

SEMESTER I

SLO T	COURSE NO.	COURSES	L-T-P	HOURS	CREDIT
A	MAT 101	LINEAR ALGEBRA AND CALCULUS	3-1-0	4	4
B 1/2	PHT 110	ENGINEERING PHYSICS B	3-1-0	4	4
	CYT 100	ENGINEERING CHEMISTRY	3-1-0	4	4
C 1/2	EST 100	ENGINEERING MECHANICS	2-1-0	3	3
	EST 110	ENGINEERING GRAPHICS	2-0-2	4	3
D 1/2	EST 120	BASICS OF CIVIL & MECHANICAL ENGINEERING	4-0-0	4	4
	EST 130	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	4-0-0	4	4
E	HUN 101	LIFE SKILLS	2-0-2	4	--
S 1/2	PHL 120	ENGINEERING PHYSICS LAB	0-0-2	2	1
	CYL 120	ENGINEERING CHEMISTRY LAB	0-0-2	2	1
T 1/2	ESL 120	CIVIL & MECHANICAL WORKSHOP	0-0-2	2	1
	ESL 130	ELECTRICAL & ELECTRONICS WORKSHOP	0-0-2	2	1
<b>TOTAL</b>				<b>23/24 *</b>	<b>17</b>

\*Minimum hours per week

**NOTE:**

To make up for the hours lost due to induction program, one extra hour may allotted to be each course



# 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  $P$  that 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 value 5 with corresponding Eigen vector  $X =$

$$\begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}. \text{ Find } A^5 X$$

**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)

- Given the function  $w = xy + z$ , use chain rule to find the instantaneous rate of change of  $w$  at each point along the curve  $x = \cos t, y = \sin t, z = t$
- Determine the dimension of rectangular box open at the top, having a volume 32 cubic ft and requiring the least amount of material for its 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.

- Evaluate  $\iint_D (x + 2y) dA$  where  $D$  is the region bounded by the parabolas  $y = 2x^2$  and  $y = 1 + x^2$
- Explain how you would find the volume under the surface  $z = f(x, y)$  and over a specific region  $D$  in the  $xy$  plane using (i) double integral (ii) triple integral?
- Find the mass and centre of gravity of a triangular lamina with vertices  $(0,0), (2,1), (0,3)$  if the density function is  $f(x, y) = x + y$
- Use spherical coordinates to evaluate  $\iiint_B (x^2 + y^2 + z^2)^3 dV$  where  $B$  is the unit ball defined by  $B = \{(x, y, z): x^2 + y^2 + z^2 \leq 1\}$

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

- What is the difference between a sequence and a series and when do you say that they are convergent? Divergent?
- Determine whether the series  $\sum_{n=1}^{\infty} \frac{5}{2n^2 + 4n + 3}$  converges or diverges.
- Is the series  $\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{n}$  convergent? Absolutely convergent? Conditionally convergent?

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

- 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?
- Use Maclaurin series of  $\ln(1 + x), -1 < x \leq 1$  to find an approximate value of  $\ln 2$ .
- Find the Fourier series of the function  $f(x) = x^2, -2 \leq x < 2, f(x + 4) = f(x)$ . Hence using Parseval's identity prove that  $1 + \frac{1}{2^4} + \frac{1}{3^4} + \dots = \frac{\pi^4}{90}$
- 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  $A = \begin{bmatrix} 2 & 0 \\ 0 & -1 \end{bmatrix}$ . 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  $x = r\cos\theta$ ,  $y = r\sin\theta$ , 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

$$f(x, y) = xy + \frac{a^3}{x} + \frac{b^3}{y} \quad (a \neq 0, b \neq 0).$$

### Module - III

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

- (b) Evaluate  $\int_0^4 \int_{\sqrt{y}}^2 e^{x^3} dx dy$  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  $\iiint \sqrt{1 - x^2 - y^2 - z^2} dx dy dz$ , 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

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

- (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  $1 + \frac{1.2}{1.3} + \frac{1.2.3}{1.3.5} + \frac{1.2.3.4}{1.3.5.7} + \dots$

### 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  $f(x) = \begin{cases} \frac{2kL}{x} & \text{if } 0 < x < \frac{L}{2} \\ \frac{2k(L-x)}{L} & \text{if } \frac{L}{2} < x < L \end{cases}$

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  $\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \dots = \frac{\pi^4}{90}$ . (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. Diagonalization 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<sup>th</sup> edition, 2015.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10<sup>th</sup> Edition, John Wiley & Sons, 2016.

