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

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

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

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

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

Mapping of course outcomes with program outcomes

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

Assessment Pattern

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

Mark distribution

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

Continuous Internal Evaluation Pattern:

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

Assignments: Assignment should include specific problems highlighting the applications of the methods introduced in this course in science and engineering.

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

Course Level Assessment Questions

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Model Question paper

QP CODE: PAGES:3

Reg No:_____

Name :_____

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

Course Code: **MAT 101**

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

LINEAR ALGEBRA AND CALCULUs

(2019-Scheme)

(Common to all branches)

PART A

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

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

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

PART B

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

Module -I

11. (a) Solve the following system of equations

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

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

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

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

Module - II

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

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

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

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

Module - III

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

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

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

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

Module - IV

17. (a) Test the convergence of the series

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

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

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

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

Module - V

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

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

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

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

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

Syllabus

Module 1 (Linear algebra)

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

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

Module 2 (multivariable calculus-Differentiation)

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

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

Module 3(multivariable calculus-Integration)

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

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

Module 4 (sequences and series)

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

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

Module 5 (Series representation of functions)

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

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

Text Books

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

Reference Books

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

Course Contents and Lecture Schedule

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

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

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

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

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

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

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

Mapping of course outcomes with program outcomes

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

Assessment Pattern

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

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

Course Level Assessment Questions

Course Outcome 1 (CO 1):

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

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

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

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

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

Course Outcome 2 (CO 2)

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

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

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

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

Course Outcome 3 (CO 3):

1. Distinguish between TGA and DTA (3 Marks)

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

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

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

Course Outcome 4 (CO 4):

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

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

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

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

Course Outcome 5 (CO 5):

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

2. Define BOD and COD (3 Marks)

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

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

MODEL QUESTION PAPER

Total Pages:

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER B.TECH DEGREE EXAMINATION

Course Code: CYT100,

Course Name: ENGINEERING CHEMISTRY

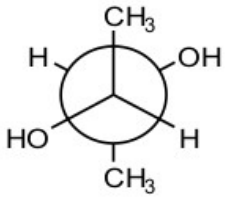
Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks Marks

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

5		What are the visualization techniques used in TLC?	(3)
6		Write the three important applications of nanomaterials.	(3)
7		Draw the Fischer projection formula and find R-S notation of	(3)



8		Write the structure of a) Polypyrroleb) Kevlar.	(3
9		What is break point chlorination?	(3)
10		What is reverse osmosis?	(3)

PART B

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

Module 1

11	a)	Give the construction of Li-ion cell. Give the reactions that take place at the electrodes during charging and discharging. What happens to anodic material when the cell is 100% charged.	(10)
	b)	Calculate the standard electrode potential of Cu, if its electrode potential at 25 °C is 0.296 V and the concentration of Cu^{2+} is 0.015 M.	(4)

OR

12	a)	Explain the mechanism of electrochemical corrosion of iron in oxygen rich and oxygen deficient acidic and basic environments.	(10)
	b)	Given below are reduction potentials of some species	(4)

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

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

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

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

Module 2

13	a)	What is spin-spin splitting? Draw the NMR spectrum of (i) CH_3 CH_2CH_2 Br (ii) $CH_3CH(Br)CH_3$ Explain how NMR spectrum can be used to identify the two isomers.	(10)
	b)	A dye solution of concentration 0.08M shows absorbance of 0.012 at 600 nm; while a test solution of same dye shows absorbance of 0.084 under same conditions. Find the concentration of the test solution.	(4)

OR

14	a)	Explain the basic principle of UV-Visible spectroscopy. What are the possible electronic transitions? Explain with examples.	(10)
	b)	Sketch the vibrational modes of CO_2 and H_2O. Which of them are IR active?	(4)

Module 3

15 a) Explain the principle, instrumentation and procedure involved in gas chromatography. (10)

b) Explain the DTA of $CaC_2O_4.H_2O$ with a neat sketch. (4)

OR

16 a) Explain the various chemical methods used for the synthesis of nanomaterial (10)

b) How TGA is used to analyse the thermal stability of polymers? (4)

