
CO 5	2	-	-	-	-	-	1	-	2	1	1	-
CO 6	3	-	-	-	1	-	2	-	2	1	2	1

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (marks)**
	1 (marks)	**2 (marks)**	
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 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. Explain different techniques used in micro and nano manufacturing.
2. Explain typical fabrication process for an Integrated Chip.
3. Describe 3 basic regimes of fabrication at microscale.

Course Outcome 2 (CO2):

1. Discuss application areas of micro-turned components.
2. Point out limitations and challenges of micro-extrusion process.
3. List out any 4 application areas of micro-milling process.

Course Outcome 3 (CO3):

1. How are micromolds designed?
2. Discuss the principle and process of micro-EDM.
3. Discuss the principle and process of micro-LBM.

Course Outcome 4 (CO4):

1. With the help of a suitable diagram, explain the principle of Magnetorheological finishing process.
2. Describe Magnetic Float Polishing.

3. Draw the schematic of Elastic Emission Machining and explain.

Course Outcome 5 (CO5):

1. Explain how an elastic stamp is manufactured using soft lithographic techniques.

2. Describe the structure and properties of CN tubes.

3. What are the different approaches to deposition of diamond in a CVD Diamond process. Explain.

Course Outcome 6 (CO6):

1. Explain Scanning white-light interferometry with the help of a suitable diagram.

2. Outline unique metrological challenges faced in micro-nano manufacturing?

3. Explain Scanning Electron Microscopy in detail.

Model Question Paper

MET464 MICRO AND NANOMANUFACTURING

Max. Marks: 100 Duration: 3 hours

Part−A

Answer all questions. Each question carries 3 marks

.

1. Define microgrinding.
2. Point out any 3 differences between macroturning and microturning.
3. Why are high speed air turbine spindles useful for micromachining?
4. What is hot embossing? Why is it particularly suited for manufacturing of optical components?
5. Draw the schematic of Chemical Mechanical Polishing process.
6. Illustrate the mechanism of material removal in Ion beam machining.
7. List out various materials used in semi-conductor industry.
8. Show by a schematic how an elastic stamp is manufactured using soft lithography?
9. Draw the schematic of typical scanning white light interferometry set up.
10. What are the merits and demerits of On-machine metrology?

Part−B

Answer one full question from each module.

Module I

11. Discuss in detail the design requirements of microturning machines. (14 marks)

OR

12. Discuss the outcomes of microgrinding of ceramic materials. (14 marks)

Module II

13. Discuss the Focused Ion Beam system. (14 marks)

OR

14. Discuss various methods available for manufacturing of micromolding tools. (14 marks)

Module III

15. Describe Magnetic float polishing with a neat diagram. (14 marks)

OR

16. Discuss the principles of MRAFF process with a suitable diagram. (14 marks)

Module IV

17. Explain how a Field effect transistor is fabricated by the process of soft lithography? (14 marks)

OR

18. Describe all properties of Carbon Nanotubes. (14 marks)

Module V

19. Explain the operation of scanning tunneling microscope. (14 marks)

OR

20. What is Atomic force microscope? Explain its modes of operation. (14 marks)

Syllabus

Module 1

Introduction to principles of micro and nano fabrication techniques- microfabrication of semi-conductor devices-standard micro machining flow chart- basics of micro fabrication-manipulative techniques. Introduction to mechanical micro machining: Micro drilling-process, tools and applications, Micro turning- principle, process, tools and applications, Diamond micro turning- principle, process, tools and applications, Micro milling and Micro grinding-processes, tools and applications, Micro extrusion- principle, process and applications.

Module 2

Introduction to Non-conventional micro-nano manufacturing: Abrasive Jet Micro-machining, WAJMM- principle, process and applications. Micro EDM, Micro WEDM, Micro EBM-principle, process and applications. Micro ECM, Micro LBM, Focused Ion Beams- process, principle and applications. Micro moulding processes: Injection moulding, Reaction injection moulding, hot embossing, injection compression moulding- micromolding tools-applications.

Module 3

Introduction to micro-nano finishing processes: Magnetorheological Finishing (MRF) processes, Magneto-rheological Abrasive Flow Finishing (MRAFF) processes- Principle, equipment and applications- Force analysis for MRAFF process. Magnetic float polishing (MFP), Elastic Emission machining (EEM), Ion Beam Machining (IBM), Chemical Mechanical Polishing (CMP)- principle, equipment and applications

Module 4

Introduction to Nano Fabrication: Nano fabrication using soft lithography- principle and applications. Introduction to Carbon nano materials- CN tubes- properties and applications. CN tube transistors-Diamonds- properties and applications- CVD Diamond technology- LIGA process. Laser micro welding- Electron Beam Micro welding.

Module 5

Introduction to micro-nano inspection and metrology: Scanning electron microscopy, Scanning white light interferometry, Optical Microscopy, Scanning probe Microscopy, Scanning tunnelling microscopy, Confocal microscopy, Atomic force microscopy. Introduction to On-machine metrology.

Text Books and References

1. Mark J. Jackson, Micro and Nanomanufacturing, Springer, 2007.
2. N.P.Mahalik, Micromanufacturing and nanotechnology, Springer, 2006.
3. Mark J. Jackson, Microfabrication and Nanomanufacturing, Taylor and Francis-CRC press, 2006.
4. V.K. Jain, Micromanufacturing Processes, Taylor and Francis- CRC press, 2012.

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures	COs
1.1	Introduction to micro-nano fabrication techniques- principles and evolution.	1	CO1
1.2	Overview of microfabrication of semiconductor devices- example-Integrated Chip.	1	CO1
1.3	Standard micro machining flow chart and basics of microfabrication-manipulative techniques.	2	CO1
1.4	Introduction to mechanical micro machining. Micro drilling-principle, process, description and applications.	1	CO2
1.5	Micro turning- principle, process, description and applications.	1	CO2
1.6	Diamond micro turning- principle, process, description and applications.	1	CO2
1.7	Micro milling and Micro grinding- principle, process, description and applications.	1	CO2 CO5
1.8	Micro grinding- principle, process, description and applications.	1	CO2
1.9	Micro extrusions- principle, process, description and applications.	1	CO2 CO5
2.1	Introduction to non-conventional micro-nano manufacturing- Abrasive jet micro machining, WAJMM- principle, process, description and applications.	2	CO3
2.2	Micro EDM, Micro WEDM, Micro EBM- process, principle, description and applications.	2	CO3
2.3	Micro ECM, Micro LBM- process, principle, description and applications.	1	CO3
2.4	Focused Ion Beams-process, principle and applications.	1	CO3
2.5	Micromolding process- Injection molding, reaction Injection molding-process, principle, description and applications.	1	CO3
2.6	Hot embossing, injection compression molding- description	1	CO3
2.7	Micromolding tools- applications.	1	CO3
3.1	Introduction to micro-nano finishing processes- magnetorheological finishing (MRF)- process, principle, description, application.	1	CO4
3.2	Magnetorheological abrasive flow finishing (MRAFF)- process, principle-Force analysis- description and applications.	1	CO4
3.3	Magnetic float polishing (MFP)- process, principle, description and applications.	1	CO4

3.4	Elastic emission machining (EEM), Ion beam machining (IBM)- process, principle, description and applications.	1	CO4
3.5	Chemical mechanical polishing (CMP)- process, principle, description and applications.	1	CO4
4.1	Introduction to Nanofabrication- Nanofabrication using soft lithography- principle and applications- examples- field effect transistor, elastic stamp.	1	CO5
4.2	Manipulative techniques- principle and description, applications.	1	CO5
4.3	Introduction to Carbon nano materials- CN tubes- properties and applications- CN tube transistors.	1	CO5
4.4	Diamonds- properties and applications- CVD diamond technology.	2	CO5
4.5	LIGA process.	1	CO5
4.6	Laser micro welding- Electron beam micro welding.	1	CO5
5.1	Introduction to micro-nano inspection and metrology- Scanning electron microscopy- principle and description.	1	CO6
5.2	Scanning white light interferometry- principle and description.	1	CO6
5.3	Optical microscopy- principle and description.	1	CO6
5.4	Scanning probe microscopy, Scanning tunnelling microscopy- principle, description and applications.	1	CO6
5.5	Confocal microscopy, Atomic force microscopy- principle and description.	1	CO6
5.6	Introduction to On-machine metrology.	1	CO6

MUT464	OFF ROAD VEHICLES	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: The aim of this subject is to offer the students a general understanding of the off road vehicles, their systems and features.

- ✓ To familiarize the students with fundamentals of off road vehicles
- ✓ To understand the constructional features of off road vehicles
- ✓ To understand the application of off road vehicle

Prerequisite: Nil

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

CO 1	Acquire theoretical knowledge of constructional details of off road vehicles.
CO 2	Acquire the knowledge of vehicle systems and features
CO 3	Acquire the knowledge of heavy earthmoving constructional machines
CO 4	Acquire the knowledge of industrial application of earth moving machines
CO 5	Acquire the knowledge of farm equipment, military and combat vehicles

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	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	-		-	-	-	-	-	-	-	-	-
CO 4	2	1		-	-	-	-	-	-	-	-	-
CO 5	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. Explain the undercarriage components of crawler tractor.

Course Outcome 2 (CO2)
1. Explain the hydraulic control system in tractors

Course Outcome 3(CO3):
1.Explain the constructional details of a concrete ready mixer

Course Outcome 4 (CO4):
1.Explain the constructional details of a military tanker

Course Outcome 5 (CO5):
1. How are dumpers classified?
2.Which equipment is best suited to dig a drainage by the side of road. Explain with neat sketch.

SYLLABUS

Module 1

Construction layout, capacity and applications of off-road vehicle - prime mover, chassis and transmission, Tyre and tracked vehicles, advantages and disadvantages, under carriage components like, tracks, roller frames, drive sprockets, track rollers, track chains and track shoes. Steering of tracked vehicles: Skid steering , articulated steering, clutch /brake steering system, controlled differential steering system and planetary steering system.

Module 2`

Brake system and actuation – OCDB and dry disc caliper brakes. Body hoist and bucket operational hydraulics. Hydro-pneumatic suspension cylinders. Power steering system. Articulated steering assembly-power and capacity of earth moving machines.

Module 3

Cranes – Construction, classification and operation, concrete ready mixers,compactors-vibratory compactors, forklift, utility vehicles, man - lift, scissors, lift trucks, material handlers, power generators.

Module 4

Tractors, classification - working attachments, power take off, special implements, paddy harvester, sugarcane harvester, feller bunchers, special features and constructional details of military tankers, AVLB gun carriers and transport vehicles. Multi axle vehicles.

Module 5

Dumpers-safety features, safe warning system for dumper, Design aspects on dumper body, Articulated Dumpers, loaders - single bucket, Multi bucket and rotary types - bulldozers, kinematics for loader and bulldozers with operational linkages, excavators, backhoe loaders, scrappers, motorgraders, power shovel, bushcutters, Bushcutters, stumpers, rippers.

Text Books

1	Moving the earth	Herbert Nicholas, David Day	McGraw Hill Edn.,2010
2	Construction, planning, equipment and methods	Robert L Peurifoy	Tata McGraw Hill Publishing company Ltd
3	Construction equipment and its management	S.C. Sharma	Khanna Publishers

Reference Books

1	Theory of Ground Vehicles	Wong JY	John Wiley & Sons, 2008
2	Vehicle and Engine Technology	Heinz Heisler	SAE-1999,USA
3	Tractors and Automobiles	Rodhiev and Rodhiev	MIR Publishers,Moscow,1984

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Fundamentals of Off Road Vehicles- Module 1 (7 hours)**	
1.1	Construction layout, capacity and applications of off-road vehicle .	1
1.2	Prime mover, chassis and transmission, Tyre and tracked vehicles, advantages and disadvantages	2
1.3	Under carriage components like, tracks, roller frames, drive sprockets, track rollers, track chains and track shoes.	1
1.4	Steering of tracked vehicles: Skid steering , articulated steering, clutch /brake steering system.	2
1.5	Controlled differential steering system and planetary steering	1
2	**Vehicle system features- Module 2 (7 hours)**	
2.1	Brake system and actuation – OCDB and dry disc caliper brakes.	1
2.2	Body hoist and bucket operational hydraulics.	2
2.4	Hydro-pneumatic suspension cylinders	1
2.5	Power steering system. Articulated steering assembly	1
2.6	Power and capacity of earthmoving machines.	2
3	**Industrial Application Equipments- Module 3 (7 hours)**	
3.1	Construction, classification and working details of cranes	2
3.2	Concrete ready mixers,	1
3.3	Compactors-vibratory compactors	1
3.4	Forklift, utility vehicles, man - lift, scissors, lift trucks	2
3.5	Material handlers, power generators.	1

4	**Farm equipment ,Military and combat vehicle- Module 4 (7hours)**	
4.1	Tractors, classification - working attachments	1
4.2	Power take off, special implements, paddy harvester, sugarcane harvester,	1
4.3	Fellerbunchers,specialfeaturesandconstructionaldetailsofmilitarytankers	2
4.4	AVLB gun carriers and transport vehicles..	2
4.5	Multi axle vehicles	1
5	**Earth moving and Construction machines- Module 5 (7 hours)**	
5.1	Dumpers-safety features ,safe warning system for dumper,	1
5.2	Design aspects on dumper body, Articulated Dumpers, loaders - single bucket, Multi bucket and rotary types	1
5.3	Bulldozers, kinematics for loader and bulldozers with operational linkages	2
5.4	Excavators, backhoe loaders, scrappers ,motor graders	2
5.5	Power shovel ,bushcutters, Bushcutters, stumpers, rippers. Microphones	1

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: MUT464

Course Name: OFF ROAD VEHICLES

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

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. How are tracked vehicle different from tyred vehicle?
2. Explain the construction of track of a crawler tractor.
3. Explain the type of valves used with hydraulic control system of tractors.
4. Explain the hydraulic brake system used with wheeled tractors.
5. Explain the process of compaction. How are compactors classified?
6. Explain the operation of a scissor type lift
7. How are PTO s classified. Explain?
8. Explain the advantages of multi axle vehicles.
9. Explain the safe warning system used with dumpers.
10. Explain the scraper loading operations.

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

11. Explain the controlled differential steering used with Crawler tractors.

Or

12. Explain the components of under carriage of crawler tractor

Module 2

13. Explain the hydraulic control system used with tractors.

Or

14. Explain the power steering system used with wheeled tractors

Module 3

15. Explain the construction of fork lift truck with neat sketch.

Or

16. Explain the construction of a concteate ready mixer with neat sketch.

Module 4

17. Explain the special features used with Military vehicles

Or

18. Explain with neat sketch construction and operation of paddy harvester

Module 5

19. Explain with neat sketch construction of Off highway dump truck.

Or

20. Explain the construction and operation of a scraper.

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

CODE MUT474	COURSE NAME: MODERN AUTOMOTIVE TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: This course aims to provide the students the various aspects related to current technology trends in Automobile engineering like electric, hybrid and fuel cell vehicles, advanced vehicle control and auxiliary systems etc.

Prerequisite: NIL.

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

CO 1	Understanding various aspects of electric and hybrid vehicles.
CO 2	To know the latest technological advancements in vehicle power plant and control systems
CO 3	Understanding the working principles of advanced navigation and driver assistance systems
CO 4	To give an in-depth knowledge of microprocessor controlled engine management systems
CO 5	Get exposed to research and development challenges involved in various types of fuel cells.

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	-	1	1	-	-	2	-	1
CO 2	2	1	-	2	-	1	2	-	-	2	-	1
CO 3	1	1	-	1	-	1	1	-	-	2	-	1
CO 4	1	-	-	-	-	1	1	-	-	2	-	1
CO 5	1	1	-	1	-	2	2	-	-	2	-	3

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	40
Apply	20	20	50
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.

SYLLABUS

Module 1

Introduction to Electric and Hybrid Vehicle technology- LEV, TLEV, ULV & ZEV, Basic components of Electric vehicles-Inverters, Battery packs and battery management system, motors, electronic power control unit, Electric wiring harness – CAN Bus, Multiplex wiring. regenerative braking, basic factors to be considered for converting automobiles to electric vehicle, hybrid electric vehicle, types - series and parallel hybrid, layouts, comparison, Power systems and control systems, Different modes of operation of hybrid vehicles for best performance.

Module 2

Recent Trends in Automotive Power Plants: Stratified charged– TSI engines, lean burn engines, RCCI engines-concept and working, Hydrogen Engines- working and fuel feed systems, Flex fuel vehicles. Vehicle Operation and engine Control: Electronic engine management systems, Application of sensors and actuators and microprocessors for operation of the vehicle to achieve best fuel economy, reduced emission and optimum road performance, Closed loop and open loop operation, Electronic cruise control, chassis control system, Integrated systems.

Module 3

Principle of automobile navigation and controls in the new generation cars-capabilities of navigation and control of modern cars- Advanced Driver Assistance Systems (ADAS)- LiDAR, RADAR, application and working of GPS, On-board Navigation Vs Mobile Navigation, Introduction to Autonomous vehicles.
Driver Assistance Systems in Automobiles: Vision in cars - Automotive night vision devices (NVD)-active and passive systems, A comprehensive driver assistance approach – Lane recognition, Traffic sign recognition, road recognition, Object recognition – Traffic lights and signals

Module 4

Modem electronic and micro control systems in automobiles: Electronically controlled concealed headlight systems, Electro chromic mirrors, automatic review mirrors, Day time running lamps (DRL), Head up display, Travel information systems, On board navigation system, Electronic climate control, Electronically controlled sun-roof, Anti-theft systems, Automatic door locks (ADL), tyre pressure sensing, automated wiper, Antilock braking system and, electronic traction and stability control (ESP).

Module 5

Introduction to Fuel Cells: Fuel cells-classification, Operational fuel cell voltages, Proton Exchange membrane fuel cells, Alkaline Electrolyte fuel cells, Medium and high temperature fuel cells, fuel and fuel chose, fuel processing, fuel cell stacks, Delivering fuel cell power, Integrated Air supply and humidification concepts for fuel cell systems, Fuel cell Auxiliary systems.

Modern Developments in Automobiles: Air compression systems, Air powered vehicles,

Text Books

1. Barry Hollembeak, Automotive Electricity, Electronics and Computer Controls,
Delmer Publishers. 8. Tom Denton, Automotive Electronics, SAE
2. Beranek. L. L., Noise Reduction, McGraw-Hill Book Co., Inc, New York, 1993.
3. Bosch Hand Book, 3rd Edition, SAE, 1993.
4. Bob Brant, Build Your Own Electric Vehicle.

References

1. SAE, Electric and Hybrid Electric Vehicles and Fuel Cell Technology, SAE.
2. Andrew Dicks and James Laminine, Fuel Cell Systems Explained, SAE.
3. SAE, Fuel cells and alternative fuels / Energy systems
4. SAE, Fuel Cell Power for Transportation, 2001.
5. Rickard Stobart, Fuel Cell Technology for Vehicles, SAE.