### Reference Books

1. J. Stewart, Essential Calculus, Cengage, 2<sup>nd</sup> edition, 2017
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9<sup>th</sup> Edition, Pearson, Reprint, 2002.
3. Peter V. O'Neil, Advanced Engineering Mathematics, Cengage, 7<sup>th</sup> 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
<b>1</b>	<b>Linear Algebra (10 hours)</b>	
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	Diagonalization of matrices, orthogonal transformation, quadratic forms	4

	and their canonical forms.	
<b>2</b>	<b>Multivariable calculus-Differentiation (8 hours)</b>	
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
<b>3</b>	<b>Multivariable calculus-Integration (10 hours)</b>	
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
<b>4</b>	<b>Sequences and series (8 hours)</b>	
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
<b>5</b>	<b>Series representation of functions (9 hours)</b>	
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 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  $\mu$  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  $1 \text{ \AA}$  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<sup>3</sup>)

**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.

**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  $7 \times 10^4$ . 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  $4800 \text{ \AA}$ . Given  $\beta = 0.0555 \text{ cm}$ . (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  $2 \text{ \AA}$ . 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  $3000 \text{ m}^3$ . It has a total absorption of  $100 \text{ m}^2$  sabine. If the hall is filled with audience who add another  $80 \text{ m}^2$  sabine, 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**

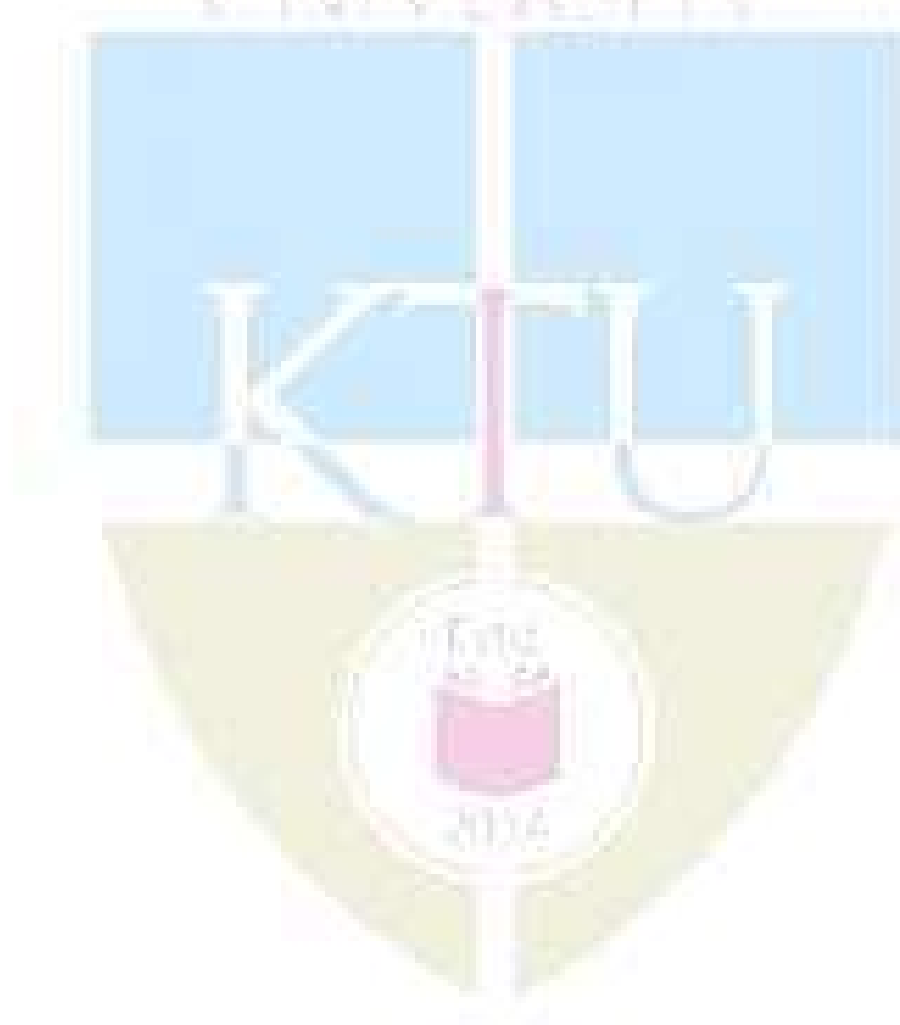
19. (a) Outline the construction and working of Ruby laser. (8)