Module 4

17 a) What are conformers? Draw the*cis* and *trans*isomers of 1, 3-dimethylcylohexane. Which conformer (chair form) is more stable in each case? (10)

b) What is ABS? Give properties and applications. (4)

OR

18 a) Explain the various structural isomers with suitable example. (10)

b) What is OLED? Draw a labelled diagram. (4)

Module 5

19 a) What are ion exchange resins? Explain ion exchange process for removal of hardness of water? How exhausted resins are regenerated? (10)

b) 50 mL sewage water is diluted to 2000 mL with dilution water; the initial dissolved oxygen was 7.7 ppm. The dissolved oxygen level after 5 days of incubation was 2.4 ppm. Find the BOD of the sewage. (4)

OR

20 a) What are the different steps in sewage treatment? Give the flow diagram. Explain the working of trickling filter. (10)

b) Calculate the temporary and permanent hardness of a water sample which contains $[Ca^{2+}]$ = 160 mg/L, $[Mg^{2+}]$ = 192 mg/L and $[HCO_3^-]$ = 122 mg/L. (4)

Syllabus

Module 1

Electrochemistry and Corrosion

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

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

Module 2

Spectroscopic Techniques and Applications

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

Module 3

Instrumental Methods and Nanomaterials

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

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

Module 4

Stereochemistry and Polymer Chemistry

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

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

Module 5

Water Chemistry and Sewage Water Treatment

Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of

hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. Municipal water treatment (brief) - Disinfection methods - chlorination, ozone andUV irradiation.

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

Text Books

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

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

Reference Books

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

Course Contents and Lecture Schedule

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

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

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

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

Prerequisite: Nil

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

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

Mapping of course outcomes with program outcomes (Minimum requirement)

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

Assessment Pattern

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

Mark distribution

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

Continuous Internal Evaluation Pattern:

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

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

Course Level Assessment Questions:

Part A

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

1. Explain D'Alembert's principle

2. Distinguish static and dynamic friction

3. State and explain perpendicular axis theorem

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

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

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

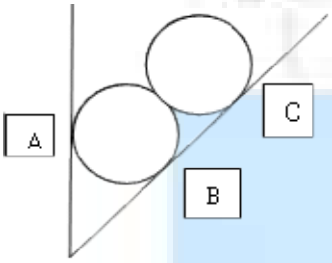
3. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

Part B

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

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

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

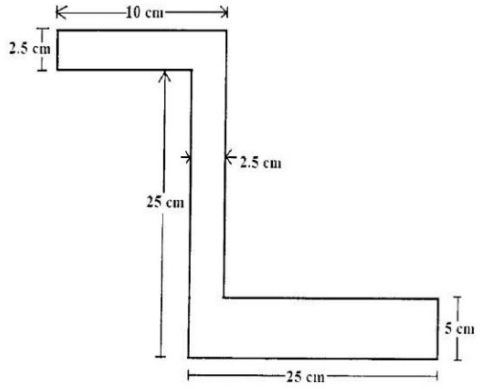


Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent equilibrium state of the body)	4
CO 4	To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

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

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

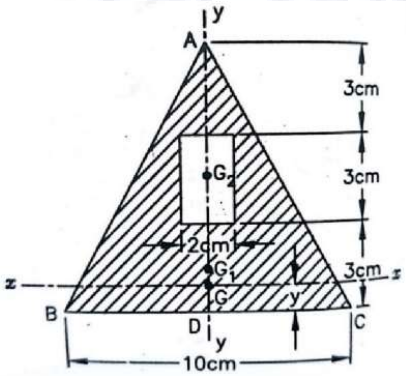
3. Determine the centroid of the given section



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

	areas and masses	given in CO3 and CO4)	
Total			14

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



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

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____ ___

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

Course Code: EST 100

ENGINEERING MECHANICS

Max. Marks: 100 Duration: 3 hours

Part A

(Answer all questions; each question carries 3 marks)

1. Explain D'Alembert's principle

2. Distinguish static and dynamic frictioni.

3. State and explain perpendicular axis theorem.

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

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

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

7. Compare damped and undamped free vibrations.

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

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

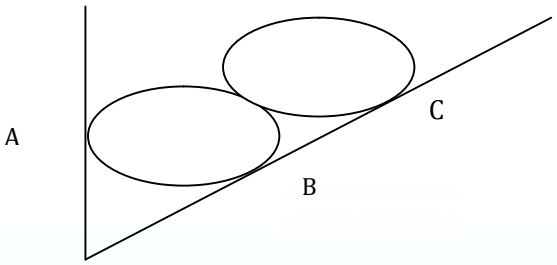
10. Highlight the principles of mechanics applied in the evaluation of elastic collusion of rigid bodies.