Course Contents and Lecture Plan

No.	Topic	No. of Lectures
1	**Electric and Hybrid Vehicle technology**	
1.1	Introduction, LEV, TLEV, ULV & ZEV, Basic components of Electric vehicles-Inverters	1
1.2	Battery packs and battery management system, motors, electronic power control unit	1
1.3	Electric wiring harness – CAN Bus Multiplex wiring. regenerative braking	1
1.4	Basic factors to be considered for converting automobiles to electric vehicle	1
1.5	Hybrid electric vehicle	1

1.6	Types - series and parallel hybrid, layouts, comparison, Power systems and control systems	1
1.7	Different modes of operation of hybrid vehicles for best performance.	1
2	**Recent Trends in Automotive Power Plants**	
2.1	Stratified charged / lean burn engines – TSI engines RCCI engines, Hydrogen Engines, Flex fuel vehicles	1
2.2	Vehicle Operation and engine Control	1
2.3	Application of sensors and actuators and microprocessors for operation of the vehicle to achieve best fuel economy	1
2.4	Reduced emission and optimum road performance	1
2.5	Closed loop and open loop operation	1
2.6	Electronic engine management systems ,Electronic cruise control	1
2.7	Chassis control system, Integrated systems	1
3	**Principle of automobile navigation and controls in the new generation cars**	
3.1	Capabilities of navigation and control of modern cars.	1
3.2	Application and working of GPS	1
3.3	Driver Assistance Systems in Automobiles	1
3.4	Vision in cars-LiDAR, RADAR	1
3.5	A comprehensive driver assistance approach ,Lane recognition,	1
3.6	Traffic sign recognition, Road recognition methods	1
3.7	Object recognition – Traffic lights and signals	1
4	**Modem electronic and micro control systems in automobiles**	
4.1	Electronically controlled concealed headlight systems	1
4.2	Electro chromic mirrors, automatic review mirrors	1
4.3	Day time running lamps (DRL)	1
4.4	Head up display, Travel information systems, On board navigation system, Electronic climate control	1
4.5	Electronically controlled sunroof, Anti-theft systems ,Automatic door locks (ADL), tyre pressure sensing	1
4.6	Automated wiper, Antilock braking system	1
4.7	Electronic traction and stability control (ESP)	1
5	**Fuel Cells and Alternative energy systems**	
5.1	Introduction to fuel cells, Operational fuel cell voltages	1
5.2	Proton Exchange membrane fuel cells,	1
5.3	Alkaline Electrolyte fuel cells	1
5.4	Medium and high temperature fuel cells , Fuel and fuel chose, fuel processing,	1
5.5	fuel cell stacks, Delivering fuel cell power, Integrated Air supply and humidification concepts for fuel cell systems	1
5.6	Fuel cell Auxiliary systems	1
5.7	Air compression systems, Air powered vehicles	1

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What are the major components in an Electric vehicle?
2. Distinguish between hybrid and plug-in electric vehicles.
3. Give the advantages of parallel hybrid vehicles.
4. What is the function of a battery management system in a hybrid vehicle?
5. Discuss the various operating modes of a hybrid vehicle for best performance.

Course Outcome 2 (CO2)

1. What are the basic characteristics of a lean burn engine?
2. Explain the different methods used for charge stratification?
3. Discuss about the different fuel feed systems used in a hydrogen vehicle.
4. Explain the working of a Lamda sensor.
5. Give a comparison of On-board Navigation Vs Mobile Navigation.

Course Outcome 3(CO3):

1. List the various Advanced Driver Assistance Systems (ADAS).
2. Explain the difference between active and passive night vision systems.
3. Discuss about the scope of application of LiDAR and RADAR for vehicle navigation.
4. Explain the working of a GPS system.
5. Give the advantages of piezo-electric fuel injectors.

Course Outcome 4 (CO4):

1. Illustrate the working of an ESP.
2. What are the basic components of a ABS?
3. Explain the working of an adaptive head light.
4. Illustrate the working of a modern climate control system.
5. Give the features of an on- board navigation system.

Course Outcome 5 (CO5):

1. What are the different types of fuel cells?
2. List down the different fuels used for the fuel cells and state their characteristics.
3. Explain the working of a PEM fuel cell.
4. What are the characteristics of an air powered vehicle?
5. Explain the working of Integrated Air supply and humidification for fuel cell systems.

Model Question Paper

QP CODE:
PAGES:02

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT 474

Course Name: MODERN AUTOMOTIVE TECHNOLOGY (Elective-II)

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

Part A
(Answer all questions. Each question carry 3 marks)

1. Explain the terms LEV, TLEV, ULV & ZEV.
2. Give the advantages of parallel hybrid vehicles.
3. What are the basic characteristics of a lean burn engine?
4. Why two Lamda sensors are used in the exhaust system of Euro VI vehicles?
5. Give the salient features of an autonomous vehicle.
6. Distinguish between active and passive night vision systems.
7. Explain the working of an adaptive head light.
8. What all sensors are used in a modern climate control system?
9. Give a comparison between a PEM and Alkaline fuel cell.
10. List the advantages and disadvantages of Air powered vehicles.

Part B
(Answer any one full question from each module. Each question carries 14 Marks)

11. (a) Explain thelayout and working of a parallel hybrid vehicle. (7)
    (b) Discuss the Basic factors to be considered for converting conventional automobiles to electric vehicle. (7)

OR

12. Explain the various components of a hybrid –electric vehicle. (14)
13. Discuss the construction and working of a Lamda sensor. (14)

OR

14. With a suitable layout sketch explain the working of a Hydrogen engine. (14)
15. Explain the application and working of GPS for fleet management. (14)

OR

16. Give a brief explanation about the working of:
    i) LiDAR ii) RADAR (14)
17. With a suitable sketch Illustrate the working of a climate control system used in modern passenger cars. (14)

OR

18. What is the difference between ABS and ESP? Explain the working of an ESP. (14)
19. Explain the working of a PEM fuel cell with a suitable sketch. (14)

OR

20. a) List the different fuels used for the fuel cells and state their characteristics. (7)
    b) What are the characteristics of an air powered vehicle? Explain its working. (7)

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEMESTER VIII

PROGRAM ELECTIVE IV

KTU Estd. 2014

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT416	AUTOMOTIVE AIR CONDITIONING	PEC	2	1	0	3

Preamble: This course aims at providing the students to understand the air-conditioning systems used in automotive applications.

Prerequisite: Basic Mechanical Engineering

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

CO 1	Understand about different types of refrigeration systems and its applications.
CO 2	Familiarize about the components and classification of air conditioning system.
CO 3	Understand about the load analysis and air distribution systems.
CO 4	Familiar with air routing and its control.
CO 5	Understand about air conditioning system maintenance and service.

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	-	1	1	-	-	2	-	1
CO 2	2	1	-	2	-	1	2	1	-	2	-	1
CO 3	-	1	-	1	-	1	1	-	-	2	-	1
CO 4	-	-	-	-	-	1	1	-	-	2	-	1
CO 5	-	1	-	1	-	2	3	-	-	2	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyze			
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. State the necessity of air conditioning and refrigeration systems in an automobile.
2. Describe about classification of refrigeration system and its applications.
3. List different refrigerants used in automotive air conditioning.

Course Outcome 2 (CO2):

1. State the importance of air conditioning protection.
2. Discuss in detail about the components of air conditioning system.
3. Describe about classification of air conditioning system and its applications.

Course Outcome 3 (CO3)

1. Discuss about the factors for cooling and heating load estimation in automobiles
2. Describe about duct systems for automobiles.
3. Discuss in detail about air distribution system.

Course Outcome 4 (CO4):

1. List out the objectives of air routing.
2. Discuss in detail about evaporator air in an automobile.
3. Describe about different air conditioning controls.

Course Outcome 5 (CO5):

1. List out different methods for leak detection in an automotive air conditioning system.
2. Describe in detail about Trouble shooting of air conditioning systems..
3. Discuss in detail about the procedure for evacuating, charging and testing.

SYLLABUS

Module 1

Refrigeration

Introduction - Methods of refrigeration, unit of refrigeration - Air refrigeration system and its applications, Vapour Compression Refrigeration System, Vapor Absorption Refrigeration System - Applications of refrigeration & air Conditioning. Automobile air conditioning-Isolated vehicles and transport vehicles- Applications related with very low temperatures. Refrigerants: commonly used refrigerants, Alternative refrigerants, Eco-friendly refrigerants, Applications of Refrigerants, Refrigerants Used in Automobile Air conditioning.

Module 2

Air Conditioning Systems

Air Conditioning System – classification and layouts, central, unitary air conditioning systems, components like compressors, evaporators, condensers, expansion devices, fan blowers, heating systems, Automotive heaters-types, Air conditioning protection, Engine protection.

Module 3

Load Analysis and Air distribution system

Load Analysis - outside & inside design consideration - Factors forming the load on refrigeration & air conditioning Systems - cooling & heating load calculations. Load calculations for automobiles - Effect of air conditioning load on engine performance

Air distribution systems**:** Distribution duct system, sizing, supply and return ducts, type of grills, diffusers, ventilation, layout of duct systems for automobiles.

Module 4

Air Routing and Control

Air routing: objectives, evaporator core air flow, through the dash recirculating unit, automatic temperature control, controlling flow, control of air handling systems.

Air conditioning control: common control such *as* thermostats, humidistat, control dampers, pressure cut outs and relays.

Module 5

Air conditioning service

Air Conditioner maintenance & service - Servicing heater System - Removing & replacing components. Causes of air conditioner failure, leak testing - detection methods. Trouble shooting of Air conditioning System -compressor service, Methods of dehydration, evacuating, charging and testing.

Text Books:

1. Steven Daly, Automotive Air conditioning and Climate Control Systems, Butterworth-Heinemann, USA
2. V Paul Lang, Principles of Air Conditioning by, CBS Publishers and Distributors Pvt.Ltd

References:

1. C.P.Arora, Refrigeration and Air conditioning, Tata McGraw Hill Publications
2. Dossat., Principles of Refrigeration, John Wiley and Sons
3. Robert H. Enerick, Basic Refrigeration and Air-Conditioning, Prentice Hall of India Ltd.
4. Stoecker W.F. and Jones J.W, Refrigeration and Air-Conditioning, McGraw- Hill
5. Jordan and Priester, Refrigeration and Air-Conditioning, Prentice Hall of India.
6. R.K.Rajput , Refrigeration and Air conditioning. Kataria publishers
7. R.S. Khurmi and J.S Gupta , Refrigeration and Air conditioning, S Chand Company

Model Question Paper

QP CODE: **PAGES:……**

Reg. No: ______________ **Name :_________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

COURSE CODE: MUT 416

COURSE NAME: AUTOMOTIVE AIR CONDITIONING

Max. Marks: 100 Duration: 3 Hours

PART A

I. Answer all questions. Each question carries 3 marks

1. Explain 1TR
2. List down the properties of a good refrigerant.
3. Explain how air conditioning systems are classified.
4. Mention different types of fan blowers used in air conditioning purpose.
5. Explain how air conditioning load affects engine performance.
6. Discuss the role of diffusers in an air distribution system.
7. List down the objectives of air routing.
8. Explain how a humidistat controls an air conditioning equipment
9. What are the causes of air conditioner failure?
10. Explain few methods for leak detection in air conditioners.

(10 x 3 =30 marks)

PART B

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

11 (a)	With neat sketch explain the working of a vapour compression refrigeration system.	(8)
(b)	Mention various applications of refrigeration and air conditioning.	(6)
	OR	
12 (a)	With the help of a neat diagram explain about air refrigeration system.	(8)
(b)	Explain in detail about different refrigerants used in refrigeration systems.	(6)
13 (a)	With neat sketches explain different types of compressors used in air conditioning systems.	(14)
	OR	
14 (a)	With neat sketches explain different types of condensers used in air conditioning systems.	(14)
15 (a)	Explain in detail about the factors forming the load on refrigeration & air Conditioning Systems	(14)
	OR	
16 (a)	With neat sketch explain about air distribution system used in automobiles.	(14)
17 (a)	Explain how air is routed and controlled in an air conditioning system.	(14)
	OR	
18 (a)	Explain in detail about different air conditioning controls.	(14)
19 (a)	Explain the procedure for dehydration, evacuation and charging of refrigerant in an air conditioning system.	(14)
	OR	
20(a)	Discuss about various trouble shooting in air conditioning system also suggest suitable remedies	(14)

(5 x 14=70 marks)

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Refrigeration**	
1.1	Introduction - Methods of Refrigeration, unit of refrigeration	1
1.2	Air Refrigeration System and its Applications, Vapour Compression Refrigeration System	1
1.3	Vapor Absorption Refrigeration System	1
1.4	Applications of Refrigeration & Air Conditioning	1
1.5	Automobile Air Conditioning-Isolated vehicles and transport vehicles- Applications Related with very low temperatures	1
1.6	Refrigerants: commonly used refrigerants, Alternative refrigerants, Eco-friendly refrigerants	1
1.7	Applications of refrigerants, refrigerants used in automobile air conditioning.	1
2	**Maintenance of Engine**	
2.1	Air conditioning system – classification and layouts	1
2.2	Central, unitary air conditioning systems	1
2.3	Air conditioning components- compressors	1
2.4	Evaporators and condensers	1
2.5	Expansion devices, Fan blowers	1
2.6	Heating systems, automotive heaters-types	1
2.7	Air conditioning protection, engine protection	1
3	**Load Analysis and Air distribution system**	
3.1	Load Analysis - outside & inside design consideration	1
3.2	Factors forming the load on refrigeration & air conditioning Systems	1
3.3	Cooling & heating load calculations	1
3.4	Load calculations for automobiles	1
3.5	Effect of air conditioning load on engine performance ,Air distribution Systems**:** Distribution duct system, sizing	1
3.6	Supply and return ducts, type of grills, diffusers, ventilation	1
3.7	Layout of duct systems for automobiles	1
4	**Air Routing and Control**	
4.1	Air routing: objectives	1
4.2	Evaporator core air flow, through the dash recirculating unit	1
4.3	Automatic temperature control	1
4.4	Controlling flow, control of air handling systems	1
4.5	Air conditioning control: common control such as thermostats	1
4.6	Humidistat	1
4.7	Control dampers, Pressure cut outs and relays	1
5	**Air conditioning service**	
5.1	Air Conditioner Maintenance & Service	1

5.2	Servicing Heater System	1
5.3	Removing & replacing components	1
5.4	Causes of air conditioner failure	1
5.5	Leak testing - detection methods	1
5.6	Trouble Shooting of air conditioning System	1
5.7	Compressor Service, Methods of Dehydration, evacuating, charging and testing.	1

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

MUT426	OPERATIONS RESEARCH	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: The aim of this subject is to provide students with a general understanding of the fundamentals and applications of operations research. So the purpose of this course is to expose the student to

- ✓ Identify and develop operational research models from the verbal description of the real system.
- ✓ Understand the role of operation research in decision making
- ✓ Understand the mathematical tools that are needed to solve optimization problems
- ✓ Develop a report that describes the model and the solving technique, analyze the results and propose recommendations in a language understandable to the decision-making processes in Management Engineering

Prerequisite: NIL

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

CO 1	**Analyse** any real life system with limited constraints and depict it in a model form. Convert the problem into a mathematical model and solve manually.
CO 2	**Understand** variety of problems such as assignment, transportation, travelling salesman etc.
CO 3	**Understand** project management and scheduling. Simulate different real life probabilistic situations using Monte Carlo simulation technique
CO 4	**Understand** different Game and queuing situations and find the optimal solutions using models for different situations.
CO 5	**Understand** inventory control and the concepts of dynamic programming

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	3	2	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-
CO 5	3	2	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
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 anyone. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Discuss the various phases in solving an OR problem.
2. State the general linear programming problem (LPP) and put it in the standard form
3. What are the various types of OR models? Explain
4. What do you understand by duality?
5. What are the assumptions of LPP?

Course Outcome 2(CO2):

1. Distinguish between transportation model and assignment model

2. Give the mathematical formulation of transportation problem. How does it differ from an assignment problem?
3. Explain situations where an assignment problem can arise
4. What is meant by an optimality test in a transportation problem?
5. How the problem of degeneracy arises in a transportation problem? Explain how does one overcome it?

Course Outcome 3 (CO3):

1. Write the principal features of monte carlo simulation models.
2. Mention any one difference between CPM and PERT
3. What is simulation? Describe its advantages in solving the problems. Give its main limitations with suitable examples.
4. List the application of Monte-Carlo Simulation in inventory control and capital budgeting
5. Explain the phases of project management

Course Outcome 4 (CO4):

1. What are the characteristics of game theory?
2. Write a brief note on maximin – minimax principle.
3. A game refers to a situation of business conflict. Discuss.
4. Discuss briefly the main characteristics of a queuing system
5. What is a rectangular game? Define pure strategy and mixed strategy in a game

Course Outcome 5 (CO5):

1. What are the demerits of dynamic programming?
2. What are the functions of inventory management? Explain.
3. Why is inventory maintained? Discuss it and give a classification of inventory models
4. What are the applications of dynamic programming problem? Explain
5. What are the objectives that should be fulfilled by an inventory control system?

SYLLABUS

Module 1

Introduction: Definition, scope, objectives of operations research (OR), OR model, limitations of OR, solving the OR model, art of modelling, phases of OR study.

Linear Programming problem: Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method, Artificial variables. big M method, two phase method, degeneracy and unbound solutions, duality, sensitivity analysis.

Module 2

Transportation Problems: Formulation, solution, unbalanced transportation problems, finding basic feasible solutions- Northwest corner rule, least cost method and Vogel's approximation method. Optimality test, the stepping stone method and MODI method

Assignment problems: formation, optimal solution, solving unbalanced problem, assignment problems and models, travelling sales man problem and processing of job through machines.

Module 3

Network Techniques: Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem. Project Management: Phases of project management. Project Scheduling and PERT-CPM: Introduction, Basic Difference between PERT and CPM, PERT/CPM Network Components and Precedence Relationship.

Simulation: advantages and limitations of the simulation technique: generation of random numbers, Monte-Carlo simulation, computer-aided simulation, applications in maintenance and inventory management.

Module 4

Theory of Games: Rectangular games, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games, reduction to linear programming model.

Waiting line models: queuing systems and concepts, various types of queuing situations, single server queues with poison arrivals and exponential service times, finite queue length model, industrial applications of queuing theory.

Module 5

Inventory Control: Models of inventory, Models with deterministic demand – model (a) demand rate uniform and production rate infinite, model (b) demand rate non-uniform and production rate infinite, model (c) demand rate uniform and production rate finite. operation of inventory system, inventory costs, quantity discount., Replacement, Replacement models: Equipment's that deteriorate with time, equipment's that fail with time.

