SEMESTER 1

PERIOD: DECEMBER 2020 – APRIL 2021

RAJAGIRI SCHOOL OF ENGINEERING & TECHNOLOGY

Department of Information Technology

Programme: Artificial Intelligence and Data Science

- Vision

To evolve into a centre of excellence in information technology by creation and exchange of knowledge through leading edge research, innovation and services, which will in turn contribute towards solving complex societal problems and thus building a peaceful and prosperous mankind.

- Mission

To impart high quality technical education, research training, professionalism and strong ethical values in the young minds for ensuring their productive careers in industry and academia so as to work with a commitment to the betterment of mankind.

- Programme Educational Objectives (PEO)

Graduates of Artificial Intelligence and Data Science program shall

PEO 1: Have strong technical foundation for successful professional careers and to evolve as key-players/ entrepreneurs in the field of information technology.

PEO 2: Excel in analyzing, formulating and solving engineering problems to promote life-long learning, to develop applications, resulting in the betterment of the society.

PEO 3: Have leadership skills and awareness on professional ethics and codes.

- Programme Outcomes (PO)

Artificial Intelligence and Data Science Program Students will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6.The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7.Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9.Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11.Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

Artificial Intelligence and Data Science *Program Students will be able to:*

PSO1: Apply the fundamentals of science, engineering and mathematics to understand, analyze and develop solutions in the areas related to artificial intelligence and data science for optimal design of intelligent systems.

PSO2: Design and Implement appropriate techniques and analytic tools for the integration of intelligent systems, with a view to engaging in lifelong learning for the betterment of society.

PSO3: Practice professional ethics in applying scientific method to model and support multi-disciplinary facets of engineering and its societal implications.

INDEX

Sl. No	Content	Page No
1	**Assignment Schedule for S1 IT**	**7**
2	**LINEAR ALGEBRA & CALCULUS**	**8**
2.1	Course Information Sheet	9
2.2	Course Plan	17
2.2	Assignment	20
2.3	Tutorial	21
3	**ENGINEERING CHEMISTRY**	**36**
3.1	Course Information Sheet	37
3.2	Course Plan	46
3.3	Assignment	49
3.4	Tutorial	50
4	**ENGINEERING GRAPHICS**	**57**
4.1	Course Information Sheet	58
4.2	Course Plan	62
4.3	Assignment	64
4.4	Tutorial	
5	**BASICS OF CIVIL & MECHANICAL ENGINEERING**	**76**
5.1	Course Information Sheet	77
5.2	Course Plan	81
5.3	Assignment	83

5.4	Tutorial	84
6	**LIFE SKILLS**	**97**
6.1	Course Information Sheet	98
6.2	Course Plan	105
6.3	Assignment	109
7	**ENGINEERING CHEMISTRY LAB**	**110**
7.1	Course Information Sheet	111
7.2	Course Plan	119
7.3	Lab Cycle	119
7.4	Open Questions	
8	**CIVIL /MECHANICAL WORKSHOP**	**120**
8.1	Course Information Sheet	121
8.2	Course Plan	123
8.3	Lab Cycle	
8.4	Open Questions	123
8.5	Advanced Questions	124

Assignment Schedule

SI No	Subject Code & Name	Faculty in-charge	Week
1	ENGINEERING MATHS (LINEAR ALGEBRA & CALCULUS)	Ms. Maria Poulose/Ms. Reya Kuruvilla	WEEK 1
2	ENGINEERING CHEMISTRY	Ms. Anju C	WEEK 2
3	ENGINEERING GRAPHICS	Mr. James Mathew	WEEK 3
4	BASICS OF CIVIL & MECHANICAL ENGINEERING	Dr.Rajeev Kumar P/Dr.Mathew Joseph	WEEK 4
5	LIFE SKILLS	Ms. Josiya P Shaju	WEEK 5
6	ENGINEERING MATHS (LINEAR ALGEBRA & CALCULUS)	Ms. Maria Poulose/Ms. Reya Kuruvilla	WEEK 6
7	ENGINEERING CHEMISTRY	Ms. Anju C	WEEK 7
8	ENGINEERING GRAPHICS	Mr. James Mathew	WEEK 8
9	BASICS OF CIVIL & MECHANICAL ENGINEERING	Dr.Rajeev Kumar P/Dr.Mathew Joseph	WEEK 9
10	LIFE SKILLS	Ms.Josiya P Shaju	WEEK 10

ENGINEERING MATHS (LINEAR ALGEBRA & CALCULUS)

COURSE INFORMATION SHEET

LINEAR ALGEBRA AND CALCULUS

DEGREE: BTECH	**COURSE**: **LINEAR ALGEBRA ANDCALCULUS**
PROGRAMME: AEI, CE, CSE, EEE, ECE, IT, ME, AI&DS	**COURSE CODE**:
COLLEGE: RAJAGIRI SCHOOL OF ENGINEERING& TECHNOLOGY	**CONTACT HOURS**: 3+1 (Tutorial) hours/Week.
SEMESTER: 1	**CREDITS**: 4

SYLLABUS

UNIT	DETAILS	HOURS
I	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.	10
II	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.	8
III	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 topolar), finding areas and volume using double integrals, mass and centre of gravity ofinhomogeneous laminas using double integral. Triple integrals, volume calculated as triple integral,triple integral in cylindrical andspherical coordinates (computations involving spheres, cylinders).	10

IV	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.	**8**
V	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).	**9**
TOTAL HOURS		**45**

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 PRE-REQUISITES

COURSE NAME	DESCRIPTION
A basic course in one-variable calculus and matrix theory.	To develop basic ideas on calculus matrix theory.

COURSE OBJECTIVES

1	To enable the students to acquire knowledge onsome basic mathematical ideas and tools which are at the core of any engineering course.

2	To familiarize students with some basic techniques in matrix theory which are essential for analysing linear systems.
3	To familiarize the students with topicslike 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.

COURSE OUTCOMES: After the completion of the course the student will be able to

SL.NO	DESCRIPTION
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	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	3	2	1			1	2		2	3		
CO 2	3	3	3	3	2	1			1	2		2		2	
CO 3	3	3	3	3	2	1			1	2		2			2
CO 4	3	2	3	2	1	1			1	2		2			3
CO 5	3	3	3	3	2	1			1	2		2	2		

JUSTIFICATIONS FOR CO-PO MAPPING

MAPPING	LOW/MEDIUM/ HIGH	JUSTIFICATION

CO1-PO1	3	Matrix theory will give a thorough knowledge in the application problems.
CO1-PO2	3	Matrix theory analyses various methods to solve linear equations.
CO1-PO3	3	Design solutions to engineering problems.
CO1-PO4	3	Analyses and interpret different data using matrix theory.
CO1-PO5	2	Apply appropriate techniques in modelling various complex engineering activates.
CO1-PO6	1	Fundamental knowledge in matrix theory help to assess various cultural issues relevant to the professional engineering practice.
CO1-PO9	1	Matrix theory helps an individual to function effectively in multidisciplinary settings.
CO1-PO10	2	Matrices are used in writing effective reports and design documentation.
CO1-PO12	2	Able to engage in independent and lifelong learning in the broadest context of technological change.
CO2-PO1	3	Basic knowledge in differential calculus of functions of several variables helps in solving engineering problems
CO2-PO2	3	Multivariable calculus can be applied to analyze deterministic systems that have multiple degrees of freedom.
CO2-PO3	3	Multivariable calculus is used in many fields of natural and social science and engineering to model and study high-dimensional systems.
CO2-PO4	3	Most of the natural phenomenon is non-linear and that can be best described by using multivariable calculus and differential equation.
CO2-PO5	2	Multivariable calculus can be used to optimise functions of two or more variables.
CO2-PO6	1	Helps to assess societal, health, safety legal and cultural issues.
CO2-PO9	1	Engineers directly use calculus in their daily practice and some use computer programs based on calculus that simplify engineering design.
CO2-PO10	2	Effective communication helps the engineering community to give and receive clear instructions.
CO2-PO12	2	Study, experience, and practice of multivariable calculus is applied with judgment to develop ways to utilize, economically.
CO3-PO1	3	Basic knowledge of multiple integrals is used to create mathematical models in order to arrive into

		an optimal solution.
CO3-PO2	3	Multiple integration helps to analyse complex engineering problems to reach substantiated conclusions.
CO3-PO3	3	Application of the double integrals helps in designing solutions for engineering problems.
CO3-PO4	3	The basic concepts of application integration develops and design a number of important issues in the research area.
CO3-PO5	2	Integration is used to create and apply appropriate techniques in solving engineering problems.
CO3-PO6	1	Integration helps us to find out the total cost function and total revenue function from the marginal cost.
CO3-PO9	1	Integration is used effectively in multi-disciplinary settings.
CO3-PO10	2	Effective presentations and clear instructions can be done using integration.
CO3-PO12	2	In the new era of technology, application of integration is used in independent and life-long learning.
CO4-PO1	3	Infinite series is applied in finding the solution of complex engineering problems.
CO4-PO2	2	Infinite series can be used as a tool in formulating various research related activities.
CO4-PO3	3	To meet the specified needs for the public health and safety, solutions of infinite series can be applied widely.
CO4-PO4	2	Various tests are used for interpreting and analysing the data in engineering field
CO4-PO5	1	Different tests of infinite series can be applied to select and create IT tools in modelling complex engineering activities.
CO4-PO6	1	Knowledge in various tests can be applied to assess societal, legal and cultural issues.
CO4-PO9	1	In multi-disciplinary settings, basic knowledge of infinite series and its related test helps to perform as a leader
CO4-PO10	2	To write effective reports and make effective presentations, the idea related to infinite series work as a tool.
CO4-PO12	2	Various tests in infinite series will enable to engage in life-long learning.
CO5-PO1	3	Knowledge in Taylor series provides different

		techniques in solving engineering problems.
CO5-PO2	3	Identify and analyse the signals in electronics and communication using Taylor series.
CO5-PO3	3	Fourier series can be used for designing system components.
CO5-PO4	3	Valid conclusions can be drawn from the synthesis of information.
CO5-PO5	2	Modern techniques are used in understanding the problems in the society.
CO5-PO6	1	Develop into a responsible engineer by assessing the knowledge in Taylor series
CO5-PO9	1	Mould an engineer with leadership quality in functioning effectively.
CO5-PO10	2	Knowledge acquired in Fourier series is an important tool in digital communication
CO5-PO12	2	Expansion of the series helps in enabling an individual to cop-up with the technological change.

JUSTIFICATIONS FOR CO-PSO MAPPING

MAPPING	***LOW/MEDIUM/ HIGH***	***JUSTIFICATION***
CO1-PSO1	3	Solving systems of linear equations, diagonalize matrices and characterise quadratic forms students are able to identify, analyze and design solutions for complex engineering problems in multidisciplinary areas by understanding the core principles and concepts of computer science and thereby engage in national grand challenges.
CO2-PSO2	2	Using computational techniques of partial and total derivatives and maxima and minima of multivariable functions,students getthe ability to acquire programming efficiency by designing algorithms and applying standard practices in software project development to deliver quality software products meeting the demands of the industry
CO3-PSO3	2	Computing multiple integrals and apply them to find areas and volumes of geometrical shapes, mass and centre of gravity of plane laminas,students are able to apply the fundamentals of computer science in competitive research and to develop innovative products to meet the societal needs thereby evolving as

		an eminent researcher and entrepreneur
CO4-PSO3	3	Performing various tests to determine whether a given series is convergent, absolutelyconvergent or conditionally convergent,students get theabilityto apply the fundamentals of computer science in competitive research
CO5-PSO1	2	Determination of the Taylor and Fourier series expansion of functions and learn their applications students are able to identify, analyze and design solutions for complex engineering problems in multidisciplinary areas by understanding the core principles and concepts of computer science .

GAPS IN THE SYLLABUS- TO MEET INDUSTRY / PROFESSION REQUIREMENTS

Sl no	Description	Proposed actions	Relevance
1	Basic concepts in limits and differential calculus	Reading	PO1 ,PSO1
2	Application of vector calculus	Reading	PO2, PSO2
3	Importance of double integrals and triple integrals	Reading	PO2, PSO3

TOPICS BEYOND SYLLABUS/ ADVANCED TOPICS/ DESIGN

Sl no	Description	Proposed actions	Relevance
1	Application of vector calculus in Engineering	Reading	PO2 ,PO3
2	Application of multiple integrals in Engineering	Reading	PO2, P03,PSO3

WEB SOURCES

The following open source software packages may be used as appropriate for practice and assignment problems

a)https://tutorial.math.lamar.edu/

b)https://www.geogebra.org/3d?lang=en

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☐ CHALK & TALK	☐ STUD. ASSIGNMENT	☐ WEB RESOURCES	☐LCD/SMART BOARDS
☐ STUD. SEMINARS	☐ ADD-ON COURSES		

ASSESSMENT METHODOLOGIES-DIRECT

☐ ASSIGNMENTS	☐ STUD. SEMINARS	☐ TESTS/MODEL EXAMS	☐ UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☐ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☐ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by

Approved by
HoD
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COURSE PLAN

Subject Name	**LINEAR ALGEBRA AND CALCULUS**
Subject Code	
Credits	**4**
Contact Hours	**3+1 (3- Theory + 1-Tutorial hour)**

MODULE - 1 LINEAR ALGEBRA

Sl No.	**TOPIC**
1	Systems of linear equations
2	Solution by Gauss elimination (row echelon form)
3	Problems
4	Rank of a matrix.
5	Fundamental theorem for linear systems (homogeneous and non-homogeneous, without proof)
6	Problems
7	Eigen values and eigen vectors
8	Diagonalization of matrices
9	Problems
10	Orthogonal transformation, quadratic form, and their canonical forms

MODULE – II MULTIVARIABLE CALCULUS (DIFFERENTIATION)

Sl No.	**TOPIC**
11	Concept of limit and continuity of functions of two variables.

12	partial derivatives
13	Problems
14	Differentials
15	Local Linear approximations
16	Problems
17	Chain rule, Total derivative
18	Relative maxima and minima
19	Absolute maxima and minima on closed and bounded set.

MODULE –III MULTIVARIABLE CALCULUS (INTEGRATION)

Sl No.	**TOPIC**
20	Double integrals (Cartesian Co-ordinates)
21	Reversing the order of integration
22	Problems
23	Change of coordinates (Cartesian to polar
24	Finding areas and volume using double integrals
25	Problems
26	Mass and centre of gravity of inhomogeneous laminas using double integral
27	Triple integrals
28	Volume calculated as triple integral
29	Triple integral in cylindrical and spherical coordinates (computations involving spheres, cylinders).
30	Problems.

MODULE –IV SEQUENCES AND SERIES

Sl No.	TOPIC
31	Convergence of sequences and series.
32	Convergence of geometric series and p-series(without proof)
33	Problems
34	Test of convergence (comparison, ratio, and root tests without proof)
35	Problems
36	Problems
37	Alternating series and Leibnitz test
38	Absolute and conditional convergence
39	Problems

MODULE –V SERIES REPRESENTATION OF FUNCTIONS

Sl No.	TOPIC
40	Taylor series (without proof, assuming the possibility of power series expansion in appropriate domains).
41	Binomial series and series representation of exponential, trigonometric, logarithmic functions (without proofs ofconvergence)
42	Fourier series
43	Euler formulas
44	Convergence of Fourier series (without proof),
45	Half range sine and cosine series,
46	Parseval's theorem (without proof).
47	Convergence of geometric series and p-series(without proof)
48	Problems.

MODULE 1

Tutorial Questions

1. Solve the following linear system given explicitly or by its augmented matrix by Gauss elimination method:

   a) $4x - 6y = -11$

   $-3x + 8y = 10$ Ans: $x = -2. y = \frac{1}{2}$

   b) $\begin{bmatrix} 13 & 12 & -6 \\ -4 & 7 & -73 \\ 11 & -13 & 157 \end{bmatrix}$ Ans: $x = 6, y = -7$

2. Find the rank of the matrix

   a) $\begin{bmatrix} 0 & 3 & 5 \\ 3 & 5 & 0 \\ 5 & 0 & 10 \end{bmatrix}$ b) $\begin{bmatrix} 2 & 4 & 8 & 16 \\ 16 & 8 & 4 & 2 \\ 4 & 8 & 16 & 2 \\ 2 & 16 & 8 & 4 \end{bmatrix}$ c) $\begin{bmatrix} 5 & -2 & 1 & 0 \\ -2 & 0 & -4 & 1 \\ 1 & -4 & -11 & 2 \\ 0 & 1 & 2 & 0 \end{bmatrix}$

3 a) Find the condition on a,b,c so that the linear system $x + y + z = a, 3x + 4y + 5z = b, 2x + 3y + 4z = c$ is consistent.