PART B

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

Module -I

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

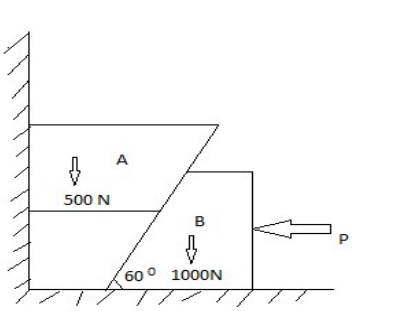


12. A string tied to a wall is made to pass over a pulley placed 2m away from it. A weight P is attached to the string such that the string stretches by 2m from the support on the wall to the location of attachment of weight. Determine the force P required to maintain 200 kg body in position for $\theta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

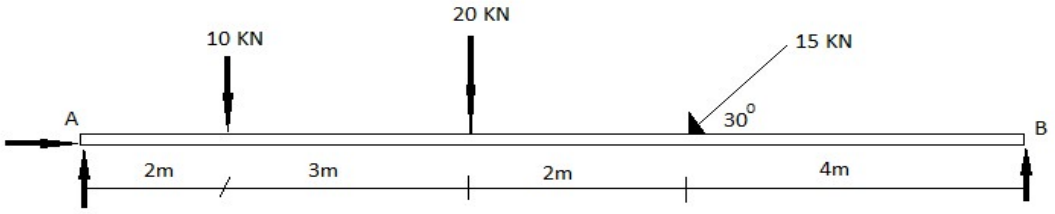
Module – 2

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

(14 marks)

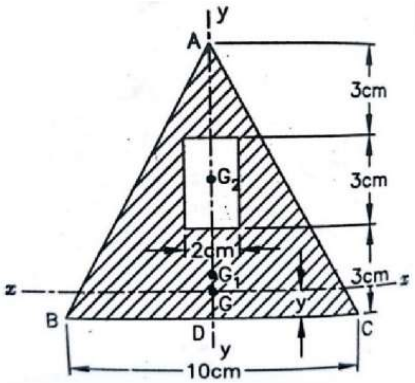


14. A beam is hinged at A and roller supported at B. It is acted upon by loads as shown below. Find the reactions at A & B. (14 marks)

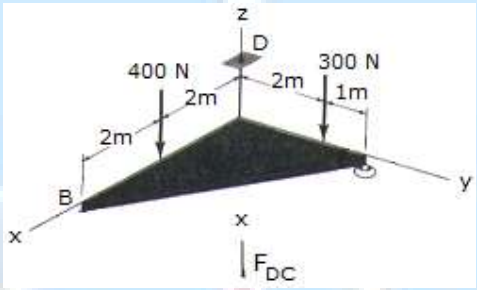


Module – 3

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



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



Module - 4

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

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

Module – 5

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

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

SYLLABUS

Module 1

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

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

Module 2

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

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

Module 3

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

Theorem of Pappus Guldinus(demonstration only)

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

Module 4

Dynamics – rectilinear translation - equations of kinematics(review)

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

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

Module 5

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

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

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

Text Books

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

References

1. Merriam J. L and Kraige L. G., Engineering Mechanics - Vols. 1 and 2, John Wiley.

2. Tayal A K, Engineering Mechanics – Statics and Dynamics, Umesh Publications

3. Bhavikkatti, S.S., Engineering Mechanics, New Age International Publishers

4. F.P.Beer abd E.R.Johnston (2011), Vector Mechanics for Engineers, Vol.I-Statics, Vol.II-Dynamics, 9th Ed, Tata McGraw Hill

5. Rajasekaran S and Sankarasubramanian G, Engineering Mechanics - Statics and Dynamics, Vikas Publishing House Pvt Ltd.

Course Contents and Lecture Schedule:

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

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

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

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

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

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

Course Outcome 7 (CO7)

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

Course Outcome 8(CO8):

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

Course Outcome 9 (CO9):

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

Course Outcome 10 (CO10):

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

Course Outcome 11 (CO11):

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

Model Question Paper

QP CODE: **EST120** page:3

Reg No:_____

Name:_____

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

Course Code: EST 120

Course Name: BASICS OF CIVIL AND MECHANICAL ENGINEERING

Max. Marks: 100 Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

PART I: BASIC CIVIL ENGINEERING

PART A

(Answer all questions. Each question carries 4 marks)

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

(5 x 4 = 20)

Part B

Answer one full question from each module.

MODULE I

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

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

OR

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

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

MODULE II

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

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

OR

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

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

MODULE III

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

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

OR

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

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

[10 x 3 = 30]

PART II: BASIC MECHANICAL ENGINEERING

PART A

Answer all questions. Each question carries 4 marks

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

4 x 5 = 20 marks

Part B

Answer one full question from each module.

MODULE I

6. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35^{o}C, 0.1MPa. The maximum temperature of the cycle is 1100^{o}C. Find
   i) Heat supplied per kg of air,
   ii) Work done per kg of air,
   iii)Cycle efficiency

   Take C_p = 1.005 kJ/kgK and C_v=0.718 kJ/kgK — 10 marks

OR

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

MODULE II

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

OR

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

MODULE III

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

OR

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

SYLLABUS

Module 1

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

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

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

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

Module 2

Surveying: Importance, objectives and principles.

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

Cement concrete: Constituent materials, properties and types.

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

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

Module 3

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

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

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

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

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

Module 4

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

Module 5

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

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

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

Module 6

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

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

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

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

Text Books:

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

References Books:

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

Course Contents and Lecture Schedule:

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

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

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

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

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

Prerequisite: None

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

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

Mapping of course outcomes with program outcomes

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

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation
Total Marks: 50

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

Regular assessment

- Group Discussion (Marks: 9)

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

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

- Presentation Skills (Marks: 6)

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

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

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

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

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

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

Course Level Assessment Questions

Course Outcome 1 (CO1):

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

Course Outcome 2 (CO2)

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

Course Outcome 3(CO3):

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

   (a) A group discussion on development.

   (b) An address from the Principal regarding punctuality.

   (c) A reporter interviewing a movie star.

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

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

Course Outcome 4 (CO4):

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

Course Outcome 5 (CO5):

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

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

Course Outcome 6 (CO6):

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

    a) A Police Inspector with subordinates reporting to him

    b) An enquiry committee constituted to investigate a specific incident

    c) The Accounts Department of a company

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

Syllabus

Module 1

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

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

Module 2

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

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

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

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

Module 3

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

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

Module 4

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

Module 5

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

Lab Activities

Verbal

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

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

Reference Books

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

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

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

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

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

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

Mapping of course outcomes with program outcomes

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

Mark distribution

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

Continuous Internal Evaluation Pattern:

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

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

LIST OF EXPERIMENTS (MINIMUM 8 MANDATORY)

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

Reference Books

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

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

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

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

Prerequisite: None

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

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

Mapping of course outcomes with program outcomes:

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

CO 7	2											
CO 8	2											

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	70	30	1 hour

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

Continuous Internal Evaluation Pattern:

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

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

PART 1

CIVIL WORKSHOP

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

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

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

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

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

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

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

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

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

Reference Books:

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

PART II

MECHANICAL WORKSHOP

LIST OF EXERCISES

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

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

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

UNIT 2:- Carpentry : Understanding of carpentry tools

Minimum any one model

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

UNIT 3:- Foundry : Understanding of foundry tools

Minimum any one model

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

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

Minimum any one model

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

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

Minimum any one model

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

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

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

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

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

Observing the qualitative difference in the hardness of these materials

Minimum any one exercise on smithy

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

UNIT 8: -Welding: Understanding of welding equipments

Minimum any one welding practice

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

UNIT 9: - Assembly: Demonstration only

Dissembling and assembling of

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

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

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

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

Course Contents and Lecture Schedule:

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

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