Dynamic programming. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems

Text Books

1	Operations Research	R. Panneer Seevam	PHI Learning, 2008
2	Introduction to Operations Research	Hillier, F. S. and Lieberman, G. J.	McGraw-Hill. 9th edn, 2010
3	Operations Research	P. Sankara Iyer	Tata- McGraw-Hill, 2008

Reference Books

1	Operations Research	Wayne L. Winston	Thomson Learning,2003
2	Total Quality Management	V.K.Khanna	New Age International, 2008
3	operation research theory and applications	J.K Sharma	3e,Macmillan India Ltd,2007
4	operation research problems and solutions	J K Sharma	3e,Macmillan India Ltd,2007
5	Operations Research	Taha, H. A	8th edn, Pearson,2007

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Module 1 (7 hours)**	
1.1	Definition, scope, objectives of operations research (OR), OR model, limitations of OR, solving the OR model, art of modelling, phases of OR study.	1
1.2	Two variable Linear Programming model and Graphical method of solution	2
1.3	Simplex method, Dual Simplex method,	1
1.4	Artificial variables. big M method,	1
1.5	two phase method, degeneracy and unbound solutions, duality, sensitivity analysis.	2
2	**Module 2 (7 hours)**	
2.1	Transportation Problems: Formulation, solution, unbalanced transportation problems, finding basic feasible solutions- Northwest corner rule, least cost method	2
2.2	Vogel's approximation method. Optimality test, the stepping stone method and MODI method	1

2.3	Assignment problems: formation, optimal solution, solving unbalanced problem,	2
2.4	assignment problems and models, travelling sales man problem and processing of job through machines.	2
3	**Module 3 (7 hours)**	
3.1	Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem. Project Management: Phases of project management.	2
3.2	Project Scheduling and PERT-CPM: Introduction, Basic Difference between PERT and CPM, PERT/CPM Network Components and Precedence Relationship.	2
3.3	Simulation: advantages and limitations of the simulation technique: generation of random numbers	1
3.4	Monte-Carlo simulation, computer-aided simulation, applications in maintenance and inventory management.	2
4	**Module 4 (7 hours)**	
4.1	Theory of Games: Rectangular games, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle	2
4.2	Rectangular games without saddle point – mixed strategy for 2 X 2 games, reduction to linear programming model.	2
4.3	Waiting line models: queuing systems and concepts, various types of queuing situations,	1
4.4	single server queues with poison arrivals and exponential service times, finite queue length model, industrial applications of queuing theory.	2
5	**Module 5 (7 hours)**	
5.1	Inventory Control: Models of inventory, Models with deterministic demand – model (a) demand rate uniform and production rate infinite, model (b) demand rate non-uniform and production rate infinite, model (c) demand rate uniform and production rate finite.	2
5.2	operation of inventory system, inventory costs, quantity discount.,	1
5.3	Replacement, Replacement models: Equipment's that deteriorate with time, equipment's that fail with time.	1
5.4	Dynamic programming. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting,	2
5.5	Stage Coach/Shortest Path, cargo loading and Reliability problems	1

Model Question Paper

QP CODE: **PAGES: 2**

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT426

Course Name: OPERATIONS RESEARCH

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

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1) What are the advantages and limitations of LP problem?

2) Explain briefly the importance of artificial variables.

3) What do you mean by a non-degenerate basic feasible solution of a transportation problem?

4) Give the mathematical formulation of an assignment problem

5) Draw the network of the project consisting of 5 jobs A, B, C, D and E with the following job sequence:

Job A precedes C and D

Job B precedes D

Job C and D precede E

6) Explain the phases of project management

7) What is a rectangular game? Define pure strategy and mixed strategy in a game

8) What do you understand by a queue? Give some important applications of queuingtheory.

9) What are the pre-requisites for applying dynamic programming?

10) Why is inventory maintained? Discuss it and give a classification of inventory models

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

11) Max $Z=3x_1+2x_2+5x^3$Subject to the constraints
$x_1+2x_2+x_3\leq 430$

$3x_1+2x_3 \leq 460$
$x_1+4x_2 \leq 420$ and $x_1,x_2,x_3 \geq 0$

Or

12) Use the Big M Method to solve the following problem:

Minimize $Z = 2x_1 + x_2 + 3x_3$ Subject to the constraints: $x_1 - 2x_2 + x_3 \geq 4$; $2x_1 + x_2 + x_3 \leq 8$;

$x_1 - x_3 \geq 0$; $x_1 \geq 0$; $x_2 \geq 0$; $x_3 \geq 0$.

Module 2

13) Draw aFind the optimum solution to the transportation problem given in the table below for which the cost, origin- availabilities and destination requirements are given

	D1	D2	D3	D4	Supply
O1	5	3	6	2	19
O2	4	7	9	1	37
O3	3	4	7	5	34
Demand	16	18	31	25	90

Or

14) Find the sequence that minimises the total elapsed time (in hours) required to complete the following tasks on two machines.

Task	A	B	C	D	E	F	G	H	I
Machine I	2	5	4	9	6	8	7	5	4
Machine II	6	8	7	4	3	9	3	8	11

Module 3

15) What do you understand by simulation? Explain briefly its advantages and disadvantages.Write a detailed note on applications of simulation in manufacturing systems.

Or

16) A project consists of seven activities for which the relevant data are given below. Draw the network and identify the critical path and find the project completion time.

Activity	Preceding Activities	Duration (days)
A	--	4
B	--	7
C	--	6

D	A, B	5
E	A, B	7
F	C, D, E	6
G	C, D, E	5

Module 4

17) Arrivals at a telephone booth are considered to be Poisson, with an average time of 10 minutes between one arrival and the next. The length of a phone call assumed to be distributed exponentially with mean 3 minutes. Then,

(i) What is the probability that a person arriving at the booth will have to wait?

(ii) What is the average length of the queue that form from time to time?

(iii)The telephone department will install a second booth when convinced that an arrival would expect to have to wait at least three minutes for the phone. By how much must the flow of arrivals be increased in order to justify a second booth?

Or

18) Obtain the optimal strategies for both players and the value of the game for two-person zero-sum game whose payoff matrix is given below:

Player A	Player B	
	B1	B2
A1	-6	7
A2	4	-5
A3	-1	-2
A4	-2	5
A5	7	-6

Module 5

19) A company uses annually 24,000 units of raw material which costs Rs. 1.25 per unit. Placing each order costs Rs. 22.50 and the carrying cost is 5.4% per year of the average inventory. Find the economic lot size and the total inventory cost (including cost of material). Should the company accept the offer made by the supplier of a discount of 5% on the cost price on a single order of 24,000 units?

Or

20) Find the non-negative real numbers such that sum of squares of these numbers is minimum with restriction that their sum is not less than 75. Show the stages in dynamic programming to solve the problem.

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

CODE MUT436	COURSE NAME AUTOMOTIVE MECHATRONICS	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: After completing the course, students will be provided with the basic knowledge on the latest developments in the applications of electronics into the automobile sector

Prerequisite: MUT204: Auto Power plant

MUT301: Auto Electrical and Electronics

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

CO 1	To study about fundamentals of Mechatronics.
CO 2	To familiarize various sensors and its application in automobile
CO 3	To Study the basics of Actuators and MEMS
CO 4	To know about the applications of PLC and microprocessors
CO 5	To familiarize Engine management 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	2	-	-	-	1	-	-	-	-	-	-	-
CO 2	3	-	-	-	2	-	-	1	-	-	-	-
CO 3	3	-	-	-	2	-	-	1	-	-	-	-
CO 4	3	-	-	-	2	-	-	1	-	-	-	-
CO 5	3	-	-	-	2	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember			
Understand	50	40	80
Apply		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. Define Mechatronics.
2. What are the functions of Signal control unit?
3. Explain 'why modern cars are mechatronics product'?

Course Outcome 2 (CO2)

1. Define Sensors.
2. What are encoders?
3. Define the functionality of a Lamda sensor.

Course Outcome 3(CO3):

1. Define a 3/2 valve.
2. How solenoid actuators work?
3. Define MEMS and its applications

Course Outcome 4 (CO4):

1. Define PLC? What is Latch Circuit?
2. What is lookup table?
3. Define the functionality of a stack and stack pointer

Course Outcome 5 (CO5):

1. Explain L-Jetronic EMS system.
2. How cold start is handled by EMS.
3. How closed loop control of knock works?

Model Question Paper

		Total Pages :
Reg No.:_______________		**Name:___________________________**

MODEL QUESTION PAPER

Course Code: MUT436

Course Name: AUTOMOTIVE MECHATRONICS

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

PART A

		Answer all questions, each carries 3 marks.	Marks
1		What are the applications of mechatronics in Automobiles?	(3)
2		Explain the working of LVDT	(3)
3		What is rotary actuator?	(3)
4		Explain the lithography process	(3)
5		Explain PID control.	(3)
6		What is mean by buses in microprocessor? Explain the different types of buses	(3)
7		What is fuel control map?	(3)
8		Explain idle speed control	(3)
9		How the spark timing can be controlled in an electronic ignition system?	(3)
10		Differentiate between MPFI and CRDI.	(3)

PART B

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

		Module I	
11	a)	What are encoders? Explain the advantages and applications of encoders	(9)
	b)	Explain Gray coded encoders	(5)
		OR	
12	a)	Explain mass airflow sensor with a sketch	(7)
	b)	Explain the lambda sensor with a sketch	(7)
		Module II	

13	a)	What is meant by micromachining?	(5)
	b)	Explain LIGA process	(9)
		OR	
14	a)	Explain with neat schematic diagram, the working of Pneumatic Power supply systems? Explain in detail its components?	(14)
		Module III	
15	a)	Explain adaptive control and fuzzy logic control.	(8)
	b)	Explain about lookup tables	(6)
		OR	
16	a)	Differentiate the open loop and closed loop control strategies	(6)
	b)	Explain the basic structure of PLC with neat sketch	(8)
		Module IV	
17	a)	Explain the layout and working of LH-Jetronic engine management system. How it is differs from L-Jetronic system?	(14)
		OR	
18	a)	Explain (1) Cold Start and warm up phases (2) Acceleration enrichment (3) Deceleration leaning	(14)
		Module V	
19	a)	Explain the working of electronic ignition system with a neat sketch	(10)
	b)	Explain the closed loop control of knock	(4)
		OR	
20	a)	What are the various fuel injection parameters affecting noise and emissions in CI engines? Explain in detail	(14)
		****	

Syllabus

MECHANICAL (AUTOMOBILE) ENGINEERING

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Introduction to Mechatronics: Sensors - Characteristics - Temperature, flow, pressure sensors. Displacement, position and proximity sensing by magnetic, optical, ultrasonic, inductive, capacitive and eddy current methods. Encoders: incremental and absolute, gray coded encoder. Resolvers and synchros. Piezoelectric sensors. Acoustic Emission sensors. Principle and types of vibration sensors. Inductive, Hall effect, hot wire, thermistor, piezo electric, piezo resistive, based sensors. Application of sensors in Automobiles: Functions and Working of various sensors used in engine and other modern systems.	7	20%
II	Actuators: Hydraulic and Pneumatic actuators - Directional control valves, pressure control valves, process control valves. Rotary actuators. Electrical actuators-AC, DC, Stepper Motors. Development of simple hydraulic and pneumatic circuits using standard Symbols. Micro Electro Mechanical Systems (MEMS): Fabrication: Deposition, Lithography, Micromachining methods for MEMS, Deep Reactive Ion Etching (DRIE) and LIGA processes. Principle, fabrication and working of MEMS based pressure sensor, accelerometer and gyroscope.	7	20%
III	Programmable Logic Controllers (PLC) –Basic structure, input/ output processing. Programming: Internal Relays, Timers and Counters. Development of simple ladder programs for specific purposes. Fundamentals of Automotive Electronics and Microprocessor control system: Microprocessor architecture, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control.	7	20%
IV	Engine Management system I: Parameters to be controlled in SI and CI engines and in the other parts of the automobile. Layout and working of SI engine management systems like Bosch L-Jetronic and LH- Jetronic. Cold start and warm up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cutoff. Fuel control maps, open loop control of fuel injection and closed loop lambda control.	7	20%
V	Engine Management system II: Electronic ignition systems and spark timing control. Closed loop control of knock. Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system.	7	20%
END SEMESTER EXAM			

Text Books:

1. Denton. (2004) Automotive Electrical and Electronic Systems, Burlington, MA01803, Elsevier Butterworth-Heinemann.
2. Bolton W., Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education Limited, New Delhi, 2007
3. Ramachandran K. P., G. K. Vijayaraghavan, M. S. Balasundaram, Mechatronics: Integrated Mechanical Electronic Systems, Wiley India Pvt. Ltd., New Delhi, 2008.
4. Robert Bosch "Diesel Engine Management" SAE Publications, 2006.
5. Robert Bosch, "Gasoline Engine Management" SAE Publications, 2006.
6. Ronald K. Jurgen , Electronic Engine Control Technologies, 2nd Edition- - SAE International

Reference Books

1. Barry Hollembeak, Automotive Electricity, Electronics and Computer Controls, Delmer Publishers.
2. HMT, Mechatronics, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
3. Bosch Hand Book, 3rd Edition, SAE, 1993.
4. David G. Aldatore, Michael B. Histand, Introduction to Mechatronics and Measurement Systems, McGraw-Hill Inc., USA, 2003.
5. Eric Chowanietz "Automobile Electronics" SAE Publications, 1994
6. Ljubo Vlacic, Michel Parent & Furnio Harshima, ―Intelligent Vehicle Technologies: Theoryand Applications‖, Butterworth-Heinemann publications, 2001
7. Robert Bosch GmbH , Automotive Electrics & Electronics, , 5/e, Springer Verlag

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Mechatronics	
1.1	Sensors	2
1.2	Automotive Sensors	2
1.3	Application of sensors in Automobiles: Functions and Working of various sensors used in engine and other modern systems.	3
2	Actuators	
2.1	Hydraulic, Pneumatic, Electrical Actuators	4
2.2	MEMS	3
3	PLC	
3.1	Ladder Programming	2
3.2	Microprocessor Architecture	2
3.3	Control Systems	3
4	EMS – 1	
4.1	Parameters to be controlled, Typical EMS for SI &CI engines	2
4.2	Cold start and warm up phases in EMS	1
4.3	Fuel control at different phases, fuel control maps	2
4.4	Open loop control of fuel injection and closed loop lambda control.	2

5	EMS – 2	
5.1	Control of electronic Fuel injection and spark timing	2
5.2	Fuel injection system parameters affecting combustion, noise and emissions in CI engines	2
5.3	Electronically controlled Unit Injection system	1
5.4	Layout of the common rail fuel injection system	2

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT446	MARKETING MANAGEMENT	PEC	2	1	0	3

Preamble: This course aims to
To introduce the concept of market and marketing
To give idea about launching a new product
To introduce the various marketing strategies

Prerequisite: NIL

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

CO 1	Understand the key marketing concepts, theories and techniques for analyzing a variety of marketing situations
CO 2	Identify and demonstrate the dynamic nature of the environment in which marketing decisions are taken
CO 3	Synthesize ideas into a marketing plan
CO 4	Understand consumer behaviour and product life cycle
CO 5	Acquire knowledge about marketing 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	2	1	-	2	-	1	1	-	-	2	-	1
CO 2	2	1	-	2	-	1	2	-	-	2	-	1
CO 3	-	1	-	1	-	1	1	-	-	2	-	1
CO 4	-	-	-	-	-	1	1	-	-	2	-	1
CO 5	-	1	-	1	-	2	3	-	-	2	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	40
Apply	20	20	50
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. Introduction to marketing.
2. Understand the concept of market and marketing.
3. Analyse the various factors in marketing.

Course Outcome 2 (CO2)

1. Understand the marketing planning process.
2. To identify the marketing mix variables and their relevance.
3. Apply various steps for new product development and its launching in the market.

Course Outcome 3(CO3):

1. To understand targeting and product positioning.
2. To understand the concept of marketing research.
3. To identify the research objectives.

Course Outcome 4 (CO4):

1. The identify the factors for determining the price of the product.
2. To understand different pricing methods.
3. To analyse the product life cycle

Course Outcome 5 (CO5):

1. To identify the steps in developing effective communication.
2. To analyse the various factors in advertising.
3. To understand the branding process.

Model Question Paper

QP CODE:
PAGES:………

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT446

Course Name: MARKETING MANAGEMENT

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

Part A
(Answer all questions. Each question carries 3 marks)

1. Define marketing
2. Write a note on the marketing environment
3. Explain Boston consultancy group model.
4. Explain the latest trends in marketing.
5. What is the need for Marketing research?
6. What is Market segmentation?
7. Explain the meaning of pricing.
8. What are perceived risks?
9. What is the role of communication in marketing?
10. Is branding a major factor in today's marketing environment?

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

11. (a) Why macro environmental variables are called as uncontrollable variables? (7)
    (b) Explain various macro and micro environmental factors in marketing. (7)

OR

12. Explain the uncontrollable factors in marketing (14)

13. (a) Explain in detail marketing planning process (7)
    (b)Explain Marketing mix elements with a case example. (7)

OR

14. Explain the various steps in Product Development and Testing (14)

15. Explain in detail segmentation, targeting and positioning in marketing (14)

OR

16. Define marketing research and explain any four scope of market research (14)

17. (a)How the study of consumer behaviour can be utilized in marketing? (7)
    (b) Explain how psychological, personal and social factors influence consumer behaviour with suitable examples (7)

OR

18. Explain the factors influencing price determination and the various pricing strategies (14)

19. (a) Define the different strategies of communication (7)
    (b) What are the steps in developing effective communication? (7)

OR

20. (a) Define advertising (7)
    (b) How do you analyse the new trends in marketing? (7)

SYLLABUS

Module 1

Introduction to marketing - concept of market and marketing – marketing environment - controllable factors - factors directed by top management - factors directed by marketing - uncontrollable factors - demography, economic conditions, competition.

Module 2

Social and Marketing planning - marketing planning process - Boston consultancy group model - marketing mix -: Marketing mix variables and their importance. Product Development: Idea generation, Concept development and Testing, Market Testing and launching of new products, Commercialization. E-Marketing, latest trends in marketing.

Module 3

Market segmentation and market targeting - introduction to segmentation - targeting and product positioning. Marketing research - need and scope - marketing research process – research objectives, developing research plan, collecting information, analysis, and findings.

Module 4

Pricing Strategies: Meaning of pricing, Importance, Objectives, Factors influencing price determination, Demand market-based pricing, Tender pricing, Product line pricing, Selecting the final price-Consumer behaviour - factors influencing consumer behaviour -perceived risks Decision making process in buying-Product life cycle - marketing strategies for different stages of product life cycle.

Module 5

Marketing communication - marketing mix variables - steps in developing effective communication - identification of target audience - determination of communication objectives

Designing the message - selecting the communication channels - promotion mix evaluation - advertising and sales promotion - factors in advertising - sales promotion tools. New trends in marketing- Brand management - significance of branding to consumers and firms.