- (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.

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3. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016
4. Aruldhas G., "Engineering Physics", PHI Pvt. Ltd., 2015
5. Ajoy Ghatak, "Optics", Mc Graw Hill Education, Sixth Edition, 2017
6. T. Pradeep, "Nano:The Essentials", McGraw Hill India Ltd, 2007
7. B. B. Laud, "Lasers and Non linear optics", New age International Publishers, 2nd Edition ,2005
8. Premlet B., "Advanced Engineering Physics", Phasor Books,10<sup>th</sup> 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	<b>Oscillations and Waves ( 9 hours)</b>	
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	<b>Wave Optics (9 hours)</b>	
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	<b>Quantum Mechanics &amp; Nanotechnology (9hours)</b>	
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	<b>Acoustics &amp; Ultrasonics (9hrs)</b>	
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	<b>Laser and Fibre optics ( 9hours)</b>	
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

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  $\mu$  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  $1 \text{ \AA}$  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  $1/(\mu_0 \epsilon_0)^{1/2}$   
(b) An electromagnetic wave is described by  $E = 100 \exp 8\pi i [10^{14} t - (10^6 z / 3)] \text{ V/m}$ . 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  $7 \times 10^4$ . 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  $4800 \text{ \AA}$ . Given  $\beta = 0.0555 \text{ cm}$ . (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  $2 \text{ \AA}$ . 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  $3.8 \times 10^{26} \text{ W}$  and its radius is  $7 \times 10^8 \text{ m}$ . (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  $\mathbf{H}$  in a plane wave is 1 A/m, find the magnitude of  $\mathbf{E}$  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.

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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,10<sup>th</sup> 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	<b>Oscillations and Waves (9 hours)</b>	
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	<b>Wave Optics (9 hours)</b>	
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	<b>Quantum Mechanics &amp; Nanotechnology (9hours)</b>	
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	<b>Magnetism &amp; Electro Magnetic Theory (9 hours)</b>	
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	<b>Superconductivity &amp; Photonics (9hours)</b>	
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

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,  $Zn / Zn^{2+} (0.1M) // Ag^+ (0.01M) // Ag$ .  
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  $4138\text{ cm}^{-1}$ . 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  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  (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  $\text{CH}_3\text{-(CHOH)}_2\text{-COOH}$  (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  $\text{CaCO}_3$  per liter, 50 mL of this required 30 mL of EDTA solution, 50 mL of sample water required 20 mL of EDTA solution. 50 mL 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

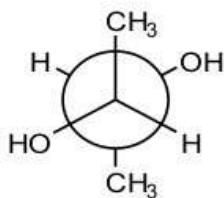
Duration: 3 Hours

**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?<br>(a) $\text{O}_2$ (b) $\text{H}_2\text{O}$ (c) $\text{N}_2$ (d) $\text{HCl}$ | (3)   |
| 4 | Which of the following molecules show UV-Visible absorption? Give reason.<br>(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) Polypyrrole b) Kevlar. (3)
- 9 What is break point chlorination? (3)
- 10 What is reverse osmosis? (3)

### PART B

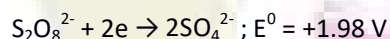
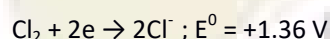
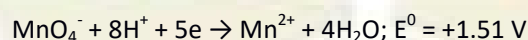
*Answer any one full question from each module, each question carries 14 marks*

#### 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  $\text{Cu}^{2+}$  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)



Use the above data to examine whether the acids, dil. HCl and dil.  $\text{H}_2\text{SO}_4$ , can be used to provide acid medium in redox titrations involving  $\text{KMnO}_4$ .