Ans: have many solutions if $a = \frac{b}{2} = c = 1$

b) Find the row-reduced echelon form of the following matrices and hence find the rank.

i) $\boldsymbol{A} = \begin{bmatrix} \mathbf{2} & \mathbf{3} & \mathbf{-1} & \mathbf{1} \\ \mathbf{1} & \mathbf{-1} & \mathbf{-2} & \mathbf{-4} \\ \mathbf{3} & \mathbf{1} & \mathbf{3} & \mathbf{-2} \\ \mathbf{6} & \mathbf{3} & \mathbf{0} & \mathbf{-7} \end{bmatrix}$ **ii)** $\boldsymbol{A} = \begin{bmatrix} \mathbf{0} & \mathbf{1} & \mathbf{-3} & \mathbf{-1} \\ \mathbf{1} & \mathbf{0} & \mathbf{1} & \mathbf{1} \\ \mathbf{3} & \mathbf{1} & \mathbf{0} & \mathbf{2} \\ \mathbf{1} & \mathbf{1} & \mathbf{-2} & \mathbf{0} \end{bmatrix}$ **Ans: i) Rank = 3 ii) Rank =2**

c) Show that if $\lambda \neq -5$the system of equations$x + 2y - 3z = -2, 6x + 5y + \lambda z = -3, 3x - y + 4z = 3$have a unique solution. If $\lambda = -5$show that the equations are consistent.

d) Test for consistency and solve$x + y - z = 0, 2x - y + z = 3, 4x + 2y - 2z = 2$Ans: $x = 1, y = t - 1, z = t$

4 a) Find the sum and product of Eigen values of the matrix $\begin{bmatrix} -2 & 2 & 3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$.Ans: $\lambda = -3, -3, 5$

b) Find the Characteristic roots and characteristic vectors of the matrices $\begin{bmatrix} -3 & -7 & -5 \\ 2 & 4 & 3 \\ 1 & 2 & 2 \end{bmatrix}$ Ans: $\lambda = 1,1,1, X_1 = \begin{bmatrix} -3 \\ 1 \\ 1 \end{bmatrix}$

c) Find the Eigen values and Eigen vectors of the matrix $A = \begin{bmatrix} 2 & 1 & -1 \\ 1 & 1 & -2 \\ -1 & -2 & 1 \end{bmatrix}$.

Ans: $\lambda = -1,1,4 X_1 = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$,$X_2 = \begin{bmatrix} 2 \\ -1 \\ 1 \end{bmatrix}$,$X_3 = \begin{bmatrix} 1 \\ 1 \\ -1 \end{bmatrix}$

d) Diagonalize the matrix $A = \begin{bmatrix} 2 & 1 & -1 \\ 1 & 2 & -2 \\ -1 & -2 & 1 \end{bmatrix}$.

Ans: $D = \begin{bmatrix} -4 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 3 \end{bmatrix}$

5 a) Find the Canonical form of the Quadratic form $3x^2 + 2xy + 3y^2$.Hence show that the equation $3x^2 + 2xy + 3y^2 - 8 = 0$ represents an ellipse in R^2.Ans: Canonical form is ${2y_1}^2 + 4{y_2}.^2$ Ellipse: $\frac{{y^2}_1}{4} + \frac{{y_2}^2}{2}$=1

b) Find the orthogonal transformation which will transform the quadratic form $6x^2 + 3y^2 + 3z^2 - 4xy - 2yz + 4xz$into Canonical form Ans: $\lambda = 2,2,8,$

$P = \begin{bmatrix} \frac{2}{\sqrt{6}} & 0 & \frac{1}{\sqrt{3}} \\ -\frac{1}{\sqrt{6}} & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{3}} \\ \frac{1}{\sqrt{6}} & \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{3}} \end{bmatrix}$

ASSIGNMENT QUESTIONS

1. Solve the following linear system given explicitly or by its augmented matrix by Gauss elimination method:

$x + 3y = 12x + y = -3, 3x + 3y = 0.$ Ans: $No\ solution$

2. Find the rank of the matrix

$\begin{bmatrix} 1 & 0 & 2 & 1 \\ 0 & 1 & -2 & 1 \\ 1 & -1 & 4 & 0 \\ -2 & 2 & 8 & 0 \end{bmatrix}$ Ans: Rank =3

3. Find the rank of the matrix

$\begin{bmatrix} 1 & -1 & 0 & 2 & 1 \\ 3 & 1 & 1 & -1 & 2 \\ 4 & 0 & 1 & 0 & 3 \\ 9 & -1 & 2 & 3 & 7 \end{bmatrix}$ Rank =3

4. Determine the values of a and b for which the system$x + 2y + 3z = 6,$

$x + 3y + 5z = 9,\ 2x + 5y + az = b$is consistent.

Ans: have many solutions if $a = 8, b = 15$

5. Find the row-reduced echelon form of the following matrices and hence find the rank.

i) $\boldsymbol{A = \begin{bmatrix} 1 & 2 & 1 & 3 \\ 2 & 3 & 2 & 5 \\ 3 & -5 & 5 & 2 \\ 3 & 9 & -1 & 4 \end{bmatrix}}$ **ii)** $\boldsymbol{A = \begin{bmatrix} -1 & 2 & 3 & -2 \\ 2 & -5 & 1 & 2 \\ 3 & -8 & 5 & 2 \\ 5 & -12 & -1 & 6 \end{bmatrix}}$ **Ans: i) Rank = 3 ii) Rank =2**

6. Show that if $\lambda \neq 1,3$ the system of equations $x + y - z = 1, x + 2y + 3z = \lambda, x + 5y + 9z = \lambda^2$have no solution.

7. Test for consistency and solve $2x + 3y + 4z = 11, x + 5y + 7z = 15, 3x + 11y + 13z = 25, 2x + y + z = 5$ Ans: $x = 2, y = -3, z = 4$

8. Find the eigen values of the matrix$\begin{bmatrix} 2 & 1 & 0 \\ 0 & 1 & -1 \\ 0 & 2 & 4 \end{bmatrix}$. Ans: $\lambda = 2,2,3$

9. Diagonalize the matrix $A = \begin{bmatrix} 2 & -2 \\ -2 & 5 \end{bmatrix}$.Ans: $D = \begin{bmatrix} 1 & 0 \\ 0 & 6 \end{bmatrix}$

10. Find the Canonical form of the Quadratic form $x^2 - 12xy + y^2 = 70$ by finding the modal matrix. . Ans: Canonical form is $-5{y_1}^2 + 7{y_2}^2$.

QUESTION BANK

1. Solve the following linear system given explicitly or by its augmented matrix by Gauss elimination method: $\begin{bmatrix} 1 & 2 & -1 & 3 \\ 3 & -1 & 2 & 1 \\ 2 & -2 & 3 & 2 \\ 1 & -1 & 1 & -1 \end{bmatrix}$ Ans: $x = -1, y = 4, z = 4$

2. Find the rank of the matrix $A = \begin{bmatrix} 1 & 2 & -1 \\ 3 & 1 & -1 \\ 2 & -1 & 0 \end{bmatrix}$ Ans: Rank= 2

3.Find the Eigen values of the matrix $A = \begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$. Ans: $\lambda = 2,3,6$

4. Find the Characteristic roots and characteristic vectors of the matrices $\begin{bmatrix} 1 & -3 & 3 \\ 0 & -5 & 6 \\ 0 & -3 & 4 \end{bmatrix}$ Ans: $\lambda = -2,1,1, X_1 = \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}, X_2 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, X_3 = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$

5. Find the orthogonal transformation which will transform the quadratic form $6x^2 + 3y^2 + 3z^2 - 4xy - 2yz + 4xz$ into Canonical form Ans: $\lambda = 2,2,8$,

$$P = \begin{bmatrix} \frac{2}{\sqrt{6}} & 0 & \frac{1}{\sqrt{3}} \\ -\frac{1}{\sqrt{6}} & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{3}} \\ \frac{1}{\sqrt{6}} & \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{3}} \end{bmatrix}$$

6. For what values of λ and μ do the system of equations$x + y + z = 6, x + 2y + 3z = 10, x + 2y + \lambda z = \mu$ has i) no solution ii) unique solution iii) more than one solution.

Ans: When $\lambda = 3, \mu \neq 10$, the system has no solution. When $\lambda \neq 3, \mu$ any value , the system has unique solution. When $\lambda = 3, \mu = 10$, the system has infinite number of solutions.

7. Solve the system of homogeneous equations

$$4x + 2y + z + 3w = 0, 6x + 3y + 4z + 7w = 0, 2x + y + w = 0$$

Ans: $w = t, x = s, z = -t, y = -s - t$

8. Investigate for the consistency of the following equations and if possible find the solutions: $4x - 2y + 6z = 8, x + y - 3z = -1, 15x - 3y + 9z = 21$

Ans: Consistent:,$x = 1, y = 3k - 2, z = k \; where \; k \; is \; arbitrary$

9. Show that the equations $x + 2y - z = 3, 3x - y + 2z = 1, 2x - 2y + 3z = 2, x - y + z = -1$ are consistent and solve them.

10. Diagonalize$A = \begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$ Ans: $\begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 6 \end{bmatrix}$

11. Find the Eigen values and Eigen vectors of the matrix A=$\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$

Ans: 2,2,8, $X_1 = a\begin{bmatrix} 1 \\ 0 \\ -2 \end{bmatrix}$, $X_2 = b\begin{bmatrix} 1 \\ 2 \\ 0 \end{bmatrix}, X_3 = c\begin{bmatrix} 2 \\ -1 \\ 1 \end{bmatrix}$, where a,b,c are arbitrary

12. Find the Eigen values of $A = \begin{bmatrix} 8 & 6 & 2 \\ -6 & 7 & -4 \\ 2 & -1 & 3 \end{bmatrix}$ Ans: 0,3,15

13. Reduce the Quadratic form to canonical form :$2x^2 + 2y^2 + 3z^2 + 2xy - 4yz - 4xz$

Ans: ${2y_1}^2 + \frac{3}{2}{y_2}^2 \frac{1}{3}{y_3}^2$

14. Reduce the Quadratic form to canonical form by applying orthogonal transformation

: $3x^2 + 5y^2 + 3z^2 - 2xy - 2yz + 2xz$

Ans: ${2y_1}^2 + 3{y_2}^2 + 6{y_3}^2$

15. Write down the Quadratic form corresponding to the matrix $A = \begin{bmatrix} 2 & 4 & 5 \\ 4 & 3 & 1 \\ 5 & 1 & 1 \end{bmatrix}$

Ans: $2x^2 + 3y^2 + z^2 + 8xy + 2yz + 10xz$

Module 2-Multi variable Calculus –Differentiation

Tutorial Questions

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

2.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$\theta = \frac{\pi}{4}$.

3.Let $z = f(x, y)$where $x = r\cos\theta\,, y = r\sin\theta\,.$

Prove that$\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial r}\right)^2 + \frac{1}{r^2}(\frac{\partial z}{\partial \theta})^2$.

4.Locate all absolute maxima and minima, if any of $f(x, y) = 13 - 6x + x^2 + 2y + y^2$.

5.Find the point on the line$2x - 4y = 4$ that is closest to the origin.

Assignment Questions

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

2.Find the points on the sphere$x^2 + y^2 + z^2 = 4$ that are closest to and farthest from the point$(3, 1, -1)$.

3.Locate all relative maxima, relative minima and saddle points of

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

4.Find the points on the circle$x^2 + y^2 = 45$ that are closest to and farthest from$(1,2)$.

5.Use a chain rule to find the value of$\frac{dw}{ds}$ at $s = 4$ if$w = r^2 - r\tan\theta\,, r = \sqrt{s},\ \theta = \pi s$.

6.Use appropriate forms of the chain rule to find $\frac{\partial z}{\partial u}$and $\frac{\partial z}{\partial v}ofz = \frac{x}{y}\ ; x = 2\cos u,$

$$y = 5\sin v.$$

7.Find three positive numbers whose sum is 36 and such that their product is as large as possible.

8.Find the absolute extrema of the function$f(x,y) = x^2 - 3y^2 - 2x + 6y; R$ is the region bounded by the square with vertices (0,0), (0,2), (2,2)and(2,0).

9.Find the local linear approximation L to the specified function $f(x,y) = xsiny$ at the point $P(0,0)$.

Compare the error in approximating f by L at the specified point$Q(0.003,0.004)$ with the distance between P and Q.

10.Find a vector in 3-space whose length is 5 and whose components have the largest possiblesum.

Unit wise Question Bank

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

2.Let$L(x,y)$ denote the local linear approximation to$f(x,y) = \sqrt{x^2 + y^2}$ at the point(3,4).

Compare the error in approximating$f(3.04,3.98) = \sqrt{(3.04)^2 + (3.98)^2}byL(3.04,3.98)$with the distance between the points(3,4) and(3.04,3.98).

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$u(x,t) = \sin(x - ct)$ is a solution of the equation$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$

5.Find the point on the plane$x + 2y + z = 2$ that is closest to the origin.

6.Use an appropriate form of the chain rule to find$\frac{dw}{dt}$ of $w = 5x^2y^3z^4, x = t^2, y = t^3,$

$$z = t^4.$$

7.Use appropriate forms of the chain rule to find$\frac{\partial z}{\partial u}$and $\frac{\partial z}{\partial v}ofz = 8x^2y - 2x + 3y; x = uv,$

$$y = u + v.$$

8.Locate all relative maxima, relative minima and saddle points, if any of

$$f(x,y) = e^{-(x^2+y^2+4x)}$$

9. Locate all relative maxima, relative minima and saddle points, if any of

$$f(x,y) = x^2 + xy + y^2 - 6x.$$

10.Find the dimensions of the rectangular box of maximum volume that can be inscribed in a sphere of radius a.

11.Find all points on the portion of the plane$x + y + z = 5$ in the first octant at which$f(x,y,z) = xy^2z^2$ has a maximum value.

12.Find the absolute extrema of the function$f(x,y) = x^2 + 2y^2 - x$on the indicated closed and bounded set$x^2 + y^2 \leq 4$.

13.a)Find the local linear approximation$L$ to the specified function$f(x,y,z) = xyz$ at the designated point$P(1,2,3)$.

b)Compare the error in approximating f by L at the specified point

$Q(1.001,2.002,3.003)$ withthe distance between the P and Q.

14.Determine the dimensions of a rectangular box, open at the top, having volume V, and requiring the least amount of material for its construction.

15.Find the absolute extrema of the function$f(x,y) = xy - x - 3y$ on the triangular region R with vertices (0,0),(0,4) and (5,0).

Answers

Tutorial Questions

1.$f_x(1,-2) = -4$.

2.$\sqrt{2}$.

4.Minimum at$(3,-1)$,no maxima.

5.$\left(\frac{2}{5}, \frac{-4}{5}\right)$.

Assignment Questions

1.$\frac{dw}{dt} = -y\sin t + x\cos t + 1$.

2. $\left(\frac{6}{\sqrt{11}},\frac{2}{\sqrt{11}},\frac{-2}{\sqrt{11}}\right),\left(\frac{-6}{\sqrt{11}},\frac{-2}{\sqrt{11}},\frac{2}{\sqrt{11}}\right)$.

3.$\left(\frac{a^2}{b},\frac{b^2}{a}\right)$ −Saddle point

4.(3,6)is closest and$(-3,-6)$ is farthest

5.$-\pi$

6.$\frac{\partial z}{\partial u}=\frac{-2\sin}{5\sin v},\frac{\partial z}{\partial v}=\frac{-2\cos u\cos v}{5sin^2 v}$

7.12, 12, 12

8.absolute maximum-3 , absolute minimum-1

9. 0.0024

10.$\frac{5(i+j+k)}{\sqrt{3}}$

Unit wise Question Bank

1.$f_y(1,-2)=61$.

2.0.0042222222.

3.$f_x(1,3)=58, f_y(1,3)=14$.

5.$(\frac{1}{3},\frac{2}{3},\frac{1}{3})$

6.$\frac{dw}{dt}=145t^{28}$

7.$\frac{\partial z}{\partial u}=24u^2v^2+16uv^3-2v+3;\ \frac{\partial z}{\partial v}=16u^3v+24u^2v^2-2u+3$

8.relative maximum at$(-2,0)$.

9.relative minimum at $(4,-2)$.

10.$\frac{2a}{\sqrt{3}},\frac{2a}{\sqrt{3}},\frac{2a}{\sqrt{3}}$

11.maximum at (1,2,2)

12.absolute maximum$\frac{33}{4}$, absolute minimum$\frac{-1}{4}$

13.a)$L=6+6(x-1)+3(y-2)+2(z-3)$. b) 0.00481

14.length and width $\sqrt[3]{2v}$, height $\frac{\sqrt[3]{2v}}{2}$

15.Absolute maximum-0, Absolute minimum-12

Module III – Multivariable calculus - Integration

TUTORIAL QUESTIONS

1. Evaluate the integral $\iint_R x\sqrt{1-x^2}\ dA$ where $R = \{(x,y): 0 \le x \le 1,\ 2 \le y \le 3\}$.
2. Evaluate $\iint_R xy\ dA$; R is the region enclosed by $y = \sqrt{x}, y = 6 - x, and\ y = 0$.
3. Evaluate $\int_0^{\pi} \int_0^{asin\theta} r^2 dr d\theta$.
4. Evaluate $\int_1^4 \int_z^2 \int_0^{\sqrt{3}y} \frac{y}{x^2+y^2} dx dy dz$.
5. Use cylindrical coordinates to find the volume of the solid enclosed by the paraboloid $z = x^2 + y^2$ and the plane $z = 16$.
6. Find the mass and center of gravity of the lamina with density $f(x,y) = xy$ in the first quadrant and bounded by the circle $x^2 + y^2 = a^2$ and the coordinate axes.

ASSIGNMENT QUESTIONS

1. Evaluate $\int_0^{ln3} \int_0^{ln2} e^{x+2y} dy dx$.
2. Evaluate $\iint_R \frac{xy}{\sqrt{x^2+y^2+1}} dA$ where $R = \{(x,y): 0 \le x \le 1, 0 \le y \le 1\}$.
3. Evaluate $\iint_R x(1+y^2)^{-\frac{1}{2}} dA$, where R is the region in the first quadrant enclosed by $y = x^2$ and $x = 0$.
4. Use double integration to find the area of the plane region enclosed by the given curves $y^2 = 9 - x$ and $y^2 = 9 - 9x$.
5. Use double integration to find the volume of the solid enclosed by the cylinder $4x^2 + y^2 = 9$ by the planes $z = 0$ and $z = y + 4$.
6. Evaluate the integral by reversing the order of integration. $\int_0^4 \int_{\sqrt{y}}^2 e^{x^3}\ dx dy$.
7. Evaluate $\iint_R rsin\theta dr d\theta$ where R is the region in the first quadrant that is outside the circle $r = 2$ and inside the cardioid $r = 2(1 + cos\theta)$.
8. Evaluate $\int_2^3 \int_x^{x^2} \int_0^{logz} xe^y dy dz dx$.
9. Use triple integration in cylindrical coordinates to find the volume of the solid G that is bounded above by the hemisphere $z = \sqrt{25 - x^2 - y^2}$, below by the XY plane and laterally by the cylinder $x^2 + y^2 = 9$.