Text Books

1. Majumdar R., Marketing Research, Text, Applications and Case Studies, New Age International (P), 1991
2. Ramaswamy V.S. & Namkumari S, Marketing Management: Planning, Implementation and Control, Macmillan India Limited, 2002
3. Robert, Marketing Research, Prentice Hall of India,1999
4. T N Chabra and S K Grover : Marketing management, Dhanpat Rai, 2007

Reference Books

1. Kotler P, Marketing Management: Analysis, Planning, Implementation and Control, Prentice Hall of India,1993
2. Stanton W.J., Etzel M.J. & Walker B.J, Fundamentals of Marketing, McGraw Hill International Edition, 1994

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Marketing**	
1.1	Introduction to marketing &marketing environment	1
1.2	Concept of market and marketing	1
1.3	Controllable factors & factors directed by top management	1
1.4	Factors directed by marketing	2
1.5	Uncontrollable factors	2
2	**Marketing planning**	
2.1	Marketing planning process	1
2.2	Marketing mix - Marketing mix variables and their importance	1
2.3	Product Development: Idea generation	1
2.4	Concept development and Testing	1
2.5	Market Testingand launching of new products	1
2.6	Commercialization. E-Marketing	1
2.7	Latest trends in marketing	1
3	**Market segmentation and market targeting**	
3.1	Introduction to segmentation. Marketing research - need and scope	1
3.2	Targeting and product positioning	1
3.3	Marketing research process	1
3.4	Research objectives	1
3.5	Developing research plan	1
3.6	Collecting information, analysis, and findings	2
4	**Pricing Strategies &Consumer behaviour**	

4.1	Meaning of pricing, Importance, Objectives	1
4.2	Factors influencing price determination	1
4.3	Demand market based pricing, Tender pricing, Product line pricing, Selecting the final price	1
4.4	Factors influencing consumer behaviour	1
4.5	Perceived risks	1
4.6	Decision making process in buying, Product life cycle	1
4.7	Marketing strategies for different stages of product life cycle	1
5	**Marketing communication**	
5.1	Marketing mix variables	1
5.2	Steps in developing effective communication - identification of target audience - determination of communication objectives	2
5.3	Designing the message - selecting the communication channels - promotion mix evaluation	2
5.5	Advertising and sales promotion - factors in advertising - sales promotion tools	1
5.6	New trends in marketing, Brand management - significance of branding to consumers and firms	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT456	THEORY OF VIBRATIONS	PEC	2	1	0	3

Preamble: Every component in an automobile goes through different types of vibrations. An automobile engineer needs to have a good understanding on vibrations and its effects for proper designing of a component

Prerequisite: NIL

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

CO 1	Understand the basics of vibrations and undamped free vibrations
CO 2	Identify the applications of the damped free vibrations
CO 3	Identify and evaluate systems with single degrees of freedom.
CO 4	Elaborate on systems with two degrees of freedom
CO 5	Analyse and solve vibration with multiple degrees of freedom

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	-	-	-	-	-	-	-	1
CO 2	1	-	3	2	-	-	-	-	-	-	-	2
CO 3	1	-	3	2	-	2	-	-	-	-	-	2
CO 4	1	-	3	2	-	-	-	-	-	-	-	2
CO 5	1	-	3	2	-	2	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
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. Explain the formulations of undamped free vibrations

Course Outcome 2 (CO2)

1. Apply the damped free vibration in different systems

Course Outcome 3(CO3):

1. Understand the working and derivations related to forced vibrations

Course Outcome 4 (CO4):

1. Understand and elaborate on two degrees of freedom system

Course Outcome 5 (CO5):

1.Apply multidegree freedom concept and its applications

Model Question Paper

QP CODE:

PAGES:…

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT456

Course Name: THEORY OF VIBRATIONS

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

Part A

(Answer all questions. Each question carry 3 marks)

1. Explain the terms (a) Logarithmic decrement; (b) transverse vibration
2. How do you represent a harmonic motion in complex form?
3. Explain the term critical speed
4. How damping can affect the critical speed?
5. List some of the examples for transient vibrations
6. What is critical damping? List any one advantage of critical damping
7. Explain forced vibration of a two DoF system. Write down its equation in matrix form
8. Derive the equation in matrix form for a forced harmonic vibration 2 DoF system
9. What is the importance of stiffness matrix in vibration calculation?
10. What is influence co-efficients? Why do we need to determine them?

PART B

11. Explain the different types of vibrations.

OR

12. Derive frequency equation for a beam with both ends free and having transverse vibration
13. Derive the equation for the amplitude of a rotating unbalanced mass with forced vibration and damping.

OR

14. Find the lowest natural frequency of transverse vibrations for the system shown in Fig. 1.

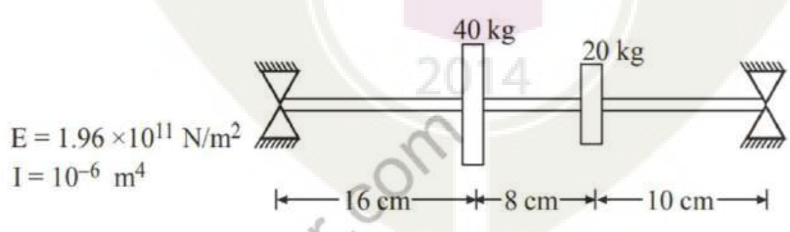


Fig. 1

15. A gun barrel of mass 600 kg has a recoil spring of stiffness 294000 N/m. If the barrel recoils 1.3 m on firing, determine @ initial recoil velocity of the barrel and the time required for the barrel to return to a position 5cm from the initial position.

OR

16. An air craft radio weighing 118 N is to be isolated from engine vibrations ranging in frequencies from 1600 to 2200 epm. What static deflection must the isolator have for 85% isolation?

17. Consider a system shown in figure. Let m_1=m, m_2=2m, k_1=k_2=k, k3= 2k. Obtain the natural modes of vibration

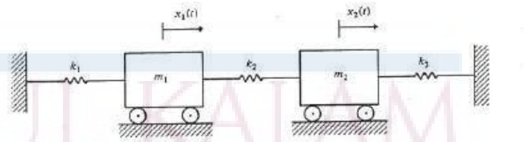
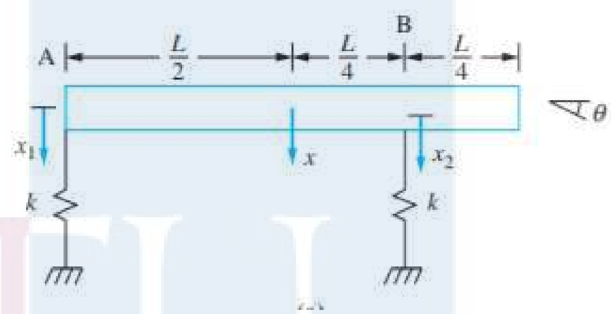


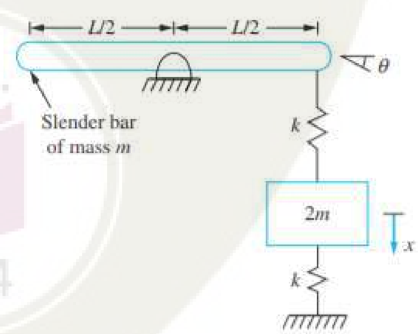
Fig 2

OR

18. Consider the system shown in Figure 3 in which the slender bar of mass m and moment of inertia is attached to springs of stiffness k at its left end and three-quarters of the way across the bar. Derive the differential equations for the system of Figure 6.2 using the following. (a) x is as generalized coordinates: the displacement of the mass center of the bar from equilibrium, and is the clockwise angular displacement of the bar. (b) x1 and x2 are the vertical displacements of particles where the springs are attached and measured from equilibrium. Assume small θ . Fig 3



19. Determine the natural frequencies and mode shapes for the system of Figure Use θ and x as generalized coordinates.



20. Calculate the natural frequencies and the mode shapes for the three degree-of-freedom system of above Figure

SYLLABUS

Module 1

Elements of Vibrations: - Introduction and basic concepts of vibration, Importance of vibration, Definitions, Methods of Vibration analysis, Types of vibrations, Periodic and Harmonic Motion, Beats, Representation of harmonic motion in complex form.

Undamped Free Vibrations: - Introduction, Derivation of differential equations, Torsional Vibrations, Equivalent stiffness of spring combinations, Compound pendulum, Transverse vibration of beams, Beams with several masses

Module 2

Damped Free Vibrations: Introduction, Types of damping, Differential equations of damped free vibrations, Logarithmic decrement, Forced Response of a Viscously Damped System Subject to a Single-Frequency Harmonic Excitation

Module 3

Forced Vibrations: Introduction, Sources of excitation, Equations of motion with harmonic force, Response of rotating and reciprocating unbalanced system, Support motion, Vibration Isolation, Vibration Transmissibility, Vibration measuring instruments, Frequency measuring device, Concept of Critical speed of shaft, resonance.

Module 4:

Two degrees of freedom systems: Introduction, Principal modes of vibrations, Torsional Vibrations, Coordinate transformations and coupling, Vibrations of undamped two degrees of freedom systems, Vibrations of damped two degrees of freedom systems, Undamped Forced vibrations with harmonic excitation, Vibration absorbers, Difference between vibration absorber and vibration isolator, Torsionally equivalent shaft

Module 5

Introduction to Multi Degree of freedom systems: - Introduction, Lagrange's equation, Rayleigh's method and Rayleigh-Ritz method, Matrix formulation, influence co-efficients, Flexibility matrix, Stiffness matrix.

Text Books

1. Theory of Vibration with Applications W.T. Thomson and Marie Dillon Dahleh, Pearson Education 5th edition, 2008
2. Mechanical Vibrations V.P. Singh DhanpatRai& Company Pvt. Ltd 2016

Reference Books

1. S Graham Kelly, Mechanical Vibrations Theory and Applications, Cengage Learning, 2011
2. Leonard Meirovitch, Fundamentals of Vibrations, Waveland Press Inc. , 2010

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Elements of Vibration**	
1.1	Introduction and basic concepts of vibration, Importance of vibration,.	1
1.2	Definitions, Methods of Vibration analysis,	1
1.3	Types of vibrations, Periodic and Harmonic Motion, Beats, Representation of harmonic motion in complex form	1
1.4	Introduction to undamped free vibration,	1
1.5	Derivation of differential equations, Torsional Vibrations,	1
1.6	Equivalent stiffness of spring combinations,	1
1.7	Compound pendulum, Transverse vibration of beams, Beams with several masses	1
2	**Damped Free Vibrations**	
2.1	Introduction	1
2.2	Types of damping	2
2.3	Differential equations of damped free vibrations	1
2.4	Logarithmic decrement	1
2.5	Forced Response of a Viscously Damped System Subject to a Single-Frequency Harmonic Excitation	2
3	**Forced Vibrations**	
3.1	Introduction	1
3.2	Sources of excitation	1
3.3	Equations of motion with harmonic force	1
3.4	Response of rotating and reciprocating unbalanced system	1
3.5	Support motion, Vibration Isolation, Vibration Transmissibility	1
3.6	Vibration measuring instruments	1
3.7	Frequency measuring device, Concept of Critical speed of shaft, resonance	1
4	**Two degrees of freedom systems**	
4.1	Introduction	1
4.2	Principal modes of vibrations , Torsional Vibrations	1
4.3	Coordinate transformations and coupling,	1
4.4	Vibrations of undamped two degrees of freedom systems ,Vibrations of damped two degrees of freedom systems	1
4.5	Undamped Forced vibrations with harmonic excitation	1
4.6	Vibration absorbers, Difference between vibration absorber and vibration isolator	1
4.7	Torsionally equivalent shaft	1
5	**Introduction to Multi Degree of freedom systems**	

5.1	Introduction	1
5.2	Lagrange’s equation	1
5.3	Rayleigh’s method and Rayleigh-Ritz method	1
5.4	Matrix formulation	1
5.5	influence co-efficients	1
5.6	Flexibility matrix	1
5.7	Stiffness matrix	1

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

MUT466	AUTOMOTIVE ERGONMICS AND SAFETY	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: The aim of this subject is to offer the students a general understanding of Automotive ergonomics and safety

- ✓ To gain essential and basic knowledge of Automotive ergonomics
- ✓ To familiarize with the procedures of Ergonomics
- ✓ To gain essential knowledge about Automotive safety and safety tests

Prerequisite: Nil

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

CO 1	Fundamentals of ergonomics and its measurement
CO 2	Introduction to features used to improve ergonomics
CO 3	Improve the knowledge about driver's visibility and methods to improve the visibility
CO 4	Introduction to Automotive safety, Active and passive safety
CO 5	Increase the knowledge about Safety equipments

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	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

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

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

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 need of anthropometry?
2.Explain the different postural conditions?

Course Outcome 2 (CO2)
1. Explain the arrangement of dash board equipment's
2. Explain the positioning of operational controls

Course Outcome 3(CO3):
1. Explain the major factors considered Mirror design
2. Explain the logical formations of cockpit

Course Outcome 4 (CO4):
1.Explain the design concept of crumple zone
2.Explain the characteristics of passenger compartment on impact

Course Outcome 5 (CO5):
1. Discuss the function of Airbag and electronic system for activating air bags
2. Explain the working of collision warning system

SYLLABUS

Module 1

Introduction To Ergonomics: Anthropometry – Need, Data Collection Methodology, Different postural Considerations

Measurement: Measuring Procedures, Subject and sampling size selection, Measurement of feet/hands/full posture, Applying anthropometry data

Module 2

Vehicle Ergonomics: Passenger Compartment, Floor Pan, technical requirements, Dash board equipment arrangement, Positioning of operational controls, Force Analysis, Seating and position - ECE Regulations, Human Factors, Navigation systems, pedal positioning.

Module 3

Visibility: Sight – All round visibility, View of Instruments, Mirror design, Logical formation of cockpit.

Vehicle packaging: R-Point, AHP, Manikin positioning of 2-D pattern, car entry/exit, Boot lid packaging

Module 4

Introduction To Safety: Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone. Active and Passive safety

Module 5

Vehicle safety Equipment: Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags

Text Books

1	An introduction to modern vehicle design	Julian Happian-Smith	Butterworth Heinmenn, 2001
2	Automotive Handbook	Bosch	9th edition - SAE publication – 2014

Reference Books

1	Automotive ergonomics	J. Brian Peacock, WaldemarKarwowski, Taylor & Francis ltd, 1993
2	Handbook of automotive body and system design	Fenton John, Wiley-Blackwell, 1998
3	Automotive Electronics Handbook	Ronald.K.Jurgen Second edition- McGrawHill Inc., - 1999.
4	Vehicle Body Engineering	J.Powloski - Business books limited, London - 1969.

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Module 1 (7 hours)**	
1.1	**INTRODUCTION TO ERGONOMICS**: Anthropometry – Need	1
1.2	Data Collection Methodology, Different postural Considerations	1
1.3	**MEASUREMENT:** Measuring Procedures, Subject and sampling size selection,	3
1.4	Measurement of feet/hands/full posture	1
1.5	Applying anthropometry data.	1
2	**Module 2 (7 hours)**	
2.1	**Vehicle Ergonomics:** Passenger Compartment,	1
2.2	Floor Pan, technical requirements, Dash board equipment arrangement, Positioning of operational controls,	3
2.4	Force Analysis, Seating and position - ECE Regulations,	1
2.5	Human Factors, Navigation systems, pedal positioning.	2
3	**Module 3 (7 hours)**	
3.1	**Visibility:** Sight – All round visibility	1
3.2	View of Instruments, Mirror design, Logical formation of cockpit.	1
3.3	**Vehicle packaging:**R-Point, AHP,	2
3.4	Manikin positioning of 2-D pattern,	1
3.5	car entry/exit, Boot lid packaging	2
4	**Module 4 (7 hours)**	
4.1	**INTRODUCTION TO SAFETY:** Design of the body for safety	2
4.2	energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle,	3
4.3	concept of crumble zone, Active and Passive safety	2
5	**Module 5 (7 hours)**	
5.1	**Vehicle safety Equipment:** Seat belt, regulations,	2
5.2	automatic seat belt tightener system,	1
5.3	collapsible steering column,	1
5.4	tiltablesteering wheel, air bags, electronic system for activating air bags	3

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: MUT 466

Course Name: AUTOMOTIVE ERGONOMICS & SAFETY

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

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. Explain the term – Anthropometry?
2. Explain the methods to measure the hands?
3. Write a short note on ECE regulations
4. Explain the various human factors affects vehicle ergonomics
5. Explain the Logical formation of cockpit
6. Write a shote note on driver visibility
7. write a short note on concept of crumble zone
8. Explain the methods to locate engine in a vehicle
9. Write a short note on automatic seat belt tightener system
10. Explain the working of collapsible steering column

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

11. Explain the various data collection methodology

Or

12. Explain the methods to select the subject and sample size

Module 2

13. Explain the Dash board equipment arrangement

Or

14. Briefly explain the Positioning of operational controls.

Module 3

15. Describe the types of Manikin positioning of 2-D pattern

Or

16. Explain the process car entry/exit, Boot lid packaging(10)

Module 4

17 Briefly explain the deceleration on impact with stationary and movable obstacle

Or

18. Explain the various safety system used in Active and passive safety

Module 5

19. Explain the regulations of seat belt and locations of seat belt

Or

20. Explain the working of electronic system for activating air bags

MUT476	NVH IN AUTOMOBILES	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: The aim of this subject is to offer the students a general understanding of the noise and vibration and their effects on human beings and nature.

- ✓ To familiarize the students with fundamentals of acoustics and noise
- ✓ To understand the effects of noise, vibration, and shock on People
- ✓ To understand the sources of noise and vibration
- ✓ To understand the methods of control of noise

Prerequisite: Nil

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

CO 1	Acquires theoretical knowledge of fundamentals of acoustics and noise, vibration
CO 2	Acquires the knowledge of effects of noise, vibration, and shock on people
CO 3	Acquires the knowledge of sources of vibration and noise
CO 4	Acquires the knowledge of methods to reduce noise and vibration
CO 5	Acquires the knowledge of NVH measurement tools and techniques

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	-	-	-	-	-	-	-	-	-	-
CO 2	2	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	2	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
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. Explain the classification of vibration.

2. Explain the propagation of sound in atmosphere.

Course Outcome 2 (CO2)

1. Explain the Effects of intense noise on people and hearing loss

Course Outcome 3(CO3):

1. Explain the noise characteristics of engines

Course Outcome 4 (CO4):

1. Explain the vibration isolation methods

Course Outcome 5 (CO5):

1. What are noise and vibration transducers?
2. Explain the principle of vibration transducer.

SYLLABUS

Module 1

Fundamentals of Acoustics and Noise, Vibration: Introduction, classification of vibration and noises: Theory of Sound—Predictions and Measurement, Sound Sources, Sound Propagation in the Atmosphere, Sound Radiation from Structures and Their Response to Sound, General Introduction to Vibration, free and forced vibration, undamped and damped vibration, linear and nonlinear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems.