#### Module 2

- 13 a) What is spin-spin splitting? Draw the NMR spectrum of (i)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$  (ii)  $\text{CH}_3\text{CH}(\text{Br})\text{CH}_3$ . 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  $\text{CO}_2$  and  $\text{H}_2\text{O}$ . 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  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  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-dimethylcyclohexane. (10)  
Which conformer (chair form) is more stable in each case?  
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  $[\text{Ca}^{2+}] = 160 \text{ mg/L}$ ,  $[\text{Mg}^{2+}] = 192 \text{ mg/L}$  and  $[\text{HCO}_3^-] = 122 \text{ mg/L}$ . (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.  $^1\text{H}$  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  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ . 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 and UV 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, 10<sup>th</sup> edn., 2014.

#### **Reference Books**

1. C. N. Banwell, "Fundamentals of Molecular Spectroscopy", McGraw-Hill, 4<sup>th</sup> edn., 1995.
2. Donald L. Pavia, "Introduction to Spectroscopy", Cengage Learning India Pvt. Ltd., 2015.
3. B. R. Puri, L. R. Sharma, M. S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., 47<sup>th</sup> Edition, 2017.
4. H. H. Willard, L. L. Merritt, "Instrumental Methods of Analysis", CBS Publishers, 7<sup>th</sup> 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. Muhammed Arif, 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, Rino Laly Jose, "Text Book of Engineering Chemistry", S. Chand & Company Pvt Ltd, 2019.

## Course Contents and Lecture Schedule

No	Topic	No. of Lectures (hrs)
<b>1</b>	<b>Electrochemistry and Corrosion</b>	<b>9</b>
<b>1.1</b>	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.	<b>2</b>
<b>1.2</b>	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.	<b>3</b>
<b>1.3</b>	Potentiometric titration - Introduction -Redox titration only. Lithium ion cell - construction and working. Conductivity- Measurement of conductivity of a solution (Numericals).	<b>2</b>
<b>1.4</b>	Corrosion-Electrochemical corrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.	<b>2</b>
<b>2</b>	<b>Spectroscopic Techniques and Applications</b>	<b>9</b>
<b>2.1</b>	Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals).	<b>2</b>
<b>2.2</b>	UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.	<b>2</b>
<b>2.3</b>	IR-Spectroscopy – Principle - Number of vibrational modes -Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications.	<b>2</b>
<b>2.4</b>	$^1\text{H}$ 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).	<b>3</b>
<b>3</b>	<b>Instrumental Methods and Nanomaterials</b>	<b>9</b>
<b>3.1</b>	Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ .	<b>2</b>

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	<b>Stereochemistry and Polymer Chemistry</b>	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	<b>Water Chemistry and Sewage Water Treatment</b>	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 and UV 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)**

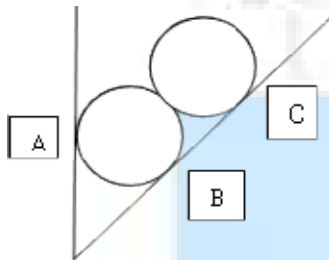
1. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.
2. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram 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.

<b>CO 3</b>	To apply the conditions of equilibrium to various practical problems involving different force system.
<b>CO 4</b>	To choose appropriate theorems, principles or formulae to solve problems of mechanics.
<b>CO 5</b>	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.