10. Use spherical coordinates to find the volume of the solid bounded above by the sphere $\rho = 4$ and below by the cone $\emptyset = \frac{\pi}{6}$.

Unit wise Question Bank

1. Evaluate $\int_{\pi/2}^{\pi}\int_{1}^{2} xsinxy\ dydx$.
2. Evaluate $\iint_R \sin y^3 dA$ where R is the region bounded by $y = \sqrt{x}, y = 2, x = 0$.
3. Evaluate $\iint_R xcosy\ dA$ where R is the triangular region bounded by $y = x, y = 0, x = \frac{\pi}{2}$.
4. Evaluate $\iint_R xy\ dA$ where R is the sector in the first quadrant bounded by
$$y = \sqrt{x}, \qquad y = 6 - x, y = 0.$$
5. Evaluate the integral by converting to polar co ordinates $\int_0^2 \int_0^{\sqrt{2x-x^2}} \sqrt{x^2+y^2}\, dydx$.
6. Using double integration find the area bounded by the curve $y^2 = 9 - x$ and$y^2 = 9 - 9x$.
7. Using double integral in polar coordinates to find the volume of a cylinder of radius 'a' and height 'h'.
8. Find the area of the region enclosed by the lemniscate$r^2 = 2a^2cos2\theta$.
9. Express the following integrals as an equivalent integral with the order of integration reversed.
   (i) $\int_0^2 \int_0^{\sqrt{x}} f(x,y)dy\ dx$
   (ii) $\int_0^1 \int_{y^2}^{\sqrt{y}} f(x,y)dx\ dy$
   (iii) $\int_0^3 \int_1^{e^y} f(x,y)dx\ dy$
10. Evaluate by reversing the order of integration $\int_0^{\frac{a}{\sqrt{2}}} \int_y^{\sqrt{a^2-y^2}} xdxdy$.
11. Evaluate $\int_0^1 \int_{y^2}^1 \int_0^{1-x} xdzdxdy$.
12. Evaluate $\int_0^{\frac{\pi}{2}} \int_0^{sin\theta} \int_0^{r^2} rsin\theta dzdrd\theta$.
13. Use triple integral to find the volume of the solid bounded by the surface $y = x^2$ and the planes $y + z = 4$ and $z = 0$.
14. Use spherical coordinates to find the volume of the solid enclosed by the sphere $x^2 + y^2 + z^2 = 4a^2$and the planes $z = 0, z = a$.
15. Use cylindrical coordinates to find the volume of the solid enclosed by the paraboloid $z = x^2 + y^2$and the plane $z = 16$.

Answers

TUTORIAL QUESTIONS

1. $\frac{1}{3}$ 2. $\frac{50}{3}$ 3. $\frac{4}{9}a^3$ 4. $\frac{-\pi}{2}$ 5. 128π 6. $M = \frac{a^4}{8}$, Center of gravity at $\left(\frac{8a}{15}, \frac{8a}{15}\right)$.

ASSIGNMENT QUESTIONS

1. 3 , 2. $\frac{1}{3}\left[3^{\frac{3}{2}}-2(2)^{\frac{3}{2}}+1\right]$, 3. $\frac{\sqrt{26}-1}{2}$, 4. 32 , 5. 18π , 6. $\frac{e^8-1}{3}$, 7. 8/3 , 8. 299/8
9. $\frac{122\pi}{3}$, 10. $\frac{64\pi}{3}(2-\sqrt{3})$.

Unit wise Question Bank

1. -1 2. $\frac{1-cos\,8}{3}$ 3. 1 4. $\frac{50}{3}$ 5. $\frac{16}{9}$ 6. 32 7. $\pi a^2 h$ 8. $2a^2$

9. (i) $0 \le y \le \sqrt{2}, y^2 \le x \le 2$. (ii) $0 \le x \le 1, x^2 \le y \le \sqrt{x}$. (iii) $1 \le y \le e^3, logx \le y \le 3$.

10. $\frac{a^3}{3\sqrt{2}}$ 11. $\frac{4}{35}$ 12. $\frac{5\pi}{320}$ 13. $\frac{256}{15}$ 14. $\frac{11\pi a^3}{3}$ 15. 128π .

MODULE 4 – SEQUENCES AND SERIES

TUTORIAL QUESTIONS

1. Find the general term of the sequence, starting with n = 1, determine whether the sequence converges, and if so find its limit
   (a) $\frac{1}{3}, \frac{-1}{9}, \frac{1}{27}, \frac{-1}{81}, \ldots$ (b) $\left(1-\frac{1}{2}\right), \left(\frac{1}{3}-\frac{1}{2}\right), \left(\frac{1}{3}-\frac{1}{4}\right), \left(\frac{1}{5}-\frac{1}{4}\right), \ldots$ (c) $\frac{1}{3^5}, \frac{-1}{3^6}, \frac{1}{3^7}, \frac{-1}{3^8}, \ldots$
2. Determine whether the series converges, and if so find its sum.
   (a) $\sum_{k=1}^{\infty}(-1)^{k-1}\frac{7}{6^{k-1}}$ (b)$\sum_{k=1}^{\infty}(\frac{1}{2^k}-\frac{1}{2^{k+1}})$(c) $\sum_{k=5}^{\infty}\left(\frac{e}{\pi}\right)^{k-1}$
3. Express the repeating decimal as a fraction.
   (a) 5.373737 ... (b) 0.451141414 ...
4. Use any method to determine whether the series converges.
   (a) $\sum_{k=1}^{\infty}\frac{k!10^k}{3^k}$ (b) $\sum_{k=1}^{\infty}\frac{2+\sqrt{k}}{(k+1)^3-1}$ (c) $\sum_{k=1}^{\infty}\left(\frac{k}{k+1}\right)^{k^2}$
5. Classify each series as absolutely convergent, conditionally convergent, or divergent.
   (a) $\sum_{k=1}^{\infty}(-1)^{k+1}\frac{1}{3k}$ (b) $\sum_{k=1}^{\infty}\frac{\sin k}{k^3}$ (c) $\sum_{k=2}^{\infty}\left(\frac{-1}{\ln k}\right)^k$

ASSIGNMENT QUESTIONS

1. Show that for all real values of x,
   $sinx-\frac{1}{2}sin^2x+\frac{1}{4}sin^3x-\frac{1}{8}sin^4x+\cdots=\frac{2\,sinx}{2+\sin x}$
2. Show that $\frac{1}{1\cdot3}+\frac{1}{2\cdot4}+\frac{1}{3\cdot5}+\cdots=\frac{3}{4}$

3. Determine whether the series converges.
   (a) $\sum_{k=1}^{\infty} \frac{1}{\sqrt[3]{2k-1}}$ (b) $\sum_{k=1}^{\infty} \frac{k}{\ln(k+1)}$ (c) $\sum_{k=1}^{\infty} \frac{tan^{-1}k}{1+k^2}$

4. Use limit comparison test to determine whether the following series converges:
   (a) $\sum_{k=1}^{\infty} \frac{4k^2-2k+6}{8k^7+k-8}$ (b) $\sum_{k=1}^{\infty} \frac{5}{3^k+1}$ (c) $\sum_{k=1}^{\infty} \frac{1}{\sqrt[3]{8k^2-3k}}$

5. Use ratio test to determine whether the following series converges:
   (a) $\sum_{k=1}^{\infty} \frac{4^k}{k^2}$ (b) $\sum_{k=1}^{\infty} k\left(\frac{1}{2}\right)^k$ (c) $\sum_{k=1}^{\infty} \frac{k!}{k^3}$

6. Use root test to determine whether the following series converges:
   (a) $\sum_{k=1}^{\infty} \left(\frac{3k+2}{2k-1}\right)^k$ (b) $\sum_{k=1}^{\infty} (1-e^{-k})^k$

7. Use comparison test to determine whether the following series converges:
   (a) $\sum_{k=1}^{\infty} \frac{5sin^2 k}{k!}$ (b) $\sum_{k=1}^{\infty} \frac{k}{k^{\frac{3}{2}-\frac{1}{2}}}$

8. Use ratio test for absolute convergence to determine whether the following series converges or diverges:
   (a) $\sum_{k=1}^{\infty} (-1)^{k+1} \frac{3^k}{k^2}$ (b) $\sum_{k=1}^{\infty} (-1)^k \frac{k^3}{e^k}$

9. Classify each series as absolutely convergent, conditionally convergent, or divergent:
   (a) $\sum_{k=1}^{\infty} \frac{cos\, k\pi}{k}$ (b) $\sum_{k=1}^{\infty} (-1)^k \frac{1}{\sqrt{k(k+1)}}$ (c) $\sum_{k=1}^{\infty} (-1)^{k+1} \frac{k!}{(2k-1)!}$

10. Use any method to determine whether the series converges :
    (a) $\sum_{k=1}^{\infty} \frac{4}{2+k3^k}$ (b) $\sum_{k=1}^{\infty} \frac{4+|cos\, x|}{k^3}$ (c) $\sum_{k=1}^{\infty} \frac{tan^{-1}k}{k^2}$

UNITWISE QUESTION BANK

1. A ball is dropped from a height of 10m. Each time it strikes the ground it bounces vertically to a height that is $3/4$ of the preceding height. Find the total distance that the ball will travel if it is assumed to bounce infinitely often.
2. Check the convergence of the series $\frac{3}{4} + \frac{3\cdot4}{4\cdot6} + \frac{3\cdot4\cdot5}{4\cdot6\cdot8} + \frac{3\cdot4\cdot5\cdot6}{4\cdot6\cdot8\cdot10} + \cdots$
3. Test the convergence of the series (a) $\sum_{k=1}^{\infty} \frac{1}{5k-1}$ (b) $\sum_{k=1}^{\infty} \frac{2^k}{k!}$

4. Use the alternating series test to show that the series converge
   (a) $\sum_{k=1}^{\infty}(-1)^{k+1}\frac{k+3}{k(k+1)}$ (b) $\sum_{k=1}^{\infty}(-1)^{k+1}\frac{\ln k}{k}$

5. Determine whether the alternating series $\sum_{k=1}^{\infty}(-1)^{k+1}\frac{k+7}{k(k+4)}$ is absolutely convergent.

6. Check whether the series converges or not:
   (a) $\sum_{k=1}^{\infty}\frac{1}{2k-1}$ (b) $\sum_{k=1}^{\infty}\frac{1}{(\ln(k+1))^k}$

7. Determine whether the series converges and if so find the sum:
   (a) $\sum_{k=1}^{\infty}\frac{1}{(k+3)(k+4)}$ (b) $\sum_{k=1}^{\infty}\frac{1}{9k^2+3k-2}$

8. Find all the values of x for which the series converges and find the sum of the series for those values of x:
   $x - x^3 + x^5 - x^7 + x^9 - \cdots$

9. Determine whether the series converge or diverge:
   (a) $\sum_{k=1}^{\infty}\frac{(2k)!}{(k!)^2}$ (b) $\sum_{k=1}^{\infty}\frac{1}{\sqrt[3]{2k-1}}$

10. Determine whether the series converge or diverge:
    (a) $\sum_{k=1}^{\infty}\frac{k!}{(k)^k}$ (b) $\sum_{k=0}^{\infty}\frac{x^k}{2^k k^2}, x > 0$

11. Check the convergence of the series:
    (a) $\sum_{k=1}^{\infty}(\frac{3k-4}{4k-5})^k$ (b) $\sum_{k=1}^{\infty}\frac{1}{(8k^2-3k)^{1/2}}$

12. Test the absolute convergence of the following series using ratio test :
    (a) $\sum_{k=1}^{\infty}(-1)^k\frac{(2k-1)!}{3^k}$ (b) $\sum_{k=1}^{\infty}(-1)^{k+1}\frac{(2k)!}{(3k-2)!}$

13. Check whether the series $\sum_{k=1}^{\infty}(-1)^{k+1}\frac{k^k}{k!}$ is absolutely convergent or not.

14. Classify each series as absolutely convergent, conditionally convergent, or divergent;
    (a) $\sum_{k=1}^{\infty}\frac{(-4)^k}{k^2}$ (b) $\sum_{k=1}^{\infty}\frac{k\cos}{k^2+1}$

15. Use any test to determine whether the following series converges:
    (a) $\sum_{k=1}^{\infty}\frac{k(k+3)}{(k+1)(k+2)(k+5)}$ (b) $\sum_{k=1}^{\infty}\frac{5^k+k}{k!+3}$ (c) $\sum_{k=1}^{\infty}\frac{[\pi(k+1)]^k}{k^{k+1}}$

ANSWERS

TUTORIAL QUESTIONS

1. (a) $\left\{(-1)^{n-1}\frac{1}{3^n}\right\}_{n=1}^{+\infty}$; $\lim_{n\to\infty}\frac{(-1)^{n-1}}{3^n}=0$, Converges.

   (b) $\left\{(-1)^{n+1}\left(\frac{1}{n}-\frac{1}{n+1}\right)\right\}_{n=1}^{+\infty}$;the sequence converges to 0.

   (c)$\left\{(-1)^{n+1}\frac{1}{3^{n+4}}\right\}_{n=1}^{+\infty}$; $\lim_{n\to\infty}\frac{(-1)^{n+1}}{3^{n+4}}=0$, Converges.
2. (a) Converges; Sum=6 (b) Converges; Sum = $1/2$ (c) Converges: Sum = $\frac{(e/\pi)^4}{1-e/\pi}$
3. (a) $\frac{532}{99}$ (b) $\frac{44663}{99000}$
4. (a) Diverges (b) Converges (c) Converges
5. (a) Diverges (b) Converges (c) Converges

ASSIGNMENT QUESTIONS

1. To prove
2. To prove
3. (a) Diverges (b) Diverges (c) Converges
4. (a) Converges (b) Converges (c) Diverges
5. (a) Diverge (b) Converge (c) Diverge
6. (a) Diverges (b) Inconclusive
7. (a) Converges (b) Diverges
8. (a) Diverges (b) Converges absolutely
9. (a)Conditionally convergent (b) Conditionally convergent (c) Absolutely convergent
10. (a) Converges (b) Converges (c) Converges

UNITWISE QUESTION BANK

1. 70
2. Converges
3. (a)Diverges (b) Converges
4. (a) Converges (b) Converges
5. Not absolutely convergent
6. (a) Diverges (b) Converges
7. (a) $\frac{1}{4}$(b) $\frac{1}{6}$
8. $|x|<1, S=\frac{x}{1+x^2}$
9. (a) Diverges (b) Diverges
10. (a) Converges (b) Converges when $x\leq 2$ and Diverges when $x>2$.
11. (a) Converges (b) Diverges

12. (a) Diverges (b) Converges
13. Diverges
14. (a) Divergent (b) Conditionally Convergent
15. (a) Diverges (b) Converges (c) Diverges

Engineering Chemistry

COURSE INFORMATION SHEET

ENGINEERING CHEMISTRY

DEGREE: BTECH	**COURSE**: ENGINEERING CHEMISTRY
PROGRAMME: AEI,CE,CSE,EEE,ECE,IT,ME,AI& DS	**COURSE CODE**: 100908/CH900B
COLLEGE: RAJAGIRI SCHOOL OF ENGINEERING & TECHNOLOGY	**CONTACT HOURS**: 3+1 (Tutorial) hours/Week.
SEMESTER: 1 & 2	**CREDITS**: 4

SYLLABUS

UNIT	DETAILS	HOURS
I	***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. Electro chemical 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-Electro chemical corrosion – mechanism. Galvanic series-cathodic protection - electroless plating –Copper and Nickel plating.	9
II	*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 -	9

	Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications. ^1H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR-including MRI (brief).	
III	*Instrumental Methods and Nanomaterials* Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $CaC_2O_4.H_2O$andpolymers.DTA-Principle,instrumentation(blockdiagram)andapplications-DTAof $CaC_2O_4.H_2O$. 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).	9
IV	*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.	9

V	*Water Chemistry and Sewage Water Treatment* Watercharacteristics-Hardness-Typesofhardness-TemporaryandPermanent-Disadvantagesof hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) – Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. Municipal water treatment (brief) - Disinfection methods - chlorination, ozone and UV irradiation. Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD- definition, estimation (only brief procedure) and significance(Numericals). Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process.	9
TOTAL HOURS		**45**

TEXT/REFERENCE BOOKS

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	*B. L. Tembe, Kamaluddin, M. S. Krishnan, "Engineering Chemistry (NPTEL Web-book)", 2018.*
T	*P.W.Atkins,"PhysicalChemistry",OxfordUniversityPress,10th edn.,2014.*
R	*C.N.Banwell,"FundamentalsofMolecularSpectroscopy",McGraw-Hill,4th edn.,1995.*
R	*DonaldL.Pavia,"IntroductiontoSpectroscopy",CengageLearningIndiaPvt.Ltd.,2015.*
R	*B.R.Puri,L.R.Sharma,M.S.Pathania,"PrinciplesofPhysicalChemistry",VishalPublishing Co., 47th Edition, 2017.*
R	*H. H. Willard, L. L. Merritt, "Instrumental Methods of Analysis", CBS Publishers, 7th Edition, 2005.*
R	ErnestL.Eliel,SamuelH.Wilen,"Stereo-chemistryofOrganicCompounds",WILEY,2008.
R	*Raymond B. Seymour, Charles E.Carraher, "Polymer Chemistry: An Introduction", Marcel Dekker Inc; 4th Revised Edition, 1996.*
R	*Muhammed Arif, Annette Fernandez, Kavitha P. Nair "Engineering Chemistry", Owl Books, 2019.*
R	*AhadJ.,"EngineeringChemistry",JaiPublication,2019.*
R	*Roy K. Varghese, "Engineering Chemistry", Crownplus Publishers,2019.*