Module 2`

Effects of Noise, Vibration, and Shock on People: General Introduction to Noise and Vibration Effects on People andHearing Conservation, Noise Exposure, Noise-Induced Annoyance, Effects of Infrasound, Low-Frequency Noise, and Ultrasound on People, Effects of Intense Noise on People and Hearing Loss, Effects of Vibration on People, Effects of Mechanical Shock on People, Rating Measures, Descriptors, Criteria, and Procedures for Determining Human Response to Noise

Module 3

Introduction to Transportation Noise and Vibration Sources, Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise

Module 4

Reduction of noise and vibrations : Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, modal analysis of the mass elastic model shock absorbersNoise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis. Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

Module 5

NVH Measuring Techniques: General Introduction to Noise and Vibration Transducers, Measuring Equipment, Measurements, Signal Acquisition and Processing, Acoustical Transducer Principles and Types of Microphones, Vibration Transducer Principles and Types of Vibration Transducers, Sound Level Meters, Noise Dosimeters, Analyzers and Signal Generators, Equipment for Data Acquisition, Noise and Vibration Measurements, Determination of Sound Power Level and Emission Sound Pressure Level, Sound Intensity Measurements, Noise and Vibration Data Analysis..

Text Books

1	Vibration Monitoring, Testing, and Instrumentation	Clarence W. de Silva	CRC Press, 2007
2	Understanding Active Noise Cancellation	Colin H Hansen	Spon Press , London 2003
3	Vibrations and Noise for Engineers	Kewal Pujara	Dhanpat Rai & Sons, 1992

Reference Books

1	Shock and Vibration Handbook	Allan G. Piersol ,Thomas L. Paez	McGraw-Hill , New Delhi, 2010
2	Engineering Noise Control: Theory and Practice	David A.Bies and Colin H.Hansen	Spon Press, London, 2009
3	Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles	Matthew Harrison	Elsevier Butterworth-Heinemann, Burlington, 2004

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Fundamentals of Acoustics and Noise, Vibration - Module 1 (7 hours)**	
1.1	Fundamentals of Acoustics and Noise, Vibration: Introduction, classification of vibration and noises	1
1.2	Theory of Sound—Predictions and Measurement, Sound Sources, Sound Propagation in the Atmosphere	2
1.3	Sound Radiation from Structures and Their Response to Sounds	1
1.4	General Introduction to Vibration, free and forced vibration, un damped and damped vibration, linear and nonlinear vibration	1
1.5	Response of damped and un damped systems under harmonic force	1
1.6	Analysis of single degree and two degree of freedom system.	1
2	**Effects of Noise, Vibration, and Shock on People - Module 2 (7 hours)**	
2.1	General Introduction to Noise and Vibration Effects on People and Hearing Conservation	1
2.2	Noise Exposure, Noise-Induced Annoyance, Effects of Infrasound, Low-Frequency Noise, and Ultrasound on People	2
2.4	Effects of Intense Noise on People and Hearing Loss	1
2.5	Effects of Vibration on People, Effects of Mechanical Shock on People	1
2.6	Rating Measures, Descriptors, Criteria, and Procedures for Determining Human Response to Noise.	2
3	**Noise and Vibration Sources - Module 3 (7 hours)**	
3.1	Introduction to Transportation Noise and Vibration Sources	1

3.2	Noise Characteristics of engines, engine overall noise levels	1
3.3	Assessment of combustion noise , mechanical noise, engine radiated noise, intake and exhaust noise	2
3.4	Engine accessory contributed noise, transmission noise	1
3.5	Aerodynamic noise	1
3.6	Tire noise, brake noise	1
4	**Reduction of noise and vibrations - Module 4 (7hours)**	
4.1	Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments	1
4.2	Modal analysis of the mass elastic model shock absorbers	1
4.3	Noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis	2
4.4	Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures,	2
4.5	Automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers	1
5	**NVH Measuring Techniques - Module 5 (7 hours)**	
5.1	General Introduction to Noise and Vibration Transducers,	1
5.2	Measuring Equipment, Measurements, Signal Acquisition and Processing, Acoustical Transducer Principles and Types of Microphones	1
5.3	Vibration Transducer Principles and Types of Vibration Transducers, Sound Level Meters, Noise Dosimeters, Analyzers and Signal Generators	2
5.4	Equipment for Data Acquisition, Noise and Vibration Measurements, Determination of Sound Power Level and Emission Sound Pressure Level	2
5.5	Sound Intensity Measurements, Noise and Vibration Data Analysis.	1

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: MUT476

Course Name: NVH IN AUTOMOBILES

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

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1. How are noise and vibration classified?
2. Explain the sound radiation from structures and response to sound.
3. Explain the effect of mechanical shock on people.
4. What is the effect of noise and vibration on hearing?
5. What are the causes of intake and exhaust noise?
6. What are the various vibration sources in automobile?
7. Explain i) Vibration Isolation ii) Damping Treatment.
8. Explain the principle of automotive noise control.
9. Explain the principle of Vibration Transducers.
10. Explain how emission sound pressure level is determined.

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

11. Explain the classification of vibration with examples.

Or

12. Explain the analysis of single degree and two degree of freedom

Module 2

13. Explain the effects of Infrasound, Low-Frequency Noise, and Ultrasound on People

Or

14. Explain the procedures for determining Human Response to Noise. .

Module 3

15. Explain the noise characteristics of engine.

Or

16. Explain the causes of aerodynamic noise

Module 4

17. Explain the Modal analysis of the mass elastic model shock absorbers

Or

18. Explain the methods for control of engine noise.

Module 5

19. Explain the Acoustical Transducer Principles.

Or

20. Explain the Calibration of Shock and Vibration Transducers

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEMESTER VIII

PROGRAM ELECTIVE V

KTU Estd. 2014

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MET468	ADDITIVE MANUFACTURING	PEC	2	1	0	3

Preamble: This course addresses additive manufacturing principles, variety and its concept, scope of additive manufacturing and areas of application

Prerequisite: NIL

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

CO Nos	Course Outcomes	Level of learning domain
CO 1	Discuss various additive manufacturing processes	2
CO 2	Explain slicing operations in additive manufacturing	2
CO 3	Use liquid and solid based additive manufacturing system	3
CO 4	Select powder based and use of pre requirement of AM	2
CO 5	Apply rapid prototyping techniques for obtaining solutions	3

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					1
CO 2	3	2			2		2					1
CO 3	2				2		2					1
CO 4	2				2		2					1
CO 5	3	2			2		2					1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	25
Understand	35	35	35
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

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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. What is additive manufacturing?
2. What is STL file?
3. What is AM process chain?

Course Outcome 2 (CO2)

1. What is Model Slicing?
2. What are the softwares used for Tool path generation
3. What are the softwares currently used for AM?
4. What are the limitations of Tool path generation?

Course Outcome 3(CO3):

1. Brief the post processing types of LENS.
2. What are process variables in FDM?
3. What are the applications of EDM?

Course Outcome 4 (CO4):
1. What is STL file?
2. How does 3d Printing Work?
3. What are the merits of SLM?

Course Outcome 5 (CO5):

1. What are the benefits of rapid tooling?
2. What are the applications of rapid tooling?
3. What is Rapid Tooling?

Model Question Paper

MET 468 ADDITIVE MANUFACTURING

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

Part – A

Answer all questions, each question carries 3 marks

1. Write a note on product development by AM?
2. Classify and Explain of additive manufacturing processes?
3.Brief about Support structure design?
4. What are the advantages of Part orientation?
5. Brief the LOM process.
6. What are the materials used in SLS
7. What are the strength and weakness of 3DP?
8. What are the merits of SLM?
9. What are the fundamentals of Rapid Prototyping?
10. List the types of industries that RP can be used in industrial applications?

PART -B

Answer one full question from each module.

MODULE – 1

11 a) Write a note on the benefits and applications of AM. (6 marks)
b) Write a note on the impact of AM on product development. (8 marks)

OR

12. a) Write a note on the need and development of AM systems. (8 marks)
b) Classify and explain the AM process. (6 marks)

MODULE – 2

13. a) Explain about data formats and data interfacing? (6 marks)
b) What is part orientation? Explain with illustrations? (8 marks)

OR

14. a) Explain the need of support generation with flow charts? (8 marks)
b) What are the steps involved in model slicing? (6 marks)

MODULE – 3

15. a) Brief about strength, Weakness and applications of SLA? (8 marks)
    b) Explain the working principle and process variables of FDM. (6 marks)

OR

16 a) Brief about strength, Weakness and applications of SLS? (8 marks)
    b) Explain the working principle and process variables of LOM. (6 marks)

MODULE – 4

17.a) Explain the working principle and process variables of 3DP (6 marks)
    b) Compare solid, liquid and powder based system of 3DP. (8 marks)

OR

18 a) what is STL Format? Explain any two translators used in place of STL? (8 marks)
    b) Explain the working principle and process variables of 3DP? (6 marks)

MODULE – 5

19 a) what are the benefits of using color in production of medical models? (6 marks)
    b) What AM materials are already approved for medical applications and for what types of application are they suitable? (8 marks)

OR

20 a) Discuss the steps followed in rapid prototyping process. (6 marks)
    b) What is rapid tooling and explain the applications of RPT in manufacturing and tooling. (8 marks)

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

SYLLABUS

Module 1

Introduction to Additive manufacturing: Importance of Additive Manufacturing- Basic principle of additive manufacturing- Procedure of product development in additive manufacturing. Classification of additive manufacturing processes, Materials used in additive manufacturing- Benefits & Challenges in Additive Manufacturing.

Module 2

Basic Concept — Digitization techniques — Model Reconstruction — Data Processing for Additive Manufacturing Technology: CAD model preparation — Part Orientation and support generation — Model Slicing —Tool path Generation- Introduction to slicing softwares: Cura.

Module 3

Principle, process parameters, advantages and applications of: Fused Deposition Modelling (FDM), Selective Laser Sintering (SLS), Stereo Lithography (SLA). Laminated Object Manufacturing (LOM), Electron Beam Melting (EBM), Laser Engineering Net Shaping (LENS),

Module 4

Principle, process parameters, advantages and applications of: Selection Laser Melting (SLM), Jetting, 3D Printing-STL Format, STL File Problems, consequence of building valid and invalid tessellated models, STL file Repairs: Generic Solution, other Translators, Newly Proposed Formats.

Module 5

Direct processes: - Rapid Prototyping, Rapid Tooling. Rapid Manufacturing; Indirect Processes: - Indirect Prototyping. Indirect Tooling, Indirect Manufacturing. Applications and case studies of Additive Manufacturing: –Biomedical- Manufacturing- Aerospace-Automotive- Food- Electronics.

Text Books

1. Gibson, I, Rosen, D W., and Stucker,B., Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing,Springer, 2010
2. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third Edition, World Scientific Publishers, 2010
3. Chee Kai Chua, Kah Fai Leong, 3D Printing and Additive Manufacturing: Principles and Applications: Fourth Edition of Rapid Prototyping, World Scientific Publishers, 2014
4. Gebhardt A., “Rapid prototyping”, Hanser Gardener Publications, 2003

Reference Books

1. Liou L.W. and Liou F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 2007
2. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006
3. Mahamood R.M., Laser Metal Deposition Process of Metals, Alloys, and Composite Materials, Engineering Materials and Processes, Springer International Publishing AG 2018

4. Ehsan Toyserkani, Amir Khajepour, Stephen F. Corbin, "Laser Cladding", CRC Press, 2004
5. Christopher Barnatt, "*3D Printing*", Explaining The Future.com, 2014.

6 . Paul F Jacobs, "Stereolithography and other RP&M Technologies: from Rapid Prototyping to Rapid Tooling", Society of Manufacturing Engineers and the Rapid Prototyping Association, New York, 1996.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
	MODULE 1	
1.1	Introduction to Additive manufacturing: Importance of Additive Manufacturing	2
1.2	Basic principle of additive manufacturing- Procedure of product development in additive manufacturing.	2
1.3	Classification of additive manufacturing processes, Materials used in additive manufacturing	2
1.4	Benefits & Challenges in Additive Manufacturing.	1
	MODULE 2	
2.1	Basic Concept — Digitization techniques — Model Reconstruction	1
2.2	Data Processing for Additive Manufacturing Technology:	1
2.3	CAD model preparation — Part Orientation and support generation	1
2.4	Model Slicing —Tool path Generation	1
2.5	Introduction to slicing softwares: Cura.	2
	MODULE 3	
3.1	Principle, process, advantages and applications of: Fused Deposition Modelling(FDM),	1
3.2	Principle, process, advantages and applications of: Selective Laser Sintering(SLS), Stereo Lithography(SLA),	2
3.3	Principle, process, advantages and applications of: Laser Engineering Net Shaping (LENS)	2
3.4	Principle, process, advantages and applications of: Laminated Object Manufacturing (LOM), Electron Beam Melting (EBM).	2
	MODULE 4	
4.1	Principle, process, advantages and applications of: Selection Laser Melting (SLM), Jetting, 3D Printing	**2**
4.2	Principle, process, advantages and applications of 3D Printing	**2**
4.3	STL Format, STL File Problems, consequence of building valid and invalid tessellated models,	**2**
4.4	STL file Repairs: Generic Solution, other Translators, Newly Proposed Formats.	**1**
	MODULE 5	
5.1	Direct processes: - Rapid Prototyping, Rapid Tooling. Rapid	**2**

	Manufacturing	
5.2	Indirect Processes: - Indirect Prototyping. Indirect Tooling, Indirect Manufacturing.	**2**
5.3	Applications and case studies of Additive Manufacturing: –Biomedical-Manufacturing-	**2**
5.4	Applications and case studies of Additive Manufacturing: –Aerospace-Automotive- Food- Electronics.	**2**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT428	METROLOGY AND INSTRUMENTATION	PEC	2	1	0	3

Preamble: This course helps the students to understand the concept of mechanical measurements. This subject is concerned with (i) establishing the units of measurements, producing these units in the form of standards and ensuring the uniformity of the measurements (ii) developing methods of measurements (iii) analysing the accuracy of methods of measurement, researching into the cause of measuring errors, and eliminating these errors. The subject metrology is not limited to length measurements but it is also concerned with the industrial inspection and its various techniques.

Prerequisite: NIL

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

CO 1	Understand the objectives of metrology, methods of measurement, standards of measurement & various characteristics of measuring instruments.
CO 2	Describe the principle and application of various measuring instruments for linear, angular, taper, screw thread and gear tooth measurements
CO 3	Explain the tolerance, limits of size, fits, Allowances and various types of gauges and their design
CO 4	Give an exposure to advanced measuring instruments like CMM, Machine vision, Autocollimator and interferometer
CO 5	Describe functioning of force, stress, strain, vibration, acceleration, surface finish and temperature measuring devices.

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
CO 2	2											1
CO 3	2	2	2									1
CO 4	2											1
CO 5	2											1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	30
Apply	20	20	60
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. List and explain the various factors that affect the accuracy of the measurement.
2. Explain the various methods of measurements.

Course Outcome 2 (CO2)

1. Explain the advantages of sine centres over sine bars.
2. Describe the measurement of effective diameter of screw threads with two wire method.

Course Outcome 3(CO3):

1. Give the differences between tolerance and allowance.
2. State and explain Taylor's principles of gauging.

Course Outcome 4 (CO4):

1. Illustrate the working of pneumatic comparator.
2. Demonstrate the operation Pitter-NPL gauge interferometer.

Course Outcome 5 (CO5):

1. Explain the evaluation of surface finish.
2. Explain the working principle of thermocouples.

Model Question Paper

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Course Code: MUT428

Course Name: METROLOGY AND INSTRUMENTATION

Max. Marks: 100 Duration: 3 Hours

Part – A

Answer all questions.

1. With the help of diagrams, explain the difference between accuracy and precision.
2. What are the 3 stages in generalized measuring system? Briefly explain.
3. What do you mean by wringing of slip gauges? Give the steps.
4. Describe any one method for the measurement of tooth thickness of spur gear.
5. Explain the relation between cost and tolerance of a part.
6. Prepare a short note on gauge material and gauge tolerance.
7. Explain the principle of interference that used in optical instruments.
8. With the help of neat diagram, explain Prony brake dynamometer.
9. Explain different order of surface irregularities.
10. Explain pneumatic load cells for the measurement of force.

(3 x 10 = 30 marks)

Part – B

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

11. (a) Explain any five method of measurement

    (b) Explain any four static characteristics of measuring instruments

OR

12. (a) What are the factors that affects the accuracy of the measuring system? Explain.

(b) Explain the various types of input quantities in measuring system.

13. (a) With the help of neat diagrams, explain different types of sine bars.

(b) List any four advantages of angle gauges over conventional sine bars.

OR

14. (a) With the help of neat diagram, describe the measurement of effective diameter of screw threads with two wire method.

(b) Explain any two methods for the measurement of tooth thickness of spur gears.

15. (a) With the help of suitable examples, explain different types of clearance fits and interference fits.

(b) Explain the concept of GO and NO-GO gauges for checking a hole part

OR

16. (a) Explain the hole basis and shaft basis system. List the advantages of the same

(b) Compare interchangeable assembly and selective assembly.

17. (a) With the help of neat diagram, explain Pitter-NPL gauge interferometer

(b) With the help of neat diagram, explain Pneumatic type comparator

OR

18. (a) With the help of neat diagrams, explain any four types of CMMs based on the Physical configuration.

(b) With the help of neat diagrams, explain the four basic steps of working of machine vision system

19. (a) With the help of neat diagrams, explain the Taylor-Hobson-Talysurf for the measurement of surface finish.

(b) Explain the piezoelectric accelerometer for the measurement of acceleration

OR

20. (a) With the help of neat diagrams, explain Hydraulic load cells and Pneumatic load cells for the force measurements.

(b) Prepare a short note on the measurement of humidity.

(14x5 = 70 marks)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY Estd 2014

SYLLABUS

Module 1

Introduction to Metrology: Definition and concept of metrology, objectives of metrology, Need of inspection.

Standards of Measurement: Wavelength Standards, Line and End standards, sub division of standards- primary, secondary, tertiary and working standards.

Errors in Measurements: concepts, types of errors-Static and Dynamic errors -gross, systematic and random errors, Abbe's Principle.

Terminologies in Measurement: Precision, accuracy, sensitivity, calibration; Factors affecting the accuracy of the measurement.

Introduction to measurements: Need for high precision measurements; Process of measurement, Methods of Measurement, Classificationof measuring instruments, Selection of measuring instruments, modes of measurements-Primary, secondary, tertiary measurements.

Stages in generalized measuring system: Sensor-Transducer stage, Signal-Conditioning stage, Readout-Recording stage; Types of input quantities.

Static characteristics of measuring instruments: Accuracy, Precision, Repeatability, Sensitivity, Reproducibility, Drift, Resolution, Threshold, Hysteresis, Static calibration.

Dynamic characteristics of measuring instruments: different order systems and their response, speed of response, Measuring lag, Fidelity, Dynamic error.

Module 2

Linear Measurement: Slip gauges, Dial indicators; Height gauges and Vernier callipers, Micrometers - Internal, external and Vernier micrometers.

Angular Measurement: Sine Bar, principle and use of sine bar, Types of sine bars, sine centre, sine table, Angle gauges, Sprit level, Clinometers, Bevel protractor.

Taper measurements: measurement of taper shaft and taper holes.

Screw thread measurement: Measurement of major diameter; Measurement of minor or root diameter, Measurement of pitch, Measurement of effective diameter with two wire method and three wire method.