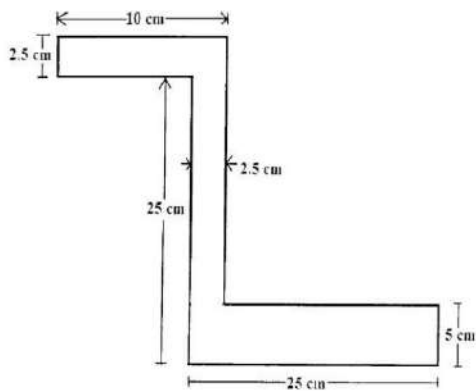


<b>Course outcome identifier</b>	<b>Description of course outcome</b>	<b>Learning level assessed</b>	<b>Marks allocated</b>
<b>CO 3</b>	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent equilibrium state of the body )	4
<b>CO 4</b>	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
<b>CO 5</b>	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
<b>Total</b>			<b>14</b>

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

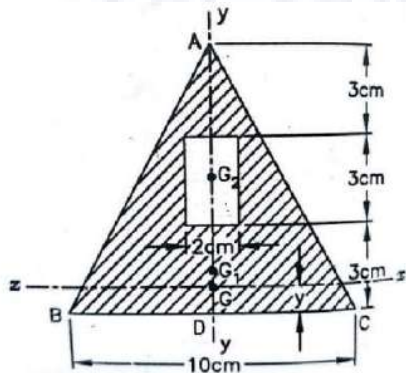
3. Determine the centroid of the given section



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)

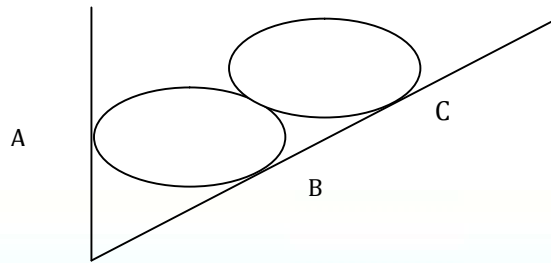
1. Explain D'Alembert's principle
2. Distinguish static and dynamic friction.
3. State and explain perpendicular axis theorem.
4. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.
5. A 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 collision of rigid bodies.

### PART B

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

#### Module -I

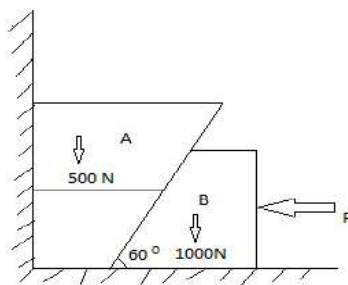
11. Two identical rollers each of weight 100 N are supported by an inclined plane, making an angle of  $30^\circ$  with the vertical, and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth. (14 marks)



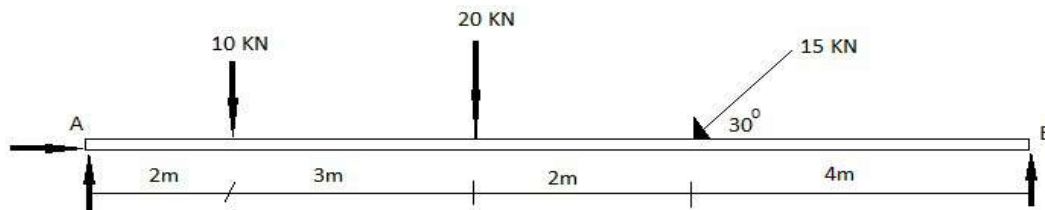
12. A string tied to a wall is made to pass over a pulley placed 2m away from it. A weight P is attached to the string such that the string stretches by 2m from the support on the wall to the location of attachment of weight. Determine the force P required to maintain 200 kg body in position for  $\theta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

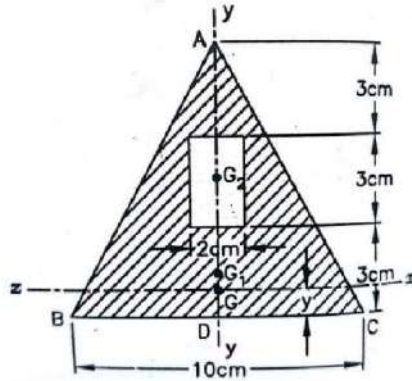


14. A beam is hinged at A and roller supported at B. It is acted upon by loads as shown below. Find the reactions at A & B. (14 marks)