R	*Soney C. George, RinoLaly Jose, "Text Book of Engineering Chemistry", S. Chand & Company Pvt Ltd,2019.*

COURSE PRE-REQUISITES

COURSE NAME	DESCRIPTION
Concepts of chemistry introduced at the plus two levels in schools	To develop basic ideas on electrochemistry, polymer chemistry, water technology etc

COURSE OBJECTIVES

1	*To enable the students to acquire knowledge in the concepts of chemistry for engineering applications*
2	*To familiarize the students with different application oriented topics like spectroscopy, electrochemistry, instrumental methods etc.*
3	*To 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.*

COURSE OUTCOMES

SL.NO	DESCRIPTION
CO 1	*Apply the basic concepts of electrochemistry and corrosion to explore its possible applications in various engineering fields and an ability to design and construct electrochemical energy storage devices like cells, batteries etc*
CO 2	*Understand various spectroscopic techniques like UV-Visible, IR, NMR and its applications and to analyze and deduce the structure of chemical compounds*
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 nano materials.*
CO 4	*Learn about the basics of stereochemistry and its application. Apply the knowledge of conducting polymers and advanced polymers in engineering.*
CO 5	*To develop skills for treating water by understanding various water treatment methods*

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					

	1	2	3	4	5	6	7
1	Knowledge on electrochemistry and corrosion can be used to find solution to various engineering problems like rusting, construction of batteries etc	Basic principles of electrochemistry and corrosion help to analyse the problems related to above fields in engineering	An awareness regarding corrosion theory and electrochemical system can be utilized in solving material corrosion tendencies and to design various energy storage systems				
2	Knowledge on spectrochemical techniques helps in structure analysis of materials used for engineering applications	Study of the basic concepts of spectroscopic techniques can be used to analyse the structural aspects of the materials		Analysis and interpretation of material structural features is possible by understanding modern analytical tools like spectroscopy	Usage of modern analytical tools like IR, UV-Visible, NMR is possible by understanding the basic working principle of spectroscopy		
3	An awareness of characterization techniques like TGA,	Appropriate choice of materials for various engineering activities can		Study of research based analytical techniques like TGA,	Usage of modern analytical tools like TGA, DTA is possible by		

	SEM and chromatography can be utilized to find thermal stability of compounds and separation and purification of mixture of compounds	be done by utilizing the knowledge on various analytical techniques		SEM etc helps in analysis and interpretation of various experimental data	understanding the basic working principle of thermal analytical techniques		
4	Knowledge of engineering materials like polymers and its stereochemistry helps in the synthesis of new polymeric materials with specific properties	An awareness of polymeric materials can be utilized in the selection of materials ideal for engineering constructions and modelling					
5	An awareness of various water treatment methods can be used to solve problems like hardness, salinity etc			Appropriate design of water treatment plants can be done by utilizing the principles of various water treatment methods			Knowledge on various water treatment methods can be utilized for the sustainable development based on societal and environmental context

MAPPING OF COURSE OUTCOMES WITH PROGRAM SPECIFIC OUTCOMES

	PSO1	PSO2	PSO3
CO1			
CO2			
CO3	1	1	
CO4			
CO5			

	PSO1	PSO2	PSO3
CO1			
CO2			
CO3	Skill to design software with integration of intelligent systems for the working of analytical instruments by applying the fundamentals of science	Skill to design software with integration of intelligent systems for the working of analytical instruments like TGA,DTA,SEM etc	
CO4			
CO5			

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS

SL.NO	DESCRIPTION	PROPOSED ACTIONS
1	Basic concepts on conductivity of electrolytes & laws associated with it, electrochemical conventions & notations	Reading, Assignment, Group discussion
2	An introduction to microwave spectroscopy	Reading, Assignment, seminar
3	CNT, Fullerene	Reading, Assignment, Group discussion
4	Types of polymerization	Reading, Assignment, seminar
5	Zeolite Method of water softening	Reading, Assignment, seminar

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS

1	➢ Concentration cell ➢ Conductometric titrations ➢ Polarization ➢ Decomposition potential ➢ Overvoltage

2	➢ Flame photometer ➢ Mass spectrometry
3	➢ Differential Scanning Calorimetry
4	➢ Moulding techniques ➢ Polymer Blends and Composites ➢ Determination of Molecular weight of polymers
5	➢ Scale and sludge formation in boilers ➢ Caustic embrittlement ➢ Boiler corrosion ➢ Chemical analysis of water ➢ Advanced oxidation process in water treatment

WEB SOURCE REFERENCES

1	https://nptel.ac.in/courses/104/108/104108078/
2	https://nptel.ac.in/content/storage2/courses/103108100/module5/module5.pdf
3	https://www.iitk.ac.in/che/pdf/resources/TGA-DSC-reading-material.pdf
4	https://nptel.ac.in/content/storage2/courses/103108100/module7/module7.pdf
5	https://www.youtube.com/watch?v=teTkvUtW4SA
6	https://www.youtube.com/watch?v=dkARLSQWHH8
7	https://www.youtube.com/watch?v=OFh_Id8Ja4Y
8	https://www.youtube.com/watch?v=k81pmfpKwIE
9	https://www.youtube.com/watch?v=712pXGSJ8Pc
10	https://freevideolectures.com/course/4649/nptel-stereochemistry

DELIVERY/INSTRUCTIONAL METHODOLOGIES

☐ CHALK & TALK	**☐ STUD. ASSIGNMENT**	**☐ WEB RESOURCES**	
☐ LCD/SMART BOARDS	**☐ STUD. SEMINARS**	**☐ ADD-ON COURSES**	

ASSESSMENT METHODOLOGIES-DIRECT

☐ **ASSIGNMENTS**	☐ **STUD. SEMINARS**	☐ **TESTS/MODEL EXAMS**	☐ **UNIV. EXAMINATION**
☐ **STUD. LAB PRACTICES**	☐ **STUD. VIVA**	☐ **MINI/MAJOR PROJECTS**	☐ **CERTIFICATIONS**
☐ **ADD-ON COURSES**	☐ **OTHERS**		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ **ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)**	☐ **STUDENT FEEDBACK ON FACULTY (TWICE)**
☐ **ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS**	☐ **OTHERS**

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Approved by
Dr. Sonia Paul (HOD)

COURSE PLAN

	Unit	Topic Planned	Date
1	UNIT 1	Introduction - Differences between electrolytic and electrochemical cells - Daniel cell - redox reactions - cell representation.	01/12/2020
2		Single electrode potential - definition - Helmholtz electrical double layer Sketching of electrochemical cells	03/12/2020
3		Free energy and EMF - Nernst Equation - Derivation - single electrode and cell (Numerical) -Application - Variation of emf with temperature.	04/12/2020
4		Different types of electrodes (brief) - Reference electrodes – SHE, Calomel electrode	07/12/2020
5		Glass Electrode - Construction and Working, Determination of E^0 using calomel electrode.	08/12/2020
6		Class Test/quiz	10/12/2020
7		Determination of pH using glass electrode. Electrochemical series and its applications	11/12/2020
8		Potentiometric titration - Introduction -Redox titration only	14/12/2020
9		Lithium ion cell - construction and working. Conductivity- Measurement of conductivity of a solution (Numerical).	15/12/2020
10		Tutorial	17/12/2020
11		Conductivity- Measurement of conductivity of a solution (Numerical)	18/12/2020
12		Corrosion-Electrochemical corrosion – mechanism	28/12/2020
13		Galvanic series- cathodic protection - electroless plating – Copper and Nickel plating	29/12/2020
14	UNIT 2	Introduction to spectroscopy	31/12/2020
15		Molecular energy level, Beer Lamberts Law	01/01/2021
16		UV Visible spectroscopy and spectrophotometer	04/01/2021
17		Energy level diagram of ethane, butadiene, benzene and	05/01/2021

		hexatriene	
18		Numerical	07/01/2021
19		Class Test/quiz	08/01/2021
20		IR Spectroscopy-vibrational modes-Force constant Numerical	11/01/2021
21		NMR Spectroscopy & MRI	12/01/2021
22		Spectral problems	14/01/2021
23		Tutorial	15/01/2021
24	UNIT 3	Thermal analysis-TGA-Thermogram, DTA-differential thermogram	18/01/2021
25		Chromatography-TLC & Column	19/01/2021
26		Class Test/quiz	21/01/2021
27		GC & HPLC	22/01/2021
28		Nanomaterials-definition-classification-preparation SEM	29/01/2021
29	UNIT 4	Introduction	01/02/2021
30		Isomerism	02/02/2021
31		Stereoisomerism-cis-trans and E-Z notations	04/02/2021
32		Enantiomers and diastereomers	05/02/2021
33		R-S Notation, chirality and optical isomerism	08/02/2021
34		Class Test/quiz	09/02/2021
35		Conformational analysis of ethane, butane and cyclohexane	11/02/2021
36		Conformational analysis of mono and di substituted cyclohexane	12/02/2021
37		Representation of 3D structures	15/02/2021
38		Representation of 3D structures	16/02/2021
39		Copolymers-types, ABS and Kevlar	18/02/2021
40		Tutorial	19/02/2021
41		Conducting polymers & OLED	22/02/2021
42	UNIT	Water Hardness-types, units and degree of hardness	23/02/2021

43	5	EDTA Method	25/02/2021
44		Reverse osmosis, municipal water treatment	26/02/2021
45		Disinfection methods &Water softening	04/03/2021
46		Dissolved oxygen-Winkler's method, BOD, COD	05/03/2021
47		Numerical	08/03/2021
48		Sewage water treatment, UASB & Trickling filter methods	09/03/2021
49		Tutorial	12/03/2021

ASSIGNMENT QUESTIONS

ASSISGNMENT 1

MODULE 1

1. Give the electrochemical reaction taking place when an iron nail is dipped in dilute HClE$^{o}(Fe^{2+}/Fe)$ = -0.44 V, $E^{o}(Fe^{3+}/Fe)$ = -0.04 V, $E^{o}(H^{+}/H_2)$ = 0 V (3 marks)

2. What are the products of electrolysis at cathode and anode when NaCl solution is electrolysed using Cu electrodes?

$Na^{+} + e^{-} \rightarrow Na$, E^{o}= -2.71 V, $Cu^{2+} + 2e^{-} \rightarrow Cu$, E^{o}= 0.34 V, $Cl_2 + 2e^{-} \rightarrow Cl^{-}$, E^{o}= 1.36 V, $H^{+} + e^{-} \rightarrow 1/2H_2$, E= -0.41 V (at pH=7), $O_2 + 2\ H_2O + 4e^{-} \rightarrow 4OH^{-}$, E= 0.82 V (at pH=7) (3 marks)

3. A cell reaction is given by $A+B^{n+} \rightarrow B+A^{n+}$. Calculate the E^{o}_{Cell} and number of electrons 'n' involved in cell reaction. Given that concentration ratio of A^{n+} to B^{n+} is 0.1 and the cell shows an emf of 1.13006 V at 30 ^{o}C and 1.13105 V at 40 ^{o}C (4 marks)

ASSIGNMENT 2

MODULE 3

1. Draw the block diagrams for GC & HPLC (3 marks)

2. Write a short note on visualization techniques used in TLC (2 marks)

3. Write any 5 differences between TGA & DTA (5 marks)

TUTORIAL QUESTIONS

MODULE-1 ELECTROCHEMISTRY & CORROSION

1. Calculate the electrode potential of a copper electrode placed in 0.015M $CuSO_4$ solution 25^0C. Given E^0 Cu = 0.34V
2. What is the potential of Ca^{2+}/ Ca electrode in which the concentration of Ca^{2+} is 0.01M 25^0C. Given E^0Ca= -2.87V
3. The standard reduction potential of zinc is -0.76V and silver is 0.80V. Calculate the E.M.F of the cell Zn/ $Zn(NO)_3$ (0.1M) // $AgNO_3$ (0.01M)/ Ag at 25^0C
4. Calculate the EMF of the cell at 300K in which the reaction is

   $Mg + 2Ag^+(10^{-2}) \rightarrow Mg^{2+}(0.130\ M) + 2Ag.$

   Given E^0 Mg = -2.37V and E^0 Ag = 0.80V
5. Calculate the EMF of the cell Zn/ Zn^{2+}(1M) // Cu^{2+} (1M) / Cu at 25^0C. Write the half cell and net cell reaction. Given E^0 Zn = -0.76 V and E^0 Cu $^{2+}$ = 0.34V (1.1V)
6. Calculate the standard reduction potential of Ni^{2+}/ Ni electrode at 25^0C when the cell potential for the cell is 0.60V. E^0 = 0.34V (Ni/ Ni $^{2+}$ (1M) // Cu^{2+} (1M)/ Cu (-0.26V)
7. Calculate the voltage of the cell Mg/ Mg^{2+} // Cd^{2+}/ Cd at 25 ^{0}C. When [Cd^{2+}]= 0.1M, [Mg^{2+}]= 1.0M and E^0Cell= 1.97V. (1.94V)
8. The potential of hydrogen gas electrode set up in an acid solution of unknown strength is found to be 0.26V at 25^0C when measured against normal hydrogen electrode. Find the pH of acid solution (4.4)
9. Hydrogen electrode and saturated calomel electrode when immersed in a solution at 25^0C showed a potential of 0.1564V. Calculate the pH of the solution. (5.48)
10. Find out the pH of asolution in which a glass electrode is dipped and is coupled with a saturated calomel electrode. The emf of the combined cell is 0.425V at 25^0C (E^oglass= 0.011V)
11. Cd/ $CdSO_4$// KCl/ Hg_2Cl_2/ Hg
12. Zn/ $ZnSO_4$// $CuSO_4$/ Cu
13. Pt/ H_2/ HCl/ AgCl/ Ag
14. Zn/ Zn^{2+} // KCl/ Hg_2Cl_2/ Hg

15. Pt/ H_2/ H^+// Cu^{2+}/ Cu
16. Pt/ Fe^{2+}; Fe^{3+}// Ag^+/ Ag
17. Al/ Al^{3+}// Fe^{2+}/ Fe
18. The specific conductivity of 0.3N KCl solution at 270C is 0.00028 ohm-1 cm-1. The resistance of the cell containing this solution is 300 ohms. Determine the cell constant.
19. A conductivity cell is found to have two parallel plates of area 1.5cm2 kept at 9.8cm apart. It gave a resistance of 1500 ohms when filled with electrolyte solution. Find the cell constant and conductivity of the solution.
20. The resistance of N/100 KCl solution in a conductivity cell at 25oC is 300ohms and has a conductivity of 1.5 x 10-3 ohm-1 cm-1. At the same temperature. If an N/50 acid solution gives a resistance of 100 ohms in the same cell, calculate the conductivity of the acid.
21. The decinormal solution of an electrolyte in an conductivity cell whose electrodes are 2.1cm apart and 4.2cm^2 in area offered a resistance of 32 ohms. Find the equivalent conductance of the solution.
22. The resistance of a 0.1M solution of an electrolyte taken in a conductivity cell containing 2 platinum electrodes 4cm apart and 10.7cm2 in area was found to be 70 ohms. Calculate the conductivity and molar conductance of the solution.
23. The specific conductance of M/10 solution of KCl at 291K is 0.0112 Scm-1. And its resistance when contained in a conductivity cell is found to be 55ohms. Calculate the cell constant.