Measurement of tooth thickness of spur gear: gear tooth Vernier, the constant chord method, the addendum comparator method, base tangent method, measurement of tooth profile using tool makers microscope.

Module 3

Limits, Fits and Tolerances: Definition and concept of Tolerance , Unilateral and bi lateral system of tolerance, relation between cost and tolerance, Terminology for limits and fits-fundamental deviation, basic shaft and basic hole, Types of fits, systems of limits and fits- Hole basis system and Shaft basis system.

Allowance: Difference between tolerance and allowance, Simple problems on tolerance and allowance, Different types of Assemblies- Interchangeable and selective.

Gauges: Introduction and Classifications, Limit Gauges – GO and NO-GO gauges; types of limit gauges.

Gauge design: Taylor's principles of gauging; Gauge tolerance, Gauge materials, wear allowance, simple problems on gauge design.

Module 4

Comparators: mechanical, electrical, optical and pneumatic comparator.

Optical Measuring Instruments: Principle of Interference, Interference band using optical flat, application in surface measurement, Interferometers – NPL flatness interferometer, Pitter-NPL gauge interferometer, Autocollimator and angle dekkor.

Coordinate Measuring Machine (CMM): Components and construction of CMM, Types of CMM; Advantages and application of CMM, CMM probes, types of probes – contact probes and non-contact probes.

Machine Vision: Introduction to machine vision, functions, applications and advantages of machine vision, Steps in machine vision.

Dynamometers: Mechanical, Hydraulic and Electrical dynamometer.

Module 5

Measurement of Surface Finish: Introduction, different order of surface irregularities, factors affecting surface finish, Designation of surface finish, evaluation of surface finish, methods of measuring surface finish.

Strain and Stress Measurement: Electrical resistance strain gauge - Principle, operation.

Measurement of Force: Strain-Gauge Load Cells, Hydraulic and Pneumatic load cells.

Vibration measurement: Vibrometers and Accelerometers – Basic principles and operation.

Temperature Measurement: Thermocouples – Principle, application laws for Thermocouples, Thermocouple materials and construction, measurement of Thermocouple EMF, Resistance Temperature Detectors (RTD), Thermistors, Pyrometers (Basic Principles).

Measurement of acceleration: Piezoelectric and Seismic type accelerometers.

Measurement of Humidity: Types of Hygrometers.

Text Books

1. Galyer J.F.W., Schotbolt C.R., Metrology for Engineers, ELBS,1990

2. Anand K Bewoor, Vinay A Kulkarni, Metrology & Measurement, McGraw-Hill, 2009

3. Ernest O. Doebelin, Dhanesh N. Manik, Measurement Systems Application and Design, McGraw-Hill, 2004

4. Thomas G. Beckwith, John H. L., Roy D. M., Mechanical Measurements, 6/E , Pearson Prentice Hall, 2007

5. R. K. Jain, Engineering Metrology, 7/E ,Khanna Publishers, 2000

Reference Books

1. ASME, Hand book of Industrial Metrology,1998

2. Hume K. J., Engineering Metrology, Macdonald &Co. Ltd.,1990

3. J.P.Holman, Experimental Methods for Engineers,Mcgraw-Hill, 2007

4. Sharp K.W.B., Practical Engineering Metrology, Sir Isaac Pitman & Sons Ltd.,1958

5. R. K. Rajput, Mechanical Measurements and Instrumentation, S. K. Kataria & Sons, 2011

Course Contents and Lecture Schedule

Module	Topics	Hours allotted
1	**Introduction to Metrology:** Definition and concept of metrology, objectives of metrology, Need of inspection. **Standards of Measurement:** Wavelength Standards, Line and End standards, sub division of standards- primary, secondary, tertiary and working standards.	**2**
	Errors in Measurements:concepts, types of errors-Static and Dynamic errors -gross, systematic and random errors, Abbe's Principle.**Terminologies in Measurement:** Precision, accuracy, sensitivity, calibration; Factors affecting the accuracy of the measurement.	**1**
	Introduction to measurements: Need for high precision measurements; Process of measurement, Methods of Measurement, Classification of measuring instruments, Selection of measuring instruments, modes of measurements-Primary, secondary, tertiary measurements.	**2**
	Stages in generalized measuring system: Sensor-Transducer stage, Signal-Conditioning stage, Readout-Recording stage; Types of input quantities.	**1**
	Static characteristics of measuring instruments: Accuracy, Precision, Repeatability, Sensitivity, Reproducibility, Drift, Resolution, Threshold, Hysteresis, Static calibration. **Dynamic characteristics of measuring instruments:** different order systems and their response, speed of response, Measuring lag, Fidelity, Dynamic error.	**1**
	Linear Measurement: Slip gauges, Dial indicators; Height gauges and Vernier callipers, Micrometers - Internal, external and Vernier micrometers.	**1**

2	**Angular Measurement:** Sine Bar, principle and use of sine bar, Types of sine bars, sine centre, sine table, Angle gauges, Sprit level, Clinometers, Bevel protractor.	**2**
	Taper measurements: measurement of taper shaft and taper holes.	**1**
	Screw thread measurement: Measurement of major diameter; Measurement of minor or root diameter, Measurement of pitch, Measurement of effective diameter with two wire method and three wire method.	**1**
	Measurement of tooth thickness of spur gear: gear tooth Vernier, the constant chord method, the addendum comparator method, base tangent method, measurement of tooth profile using tool makers microscope.	**2**
3	**Limits, Fits and Tolerances:** Definition and concept of Tolerance , Unilateral and bi lateral system of tolerance, relation between cost and tolerance, Terminology for limits and fits-fundamental deviation, basic shaft and basic hole, Types of fits, systems of limits and fits-Hole basis system and Shaft basis system.	**2**
	Allowance: Difference between tolerance and allowance, Simple problems on tolerance and allowance, Different types of Assemblies-Interchangeable and selective.	**2**
	Gauges: Introduction and Classifications, Limit Gauges – GO and NO-GO gauges; types of limit gauges.	**1**
	Gauge design: Taylor's principles of gauging; Gauge tolerance, Gauge materials, wear allowance, simple problems on gauge design.	**2**
4	**Comparators:** mechanical, electrical, optical and pneumatic comparator.	**1**
	Optical Measuring Instruments: Principle of Interference, Interference band using optical flat, application in surface measurement, Interferometers – NPL flatness interferometer, Pitter-NPL gauge interferometer, Autocollimator and angle dekkor.	**2**
	Coordinate Measuring Machine (CMM): Components and construction of CMM, Types of CMM; Advantages and application of CMM, CMM probes, types of probes – contact probes and non-contact probes.	**2**
	Machine Vision: Introduction to machine vision, functions, applications and advantages of machine vision, Steps in machine vision.	**1**
	Dynamometers: Mechanical, Hydraulic and Electrical dynamometer.	**1**
	Measurement of Surface Finish: Introduction, different order of surface irregularities, factors affecting surface finish, Designation of surface finish, evaluation of surface finish, methods of measuring surface finish.	**2**

5	**Strain and Stress Measurement:** Electrical resistance strain gauge - Principle, operation.	1
	Measurement of Force: Strain-Gauge Load Cells, Hydraulic and Pneumatic load cells. **Vibration measurement:** Vibrometers and Accelerometers – Basic principles and operation.	1
	Temperature Measurement: Thermocouples – Principle, application laws for Thermocouples, Thermocouple materials and construction, measurement of Thermocouple EMF, Resistance Temperature Detectors (RTD), Thermistors, Pyrometers (Basic Principles).	2
	Measurement of acceleration: Piezoelectric and Seismic type accelerometers. **Measurement of Humidity:** Types of Hygrometers.	1

MUT438	HYDROGEN FUELLED VEHICLES	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: Hydrogen is a powerful, transportable energy carrier that can produce electricity, power industry, and enable transportation minimizing the adverse impacts of fossil fuels. This course is designed to impart fundamentals understanding of hydrogen as a fuel, its associated hazards, hydrogen production, application of hydrogen as fuel in IC Engines and fuel cells, hydrogen storage and transportation.

Prerequisite:

1. Fundamental understanding of physics and chemistry
2. Fundamentals of internal combustion engines

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

CO 1	Understand the fundamentals of hydrogen as a fuel and remember the hazards which limit the use of hydrogen.
CO 2	illustrate different methods of hydrogen production
CO 3	analyse hydrogen as a fuel for internal combustion engines
CO 4	demonstrate the fuel cell propelled automobiles
CO 5	interpret the storage and transportation aspects of hydrogen fuel

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	-	2	-	-	-	-	-	-	-	1
CO 2	1	-	3	2	-	-	-	-	-	-	-	2
CO 3	1	-	3	2	-	2	-	-	-	-	-	2
CO 4	1	-	3	2	-	-	-	-	-	-	-	2
CO 5	1	-	3	2	-	2	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	10	10	10
Apply	20	20	60
Analyse	10	10	20
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. On a scale of 5, to what extend you are able to summarize the properties of hydrogen as a fuel. (1 for least and 5 for best)

Course Outcome 2 (CO2)

1. Are you able to demonstrate different methods to production hydrogen? (Always/Very often/Sometimes/Rarely/Never)

Course Outcome 3(CO3):

1. Can you compare different types of hydrogen internal combustion engines? (Very frequently/Frequently/Rarely Very rarely/Never)

Course Outcome 4 (CO4):

1. To what extent, you can interpret fuel cell vehicles.
   (Very advanced/Advanced/Proficient/Basic/ Minimal)

Course Outcome 5 (CO5):

1. Are you able to demonstrate the Storage and Transportation systems related to hydrogen fuel?
   (5 out of 5/4 out of 5/3 out of 5/2 out of 5/1 out of 5)

Model Question Paper

QP CODE: PAGES: 2

Reg. No: ______________ Name :______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT438

Course Name: HYDROGEN FUELLED VEHICLES

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

(Answer all questions; each question carries 3 marks) Marks

1		Discuss physical properties of hydrogen fuel	3
2		Explain the hazards in hydrogen use as a fuel for transport	3
3		List different methods to produce hydrogen	3
4		Briefly explain hydrogen purification process	3
5		What is the effect of hydrogen on the abnormal combustion	3
6		Explain the combustion strategies for increasing the efficiency of hydrogen fuelled internal combustion engine.	3
7		Briefly explain the current voltage curve of fuel cells	3
8		List the obstacles for fuel cell vehicles	3
9		Prepare a list of different methods to store hydrogen	3
10		Summarize the challenges in selecting suitable material for hydrogen transportation pipes	3

PART B

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

Module -1

11	a)	Describe the fuel properties of hydrogen in detail.	10
	b)	Explain the hazards in hydrogen storage facilities	4
12	a)	Discuss hydrogen properties associated with hazards	10
	b)	Briefly explain the chemical properties of hydrogen	4

Module -2

13		Demonstrate the method pf production of hydrogen from hydrocarbons	14
14		Illustrate the method to produce hydrogen from biomass	14

Module -3

15	a)	Describe the different techniques for inducting hydrogen in to internal combustion engines	8

	b)	Discuss the effect of use of hydrogen on LPG engines	6
16	a)	Illustrate the performance, combustion and emission characteristics of a hydrogen fuelled internal combustion engine.	6
	b)	Explain the important features to be considered in engines designed for hydrogen fuel	8
		Module -4	
17	a)	Illustrate and describe the construction and working of proton exchange membrane fuel cell	14
18	a)	Describe the layout of a hydrogen fuel cell road vehicles	8
	b)	Discuss the features of any one production fuel cell vehicle	6
		Module -5	
19	a)	Describe the parameters to be considered for the design of hydrogen storges systems	14
20	a)	Discuss different methods for vehicular hydrogen storage	8
	b)	Explain the working of sensor used to detect hydrogen leakage	6

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SYLLABUS

Module 1: Fundamentals of Hydrogen as a Fueland its Hazards

Potential of hydrogen as a future fuel, physical properties, chemical properties, fuel properties (energy content, combustibility properties, wide range of flammability, low ignition energy, small quenching distance, autoignition temperature, high flame speed, hydrogen embrittlement, hydrogen leakage, air/fuel ratio), historical survey of hydrogen accidents, hydrogen properties associated with hazards (physiological hazards,physical hazardsand chemical hazards) , hydrogen hazards (hazard spotting, hazard evaluation, and qualitative prediction of cloud travel) , hazards in hydrogen storage facilities, hazards in hydrogen use as a fuel for transport

Module 2: Hydrogen Production

Production of hydrogen from hydrocarbons(overview, oxidative processing of hydrocarbons-steam methane reforming, nonoxidative processing of hydrocarbons) , hydrogen production from coal(overview, technologies for producing hydrogen from coal- process components and coal gasification), hydrogen production from nuclear energy(high-temperature electrolysis of steam, thermochemical water splitting by iodine–sulphur cycle, hydrogen production with very high-temperature reactor), hydrogen production from wind energy (water electrolysis, wind power for electrolysis, wind energy systems for hydrogen production) , sustainable hydrogen production by thermochemical biomass processing (overview of biomass conversion processes, thermochemical gasification of biomass) use of solar energy to produce hydrogen, hydrogen separation and purification

Module 3: Hydrogen fuelled Internal Combustion Engine

Problems caused by using hydrogen in internal combustion engines, abnormal combustion challenges - Premature ignition and knock, Hydrogen fuel induction techniques - fuel delivery systems, central injection, port injection, direct injection, ignition systems, crankcase ventilation, power output, hydrogen gas mixtures, performance, combustion and emission characteristics of HICE, hydrogen-only ices, mixing hydrogen with conventional fuels in ICEs,Effects of hydrogen use on gasoline engines, Effects of hydrogen use on diesel engines, Effects of hydrogen use on LPG engines, combustion strategies for increased efficiency, Important features to be considered in engines designed for hydrogen fuel, engine conversion to hydrogen fuelling, operational damage and future challenges.

Module 4: Fuel Cell Vehicles

Overview of fuel cell vehicles, operation principles of fuel cells, electrode potential and current–voltage curve, fuel and oxidant consumption, fuel cell system characteristics, fuel cell technologies (proton exchange membrane fuel cell, solid oxide fuel cell, molten carbonate fuel cell, direct-methanol fuel cell, phosphoric acid fuel cell, alkaline fuel cell), obstacles for fuel cell vehicles, design of hydrogen fuel cell systems for road vehicles, case studies of fuel cell vehicles

Module 5: Storage and Transportation Aspects of Hydrogen

Hydrogen storage design considerations (hydrogen storage system capacity: weight and volume, cost: storage system cost and fuel cost, durability and operability requirements, temperature and pressure, cycle life and durability, charging and discharging rates, start-up time and transient response for storage systems hydrogen quality, environmental, health, and safety), hydrogen storage systems, pipelines for hydrogen transport (material challenges: pipeline steels, hydrogen embrittlement, composites), sensors for leak detection and pipeline integrity monitoring, hydrogen compression, bulk storage and vehicular hydrogen storage, hydrogen storage in carbon materials, hydrogen storage in organic chemical hydrides on the basis of superheated liquid-film concept (organic chemical hydrides for hydrogen storage, superheated liquid-film-type catalysis for hydrogen supply)

Text Books

1. Ram B. Gupta; Hydrogen Fuel- Production, Transport, and Storage; CRC Press Taylor & Francis Group; 2009.

Reference Books

1. Frederick J. Barclay; Fuel Cells, Engines and Hydrogen - An Exergy Approach; John Wiley & Sons Ltd, 2006.

2. International energy agency; Hydrogen & Fuel Cell- Review of National R&D programs; OECD; 2004.

3. International energy agency; prospects for hydrogen and fuel cells; OECD; 2005.

4. Richard Cammack, Michel Frey, Robert Robson; Hydrogen as a Fuel; Taylor & Francis; 2001.

5. Pasquale Corbo, Fortunato Migliardini, Ottorino Veneri; Hydrogen Fuel Cells for Road Vehicles; Springer, 2011.

6. Jack Erjavec; Hybrid, electric & fuel-cell vehicles; Delmar, Cengage Learning; 2013.

7. Reference papers (https://doi.org/10.1080/15435075.2019.1685999, https://doi.org/10.3390/en14206504, https://doi.org/10.1016/j.ijhydene.2020.02.001, http://dx.doi.org/10.1016/j.ijhydene.2013.10.102)

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Fundamentals and Use of Hydrogen as a Fuel**	
	Suggested Reference:Ram B. Gupta; Hydrogen Fuel- Production, Transport, and Storage; CRC Press Taylor & Francis Group; 2009.	
1.1	Potential of hydrogen as a future fuel, Physical Properties, Chemical Properties	1
1.2	Fuel Properties	1
1.3	Historical Survey of Hydrogen Accidents	1
1.4	Hydrogen Properties Associated with Hazards	1
1.5	Hydrogen Hazards	1
1.6	Hazards in Hydrogen Storage Facilities	1
1.7	Hazards in Hydrogen Use as a Fuel for Transport	1
2	**Hydrogen Production**	
	Suggested Reference:Ram B. Gupta; Hydrogen Fuel- Production, Transport, and Storage; CRC Press Taylor & Francis Group; 2009.	
2.1	Production of Hydrogen from Hydrocarbons	1
2.2	Hydrogen Production from Coal	1
2.3	Hydrogen Production from Nuclear Energy	1
2.4	Hydrogen Production from Wind Energy	1
2.5	Sustainable Hydrogen Production by Thermochemical Biomass Processing	1
2.6	Use of Solar Energy to Produce Hydrogen	1
2.7	Hydrogen Separation and Purification	1
3	**Hydrogen fuelled Internal Combustion Engine**	
	Suggested Reference:Reference papers sited in 7	
3.1	Problems caused by using hydrogen in internal combustionengines, abnormal combustion challenges- Premature ignition and knock	1
3.2	Hydrogen fuel induction techniques - fuel delivery systems, central injection, port injection, direct injection, ignition systems	1
3.3	crankcase ventilation, power output, hydrogen gas mixtures, performance, combustion and emission characteristics of HICE	1
3.4	hydrogen-only ices, mixing hydrogen with conventional fuels in ICEs	1
3.5	Effects of hydrogen use on gasoline engines, Effects of hydrogen use on diesel engines, Effects of hydrogen use on LPG engines	1
3.6	combustion strategies for increased efficiency, Important features to be considered in engines designed for hydrogen fuel, engine conversion to hydrogen fuelling	1
3.7	operational damage and future challenges	1

4	**Fuel Cell Vehicles**	
	Suggested Reference: 1. Pasquale Corbo, Fortunato Migliardini, Ottorino Veneri; Hydrogen Fuel Cells for Road Vehicles; Springer, 2011. **2.** Jack Erjavec; Hybrid, electric & fuel-cell vehicles; Delmar, Cengage Learning; 2013.	
4.1	Overview of fuel cell vehicles, operation principles of fuel cells	1
4.2	electrode potential and current–voltage curve, fuel and oxidant consumption, fuel cell system characteristics	1
4.3	fuel cell technologies (proton exchange membrane fuel cell, solid oxide fuel cell, molten carbonate fuel cell, direct-methanol fuel cell, phosphoric acid fuel cell, alkaline fuel cell)	2
4.4	obstacles for fuel cell vehicles, design of hydrogen fuel cell systemsfor road vehicles	1
4.5	case studies of fuel cell vehicles	2
5	**Storage and Transportation of Hydrogen**	
	Suggested Reference:Ram B. Gupta; Hydrogen Fuel- Production, Transport, and Storage; CRC Press Taylor & Francis Group; 2009.	
5.1	Hydrogen storage design considerations (Hydrogen Storage System Capacity: Weight and Volume, Cost: Storage System Cost and Fuel Cost, Durability and Operability Requirements, Temperature and Pressure, Cycle Life and Durability, Charging and Discharging Rates, Start-Up Time and Transient Response for Storage Systems Hydrogen Quality, Environmental, Health, and Safety)	2
5.2	Hydrogen storage systems, Pipelines for Hydrogen Transport (Material Challenges: Pipeline Steels, Hydrogen Embrittlement, Composites)	1
5.3	Sensors for leak detection and pipeline integrity monitoring	1
5.4	Hydrogen compression, Bulk storage and vehicularhydrogen storage	1
5.5	Hydrogen Storage in Carbon Materials	1
5.6	Hydrogen Storage in Organic Chemical Hydrides on the Basis of Superheated Liquid-Film Concept (Organic Chemical Hydrides for Hydrogen Storage, Superheated Liquid-Film-Type Catalysis for Hydrogen Supply)	1

MUT448	ADVANCED METAL JOINING TECHNIQUES	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: This course provides student to learn fundamental concepts of advanced welding techniques and their applications to an extent to enable the learner to arrive at a firsthand conclusion on selection of a particular technique best suited to resolve a metal joining problem

Prerequisite:MET204 Manufacturing process.