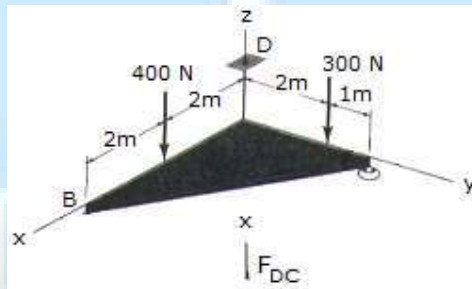


### Module – 3

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  $30^\circ$  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 and E.R.Johnston (2011), Vector Mechanics for Engineers, Vol.I-Statics, Vol.II-Dynamics, 9<sup>th</sup> 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
<b>1</b>	<b>Module 1</b>		<b>Total: 7</b>
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
<b>2</b>	<b>Module 2</b>		<b>Total: 7</b>
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,CO4 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
<b>3</b>	<b>Module 3</b>		<b>Total: 7</b>
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
<b>4</b>	<b>Module 4</b>		<b>Total: 7</b>

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 collisions). Concepts on Moment of momentum and work energy equation (curvilinear translation).	CO1 and CO2	1
<b>5</b>	<b>Module 5</b>		<b>Total: 7</b>
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

AL-FAYOUZ KARAM  
TECHNOLOGICAL  
UNIVERSITY



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

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

**Prerequisite:** NIL

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

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

**Mapping of course outcomes with program outcomes**

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

**Assessment Pattern**

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

### Mark distribution

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

### Continuous Internal Evaluation Pattern:

Attendance : 10 marks

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

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

### End Semester Examination Pattern:

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

### Course Level Assessment Questions

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

#### Course Outcome 1 (CO1):

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

#### Course Outcome 2 (CO2)

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

#### Course Outcome 3 (CO3):

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

#### Course Outcome 4 (CO4):

1. Draw Isometric views/projections of solids
2. Draw Isometric views/projections of combination of solids
3. Draw Perspective views of Solids

#### 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  $30^\circ$  to VP. Draw the projections of the solid.

- 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  $30^\circ$  to HP and  $45^\circ$  to VP. Draw the projections of the solid.

### MODULE III

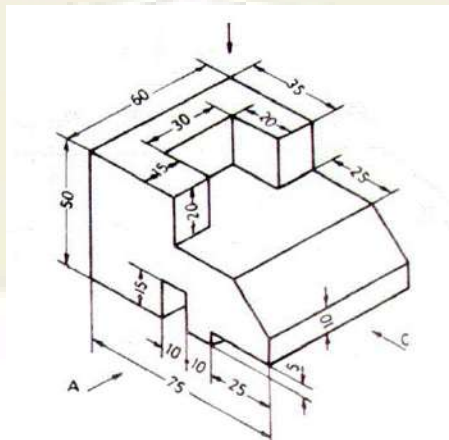
- A triangular prism of base side 40mm and height 70mm is resting with its base on the ground and having an edge of the base perpendicular to VP. Section the solid such that the true shape of the section is a trapezium of parallel sides 30mm and 10mm. Draw the projections showing the true shape. Find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

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

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



(20X5=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- 3<sup>rd</sup> 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	<b>MODULE I</b>	
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	<b>MODULE II</b>	
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	<b>MODULE III</b>	
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	<b>MODULE IV</b>	
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	<b>MODULE V</b>	
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
	<b>SECTION B (To be conducted in CAD lab)</b>	
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

Bloom's Category	Basic Civil Engineering			Basic Mechanical Engineering		
	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°C, 0.1 MPa. 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 efficiencyTake  $C_p = 1.005 \text{ kJ/kgK}$  and  $C_v = 0.718 \text{ kJ/kgK}$
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  $0.3 \text{ m}^3$ . 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°C and 620°C respectively. The temperature at the beginning and end of the expansion is 1850°C and 850°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  $9 \text{ m}^3/\text{s}$ . 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, 9<sup>th</sup> Edition, 2018
12. Balachandran, P. Basic Mechanical Engineering, Owl Books