MODULE -2 SPECTROSCOPIC TECHNIQUES & APPLICATIONS

1. The intensity of monochromatic radiation is found reduced to 1/3rd of the initial value after passing through 8cm length of a 0.05M solution of a substance. Calculate the molar absorption co-efficient of the substance.
2. A 0.01M solution of a substance absorbs10% of an incident monochromatic light in a path of 1cm length. What should be the concentration of its solution if it is to absorb 90% of the same radiation in the same path length

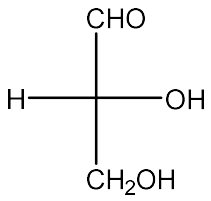
3. An aqueous solution of an organic dye in a Beer cell absorbs 10% of the incident light. What fraction of the incident light will the same solution absorb if a cell 4 times longer than the first is used.
4. Calculate the frequency of radiation having wavelength $5000A^{0.}$ Given c= 2.996×10^{10}
5. Calculate the force constant of the CO molecule, if its fundamental vibrational frequency is $2140cm^{-1}$. Atomic masses of C= 1.99×10^{-26} Kg and O= 2.66×10^{-26}Kg
6. The wave number of fundamental vibration of 79Br- Br81 is 323.2cm-1. Calculate the force constant of the bond. Given 79Br= 78.9183 amu and 81Br =80.9163 amu
7. CH_3-CH_3
8. CH_3-CH_2-CH_3
9. CH_3-O-CH_3
10. $(CH_3)_2$-CH-CH_3
11. CH_3-OH
12. CH_3-CH_2-CH_2-OH
13. CH_3-CHO
14. CH_3-CO-CH_3
15. C_6H_5-CH_2-CH_2-CH_3
16. C_6H_6
17. C_6H_5-CO-CH_3
18. CH_3-F
19. CH_3-COOH
20. $(C_2H_5)_2$-CH_2-CH_2-Cl

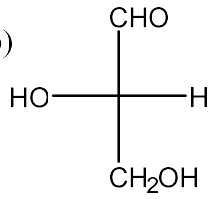
MODULE -3 INSTRUMENTAL METHODS & NANO MATERIALS

1. Draw the block diagram of the following
   a) TGA
   b) DTA
   c) HPLC
   d) GC
   e) SEM

MODULE -4 STEREOCHEMISTRY & POLYMER CHEMISTRY

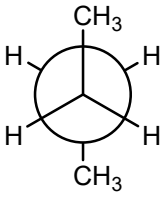
1. Draw the enantiomers of 2-butanol
2. Assign R-S notation for the following compounds
   a) 2, 3-butane diol
   b) 2, 3-dichlorobutane
   c) meso tartaric acid
   d) L(+) lactic acid
3. Assign R and S configuration from the following Fischer projections

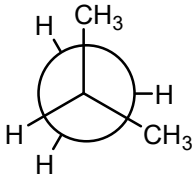
a) 

b) 

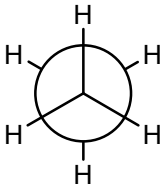
4. Draw the Newman projections of C_4H_{10}

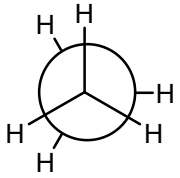
5. Draw the Fischer projection and assign R-S notation for the following

a) 

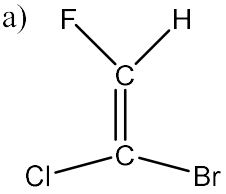
b) 

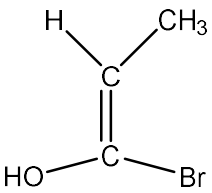
6. Draw the Sawhorse projections of following Newman projections

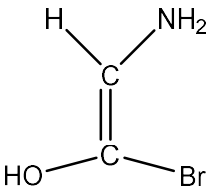
a) 

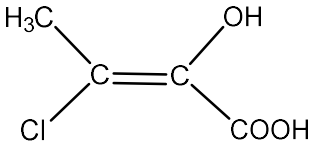
b) 

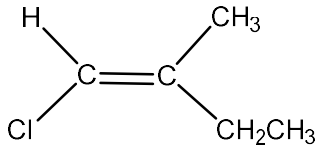
7. Draw the conformations of methyl cyclohexane
8. Assign E-Z configuration for

a) 

b) 

c) 

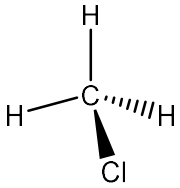
d) 

e) 

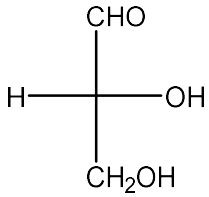
9. How many enantiomers are possible for CH3-CH (OH)-COOH? Draw the possible enantiomers.

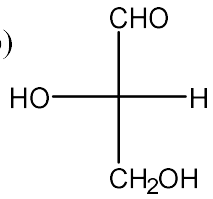
10. Draw the possible stereoisomers possible for 2-bromo-3-chloro butane.

11. Draw the Fischer projection of the following compound

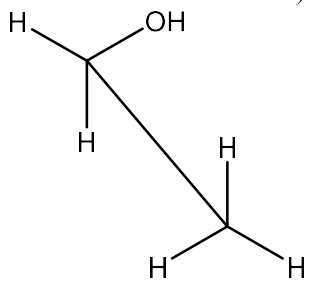


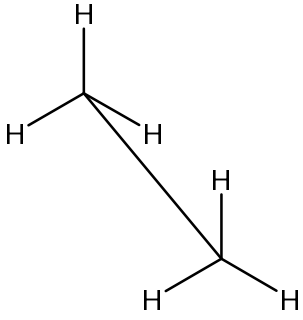
12. Draw the Wedge projection of

a) 

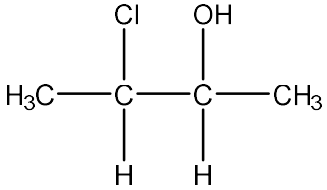
b) 

13. Draw the Wedge projections of

a) 

b) 

14. Draw the diastereomers for the following



15. Draw the chair and boat conformation of

a) Cyclohexane b) 1, 3-dimethyl cyclohexane c) 3-methyl cyclohexane

16. Outline the preparation of the following compounds
    1. Styrene butadiene rubber
    2. Acrylonitrile butadiene styrene
    3. Kevlar
    4. Polybutadiene
    5. Silicone rubber

MODULE -5 WATER CHEMISTRY & SEWAGE WATER TREATMENT

1. A Sample of water contains 30ppm of $MgSO_4$.What is the degree of hardness o sample of water?
2. A water sample contains 408mg of $CaSO_4$ per liter. Calculate the hardness in terms of $CaCO_3$ equivalents.
3. How many grams of $MgCO_3$ dissolved per liter gives 84ppm of hardness?
4. Calculate the degree of hardness of water containing 0.01% $MgSO_4$ & 0.02% $CaSO_4$
5. The data of a sample of water analysis is given below
   $Ca(HCO_3)_2$ =160mg/lit ; MgCl2=90mg/lit ;$Mg(HCO_3)_2$ =70mg/lit ;NaCl=500g/lit
   Calculate the temporary &total hardness of water sample.
6. Calculate the hardness of (a)0.05M Calcium chloride solution. (b) 0.08N $MgSO_4$ solution.
7. Calculate the temporary & permanent hardness of water which contain Ca^{2+} =200ppm,Mg^{2+} =96ppm,HCO_3^- =976ppm,Cl^- =146ppm,SO_4^{2-} =96 ppm, Na^+ =112ppm
8. Calculate the temporary, permanent & total hardness of water (in ppm) having followingcomposition.$Ca(HCO_3)_2$=4ppm,$Mg(HCO_3)_2$=6ppm,$CaSO_4$=8ppm,$MgSO_4$=10ppm

9. Calculate the temporary, permanent & total hardness of water (in ppm) having followingcomposition.$Ca(HCO_3)_2$=4ppm,$Mg(HCO_3)_2$=6ppm,$CaSO_4$=8ppm,$MgSO_4$=10ppm &$Na(HCO_3)_2$=3ppm
10. Calculate the hardness of a water sample, whose 10ml required 10ml of EDTA.20ml of CaCl2 solution whose strength is equivalent 1.5g of $CaCO_3$ per liter, required 30ml of EDTA solution.
11. 50ml of a standard hard water containing 1 mg of pure $CaCO_3$ per ml consumed 25ml of EDTA.50mlo a water sample consumed 25ml of the same EDTA solution. Using EBT as indicator. Calculate the total hardness of water sample in ppm.
12. A sample of hard water contains 150ppm of temporary hardness and 300ppm of permanent hardness. Express the above hardness in degree clark& degree French.
13. Find the BOD of water sample containing 60mg of carbohydrate (CH2O)per liter.
14. 100mL of water sample after reaction with fixed amount of acidifiedK2Cr2O7 consumes 15ml ,0.1N Ferrous solution. For blank titration the ferrous solution consumed is 25ml.Find COD of water sample.
15. 100mL sewage water is diluted to 500mL with dilution water; the initial dissolved oxygen was 7.5ppm. The dissolved oxygen level after 5days of incubation was 3.5ppm.Find the BOD of the sewage.

Engineering Graphics

COURSE INFORMATION SHEET

PROGRAMME:ARTIFICIAL INTELLIGENCE & DATA SCIENCE	***DEGREE: B.TECH***
COURSE:ENGINEERING GRAPHICS	***SEMESTER:* S1*CREDITS:* 3**
COURSE CODE: 100908/ME900C ***REGULATION:***2020	**COURSE TYPE:** CORE
COURSE AREA/DOMAIN: BASIC ENGINEERING	**CONTACT HOURS:**2+0+2 (L+T+P) hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY):NIL	**LAB COURSE NAME:** NA

SYLLABUS:

MODULE	*DETAILS*	*HOURS*
	Section A	
I	Introduction: Relevance of technical drawing in engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing. **Orthographic projection of Points and Lines**: Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Trace of line. Inclination of lines withreference planes. True length of line inclined to both the reference planes.	9
II	**Orthographic projection of Solids**: Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone and Cylinder. Projection of solids in simple position including profile view. Projection of solids with axis inclined to one of the reference planesand with axis inclined to both reference planes.	8
III	**Sections of Solids**: Sections of Prisms, Pyramids, Cone, Cylinder with axis in vertical position and cut by different section planes. True shape of the sections. Also locating the section plane when thetrue shape of the section is given. **Development of Surfaces**: Development of surfaces of the above solids and solids cut by differentsection planes. Also finding the shortest distance between two points on the surface.	8
IV	**Isometric Projection**: Isometric View and Projections of Prisms, Pyramids, Cone , Cylinder, Frustum of Pyramid, Frustum of Cone, Sphere, Hemisphere and their combinations.	6
V	**Perspective Projection**: Perspective projection of Prisms and Pyramids with axis perpendicular to the ground plane, axis perpendicular to picture plane. **Conversion of Pictorial Views**: Conversion of pictorial views into orthographic views.	6

Section B (To be conducted in CAD Lab)		
VI	Introduction to Computer Aided Drawing: Role of CAD in design and development of new products, Advantages of CAD. Creating two dimensional drawing with dimensions using suitable software.(Minimum 2 exercises mandatory) Introduction to Solid Modelling: Creating 3D models of various components using suitable modeling software. (Minimum 2 exercises mandatory)	8
TOTAL HOURS		**45**

TEXT/REFERENCE BOOKS:

T/R	*BOOK TITLE/AUTHORS/PUBLICATION*
T1	**Anilkumar, K. N.**, Engineering Graphics, Adhyuth Narayan Publishers
T2	**Varghese, P. I.**, Engineering Graphics, V I P Publishers
R1	John, K. C., Engineering Graphics, Prentice Hall India Publishers
R2	Bhatt, N. D. Engineering Drawing, Charotar Publishing House Pvt Ltd.
R3	Agrawal, B. and Agrawal, C. M., Engineering Drawing, Tata McGraw Hill Publishers
R4	Benjamin, J., Engineering Graphics, Pentex Publishers
R5	Duff, J. M. and Ross, W. A., Engineering Design and Visualization, Cengage Learning, 2009
R6	Kulkarni, D. M., Rastogi, A. P. and Sarkar, A. K., Engineering Graphics with AutoCAD, PHI 2009
R7	Luzadder, W. J. and Duff, J. M., Fundamentals of Engineering Drawing, PHI 1993
R8	Venugopal, K., Engineering Drawing & Graphics, New Age International Publishers

COURSE OUTCOMES:

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

Sl. No.	*DESCRIPTION*	*LEVEL*
CO. ME900C.*1*	Draw the projection of points and lines located in different quadrants	Apply Level 3
CO. ME900C.*2*	Prepare multi-view orthographic projections of objects by visualizing them in differentpositions	Apply Level 3
CO. ME900C.*3*	Draw sectional views and develop surfaces of a given object	Apply Level 3
CO. ME900C.*4*	Prepare pictorial drawings using the principles of isometric and perspective projections tovisualize objects in three dimensions.	Apply Level 3

CO. ME900C.*5*	Convert 3D views to orthographic views	Apply Level 3
CO. ME900C.*6*	Obtain multi-view projections and solid models of objects using CAD tools.	Apply Level 3

CO-PO AND CO-PSO MAPPING

	PO 1	***PO 2***	***PO 3***	***PO 4***	***PO 5***	***PO 6***	***PO 7***	***PO 8***	***PO 9***	***PO 10***	***PO 11***	***PO 12***	***PSO 1***	***PSO 2***	***PSO 3***
CO. ME900C.***1***	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO. ME900C.***2***	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO. ME900C.***3***	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO. ME900C.***4***	3	-	-	-	-	-	-	-	-	1	-	-	-	-	-
CO. ME900C.***5***	3	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO. ME900C.***6***	3	-	-	-	3	-	-	-	-	3	-	-	-	-	-

JUSTIFICATIONS FOR CO-PO MAPPING

MAPPING	LOW/MEDIUM/HIGH	JUSTIFICATION
CO.1-PO1	H	Ability to draw projections of points and lines located in different quadrants helps students to identify suitable methods to solve various engineering problems.
CO.2-PO1	H	Ability to prepare multi-view orthographic projections of objects by visualizing them in different quadrants is the basis for understanding the exact shape of an object and hence will be useful for the students to solve engineering problems.
CO.3-PO1	H	Ability to draw sectional views and develop surfaces of a given objectwill be highly useful for the students to solve engineering problems.
CO.3-PO2	L	Ability to draw sectional views of a given object will be useful for the students to analyse internal parts of object.
CO.4-PO1	H	Ability to prepare pictorial drawings using the principles of isometric and perspective projections helps the students to visualize objects in three dimensions which is useful in solving engineering problems.
CO.4-PO10	L	Ability to prepare pictorial drawings using the principles of isometric and perspective projections helps the students to communicate effectively on complex engineering activities.

CO.5-PO1	H	Ability to convert 3D views to orthographic viewswill be useful for the students to solve engineering problems.
CO.5-PO10	M	Ability to convert 3D views to orthographic views helps the students to communicate effectively on complex engineering activities.
CO.6-PO1	H	Ability to obtain multi-view projections and solid models of objects using CAD tools helps students to use these modern engineering and IT tools for solving engineering problems.
CO.6-PO5	H	Ability to obtain multi-view projections and solid models of objects using CAD tools helps students to use these modern engineering and IT tools for the modeling and prediction of complex engineering problems.
CO.6-PO10	H	Ability to obtain multi-view projections and solid models of objects using CAD tools helps students for accurately preparing engineering drawings of various structures to effectively communicate with in an industry.

WEB SOURCE REFERENCES:

1	http://nptel.ac.in/courses/112103019/
2	https://www.youtube.com/watch?v=9PMvYc7wPbs
3	https://www.youtube.com/watch?v=tztXIaLV2-k
4	https://www.youtube.com/watch?v=YAHhjNkT-lw
5	https://www.youtube.com/watch?v=3xCDfxltu5M
6	https://www.youtube.com/watch?v=_rir4KhIcWw
7	https://www.youtube.com/watch?v=0s6Qnmyp02w
8	https://www.youtube.com/watch?v=lr1dL615WVk

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☑ CHALK & TALK	☑ STUD. ASSIGNMENT	☑LCD PROJECTOR
☑ ONLINE LECTURE		

ASSESSMENT METHODOLOGIES-DIRECT

☑ ASSIGNMENTS	☑ TESTS/MODEL EXAMS	☑ END SEMESTER EXAMINATION

ASSESSMENT METHODOLOGIES-INDIRECT

☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☑ STUDENT FEEDBACK ON FACULTY (TWICE)

Prepared by

Senjo Manuel
(Faculty)

Approved by

Dr. Manoj G. Tharian
(HOD)

ENGINEERING GRAPHICS COURSE PLAN S1 AIDS - 2020			
Sl. No.	Day	Module	Topic
1	1	1	Introduction, Orthographic projection of points
2	2	1	Orthographic projection of lines: Line parallel to one reference plane and inclined to other
3	3	1	Line inclined to both reference planes - Line rotation method
4	4	1	Line rotation method-problems
5	5	1	Traces of a Line
6	6	1	Line rotation method: Midpoint based
7	7	1	Line rotation method-problems
8	8	1	Plane rotation method
9	9	1	Plane rotation method
10	10	1	Plane rotation method
11	11	2	Orthographic projection of solids: Axis inclined to one plane
12	12	2	Orthographic projection of solids: Axis inclined to one plane
13	13	2	Orthographic projection of solids: Axis inclined to both planes
14	14	2	Axis inclined to both planes Contd.
15	15	2	Axis inclined to both planes Contd.
16	16	2	Axis inclined to both planes Contd.
17	17	2	Axis inclined to both planes Contd.
18	18	2	Special Cases
19	19	2	Special Cases
20	20	3	Sections of solids - Pyramids
21	21	3	Sections of solids - Cone
22	22	3	Sections of solids - Prisms and Cylinder
23	23	3	Sections of solids - true shape given problems
24	24	3	Sections of solids - true shape given problems
25	25	3	Development of Solids, Prisms/Cylinder
26	26	3	Development of Solids, Pyramids/cone
27	27	3	Development of Sectioned solids
28	28	3	Development of sectioned solids
29	29	3	Development: Shortest distance between two points on the surface
30	30	3	Development: Shortest distance between two points on the surface
31	31	4	Isometric view & projection, simple solids
32	32	4	Isometric view & projection, simple solids
33	33	4	Isometric view & projection, sectioned solids

34	34	4	Isometric view & projection, sectioned solids
35	35	4	Isometric view & projection: Spheres/Hemispheres
36	36	4	Isometric view & projection: Spheres/Hemispheres
37	37	4	Isometric view & projection - Frustum of Solids
38	38	4	Isometric view & projection - Combination of Solids
39	39	4	Isometric view & projection - Combination of Solids
40	40	4	Isometric view & projection - Combination of Solids
41	41	5	Perspective projection: Prisms
42	42	5	Perspective projection: Prisms
43	43	5	Perspective projection: Prisms
44	44	5	Perspective projection: Pyramids
45	45	5	Perspective projection: Pyramids
46	46	5	Perspective projection: Pyramids
47	47	5	Conversion of pictorial views into orthographic views
48	48	5	Conversion of pictorial views into orthographic views
49	49		Revision
50	50		Revision

QUESTION BANK

MODULE - I

PROJECTION OF POINTS &LINES

1. A line AB, 70 mm long has one of its extremities 20 mm in front of VP and the other 50 mm above HP. The line is inclined 40^0 to HP and 25^0 to VP. Draw its projections. Also show its traces. Find the apparent angles.
2. A line AB of length 130mm has its end A, 52mm in front of VP. The HT of the line is 44mm in front of VP and its VT is 50mm above HP. If the distance between HT and VT when measured parallel to the line of intersection of HP and VP is 110mm, draw the projections and find its inclinations with HP and VP.
3. A line RS, 70mm long, has its midpoint at a distance of 40mm and 30mm from H.P and V.P. Its top view makes 30^0 and front view makes 45^0 with XY line. Draw its projections and locate its traces. Find the true inclinations with HP and VP.
4. A line PQ 100mm long has its end P in the first quadrant and end Q in the 3rd quadrant. Its midpoint is in VP and 20mm above HP. The line is inclined 30^0 to HP and 45^0 to VP. Draw the projections of the line. Locate its traces and find the apparent angles.
5. The line RS 100mm long has its end R 20mm above HP and 30mm in front of VP. Its FV measures 90mm and TV measures 75mm. Draw its projections and find its inclinations with HP and VP. Also locate the traces
6. Draw the projections of the line AB of length 90 mm, inclined at 30° with HP and 45° with VP. A point *'M'* on AB, 30 mm from A at a distance of 35 mm above HP and 40 mm in front of VP. Also find the position of A if the portion containing A is rotated towards the reference planes.
7. A pipe is to be fixed on a vertical wall. One end of the pipe is touching on the floor and the other end is at a height of 3m. If the distance between the ends of the pipe measured along the floor is 6m, find graphically the length of the pipe and its inclination to the floor.
8. A line AB of length 70 mm is parallel to VP and 30 mm in front of it. If the point A is 15mm and the point B is 45 mm above HP, draw its projections and find the horizontal trace of the line.
9. A point P is 25 mm. above HP and 40 mm in front of VP. Another point Q is 50mm. above HP and 30 mm. in front of VP. The distance between their projectors is 60 mm. A third point R is 50mm. from P and 65 mm. from Q and lies in the HP. Draw the projections of the triangle thus formed.
10. A line AB, 90 mm. long has a length of 70mm. in the top view and 80 mm. in the front view. If one end is 20 mm. above HP and 12mm. in front of VP, determine the inclinations of the line with HP and VP. Also locate the traces of the line AB.
11. A line AB 75mm long is inclined at 45^0 to HP and 30^0 to VP. The end B is in HP and A is in the VP. The line is in the first quadrant. Draw the projections of AB and determine its traces.