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

CO 1	Explain the physics, equipment, applications of EBW and LBW.
CO 2	Summarise the physics, equipment, applications of diffusion welding and adhesive bonding processes.
CO 3	Contrast the physics, equipment, applications of explosive welding with friction welding.
CO 4	Outline the physics, equipment, applications of ultrasonic welding and brazing.
CO 5	Illustrate the physics, equipment, applications of plasma arc welding and magnetically impelled arc butt welding.
CO 6	Select an appropriate welding technique to resolve a metal joining problem.

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	2	-	-	-	-	-	-	-	-	-	-	2
CO 3	2	-	-	2	-	-	-	-	-	-	-	3
CO 4	3	-	2	-	-	-	-	-	-	-	-	2
CO 5	2	-	-	-	1	-	-	-	-	-	-	2
CO 6	3	-	-	-	2	-	-	-	-	-	-	1

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 anyone. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions.

Course Outcome 1 (CO1):

1.Explain principle of operation of Electron Beam Welding.
2.Illustrate a typical EBW gun.
3.List 2 applications of laser beam welding. Identify the inherent process capability of LBM which makes it suitable for above listed applications.

Course Outcome 2 (CO2):
1.With the help of suitable diagrams, describe various stages in diffusion welding process.
2.Describe various diffusion welding methods.
3.Explain the physics of adhesive bonding.

Course Outcome 3 (CO3):
1.With the help of suitable diagram, describe parallel stand-off and angular stand-off.
2.Compare the mechanism of metal joining in explosive welding with that of friction welding. Give one application for each.
3.Show the effect of rotational speed on duration of friction welding.

Course Outcome 4 (CO4):
1.Describe principle of operation of ultrasonic welding.
2.List all design considerations for a brazed joint.
3.Make a note on hand torch brazing.

Course Outcome 5 (CO5):
1.Differentiate transferred and non-transferred plasma arc processes.
2.Sketch and explain a plasma arc welding system.
3.Describe the steps involved in MIAB with appropriate diagrams.

Course Outcome 6 (CO6):
1.Select a welding process which is considered relatively best for underwater welding. Correlate relevant process capability of the selected technique to support your selection.
2.Select a welding process that is considered best for welding stainless steel. Correlate relevant process capability of the selected technique to support your selection.
3.Suggest a best welding technique to join materials having thin sections. Explain why.

Model Question Paper

MUT448 ADVANCED METAL JOINING TECHNIQUES

Max. Marks: 100 Duration: 3 hours

Part−A

Answer all questions. Each question carries 3 marks.

1. Draw typical joint designs for electron beam welding.
2. How do you define “f number” for a laser beam?
3. What is vacuum fusion bonding?
4. Write a short note on crack extension test performed on adhesive bonds.
5. What is Impact velocity? How critical is it in creating an explosive weld?
6. Sketch and mark a simple friction welding setup.
7. What is principle of operation of ultrasonic welding?
8. List down essential properties of brazing filler metals.
9. What is “keyholing” in plasma arc welding?
10. What are the advantages of magnetically impelled arc butt welding?

Part–B

Answer one full question from each module.

Module I

11. (a) Draw and explain an EBW equipment. (7 marks)

(b) Discuss all joint configurations commonly used for LBW. (7 marks)

12. (a) Discuss process characteristics of EBW. (7 marks)

(b) Discuss Carbon Dioxide lasers used for welding. (7 marks)

Module II

13. Explain the theory of diffusion welding process. (14 marks)

14. Classify adhesives used for adhesive bonding and explain their characteristics. (14 marks)

Module III

15. With the help of a neat diagram describe different stages in explosion welding. (14 marks)

16. Draw and explain various joint designs employed in friction welding. (14 marks)

Module IV

17. State and explain all variables in ultrasonic welding. (14 marks)

18. Write short notes on (i) torch brazing (ii) furnace brazing (iii) vacuum brazing (14 marks)

Module V

19. Explain the principle of operation of MIAB welding and steps involved in it with the help of suitable diagrams. (14 marks)

20. Describe the components of a Plasma Arc Welding system and list all applications of PAW.

(14 marks)

SYLLABUS

Module 1

Radiant energy welding: Electron Beam Welding (EBW) - principle and theory- equipment and systems- process characteristics and variables- weld joint design- applications- EBW process variants. Laser Beam Welding-principle and theory-operation-types of lasers-process variables and characteristics-applications.

Module 2

Diffusion welding-principle and theory-methods- welding parameters-advantages and limitations- applications. Cold pressure welding-process, equipment and set-up-applications. Adhesive Bonding- principle and theory-types of adhesives-joint design-bonding methods-applications.

Module 3

Explosive welding-principle and theory-process variables-equipment-joint design-advantages and limitations-applications. Friction welding-principle and theory-process variables-advantages and limitations-applications. Friction stir welding- metal flow phenomena-tools-process variables – applications.

Module 4

Ultrasonic welding-principle and theory-process variables and equipment-types of ultrasonic welds- advantages and limitations-applications. Brazing- principle- brazing processes-torch brazing- furnace brazing- vacuum brazing-induction brazing-advantages and limitations-applications.

Module 5

Plasma arc welding –principle and theory- transferred arc and non-transferred arc techniques-equipment-advantages and limitations-applications. Magnetically impelled arc butt (MIAB) welding- principle of operation-applications. Under water welding-wet and dry under water welding- set-up for underwater welding systems.

Text Books

1. Parmar R.S., Welding Processes and Technology, Khanna Publishers, Delhi, 1998.

Reference Books

1. ASM Metals Handbook "Welding and Brazing", Vol.6, ASM, Ohio, 1988
2. Parmar R.S., "Welding Engineering and Technology" Khanna Publishers, Delhi, 1997
3. Rossi, B.E., Welding Engineering, Mc Graw-Hill, 1954
4. Schwartz M.M., "Metal Joining Manual", McGraw-Hill Inc., 1979
5. Udin et al., Welding for Engineers, John Wiley & Sons, New York, 1967
6. Welding Engineers Handbook – ASHE Vol. I, II, III, IV

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1.1	Radiant energy welding: Principle of Electron Beam Welding and theory.	1
1.2	Types of EBW welding guns. EBW equipment and systems.	1
1.3	Process variables –effect of beam current on weld penetration-effect of welding speed on weld penetration.	1
1.4	Process variants of EBW-medium vacuum EBW and non vaccum EBW	1
1.5	Typical weld joint design and preparation for EBW. Weldable materials using EB and applications of EBW.	1
1.6	Principle of Laser Beam Welding, mechanism and operation- types of laser systems- process variables and characteristics	1
1.7	Weld joint design – weldable materials and applications of laser beam welding.	1
2.1	Diffusion welding- principle and theory.	1
2.2	Diffusion welding methods- Gas-pressure bonding, Vacuum fusion bonding, Eutectic fusion bonding.	1
2.3	Diffusion welding parameters.	1
2.4	Weldable materials using diffusion welding- advantages, limitations and applications.	1
2.5	Cold pressure welding equipment and set-up-applications.	1
2.6	Adhesive bonding- principle and theory- classification of adhesives and types of adhesive materials.	1
2.7	Joint design and bonding methods – applications.	1
3.1	Explosive welding- principle and theory- process variables.	1
3.2	Set-up for explosion welding- Joint design- advantages and limitations- applications.	1
3.3	Friction welding- principle and theory- process variables.	2
3.4	Effect of rotational speed on duration of welding- process characteristics.	1
3.5	Advantages and limitations-applications. Variants of friction welding- friction stir welding-metal flow phenomena.	2
4.1	Ultrasonic welding- principle and theory.	1
4.2	Ultrasonic process variables and equipment-types of ultrasonic welds.	2
4.3	Advantages and disadvantages of ultrasonic welding- applications.	2
4.4	Brazing-principle-brazing processes- torch brazing- furnace brazing- vacuum brazing-induction brazing-advantages and limitations- applications.	2

5.1	Plasma Arc welding –principle and theory- transferred arc and non-transferred arc processes.	1
5.2	Plasma arc welding system.	1
5.3	Advantages, limitations and applications.	1
5.4	Magnetically Impelled Arc Butt (MIAB) welding- principle of operation-applications.	2
5.5	Under water welding techniques – wet and dry welding- general arrangement for underwater welding systems.	2

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUT458	COMPUTER SIMULATION AND ANALYSIS OF AUTOMOTIVE COMPONENTS	PEC	2	1	0	3

Preamble: The course aims at providing the student an understanding on analysis of different automotive systems using design and analysis softwares.

Prerequisite: MUT306: Auto Component Design

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

CO 1	Design and analyse chassis and suspension system of a vehicle
CO 2	Design and analyse clutch system
CO 3	Design and analyse Driveline and rear axle
CO 4	Design and analyse steering and front axle
CO 5	Design and analyse the suspension system

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO
CO 1	2	-	-	2	-	-	-	-	-	-	-	1
CO 2	1	-	3	2	-	-	-	-	-	-	-	2
CO 3	1	-	3	2	-	2	-	-	-	-	-	2
CO 4	1	-	3	2	-	-	-	-	-	-	-	2
CO 5	1	-	3	2	-	2	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember			
Understand	20	20	20
Apply	20	20	70
Analyse	10	10	10
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.Explain different approximation techniques used in FEA

Course Outcome 2 (CO2)
1. Derive the equation for rod, bar, beam and truss

Course Outcome 3(CO3):
1. Identify isoparametric elements and jacobian matrix

Course Outcome 4 (CO4):
1. Create a database for the FEA software calculation

Course Outcome 5 (CO5):
1.Develop different structural and thermal analysis using softwares and compare using experimental methods

Model Question Paper

QP CODE:

PAGES:…

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT458

Course Name: COMPUTER SIMULATION AND ANALYSIS OF AUTOMOTIVE COMPONENTS

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

Part A

(Answer all questions. Each question carry 3 marks)

1. Draw the free body diagram for the forces acting on a vehicle frame
2. List the difference between the frame analysis for passenger and commercial vehicles
3. Why do we consider torque as the base for the analysis of clutch in place of power?
4. What is the type of progression preferred for the identification of intermediate gear ratios? Why do we prefer it?
5. List the types of loads acting on the rear axle
6. Explain with a free body diagram, the loads acting on a dead and fully floating live rear axle
7. Explain the term steering error. How do we minimize it?
8. Why do we prefer taper roller bearing in the front axle in place of needle or ball bearing?
9. Explain the load distribution in a leaf spring
10. How do we analyse a torsion bar?

PART B

(ANSWER ANY ONE QUESTION FROM EACH MODULE. EACHFULL QUESTION CARRY 14 MARKS)

11. Explain the step-by-step methodology for the analysis of a vehicle frame

OR

12.
    a. Which are the stresses and moments that act on a frame? (7 marks)
    b. What are the inputs required for the design of a frame? (7 marks)
13. Derive the equation for the torque capacity of a single plate clutch

OR

14. Explain the methodology for the finalisation of gear ratio of a vehicle. Explain the inputs required for the same
15. Explain the methodology adopted for finalising the size of axle and axle housing of a semi floating drive axle

OR

16. Why is propeller shaft made as a hollow shaft in place of solid shaft? How do we finalise the size of the propeller shaft
17. How do we optimise the dimensions of the steering linkages?

OR

18. Explain the moments and stresses acting at different sections of the front axle
19. I would like to convert my leafspring to single leaf composite spring. How should I go about finalising the size and dimensions of the leafspring?

OR

20. Explain the methodology of CFD analysis of the hydraulic damping system

SYLLABUS

Module 1: VEHICLE FRAME

Vehicle frame: Study of loads - moments and stresses on frame members. computer aided design and analysis of frame for passenger and commercial vehicle

Module 2: CLUTCH& GEARBOX

Clutch torque capacity of clutch. computer aided design of clutch components, design details of roller and sprag type of clutches. Gearbox –Finalisation of gear ratios, computer aided design of three speed and four speed gear boxes.

Module 3: DRIVELINE AND REAR AXLE

Drive line and rear axle computer aided design of propeller shaft. design details of final drive gearing. design details of full floating and semi-floating rear shafts and rear axle housings.

Module 4: FRONT AXLE AND STEERING SYSTEM

Analysis of loads, moments and stresses at different sections of front axle. determination of bearing loads at kingpin bearings. wheel spindle bearings. choice of bearings. determination of optimum dimensions and proportions for steering linkages ensuring minimum error in steering.

Module 5: SUSPENSION

Computer aided design and analysis of leaf springs, coil springs and torsion bar, analysis of hydraulic damper using any CFD software

Text Books

1. Ganesan.V. " Computer Simulation of spark ignition engine process ", Universities Press (I) Ltd, Hyderbad, 1996.
2. Giri.N.K. " Automobile Mechanics ", Khanna Publisher, New Delhi, 1996
3. Newton, Steeds & Garret, " Motor vehicle ", llliffe Books Ltd., London, 1982.

Reference Books

1. Dean Averns, " Automobile Chassis Design ", llliffe Books Ltd, 1992.
2. Giles.J.G., "Steering, Suspension and tyres ", llliffe Books
3. Heldt.P.M., " Automotive Chassis ", Chilton Co., New York, 1992.

4. Ramoss.A.L., " Modelling of Internal Combustion Engines Processes ", McGraw Hill Publishing Co., 1992
5. Steeds.W., " Mechanics of Road vehicles ", llliffe Books Ltd., London, 1990.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**VEHICLE FRAME**	
1.1	Study of loads - moments and stresses on frame members.	3
1.2	computer aided design and analysis of frame for passenger and commercial vehicle	4
2	**CLUTCH & GEARBOX**	
2.1	Torque capacity of clutch	1
2.2	Computer aided design of clutch components	2
2.3	design details of roller and sprag type of clutches.	1
2.4	Gearbox –Finalisation of gear ratios,	1
2.5	Computer aided design of three speed and four speed gear boxes.	2
3	**DRIVELINE AND REAR AXLE**	
3.1	Computer aided design of propeller shaft.	2
3.2	Design details of final drive gearing	2
3.3	Design details of full floating and semi-floating rear shafts and rear axle housings	3
4	**FRONT AXLE AND STEERING SYSTEM**	
4.1	Analysis of loads, moments and stresses at different sections of front axle.	2
4.2	Determination of bearing loads at kingpin bearings. wheel spindle bearings.	2
4.3	Choice of bearings.	1
4.4	Determination of optimum dimensions and proportions for steering linkages ensuring minimum error in steering.	2
5	**SUSPENSION**	
5.1	computer aided design and analysis of leaf springs,	2
5.2	coil springs and torsion bar,	3
5.3	analysis of hydraulic damper using any CFD software	2

CODE MUT468	COURSE NAME AUTOMOTIVE NAVIGATION AND CONTROLS	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: This course aims at providing the students, an insight on the advanced navigation and control systems employed in an automobile., mainly employed for freight management.

Prerequisite: NIL

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

CO 1	Understand the navigation and controls in a new generation car
CO 2	Understand the basics of CAN and sensors in automobile navigation and control
CO 3	Understand the working of GPS technology in automotive navigation systems
CO 4	Understand the radio communication technologies for vehicle information systems
CO 5	Understand the driver assistance systems used in automobiles

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	-	-	-	3	-	-	-	-	-	-	-
CO 2	3	-	-	-	3	-	-	-	-	-	-	-
CO 3	2	-	-	-	3	-	-	-	-	-	-	-
CO 4	3	-	-	-	3	-	-	-	-	-	-	-
CO 5	3	-	-	-	3	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	40
Apply	20	20	50
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.

Expected outcome:

The students will become aware of the latest developments and advancement in the field of IC engines.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the types of navigation systems used in automobiles.
2. Mention the components used in the automotive navigation and control
3. What are the control systems applicable in future cars?
4. Explain the use of accelerometers and gyroscopes in navigation system
5. Differentiate between navigation, positioning and tracking.

Course Outcome 2 (CO2)

1. What is CAN protocol? Why is it used in automobiles?
2. Explain the various applications of CAN protocol in automobile navigation
3. Explain the hierarchical organization and implementation of CAN
4. What are the advantages of using CAN protocol?
5. Explain the functional concepts of CAN with neat diagram ?
6. Briefly explain about the types of sensors used in automotive navigation?

7. With a neat diagram, explain the working of Laser radar system?
8. Discuss the major types and comparison of road surface recognition sensors
9. What are the types of sensors used for ETC systems?
10. Why laser radar systems are preferred over LIDAR?

Course Outcome 3 (CO3):

1. Explain briefly about the history of GPS technology?
2. What is NAVSTAR GPS system? Explain
3. What are the errors considered during the GPS correction?
4. Explain the GPS receiver technologies in detail.
5. Explain the applications of GPS technology.

Course Outcome 4 (CO4):

1. Explain the various communication technologies for the vehicle information system.
2. What are the vision for Intelligent Transportation System communication?
3. Briefly explain V2V, V2I and V2R communication systems.
4. Briefly explain the Millimetric view devices and optical devices used for communication?
5. What are the advantages off Millimetric view devices and optical devices.

Course Outcome 5 (CO5):

1. What are the various driver assistance systems used in automobile .
2. What are the vision for Intelligent Transportation System communication?
3. Briefly explain lane recognition systems.
4. Briefly explain the traffic sign recognition, stereo vision and road recognition
5. What are the object recognition techniques used in automobiles.