**Course Contents and Lecture Schedule:**

No	Topic	Course outcomes addressed	No. of Lectures
<b>1</b>	<b>Module I</b>		<b>Total: 7</b>
1.1	<i>General Introduction to Civil Engineering:</i> 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	<i>Introduction to buildings:</i> Types of buildings, selection of site for buildings, components of a residential building and their functions.	CO2	2
1.4	<i>Building rules and regulations:</i> Relevance of NBC, KBR & CRZ norms (brief discussion only)	CO2	1
1.5	<i>Building area:</i> Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.	CO2	1
<b>2</b>	<b>Module 2</b>		<b>Total: 7</b>
2.1	<i>Surveying:</i> Importance, objectives and principles.	CO3	1
2.2	Bricks: - Classification, properties of good bricks, and tests on bricks	CO2	1
2.3	Stones: - <i>Qualities</i> 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
<b>3</b>	<b>Module 3</b>		<b>Total: 7</b>
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	<i>Basic infrastructure services:</i> MEP, HVAC, Elevators, escalators and ramps (Civil Engineering aspects only) fire safety for buildings	CO4	2
3.4	<i>Green buildings:-</i> Materials, energy systems, water management and environment for green buildings. (brief discussion only)	CO5	1
<b>4</b>	<b>MODULE 4</b>		
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
<b>5</b>	<b>MODULE 5</b>		
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	<b>MODULE 6</b>	
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 circuits

##### 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**

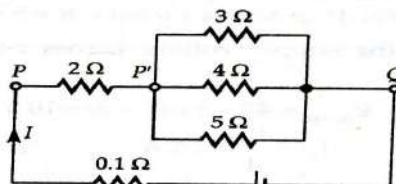
**PART I**

**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:



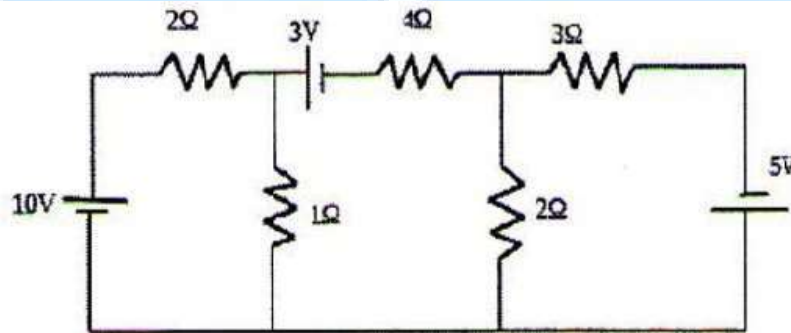
2. Calculate the RMS and average values of a purely sinusoidal current having peak value 15A.
3. An alternating voltage of  $(80+j60)V$  is applied to an RX circuit and the current flowing through the circuit is  $(-4+j10)A$ . Calculate the impedance of the circuit in rectangular and polar forms. Also 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.**

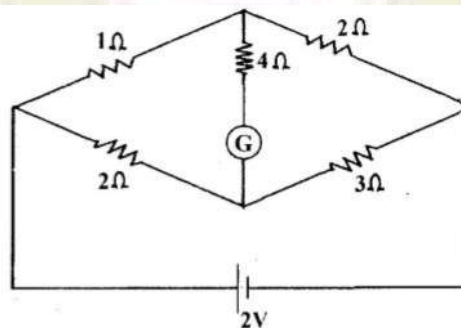
**Module 1**

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



7. (a) State and explain Kirchoff'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  $60^\circ$  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  $4\Omega$  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. 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.

**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, Basic Electronics, McGraw Hill.
10. A. Bruce Carlson, Paul B. Crilly, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, Tata McGraw Hill, 5<sup>th</sup> Edition.