12. The top view of a line AB, 80 mm. long measures 65 mm. and the length of the front view is 60 mm. The end A is in HP and 15 mm. in front of VP. Draw the projection of line AB and determine its inclination with HP and VP. Locate the traces of the line AB.
13. The top view of a line PQ makes an angle of 30^0 with the horizontal and has a length of 100 mm. The end Q is in the HP and P is in the VP and 65 mm. above the HP. Draw the projections of the line and find the true length and true inclinations with the reference planes. Also show its traces.
14. A line AB, 64mm long has one of its extremities 20mm in front of VP and the other 50mm above HP. The line is inclined at 40^0 to HP and 25° to VP. Draw its top and front views.
15. An end A of a line AB is 16 mm above HP and 20mm in front of VP, while the end B is 60mm above HP and 50mm in front of VP. If the end projectors are at a distance of 70mm, find the true length and true inclination of the line to the reference planes by the parallel line method.
16. A line of length 80 mm. has one of its ends 20 mm. above HP and 40 mm. in front of VP. The other end is 10 mm. above HP and 60 mm. in front of VP. Draw its projections and find its inclination with HP and VP.
17. The end A of a line AB is in HP and 25 mm. in front of VP. The end B is in VP and 50 mm. above HP. The distance between the end projectors when measured parallel to the line of intersection of HP and VP is 65 mm. Draw the projection of line AB and determine its true length and true inclination with HP and VP.
18. The end A of a line AB is 10 mm in front of VP and 20 mm above HP. The line is inclined at 30° to HP and front view is 45° with XY. Top view is 60 mm long. Draw its projections. Find the true length and true inclination with VP.
19. A line AB, 75mm. long is in the first quadrant with the end A in the HP and the end B in the VP. The line is inclined at 30° to the HP and at 45° to the VP. Draw the projections of AB.
20. A straight line has its mid-point at a distance of 45 mm. from both HP and VP. Its true length is 80 mm. and the top view makes 30° with XY and the front view makes 45° with XY. Draw the projections and locate the traces.
21. A line AB 80mm long has its end A 20mm above HP and 25mm in front of VP. The line is inclined at 45^0 to HP and 35^0 to VP. Draw its projections.
22. A line AB measuring 75 mm long has one of its ends 50 mm in front of VP and 15 mm above HP. The top view of the line is 50 mm long. Draw and measure the front view. The other end is 15 mm in front of VP and is above HP. Determine the true inclinations and traces.
23. A line AB has its end A 20mm above HP and 25mm in front of VP. The other end B is 45mm above HP and 55mm in front of VP. The distance between the end projectors is 60mm. Draw its projections. Also find the true length and true inclinations of the line with HP and VP.

24. The FV of a line JK makes an angle of 30° with the XY line. The HT of the line is 32 mm behind VP and the VT of the line is 30 mm above HP. The end J of the line is 12mm below HP, while the other end K is 22 mm in front of VP. Draw the projections of the line; measures the true length and true inclinations with the reference planes.
25. The TV of a line PQ, 60mm long measures 50mm, while the length of its FV is 39mm. Its end P is in the VP and 10mm below the HP. Draw the projections of the line and finds its inclination with HP and VP.
26. A line AB of length 130mm has its end A, 52mm in front of VP. The HT of the line is 44mm in front of VP and its VT is 50mm above HP. If the distance between HT and VT is 110mm, draw the projections and find its inclinations with HP and VP.
27. The front view of a line, 50 mm. long measures 35 mm. The line is parallel to the HP and one of its ends is in the VP and 25 mm. above HP. Draw the projections of the line and determines its inclination with the VP.
28. The front view of a line makes an angle of 30° with the XY line. The HT of the line is 36 mm. behind VP and the VT of the line is 30 mm. above HP. One end of the line is 10 mm. below the HP, while the other end is 20 mm. in front of the VP. Draw the projections of the line.
29. Draw the projections of a line AB, 90 mm. long, its mid-point M being 50 mm. above the HP and 40 mm. in front of VP. The end A is 20 mm. above the HP and 10 mm. in front of the VP. Show the traces and measure the inclinations of the line with HP and the VP.
30. A line PQ measuring 150 mm has its VT 15 mm above HP. The end P is 40 mm above HP and 30 mm in front of VP. The projections through its VT and end P are 60mm apart. Determine the projections and HT of the line. Also find its inclinations to reference planes.
31. A straight line 65mm long has one end 15mm in front of VP and 40mm above HP while the other end is 30mm in front of VP and 20mm above HP. Draw the plan and elevation of the line. What is true inclination of the line with HP?
32. The front view of a straight line 75 mm long measures 55 mm. The line is parallel to HP and one of its ends is in the VP and 25 mm below HP. Draw the projections of the line and determine its inclination to VP.
33. The end A of a line AB is in the HP and 30 mm in front of VP. The other end B is in the VP and 55 mm below HP. Draw its projections. The distance between the end projectors may be taken as 75 mm. Determine the true length of the line, and inclinations with the HP & VP, and locate its traces.
34. A line AB, 55 mm. long has its end B, 20 mm. from H.P. and 25 mm. from VP.The whole line lies in one quadrant. Draw its projections in all the four quadrants if it is inclined to H.P. at 35° and is parallel to V.P. Locate its traces.
35. A line AB, 75 mm long is in the first quadrant. Point A is 10 mm above HP and the point B is 15 mm in front of VP. The inclinations of the line to HP and VP are 40° and 30° respectively. Draw the projections of the line and mark the traces.

MODULE – II

PROJECTION OF SOLIDS

1. A pentagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant edges. Draw the projection of the pyramid when the axis appears to be inclined to VP at 45°.(May'12)
2. A pentagonal pyramid, base edge 30 mm and height 70 mm is resting on a corner in VP such that the above corner is at a height of 30 mm above HP and apex on HP. Draw the projections if the apex is at a distance of 25 mm away from VP.(May'12)
3. Draw the projections of a cube of 40mm edge resting on one of its corner with a solid diagonal vertical.(April'11)
4. A square pyramid, base 40mm side and axis 90mm long has a triangular face on the ground and the vertical plane containing the axis makes an angle of 45^0 with the VP. Draw its projections. (April'11, May'10)
5. A pentagonal pyramid side of base 30mm and height 30mm lies on HP on a triangular face. Draw its projection when its axis makes 70^0 with VP.(May'10)
6. A cube of solid diagonal length 80 mm. rests with one of its corners on HP such that a solid diagonal is parallel to HP and perpendicular to VP. Draw its projections.(May'09)
7. A cone of base 50mm diameter and axis 60mm long has one of its generators on HP. If the axis is parallel to VP, draw its projections.(Nov'08)
8. Draw the projections of a right circular cone of 60 mm. base diameter and 80 mm height when one of its generators lies in VP and makes an angle of 30° to HP.(May'08)
9. A square prism of base side 30 mm and axis length 60 mm is resting on HP on one of its base sides with its axis inclined at 45° to HP. The plane containing its axis is inclined at 35° to VP. Draw its projections.(Dec'07)
10. A regular triangular pyramid with the side of base 50 mm. and height 80 mm. is placed in such a way that its axis is 60° inclined to VP and parallel to H.P. The vertex is touching VP at a height of 40 mm. from HP. If one of the edges of the base is making 20° with HP, draw its projections.(Jul'07)
11. Draw the projections of a cube of 35 mm edge resting on the HP on one of its corners with a solid diagonal perpendicular to V.P.(Jul'07)
12. A triangular pyramid of base side 40 mm and axis 56 mm. long is freely suspended from one of the corners of its base. Draw its projections, if the axis is parallel to VP.(Jan'07)
13. A hexagonal prism of 25 mm, side of base and height 70 mm. is suspended freely from a comer. The axis of the prism is inclined 30^0 to the VP. The end containing the corner from which the prism is suspended is nearer to the VP. Draw the projections.(Sep'06)
14. A cone of base diameter 56 mm and 70 mm. height has one of its generators on HP. If the axis of the cone is seen as 50° inclined to XY line in the top view and the apex is pointing to the observer, draw the projections of the cone.(May'06)
15. A tetrahedron of 80 mm. long edge has an edge parallel to the HP and inclined at 45^0 to the VP, while the face containing that edge is vertical. Draw its projections.(Dec'05)
16. A cone of base 50 mm diameter and axis 75 mm. long has one of its generators on the HP. A plane containing that generator and the axis is perpendicular to the HP and inclined at 60° to the VP. Draw the projections of the cone when the base is nearer to the VP than the apex.(May'05)

17. A hexagonal prism base 20 mm. side and axis 40mm long is placed with one of its base edges on the VP such that the axis is inclined at 30 degree to HP and 45 degree to the VP. Draw the projections of the prism.(May'04)
18. Draw the projections of a pentagonal pyramid having a side of 40 mm. and a height of 75 mm .The pyramid rests on one of its base edges and the axis makes an angle of 45° with the HP and 60° with the VP.(Nov'03)
19. A cube of 50 mm. size is resting on HP keeping on one of its faces inclined 20° to VP. The cube is then rotated about a horizontal axis, parallel to VP, such that the bottom face makes 20° with HP. Draw the front view of the cube.(May'03)

MODULE - IV

ISOMETRIC PROJECTION

1. A solid in the form of a truncated hexagonal pyramid base 30 mm side, axis 60mm long and an edge of the base parallel to the VP is resting on its base on the horizontal plane. The truncated surface of the pyramid is contained in a plane which is inclined 30° to HP. The plane passes througha point on the axis of the pyramid and the point is 30 mm above the base. Draw the isometric view of the solid.(May'12)
2. A cylindrical slab 80 mm diameter and 16 mm thick is surmounted by a cube of 40mm side. On the top of the cube, rests a square pyramid of altitude 40 mm and side of base 32 mm. The axes of the solids are in the same straight line. Draw the isometric projection of the solid. (May'12)
3. A cylindrical block of base 60mm diameter and height 90mm,standing on the HP with its axis perpendicular to the HP. Draw its isometric projection.(April'11)
4. A tetrahedron of sides 40mm is resting centrally on the largest face of a rectangular block of size 60mm x 80mm x 40mm. Draw the isometric projection of the combination using isometric scale.(April'11)
5. A right regular hexagonal prism edge of base 20mm and height 50mm has a co-axial hole of 20mm diameter. Draw its isometric projection.(May'10)
6. A frustum of a cone of base diameter 50mm, top diameter 30mm and height 40mm is resting upon its base on HP. Draw the isometric projection of the frustum.(May'10)
7. A hexagonal based prism of base edge 30 mm. and axis length 80 mm. is resting with one of its rectangular faces on HP. A cylinder of diameter 30 mm and height 40 mm rests centrally with its base on the top rectangular face of the prism. Draw the isometric projection for the combination of solids.(May'09)
8. A cone of base diameter 60mm and height 80mm is cut by a plane inclined at 30° to HP and bisecting the axis. Draw the isometric view of the cone, showing the cut-surface.(Nov'08)
9. Draw the isometric projection of a horizontal cylinder of base diameter 50 mm. and axis length 60 mm.(May'08)
10. A square pyramid of side 30 mm, axis length 50 mm is centrally placed on top of a cube of side 50 mm. Draw the isometric projection of the solids.(July'07)

11. Draw the isometric projection of a funnel consisting of cylinder and a frustum of a cone. The diameter of the cylinder is 20.mm. and top diameter of the frustum is 70 mm. The height of the frustum and cylinder each equal to 40 mm.(July'07)
12. Draw the isometric projection of a sphere of 60 mm diameter resting centrally on the top of a square prism of base 60 mm and height 20mm.(Dec'07)
13. A pentagonal prism, side of base 30 mm. and height 70 mm is resting upon HP on its base keeping one of its rectangular faces perpendicular to VP. A section plane, 45° inclined to HP, bisects the axis of the prism. Draw the isometric view of the truncated prism showing the sectioned surface.(Jan'07)
14. A cylinder, 40 mm. base diameter and 50 mm. high, is resting on its base upon HP. It is surmounted by a sphere of 40 mm. diameter. Draw the isometric view of the solids.(May'06)
15. Draw the isometric view of a triangular lamina whose sides are 50 mm 70 mm. and 80 mm. when the lamina is positioned in such a way that its plane is parallel to the VP and the largest edge is parallel to the HP.(Sep'06, May'03)
16. A truncated cone is having base diameter 60 mm, top diameter 30 mm and axis 40 mm. A hemisphere 40 mm. in diameter is resting centrally on top of this, with its flat face facing upward. Draw the isometric projection of the combination of solids.(May'05)
17. A cone of base diameter 40 mm. and axis length 50 mm. is mounted centrally on the top of a square slab of side 60 mm. and thickness 15 mm. Draw the isometric projection of the solids.(Dec'05)
18. A hemisphere of radius 25mm rests centrally on a cube of 60mm side such that the circular face of the hemisphere is at the top. Draw the isometric projection of the solids in the given position.(May'03)
19. Draw the isometric view of a sphere of diameter 65 mm which is kept centrally on a square prism of side 55 mm. and height 50 mm.(Nov'03)

MODULE – III

SECTION OF SOLIDS

1. A hexagonal prism of edge of base 30 mm, altitude 70 mm lying with a face on HP is cut into two halves by a vertical plane inclined at 60^0 to the axis. Draw the sectional elevation and the true shape of one of the halves.(May'12)
2. A tetrahedron of 70 mm edge is lying on HP on one of its faces with an edge perpendicular to VP. It is cut by a section plane perpendicular to VP so that the true shape of the section is an isosceles triangle of base 56 mm long and altitude 44 mm. Draw the sectional top view and the true shape of the section. (May'12)
3. A cube of 65mm long edges has its vertical faces equally inclined to the VP. It is cut by a section plane perpendicular to VP, so that the true shape of section is a regular hexagon. Draw the projections of the sectioned cube and find the inclination of the section plane with HP. Also measure the length of sides of the hexagon in the true shape of section.(April'11, May'10, Jul'07)

4. A cone of base 60mm, height 70mm is cut by a section plane so that the true shape of section is an ellipse of major axis 50mm. Draw the projections of the sectioned cone and the true shape of the section. Find the inclination of the section plane with HP.(April'11)
5. A square prism having base of sides 30 mm. is cut by a section plane **such** that the true shape of section is a hexagon having two opposite sides 30 mm. long and the remaining four sides 40 mm long. Draw top view, front view and true shape of section. Determine the height of the prism and inclination of the section plane.(May'10,'05)
6. Draw the top and front view of a cylinder cut by a section plane in such a manner that the true shape of section is an ellipse of 50 mm. and 100 mm. as its minor and major axis respectively. Find the slope angle of cutting plane. Take the smallest generator to be 25mm in length.(May'09)
7. A pentagonal pyramid, base 36mm side and axis 70mm long, is lying on one of its triangular faces on the ground with the axis parallel to VP. A vertical section plane whose HT passes through the topmost point of the pyramid in the given position makes an angle of 30^0 with the reference line and cuts the pyramid removing a portion of the base. Draw the top view, sectional front view and the true shape of section.(Nov'08)
8. A square prism of base side 30 mm. and axis length 60 mm. is resting on HP on one of its bases, with a base side inclined at 25° to VP. It is cut by a plane inclined at 40° to HP and perpendicular to VP and is bisecting the axis of the prism. Draw its front view, sectional top view and true shape of section.(May'08)
9. A cone of diameter of base 60 mm and axis 60 mm rests with its base on HP. A section plane perpendicular to VP and inclined at 75° to HP passes through the apex of the cone. Draw the sectional top view and true shape of the section.(Dec'07)
10. A cylinder of base diameter 45 mm and height 65 mm rests on its base on HP. It is cut by a plane perpendicular to VP and inclined at 30° to HP and meets the axis at a distance of 30 mm from base. Draw the front view, sectional topview and the true shape of section.(Jul'07)
11. A square pyramid, edge of base 40 mm. and height 70 mm. is resting upon HP on its base, keeping the base edges equally inclined to VP. A cutting plane, parallel to VP and passing through a point located 10 mm. in front of the top view of the axis, cuts the solid. Draw the sectional front view of the pyramid.(Jan'07)
12. A cone 75 mm. base diameter and height 85 mm. is resting on the base on HP. It is cut by a 60° inclined plane perpendicular to VP and cutting the axis at a height 30 mm. from the base. Draw the sectional top view and the true shape of the section.(Sep'06)
13. A tetrahedron of 50 mm. long edges is lying with one of its faces on HP, with an edge perpendicular to the VP. A section plane perpendicular to VP cut the tetrahedron such that the true shape of the section is an isosceles triangle of base 40 mm long and altitude 35mm. Draw its front view, sectional top view and true shape of the section.(May'06)