Model Question Paper

QP CODE:
PAGES:…

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT468

Course Name: AUTOMOTIVE NAVIGATION AND CONTROLs

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

Part A
(Answer all questions. Each question carries 3 marks)

1. Explain the types of navigation systems used in automobiles.
2. Differentiate between navigation, positioning and tracking
3. What is CAN protocol? Why is it used in automobiles?
4. Why laser radar systems are preferred over LIDAR?
5. What are the advantages of using CAN protocol?
6. What are the types of sensors used for ETC systems
7. Explain briefly about the history of GPS technology
8. Briefly explain V2V, V2I and V2R communication systems.
9. Briefly explain lane recognition systems
10. What are the object recognition techniques used in automobiles

Part B
(Answer any one full question from each module. Each question carries 14 Marks)

11. (a) Mention real-time application of autonomous vehicles (7)
    (b) Differentiate a fully autonomous and semi-autonomous vehicle (7)

OR

12. Explain the need for adoption of autonomous vehicle in detail for future (14)

13. Explain the autonomous vehicle concept from a hardware perspective (14)

OR

14. Explain the autonomous vehicle concept from a software perspective (14)

15. Explain the recognition methods used in an autonomous vehicle (14)

OR

16. Explain the vision systems in autonomous vehicle with neat diagrams (14)

17. Explain V2V, V2I AND V2R communication systems (14)

OR

18. Explain in detail assistance systems used in autonomous vehicle (14)

19. Explain the significance of planning in autonomous vehicles (14)

OR

20. What are the motion planning primitives used in an autonomous vehicle (14)

SYLLABUS

Module 1

Introduction to Navigation – Position Fixing – Dead Reckoning – Inertial Navigation – Radio and satellite Navigation – Principle of Automobile Navigation and controls in the new generation cars – Capabilities of the navigation and control in future cars – Introduction of various components in automobile navigation and control.

Module 2

Basic need of CAN in automotive navigation and control – Vehicle, Features – Advantages and Applications of CAN – Functional Concept of CAN – Hierarchical organization and implementation of CAN – CAN standards– Application in vehicles

Various sensors in Automotive Navigation system – Laser radar principle and working –Non contact ground velocity sensors for vehicles – major types and comparison – Road surface recognition sensor — Vehicle sensors for ETC systems

Module 3

Global Positioning System – History of GPS – NAVSTAR GPS systems – Fundamentals of satellite based positioning – GPS receiver technologies – Application of GPS technology

Module 4

Communication technologies for vehicle information system – Vision for ITS communication – ITS communication in automobiles, vehicle – Vehicle and road-vehicle communication systems – Inter-vehicle communication system – Device technologies in ITS communication – Optical devices, Millimetric view devices.

Module 5

Driver assistance systems in automobiles – Vision in cars – A comprehensive driver assistance approach – Lane recognition, Traffic sign recognition, Stereo vision, road recognition, Object recognition – Traffic lights and signals, pedestrian recognition, Building intelligent systems in new generation cars.

.

Text Books:

1. Ljubo Vlacic, Michel Parent, Fumio Harashima, Intelligent Vehicle Technologies: Theory and Applcations, Butterworth-Heinemann, 2001
2. Kala, Rahul. On-road intelligent vehicles: Motion planning for intelligent transportation systems. Butterworth-Heinemann, 2016.
3. Zhao, Yilin. Vehicle location and navigation systems. 1997.
4. Groves, Paul D. "Principles of GNSS, inertial, and multisensor integrated navigation systems, [Book review]." IEEE Aerospace and Electronic Systems Magazine 30.2 (2015): 26-2

References:

1. Gerhart, Grant R., Robert W. Gunderson, and Chuck M. Shoemaker. "Unmanned Ground Vehicle Technology." Unmanned Ground Vehicle Technology 3693 (1999).

Course Contents and Lecture Schedule

No	Topics	No. of Lectures
1	MODULE – 1:	
1.1	Introduction to Navigation – Position Fixing – Dead Reckoning	1
1.2	Inertial Navigation –Radio and satellite Navigation	1
1.3	Principle of Automobile Navigation and controls in the new generation cars	1
1.4	Capabilities of the navigation and control in future cars	2
1.5	Introduction of various components in automobile navigation and	2
2	MODULE – 2	
2.1	Basic need of CAN in automotive navigation and control	1
2.2	Vehicle, Features – Advantages and Applications of CAN	1
2.3	Functional Concept of CAN	1
2.4	Hierarchical organization and implementation of CAN, CAN standards ,Application of CAN in vehicles	1
2.5	Various Sensors in Automobile Navigation System, Laser Radar Principle and Working	1
2.6	Non-contact Ground Velocity Sensors for Vehicles	1
2.7	Major types and comparison, Road Surface Recognition Sensors, Vehicle Sensors for ETC systems	1
3	MODULE – 3	
3.1	History of GPS	2
3.2	Navistar GPS system	2
3.3	Fundamentals of satellite based positioning, GPS receiver technologies ,Application of GPS technology	3

4	MODULE – 4	
4.1	Communication technologies for vehicle information system	1
4.2	Vision for ITS communication	1
4.3	ITS communication in automobiles	1
4.4	Vehicle-Vehicle and Road-Vehicle communication systems	1
4.5	Device Technologies in ITS communication	1
4.6	Optical Devices and Millimetre view devices	2
5	MODULE – 5	
5.1	A comprehensive driver assistance approach	1
5.2	Lane Recognition, Traffic Sign Recognition	1
5.3	Stereo Vision, Road Recognition	2
5.4	Object Recognition - Traffic lights and signals	2
5.5	Pedestrian Recognition, Building Intelligent systems in new generation cars	1

MUT478	ADVANCED ENERGY ENGINEERING	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: The aim of this subject is to provide students with a general understanding of the fundamentals and applications of energy engineering. So the purpose of this course is to expose the student to

- ✓ Understand energy scenario and the environmental effects of energy conversion.
- ✓ Understand the concepts on renewable energy sources and their utilisation
- ✓ Become aware of different renewable energy sources and choose sustainable energy

Prerequisite: NIL

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

CO 1	Understand solar power and its economics
CO 2	Understand wind power and its economics
CO 3	Understand about global energy scenario and conventional energy sources
CO 4	Understand the concepts on other renewable and newer technologies such as fuel cells and hydrogen energy conversion systems
CO 5	Understand the awareness on the impacts of energy conversion and importance of sustainable energy

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	3	2	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-
CO 5	3	2	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	25	25	50
Understand	25	25	50
Apply			
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 anyone. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What is the principle of solar cell?
2. Explain with a neat sketch, working of a solar photovoltaic cell.
3. Explain the applications of solar photovoltaic cells.
4. Explain attenuation of solar radiation.
5. sketch and explain solar flat plate collector
6. Explain with a neat sketch, the working of space heating and cooling by using solar collectors

Course Outcome 2(CO2):

1. Discuss the environmental impact of wind turbines
2. Discuss site selection for wind power plants?
3. What are vertical axis wind turbines? Explain the construction and working of anyone type of vertical axis wind turbine with the help of neat sketches
4. Explain the basic principle of wind energy conversion.
5. Discuss the advantages and disadvantages of wind energy conversion systems.

Course Outcome 3 (CO3):

1. How the hydel power plants are classified and explain with neat sketch pumped storage plant?
2. explain the necessity of using the components like surge tank, gates and valves in hydel power plant
3. explain briefly the method of biomass gasification
4. Explain the biochemical and thermo chemical methods of biomass conversion
5. What are the advantages and disadvantages of a floating drurn biogas plant?

Course Outcome 4 (CO4):

1. Explain fundamental characteristics of Tidal power plant selection
2. Describe the principle of power generation methods using tidal energy source.
3. Write the difference between geothermal power plant and thermal power plant?
4. Give the sources of geothermal energy
5. What is fuel cell? How fuel cells are classified? Discuss the application and economic aspect of fuel cells
6. Explain any four methods of hydrogen storage

Course Outcome 5 (CO5):

1. Explain ozone layer depletion in brief
2. What are eutrophication? Why is it undesirable?
3. What are the harmful effects of acid rain? How does it cause?

SYLLABUS

Module 1

Solar Energy- passive and active solar thermal energy, solar collectors, solar thermal electric systems, solar photovoltaic systems. Economics of solar power, sustainability attributes

Module 2

Wind Energy-Principle of wind energy conversion system, wind data and energy estimation, wind turbines, aerodynamics of wind turbines, wind power economics. Introduction to solar-wind hybrid energy systems,

Module 3

Biomass Energy – Biomass as a fuel, thermo-chemical, bio-chemical and agro-chemical conversion of biomass- pyrolysis, gasification, combustion and fermentation, transesterification, economics of biomass power generation, future prospects.

Energy Demand and supply- Global and Indian energy resources. Components, layout and working principles of steam, hydro, nuclear, gas turbine and diesel power plants Small, mini and micro hydro power plants.

Module 4

Other Renewable Energy sources – Brief account of Geothermal, Tidal, Wave, MHD power generation, Fuel cells – general description, types, applications. Hydrogen energy conversion systems, hybrid systems- Economics and technical feasibility

Module 5

Environmental impact of energy conversion – ozone layer depletion, global warming, greenhouse effect, loss of biodiversity, eutrophication, acid rain, air and water pollution, land degradation, thermal pollution, Sustainable energy, promising technologies, development pathways

Text Books

1	Power Plant Engineering	P.K.Nag	Tata- McGraw-Hill, 2002
2	Sustainable Energy: Choosing Among Options	Jefferson W Tester et.al	PHI, 2006
3	Fundamentals of renewable energy sources	Tiwari G N, Ghosal M K	Alpha Science International Ltd., 2007

Reference Books

1	Energy, Present and Future Options, Vol.I & II	David Merick, Richard Marshall	John Wiley & Sons, 2001
2	Renewable Energy : Power for a Sustainable Future	Godfrey Boyle	Oxford University Press, 2012
3	Renewable Energy: Sustainable energy concepts for the future	Roland Wengenmayr, Thomas Buhrke	Wiley – VCH, 2012
4	Renewable Energy Resources	Twidell J W and Weir A D	UK, E&F.N. Spon Ltd., 2006

Course Contents and Lecture Schedule

No.	**Topic**	**No. of Lectures**
1	**Module 1 (7 hours)**	
1.1	passive and active solar thermal energy, solar collectors,	2
1.2	solar thermal electric systems	2
1.3	solar photovoltaic systems.	2
1.4	Economics of solar power, sustainability attributes	1
2	**Module 2 (7 hours)**	
2.1	Principle of wind energy conversion system, wind data and energy estimation,	3
2.2	wind turbines, aerodynamics of wind turbines,	2
2.3	wind power economics. Introduction to solar-wind hybrid energy systems	2
3	**Module 3 (7 hours)**	
3.1	Biomass as a fuel, thermo-chemical, bio-chemical and agro-chemical conversion of biomass- pyrolysis, gasification, combustion and fermentation, transesterification	2
3.2	economics of biomass power generation, future prospects.	1
3.3	Energy Demand and supply- Global and Indian energy resources.	1
3.4	Components, layout and working principles of steam, hydro, nuclear, gas turbine and diesel power plants Small, mini and micro hydro power plants.	3

4	**Module 4 (7 hours)**	
4.1	Brief account of Geothermal, Tidal, Wave, MHD power generation, Fuel cells – general description, types, applications.	4
4.2	Hydrogen energy conversion systems,	2
4.3	hybrid systems- Economics and technical feasibility	1
5	**Module 5 (7 hours)**	
5.1	Environmental impact of energy conversion – ozone layer depletion, global warming, greenhouse effect,	1
5.2	loss of biodiversity, eutrophication, acid rain, air and water pollution,	2
5.3	land degradation, thermal pollution,	2
5.4	Sustainable energy, promising technologies, development pathways	2

Model Question Paper

QP CODE:
PAGES: 2

Reg. No: ______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MUT478

Course Name: ADVANCED ENERGY ENGINEERING

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

PART A

Answer all Questions.

Each question carries 3 Marks (2 questions from each module)

1) Explain the difference between passive and active solar energy systems with neat sketch

2) List any three advantages and disadvantages of solar energy.

3) Explain the main considerations in selecting a site for wind energy converters.

4) Discuss the advantages of vertical axis wind turbines over horizontal axis wind turbines.

5) What is the difference between biornass and biogas?

6) Discuss micro hydro power plants.

7) What are the disadvantages of using geothermal energy?

8) What are the chemical reactions involved in hydrogen-oxygen fuel cells?

9) What is greenhouse effect?

10) What is biodiversity?

PART B

Answer any one full question from each module.

Each question carries 14 Marks

Module 1

11) How solar thermal power plants classified. List the methods for converting solar energy into electric power

Or

12) a) The incident beam of sunlight has a power density of $1 kW/m^2$ in the direction of beam. The angle of inclination is 60^o. Calculate the power collected by the surface having a total area of $120\ m^2$ (7 marks) b)Discuss the various types of concentrating solar collectors (7 marks)

Module 2

13) a)How are wind turbines classified? (4 marks)

b) what are the major problems associated with wind power? explain with sketch, Horizontal axis type wind mill (10 marks)

Or

14) a)Wind at 1 atmospheric pressure and 15^0C temperature has a velocity of 15m/s with turbine operating speed of 40rpm at maximum efficiency. Assume turbine meter 120m. calculate

i. Total power density in the wind stream

ii. The maximum obtainable power density

iii. A reasonably obtainable power density if the efficiency is 35%

iv. Total power (8 marks)

b) Write notes on solar- wind hybrid systems (6 marks)

Module 3

15) a) With a neat sketch explain the working of a fixed dome type biogas plant. (8 marks)

b) What are the advantages of using biomass as an energy source? (6 marks)

Or

16) List the advantages, limitation and application of Diesel power plant, along with a neat sketch

Module 4

17) How Tidal power plants are classified and what are the advantages and limitations of Tidal power plant?

Or

18) a) explain with sketch, the working of "hot dry rock" geothermal plant (7 marks)

b) With the help of a schematic diagram explain the closed cycle MHD? (7 marks)

Module 5

19) a) What is cause for the loss of biodiversity and how is biodiversity protected? (9 marks)

b) Describe the actions to be taken for sustainability of energy (5 marks)

Or

20) a) What is thermal pollution? List the harmful effects of thermal pollution. (8 marks

b) Explain the causes and effects of eutrophication (6 marks)

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY Estd. 2014

SEMESTER VIII

MINOR

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUD482	MINIPROJECT	PWS	0	0	3	4

Preamble: This course is designed for enabling the students to apply the knowledge to address the real-world situations/problems and find solutions. The course is also intended to estimate the ability of the students in transforming theoretical knowledge studied as part of the curriculum so far in to a working model of a software system. The students are expected to design and develop a software/hardware project to innovatively solve a real-world problem.

Prerequisites: Subjects studied up to sixth semester.

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

CO No.	Course Outcome (CO)	Bloom's Category Level
CO 1	Make use of acquired knowledge within the selected area of technology for project development.	Level 3: Apply
CO 2	Identify, discuss and justify the technical aspects and design aspects of the project with a systematic approach.	Level 3: Apply
CO 3	Interpret, improve and refine technical aspects for engineering projects.	Level 3: Apply
CO 4	Associate with a team as an effective team player for the development of technical projects.	Level 3: Apply
CO 5	Report effectively the project related activities and findings.	Level 2: Understand

Mapping of course outcomes with program outcomes

POs / COs	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	3	3	3	3	-	-	-	3
CO 2	3	3	3	3	3	-	2	3	-	3	2	3
CO 3	3	3	3	3	3	2	3	3	-	2	3	3
CO 4	3	3	2	2	-	-	-	3	3	3	3	3
CO 5	3	-	-	-	2	-	-	3	2	3	2	3

3/2/1: high/medium/low

Assessment Pattern

The End Semester Evaluation (ESE) will be conducted as an internal evaluation based on the product, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, academic coordinator for that program and project guide/coordinator. The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, working knowledge and involvement.

The Continuous Internal Evaluation (CIE) is conducted by evaluating the progress of the mini project through minimum of TWO reviews. At the time of the 1st review, students are supposed to propose a new system/design/idea, after completing a thorough literature study of the existing systms under their chosen area. In the 2nd review students are expected to highlight the implementation details of the proposed solution. The review committee should assess the extent to which the implementation reflects the proposed design. A well coded, assembled and completely functional product is the expected output at this stage. The final CIE mark is the average of 1st and 2nd review marks.

A zeroth review may be conducted before the beginning of the project to give a chance for the students to present their area of interest or problem domain or conduct open brain storming sessions for innovative ideas. Zeroth review will not be a part of the CIE evaluation process.

Marks Distribution

Total Marks	CIE	ESE
150	75	75

Continuous Internal Evaluation Pattern:
Attendance : 10 marks
Marks awarded by Guide : 15 marks
Project Report : 10 marks
Evaluation by the Committee : 40 Marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks.
(a) Demonstration : 50 Marks
(b) Project report : 10 Marks
(d) Viva voce : 15marks

Course Plan

In this course, each group consisting of three/four members is expected to design and develop a moderately complex software/hardware system with practical applications. This should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty-in-charge of miniproject/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. Demonstrate the novelty of the project through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews**.**

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.

SEMESTER VIII

HONOURS

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MUD492	MINIPROJECT	PWS	0	0	3	4

Preamble: This course is designed for enabling the students to apply the knowledge to address the real-world situations/problems and find solutions. The course is also intended to estimate the ability of the students in transforming theoretical knowledge studied as part of the curriculum so far in to a working model of a software system. The students are expected to design and develop a software/hardware project to innovatively solve a real-world problem.

Prerequisites: Subjects studied up to sixth semester.

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

CO No.	Course Outcome (CO)	Bloom's Category Level
CO 1	Make use of acquired knowledge within the selected area of technology for project development.	Level 3: Apply
CO 2	Identify, discuss and justify the technical aspects and design aspects of the project with a systematic approach.	Level 3: Apply
CO 3	Interpret, improve and refine technical aspects for engineering projects.	Level 3: Apply
CO 4	Associate with a team as an effective team player for the development of technical projects.	Level 3: Apply
CO 5	Report effectively the project related activities and findings.	Level 2: Understand

Mapping of course outcomes with program outcomes

POs / COs	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	3	3	3	3	-	-	-	3
CO 2	3	3	3	3	3	-	2	3	-	3	2	3
CO 3	3	3	3	3	3	2	3	3	-	2	3	3
CO 4	3	3	2	2	-	-	-	3	3	3	3	3
CO 5	3	-	-	-	2	-	-	3	2	3	2	3

3/2/1: high/medium/low

Assessment Pattern

The End Semester Evaluation (ESE) will be conducted as an internal evaluation based on the product, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, academic coordinator for that program and project guide/coordinator. The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, working knowledge and involvement.

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Total Marks	CIE	ESE
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Students should identify a topic of interest in consultation with Faculty-in-charge of miniproject/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. Demonstrate the novelty of the project through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews**.**

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY KTU Estd. 2014