## COURSE CONTENTS AND LECTURE SCHEDULE

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

3.1	<p><b>AC Circuits:</b> Phasor representation of sinusoidal quantities. Trigonometric, Rectangular, Polar and complex forms.</p> <p>Analysis of simple AC circuits: Purely resistive, inductive &amp; capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power, Power factor.</p> <p>Analysis of RL, RC and RLC series circuits-active, reactive and apparent power.</p> <p>Simple numerical problems.</p>	1 2 1 2
3.2	<p><b>Three phase AC systems:</b> 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.</p>	2
<b>4</b>	<b>Introduction to Semiconductor devices</b>	
4.1	Evolution of electronics – Vacuum tubes to nano electronics (In evolutionary perspective only)	1
4.2	Resistors, Capacitors and Inductors: types, specifications. Standard values, color coding (No constructional features)	2
4.3	<b>PN Junction diode:</b> Principle of operation, V-I characteristics, principle of avalanche breakdown	2
4.4	<b>Bipolar Junction Transistors:</b> 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
<b>5</b>	<b>Basic electronic circuits and instrumentation</b>	
5.1	<b>Rectifiers and power supplies:</b> 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	<b>Amplifiers:</b> 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	<b>Electronic Instrumentation:</b> Block diagram of an electronic instrumentation system	2
<b>6</b>	<b>Introduction to Communication Systems</b>	
6.1	Evolution of communication systems – Telegraphy to 5G	1

6.2	<b>Radio communication:</b> 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	<b>Mobile communication:</b> 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.

<b>HUN 101</b>	<b>LIFE SKILLS</b>	<b>CATEGORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>CREDIT</b>	<b>YEAR OF INTRODUCTION</b>
		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

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

21<sup>st</sup> 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 Prakashan Publishers, 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

<b>CO 1</b>	Understand and practice different techniques of quantitative chemical analysis to generate experimental skills and apply these skills to various analyses
<b>CO 2</b>	Develop skills relevant to synthesize organic polymers and acquire the practical skill to use TLC for the identification of drugs
<b>CO 3</b>	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
<b>CO 4</b>	Acquire the ability to understand, explain and use instrumental techniques for chemical analysis
<b>CO 5</b>	Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments
<b>CO 6</b>	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
<b>CO 1</b>	3				2							3
<b>CO 2</b>	3				3							3
<b>CO 3</b>	3				3							3
<b>CO 4</b>	3				3							3
<b>CO 5</b>	3				1							3
<b>CO 6</b>	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  $\text{Fe}^{3+}$  in solution
8. Determination of molar absorptivity of a compound ( $\text{KMnO}_4$  or any water soluble food colorant)
9. Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
10. Estimation of iron in iron ore
11. Estimation of copper in brass
12. Estimation of dissolved oxygen by Winkler's method
13. (a) Analysis of IR spectra (minimum 3 spectra) (b) Analysis of  $^1\text{H}$  NMR spectra (minimum 3 spectra)
14. Flame photometric estimation of  $\text{Na}^+$  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.



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

Disassembling 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	<b>INTRODUCTION</b>	
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	<b>CARPENTRY</b>	
2.1	Understanding of carpentry tools and making minimum one model	2

3	<b>FOUNDRY</b>	
3.1	Understanding of foundry tools and making minimum one model	2
4	<b>SHEET METAL</b>	
4.1	Understanding of sheet metal working tools and making minimum one model	2
5	<b>FITTING</b>	
5.1	Understanding of fitting tools and making minimum one model	2
6	<b>PLUMBING</b>	
6.1	Understanding of pipe joints and plumbing tools and making minimum one model	2
7	<b>SMITHY</b>	
7.1	Understanding of smithy tools and making minimum one model	2
8	<b>WELDING</b>	
8.1	Understanding of welding equipments and making minimum one model	2
9	<b>ASSEMBLY</b>	
9.1	Demonstration of assembly and dissembling of multiple parts components	1
10	<b>MACHINES</b>	
10.1	Demonstration of various machines	1
11	<b>MODERN MANUFACTURING METHODS</b>	
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.