14. A hexagonal prism 25mm side and 70mm long rests with one of its rectangular faces on ground with the axis parallel to VP. A section plane perpendicular to VP and inclined at 30^0 to HP bisects the axis of the prism. Draw its sectional top view and true shape of section.(Dec'05)
15. A cone of base diameter 60 mm. standing upright is cut by a section plane such that the true shape is a parabola whose double ordinate is 50 mm. and abscissa is 70 mm. Draw the front view, top view and true shape of section.(May'04)
16. The base diameter of a cone is 60 mm. and the axis is 80 mm. long. The axis of the cone is inclined at 45° to HP and parallel to VP. A horizontal plane cuts the cone through the midpoint of the axis. Draw the front view and the sectional top view.(Nov'03)
17. A right circular cone, diameter of base 60 mm and altitude 70 mm stands with its base on HP. A cutting plane normal to HP inclined 40° to VP and at a distance of 10 mm from the axis, cuts the cone. Draw the projections of the sectioned cone and the true shape of the section.(May'03).
18. A cone is resting on its base on HP. It is cut by a plane inclined 45^0 to HP and perpendicular to VP. It cuts the axis of the cone at a point 40 mm below the vertex. Draw the front view, sectional top view and the true shape of the section, if the diameter of the cone base is 80mm and the length of the axis is 90 mm.(May'03)

DEVELOPMENT OF SOLIDS

1. A circular cone, base circle diameter 50 mm and height 70 mm is resting on its base. A semicircular hole, diameter 26 mm is drilled such that the axis of the hole is perpendicular to VP and intersects with the axis of the cone at a height of 20 mm above HP. Develop the lateral surface of the cone if the top surface of the hole is flat.(May'12)
2. A vertical hexagonal prism of 30 mm side and axis 65 mm long has one of its rectangular faces parallel to VP and nearer to it. A circular hole of 20 mm diameter is drilled through the prism completely such that the axis of the hole bisects the axis of the prism at right angles and is perpendicular to VP. Draw the development of the prism showing the shape of the hole on it.(May'12)
3. A frustum of a square pyramid has its base 50mm side, top 25mm side and height 75mm. Draw the development of its lateral surface.(April'11)
4. A vertical cylinder is 80mm diameter and 100mm high. A circular hole of 65mm dia. is drilled centrally such that the axis of the hole bisects the axis of the cylinder at right angles and is perpendicular to VP. Develop the lateral surface of the cylinder showing true shape of the hole on it.(April'11)
5. A vertical cone of 35mm dia. of base and axis 50mm is cut by a section plane which makes 45^0 to HP and bisects the axis of the cone. Draw the development of the lateral surface of the truncated cone.(May'10)
6. Develop the lateral surface of a 90^0 elbow. Each pipe has a dia. of 40mm. The maximum length of one leg of the elbow is 60mm.(May'10,May'08, May'05)
7. Draw the development of a right circular cone of base diameter 50 mm and height 54 mm resting upon HP on its base. An insect moves from a point on the base edge to the diametrically opposite point on the same edge through a shortest path along the curved surface. Mark the shortest path in the front and top views of the cone. (Nov'08)

8. Draw the development of the lower portion of a cylinder of diameter 50 mm and axis 71 mm when sectioned by a plane inclined at 40° to HP and perpendicular to VP and bisecting the axis.(Dec'07)
9. A cube of side 30 mm rests on one of its faces on HP with a vertical face inclined at30° to the VP. It is cut by a plane perpendicular to the VP and inclined at 50° to the HP. The plane bisects the axis of the cube. Draw the development of the surface of the Right portion of the cut cube.(Jul'07)
10. Draw- the development of a T-shaped pipe of diameter 30 mm.(Jul'07)
11. A square pyramid of 20 mm. side base and 40 mm. height rests on its base. A cutting plane is making an angle of 45° with the HP and cutting the axis at a height of 25 mm. from the base. Develop the truncated pyramid. (Jan'07)
12. A cylinder is cut by a plane which is perpendicular to VP and at an angle of 45° to HP. The upper portion of the cylinder is removed. Draw the development of the remaining portion of the cylinder. (May'06)
13. Draw the development of a tetrahedron of base 60 mm. (Sep'06)
14. A cone of base diameter 60 mm. and height 70 mm. is resting on its base on HP. It is cut by a plane perpendicular to both HP and VP at a distance 15 mm. to the left of the axis. Draw the development of the lateral surface of the right portion of the cut cone. (Dec'05)
15. A sugar jar in the form of a right circular cone of base diameter 60 mm. and height 90 mm. and it rests on HP. An ant moves from extreme left end on its base, returns to its starting point, after moving around it. Find geometrically the length of the shortest path the ant can take. Show the path in both front and top views.(May'04)
16. A pentagonal pyramid of side 30 mm. and height 80 mm. is resting on its base on the HP. One edge of the base is inclined at 30° to the VP. It is cut by a section plane perpendicular to the VP and inclined 45° to the HP. The section plane passes through the middle of the axis. Draw the development of the bottom portion of the solid. (Nov'03)
17. A right regular pentagonal prism edge of base 25mm and height 64mm rests on its base with one of its edges perpendicular to VP. An ant moves from the bottom corner to the diagonally opposite corner lying in a vertical face perpendicular to VP. Draw the development of the surface and mark the path of the ant in the elevation.(May'03)
18. Draw the development of the lateral surface of a right regular hexagonal prism of 30 mm base edge and 80 mm height. An ant moves on its surface from a corner on the base to the diametrically opposite corner on the top face by the shortest route. Sketch the path of the ant in the elevation.(May'03)

MODULE - V

PERSPECTIVE PROJECTION

1. A triangular prism of base edge 30 mm and 50 mm long is resting on one of its rectangular faces on the ground with its base edge making an angle of 40^0 with the picture plane. The nearest corner of the rectangular face on the ground is 10 mm behind the PP. The station point is 70 mm from the PP and 10mm to the left of the corner nearest to PP. The horizon plane is 60 mm above the ground. Draw the perspective view of the object.(May'12)

2. Draw the perspective view of a rectangular prism of 100 mm x 60 mm x 40 mm size lying on its 100 mm x 60 mm rectangular face on the ground plane, with a vertical edge touching the picture plane and the end faces inclined 60° with the picture plane. The station point is 100 mm in front of the picture plane, 80 mm above the ground plane and lies in a central plane which is passing through the centre of the prism.(May'12)
3. A cube of side 40mm is resting on the ground such that one of its faces is parallel to and the mid of the solid is on the PP. The central plane is located 20mm to the left of the nearest corner of the cube. The station point is 60mm in front of the picture plane and 70mm above the GP. Draw the perspective view of the solid.(April'11)
4. A rectangular block of dimensions 3 cm *x* 2 cm x 1.5 cm is lying on the ground on one of its largest faces. A vertical edge is in the PP and longer face containing that edge makes 30^0 inclinations with PP. The station point is 5 cm in front of the PP, 3 cm above the ground and lies in a central plane which passes through the centre of the block. Draw the perspective view.(April'11)
5. A regular hexagonal pyramid of base 30mm and height 50mm rests its base on the GP with one of its base edge in the PP. The station point is 60mm above the GP and 50mm in front of PP. The central plane is 25mm to the left of the axis. Draw the perspective view of the solid.(May'10)
6. A cube edge 40mm stands on a face on the GP. Its nearest vertical edge is 15mm from the PP. One face inclined at an angle of 60^0 to PP. The SP is 120mm from the PP, the nearest corner lies in the central plane and the top face on the horizon. Draw its perspective projection.(May'10)
7. A pentagonal prism, 30 mm, side and 100 mm. long rests on one of its rectangular faces on ground, the axis of which is inclined at 45^0 to the picture plane. The nearest corner of the front face lies 20 mm. to the left of the station point and 10 mm. behind the picture plane. The eye is 60 mm. above the ground and 90 mm. in front of the picture plane. Draw the perspective view of the prism.(May'09)
8. A hexagonal pyramid of base 10 cm and height 15 cm rests on the ground with the nearest edge of the base parallel to and 4 cm behind the picture plane. The station point is situated at a distance of 40 cm from the picture plane and 10 cm above the ground plane and 15 cm to the right of the apex. Draw the perspective view.(Nov'09)
9. A rectangular prism of dimensions 80 cm *x* 40 cm x 32 cm is lying on the ground in such a way that one of the largest faces is on the ground. A vertical edge is 10 cm behind PP and longer face containing that edge makes 30^0 inclinations with PP. The station point is 80 cm in front of the PP, 60 cm above the ground and lies on a central plane which passes through the centre of the prism. Draw the perspective view by vanishing point method.(Nov'08,May'06)
10. A square prism of side base 30 mm and height 50 mm rests with its base on the ground and one of the rectangular faces inclined at 30° to the picture plane. The nearest vertical edge touches the PP. The station point is 45 mm. in front of the PP, 60 mm. above the ground and opposite to the nearest vertical edge that touches the PP. Draw the perspective view of the prism.(May'08).
11. A cube of edge 5cm rests with one of the faces on the ground, the nearest vertical edge being 1cm to the left of the station point and 2.5cm behind PP. A face containing the

nearest vertical edge is inclined at 60° to the PP. The station point is 7.5cm above the ground and 10cm in front of PP. Draw the perspective view of the cube.(Dec'07)

12. Draw the perspective view of a cube of 25 mm edge, resting on ground on one of its faces. It has one of its vertical edges in the picture plane and all its vertical faces are equally inclined to the picture plane. The station point is 55 mm in front of the picture plane, 40 mm above the ground and lies in the central plane which is 10 mm to the left of the center of the cube.(Jul'07)
13. A rectangular pyramid base 3.5 cm. x 2 cm. and axis 5 cm. long is placed on the ground plane on its base, with the longer edge of the base parallel to and 3 cm. behind the picture plane. The central plane is 3 cm. to the left of the apex and the station point is 5 cm. in front of the picture plane and 2.5 cm. above the ground plane. Draw the perspective view of the pyramid.(May'06,'04)
14. A square prism, side of base 40 mm. and height 60 mm. rests with its base on the ground such that one of its rectangular faces is parallel to and 10 mm. behind the picture plane. The station point is 30 mm. in front of PP, 80 mm. above the ground plane and lies in a central plane 45 mm. to the right of the centre of the prism. Draw the perspective view.(Jul'07,May'05)
15. A square prism of base 30 *x* 30 cm. and height 60 cm. stands on Ground Plane (GP), with edges of the base making 50° with the picture plane (PP). The nearest corner is 30 cm. to the right of the station point and 30 cm. behind PP. The station point is 50 cm. above GP and 100 cm. in front of PP. Draw the perspective view of the square prism.(Jan'07)
16. A rectangular prism, sides of base 50 mm. x 30 mm. and height 55 mm, rests with its base on the ground plane. A vertical edge is in the picture plane and one of the longer edges of the base is inclined at 45° to PP and behind it. The station point is 50 mm. in front of PP, 75 mm. above the ground plane and lies in a central plane which passes through the centre of the prism. Draw the perspective view.(Dec'05)
17. A rectangular pyramid of base 35 mm by 20 mm and axis 50 mm long stands in the ground plane on its base. The longer side of the base is parallel to and 30 mm behind the PP. The central plane is 25 mm to the left of the apex and the station point is 50 mm in front of the PP and 25 mm above the ground plane. Draw the perspective view of the pyramid.(May'04)
18. A cube of 45 mm side lies on the ground with an edge in the PP and all vertical faces equally inclined to the PP. The station point is 100mm in front of the PP and 70mm above the ground plane and lies in a central plane, which is 20mm to the left of the centre of the cube. Draw the perspective view of the cube.(May'04)
19. A pentagonal prism has a side of 30mm and length of 60mm lies on one of its rectangular faces on the ground plane with one base touches the PP. The station point is 60 mm in front of PP, 40mm above the ground plane and lies in a central plane which is 75mm to the left side of the centre of the prism. Draw the perspective projection of the prism.(Nov'03)
20. A circular lamina of diameter 60 mm is lying in the ground plane touching the picture plane. The station point is60 mm above the ground plane and 70mm in front of the picture plane. The station point is contained in the central plane, which passes at a distance of 50 mm from the centre of the circle. Draw the perspective view of the circle by visual ray method.(May'03)

21. A square prism 120 mm x 60 mm x 60 mm size is lying on one of its rectangular faces on the ground plane such that a vertical edge touches the picture plane and the square faces are inclined 30° to the same plane. The station point is 130mm in front of the picture plane, 90 mm above the ground plane and lies in a central plane, which is passing through the centre of the prism. Draw perspective view of the prism following the visual ray method.(May'03)
22. A hexagonal prism side of base 50mm and height 60mm has its base on the ground with an edge of the base parallel to and 40mm behind the picture plane. The station point is 100mm from the PP and 90mm above the ground in a CP through the axis of the prism. Draw the perspective view of the prism.(June'04, CU)
23. A square prism side of base 30mm and length 50mm rests on a long edge on the ground plane with another long edge touching the PP, so that the four rectangular faces being equally inclined to the PP. The CP is 30mm to the right of the centre of the solid. The station point is 90mm above the GP and 75mm in front of the PP. Draw the perspective projection of the prism.(June 2000, CU)
24. A hexagonal prism of 25mm side and 30mm height is placed vertically with one of its 30mm edges on the PP such that the two rectangular faces of that edge are equally inclined to PP. the top hexagonal end face touching an auxiliary ground plane (AGP) at a height of 60mm above the horizon plane. Draw the perspective view of the prism if the station point is 70mm in front of the PP and lies in the CP which is 35mm to the right side of the centre of the prism.(June '01, CU)

BASICS OF CIVIL & MECHANICAL ENGINEERING

COURSE INFORMATION SHEET

PROGRAMME: AI&DS	DEGREE: BTECH
COURSE: BASICS OF CIVIL ENGINEERING	SEMESTER: S1 LTPCREDITS:2-0-0 - 2
COURSE CODE:100908/CO900D REGULATION: 2019	COURSE TYPE: BASIC
COURSEAREA/DOMAIN:CIVIL ENGINEERING	CONTACT HOURS: 2 hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME: BASIC CIVIL & MECHANICAL ENGINEERING WORKSHOP

SYLLABUS:

UNIT	DETAILS	HOURS
I	**GeneralIntroductiontoCivilEngineering**:RelevanceofCivilEngineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment. Brief introductiontomajordisciplinesofCivilEngineeringlikeTransportation 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.	9
II	**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, water proofing materials. Modern uses of gypsum, pre-fabricated building components (brief discussion only).	7

III	**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.	7
	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).	
TOTAL HOURS		23

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	SatheeshGopi, Basic Civil Engineering, Pearson Publishers
T2	Rangwala, Essentials of Civil Engineering, Charotar Publishing House
T3	Anurag A. Kandya, Elements of Civil Engineering, Charotar Publishing house
T5	Rangwala S C and Ketki B Dalal, Engineering Materials, Charotar Publishing house
T6	Rangwala S C and Ketki B Dalal, Building Construction, Charotar Publishing house
T7	McKay, W. B. and McKay, J. K., Building Construction Volumes 1 to 4, Pearson India Education Services
T8	Chen W.F and Liew J Y R (Eds), The Civil Engineering Handbook. II Edition CRC Press (Taylor and Francis)
T9	Chudley, R and Greeno R, Building construction handbook, Addison Wesley, Longman group, England
T10	Chudley, R, Construction Technology, Vol. I to IV, Longman group, England Course Plan
T11	Kandya A A, Elements of Civil Engineering, Charotar Publishing house
T12	Mamlouk, M. S., and Zaniewski, J. P., Materials for Civil and Construction Engineering, Pearson Publishers

COURSE PRE-REQUISITES: NIL

COURSE OBJECTIVES:

1	To inculcate the essentials of Civil Engineering field to the students of all branches of Engineering.
2	To provide the students an illustration of the significance of the Civil Engineering Profession in satisfying societal needs.

COURSE OUTCOMES:

Sl No:	DESCRIPTION
1	Recalltheroleofcivilengineerinsocietyandtorelatethevariousdisciplinesof Civil Engineering.
2	Explain different types of buildings, building components, building materials and building construction
3	Describe the importance, objectives and principles of surveying
4	Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and Ramps

GAPS IN THE SYLLABUS-TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

Sl NO	DESCRIPTION	PROPOSED ACTIONS
1	Cement Mortar, Processes in concreting, Grades of concrete.	Classroom lectures
2	Significance of water cement ratio in concreting	Classroom lectures

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCEDTOPICS/DESIGN:

1	Building finishes (Plastering, Painting etc.)
2	Introduction to construction equipments

WEB SOURCE REFERENCES:

1	IntroductiontoCivilEngineeringProfession–Nptel-https://nptel.ac.in/courses/105/106/105106201/
2	Civil Engineering - Building materials and Construction - Nptel - https://nptel.ac.in/courses/105/102/105102088/

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

CHALK&TALK√	**STUD.ASSIGNMENT√**	**WEB RESOURCES√**
LCD/SMART BOARDS√	**STUD.SEMINARS √**	ADD-ONCOURSES

ASSESSMENT METHODOLOGIES-DIRECT

ASSIGNMENTS√	**STUD.SEMINARS √**	**TESTS/MODEL EXAMS√**	**UNIV. EXAMINATION√**
STUD.LAB PRACTICES√	**STUD.VIVA√**	MINI/MAJOR PROJECTS	CERTIFICATIONS
ADD-ON COURSES	OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

ASSESSMENTOFCOURSEOUTCOMES(BY FEEDBACK, ONCE) √	**STUDENTFEEDBACKONFACULTY (TWICE) √**
ASSESSMENTOFMINI/MAJORPROJECTS BY EXT. EXPERTS	OTHERS

COURSE PLAN

HOUR	MODULE	TOPICS PLANNED
HOUR 1	1	General Introduction to Civil Engineering, Relevance of Civil Engineering in the overall infrastructural development of the country.
HOUR 2	1	Responsibility of an engineer in ensuring the safety of built environment.
HOUR 3	1	Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo- technical Engineering, Water Resources Engineering and Environmental Engineering.
HOUR 4	1	Introduction to buildings: Types of buildings
HOUR 5	1	selection of site for buildings
HOUR 6	1	components of a residential building and their functions
HOUR 7	1	Building rules and regulations: Relevance of NBC, KBR
HOUR 8	1	Building rules and regulations: Relevance of CRZ norms
HOUR 9	2	Building area: Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.
HOUR 10	2	Surveying: Importance, objectives and principles
HOUR 11	2	Construction materials, Conventional construction materials: types, properties and uses of building materials: bricks,
HOUR 12	2	Construction materials, Conventional construction materials: types, properties and uses of building materials: stones,
HOUR 13	2	Construction materials, Conventional construction materials: types, properties and uses of building materials: cement,
HOUR 14	2	Construction materials, Conventional construction materials: types, properties and uses of building materials: timber

HOUR 15	2	Construction materials, Conventional construction materials: types, properties and uses of building materials: sand
HOUR 16	2	Cement concrete: Constituent materials, properties and types.
HOUR 17	3	Steel: Steel sections and steel reinforcements, types and uses.
HOUR 18	3	Modern construction materials:- Architectural glass, ceramics,
HOUR 19	3	Modern construction materials:- Plastics, composite materials, thermal and acoustic insulating materials
HOUR 20	3	Modern construction materials:- decorative panels, water proofing materials.
HOUR 21	3	Modern construction materials:- Modern uses of gypsum, pre-fabricated building components
HOUR 22	3	Building Construction: Foundations: Bearing capacity of soil (definition only), functions of foundations
HOUR 23	3	Building Construction: Foundations: types– shallow and deep
HOUR 24	3	Load bearing and framed structures
HOUR 25	3	Brick masonry: - Header and stretcher bond, English bond & Flemish bond
HOUR 26	3	random rubble masonry
HOUR 27	4	Roofs and floors: - Functions, types; flooring materials
HOUR 28	4	Basic infrastructure services: MEP, HVAC, elevators, escalators and ramps
HOUR 29	4	fire safety for buildings.
HOUR 30	4	Green buildings:- Materials, energy systems, water management and environment for green buildings.
HOUR 31	4	Revision

ASSIGNMENT – I (To be submitted on/before 15th Jan 2021)

All questions are compulsory

1. With a neat sketch, explain the functions of various building components
2. Briefly discuss on (i) coastal regulation zones and (ii) Kerala building rules.
3. Briefly discuss the use of stone and timber as building materials.
4. Discuss the various disciplines of Civil Engineering and the role played by a Civil Engineer in a society.

ASSIGNMENT – II (To be submitted on/before 20th Feb 2021)

All questions are compulsory

1. Write short notes on the following modern construction materials:
    a. Architectural glass
    b. Ceramics
    c. Plastics
    d. Composite materials
    e. Thermal and acoustic insulating materials
    f. Decorative panels
    g. Water proofing materials

2. Distinguish between load bearing and framed structures

3. With neat sketches compare Flemish bond and English bond ($1\frac{1}{2}$ brick thick). Is English bond stronger when compared to Flemish bond? Justify

4. Discuss the following basic infrastructure services required for a building in a civil engineering perspective.
    a. MEP services
    b. HVAC services

UNIT WISE QUSTION BANK

Module I

1) Explain the functional requirements of residential buildings.
2) Explain the role of civil engineer to the society.
3) Explain the general requirements of site and building for planning a residential building.
4) What are the factors to be considered in the selection of site for a residential building?
5) Explain in detail about the classification of buildings as per NBC.
6) Briefly discuss on KBR and CRZ
7) With neat sketch explain the essential components of a residential building.
8) List out the various building components of your house. (2 marks)
9) Give the functions of any three building components. (3 marks)
10) Classify the types of buildings as per National Building Code of India. (3 marks)
11) Explain the relevance of Civil Engineering in the overall infrastructural development of the country. (3 marks)
12) Explain the responsibility of an engineer in ensuring the safety of built environment. (3 marks)
13) List out the types of building as per occupancy. Explain any two, each in about five sentences. (6 marks)
14) Explain very briefly about the classification of buildings based on occupancy. (3 marks)
15) Write a short note on various components of a residential building and their functions. (6 marks)
16) Write a note on the importance of civil engineering on infrastructural development of India.(6 marks)
17) What is civil engineering? Explain the role of Civil engineer in society.
18) What measures should be taken during the site selection for building?
19) What are the various disciplines of civil engineering?
20) Explain the different fields of civil engineering.
21) What is the scope of civil engineering in the different field?
22) Discuss some recent remarkable infrastructure developments in India.
23) What are the different types of buildings according to NBC(National Building Code)?
24) Explain the kinds of buildings as per NBC and also write the comparison of load bearing and framed structure.
25) What are the different components of the residential building and explain their function.
26) Explain coverage and FAR.
27) Explain plinth area and plot area.

28) Differentiate carpet area and floor area

Module II

1) Define surveying. What are the objectives of surveying
2) What is meant by Grade of cement? Give different grades of cement available in the market.
3) What are the chemical properties of cement?
4) Differentiate initial and final setting time of cement.
5) What are the properties of mild steel?
6) What is meant by tor steel? List out its advantages.
7) Explain the importance of steel in concrete.
8) Give the qualities of ideal brick.
9) List out the uses of brick.
10) Explain the manufacture of OPC.
11) Explain different types of cement
12) With neat sketches explain the different types of structural steel sections available in the market.
13) What are the different types of brick? Explain.
14) Differentiate cement mortar and cement concrete.
15) Differentiate between plain cement concrete and reinforced cement concrete.
16) What are the functions of water in concrete?
17) What are the objects of curing on concrete?
18) Describe the cement mortar preparation.
19) Give the advantages and disadvantages of concrete.
20) Explain the types of concrete.
21) What are the properties of concrete? Explain.
22) List out the grades of Ordinary Portland Cement (ICE,January,2016)
23) Sketch and explain any three structural steel sections (ICE,January,2016)
24) Which is the strongest bond in brick work? (ICE,January,2016)
25) What are the different flooring materials and factors affecting its selection?(ICE,January,2016)
26) Write any one relevant factor for selecting suitable flooring material.
27) List out the various types of tiles used in civil engineering (ICE,January,2016)
28) What are the uses of mild steel ?(ICE,January,2016)
29) What are the different types of roofing material? (ICE,January,2016)
30) Explain different types of steel with their properties (BCE,January,2016)
31) What are the constituents of cement and explain the functions of each? (BCE,January,2016)
32) What are the different kinds of cement available and what is their use?
33) Briefly discuss on Modern construction materials - Architectural glass, ceramics, Plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials.

Module III

1) What are the objectives of foundations?
2) Define bearing capacity of soil.
3) Differentiate between ultimate bearing capacity and safe bearing capacity of soil
4) Give the difference between deep and shallow foundations.
5) Draw neat sketch of the following: a) Isolated Stepped Footing b) Cantilever Footing c) continuous Footing (BCE January 2016)
6) Define Stretcher and Header
7) Draw the elevation and plan of one brick thick wall with English Bond. (BCE January, 2016)
8) Draw the elevation and plan of one brick thick wall with Flemish Bond. (BCE January, 2016)
9) Compare and contrast English Bond and Flemish Bond with sketches.
10) What are the essential features of English Bond. (ICE January, 2016)
11) What are the essential features of Flemish Bond.
12) List the functions/requirements of roofs.
13) Explain different types of roofs. (Please note roofs and roofing materials are different)
14) What are the various roofing materials available? (BCE January, 2016)
15) List out seven advantages and disadvantages of flat roof. (ICE January, 2016)
16) List the functions/requirements of floors.
17) Explain different types of floors.
18) List the various types of flooring materials.
19) Write short note on lifts/elevators.
20) Explain the various design considerations for provision of lifts/elevators in a building.
21) Write short note on escalators.
22) Difference between elevators and escalators. (BCE, January 2016)
23) Write short note on ramps.
24) Explain the concept of air conditioning.
25) What are the purposes of air conditioning in a building? (BCE, January 2016)
26) Explain the different types of air conditioning systems. (BCE, January 2016)
27) What are the major sound proofing materials? Explain briefly. (BCE, January 2016)
28) Write short note on fire safety for buildings
29) Write a short on intelligent buildings.
30) What is meant by intelligent buildings? What are the various conditions to be satisfied by intelligent buildings? (BCE, January 2016)
31) Write a short note on Green Buildings.

COURSE INFORMATION SHEET (2020)

PROGRAMME: **Artificial Intelligence & Data Science**	DEGREE: **B.TECH** UNIVERSITY: **APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**
COURSE: **BASICS OF MECHANICAL ENGINEERING**	SEMESTER: **S1** CREDITS: **2**
COURSE CODE: **100908-CO900D** REGULATION: **2020**	COURSE TYPE: **CORE**
COURSE AREA/DOMAIN: **BASIC SCIENCE& ENGINEERING**	CONTACT HOURS: **2(L)hours/week**
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME: BASIC MECHANICAL ENGINEERING WORKSHOP

SYLLABUS:

UNIT	DETAILS	HOURS
I.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
I.2	IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines, efficiencies IC Engines(Description only)	2
I.3	Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines	2
II.1	Refrigeration: Unit of refrigeration, reversed Carnot cycle, COP, Vapour compression cycle (only description and no problems)	1
II.2	Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.	1
II.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	4
II.4	Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches	3
III.1	Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.	2
III.2	Metal Joining Processes: List types of welding, Description with sketches of Arc Welding, Soldering and Brazing, and their applications.	1
III.3	Basic Machining operations: Turning, Drilling, Milling and Grinding Description about working with block diagrams of: Lathe, Drilling machine, Milling machine, CNC Machine	3
III.4	Principle of CAD/CAM, Rapid and Additive manufacturing	1
TOTAL HOURS		**24**

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Benjamin J., *Basic Mechanical Engineering,* Pentex books, 9th Edition,2018
T2	Balachandran P., Basic Mechanical Engineering, Owl Books
R1	Clifford, M., Simmons, K. and Shipway, P., An Introduction to Mechanical Engineering Part I - CRC Press
R2	Roy and Choudhary, Elements of Mechanical Engineering, Media Promoters &Publishers Pvt. Ltd., Mumbai.
R3	P.K.Nag, *Engineering Thermodynamics,* McGraw Hill
R4	P.L. Bellany, *Thermal Engineering,* Khanna Publishers
R5	Sawhney G. S., Fundamentals of Mechanical Engineering, PHI

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
-	BASIC SCIENCES	Basics of Physics and Chemistry at the level of Higher Secondary Education	Secondary school level

COURSE OBJECTIVES:

1	To introduce the students to the basic principles of mechanical engineering

COURSE OUTCOMES:

SL. NO.	DESCRIPTION	Blooms' Taxonomy Level
C0.1	Students will be able to *understand* the important concepts of thermodynamics and will be able to analyze thermodynamic cycles	Understand and Analyze (level 2, 3)
C0.2	Students will be able to *Illustrate* the working and features of IC Engines and can *identify* the scope of electronics in IC engines	Understand (level 2)
C0.3	Students will be able to *identify* and *differentiate* the different components of a refrigerator and air-conditioning unit.	Understand (level 2)
C0.4	Students will be able to *understand* the working of hydraulic machines	Understand (level 2)
C0.5	Students will be able to *understand* the working of power transmission devices. And will be able to select appropriate transmission device for a specific requirement.	Apply (level 3)
C0.6	Students will be able to *classify* different manufacturing processes for various applications.	Understand (level 2)
C0.7	Students will be able to apply their knowledge in machine tools to *extend* their opportunities in CNC machine tools.	Understand (level 2)

CO-PO AND CO-PSO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	-	-	-	-	-	-	-	1	-	-	-	-	-
CO2	2	-	-	-	-	1	-	-	-	1	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	1	-	-	-	-	-
CO4	2	1	-	-	-	-	-	-	-	1	-	-	-	-	-
CO5	2	1	-	-	-	-	-	-	-	1	-	-	-	-	-
CO6	2	-	-	-	-	-	-	-	-	1	-	-	-	-	-
CO7	2	-	-	-	1	1	-	-	-	1	-	-	-	-	-

JUSTIFATIONS FOR CO-PO MAPPING

MAPPING	LOW/MEDIUM/ HIGH	JUSTIFICATION
CO1-PO1	M	Apply the knowledge of mathematics, science and engineering fundamentals to understand the concepts of thermodynamics.
CO1-PO2	M	Problem analysis and obtaining the efficiencies of different thermodynamic cycles using the using the first principles of mathematics and thermodynamic process.
CO1-PO10	L	Effectively communicate about the various terminologies used in thermodynamics.
CO2-PO1	M	Apply the knowledge of mathematics, science and engineering fundamentals to understand the concepts of various energy conversion devices.
CO2-PO6	L	Apply the knowledge in different energy conversion devices for the betterment of societal and safety issues of the society.
CO2-PO10	L	Effectively communicate about the working of various energy conversion devices.
CO3-PO1	M	Apply the knowledge of mathematics, science and engineering fundamentals to understand the concepts of refrigerator and air-conditioning unit.
CO3-PO10	L	Effectively communicate about the working of refrigerator and air-conditioning unit.
CO3-PO2	L	Understanding the fundamental terms/parameters involved in RAC

CO4-PO1	M	While understanding the principles of hydraulic machines students may apply knowledge in science and engineering
CO4-PO2	L	Basic calculations of efficiency of hydraulic machines
CO4-PO10	L	Effectively communicate about hydraulic machinery
CO5-PO1	M	Apply the knowledge of mathematics, science and engineering fundamentals to understand the concepts of power transmission devices.
CO5-PO2	L	Basic understanding of calculations involved in power transmission devices
CO5-PO10	L	Effectively communicate about the working of Power transmission devices.
CO6-PO1	M	Apply the knowledge of mathematics, science and engineering fundamentals to understand the different engineering materials and manufacturing process.
CO6-PO10	L	Effectively communicate about different manufacturing process.
CO7-PO1	M	Apply the knowledge of mathematics, science and engineering fundamentals to understand the working of machine tools.
CO7-PO5	L	Students will be able to gain the knowledge regarding modern machine tools
CO7-PO6	L	Effective utilization of machine tools can reduce material and energy wastage.
CO7-PO10	L	Effectively communicate about working of machine tools.

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SL NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Gas Laws, Ideal Gas Equation	See Topics beyond syllabus	1	-
2	Psychrometric Chart	Video Lecture	1	-

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SL NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Lab visit to show the different parts of an automobile	Lab Visit	1	-
2	Gas Laws, Ideal Gas Equation	Lectures	1	-
3	Steam Turbines and Gas Turbines	Video lectures	1	-

WEB SOURCE REFERENCES:

1	https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLD8E646BAB3366BC8
2	https://www.youtube.com/watch?v=2iYqZ8tIP1I&list=PLT7nZHsCM2mxVhbXn7BeHTXg4w7btBf5I
3	https://www.youtube.com/watch?v=RR-3Uq--4Oo&list=PLE2DA184A2E479885&index=11
4	https://nptel.ac.in/content/storage2/courses/112105125/pdf/mod13les2.pdf
5	https://nptel.ac.in/courses/112/104/112104117/
6	https://nptel.ac.in/courses/112/107/112107219/
7	https://nptel.ac.in/content/storage2/courses/108105063/pdf/L-23(SM)%20(IA&C)%20((EE)NPTEL).pdf

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☐ CHALK & TALK	☑ STUD. ASSIGNMENTS	☑ WEB RESOURCES	☑ ONLINE CLASSES
☑ LCD/SMART BOARDS	☐STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

☑ASSIGNMENTS	☐STUD. SEMINARS	☑ TESTS/MODEL EXAMS	☑UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☐STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☑ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Course Plan

Sl.No	Module	Planned Date	Planned
1	4	01-Dec-20	Introduction to BME, Basics of Thermodynamics -Terms (Gap in the syllabus)
2	4	03-Dec-20	Introduction to civil engineering. Role of civil engineer in the development of the nation.
3	4	04-Dec-20	Basics of Thermodynamics - Laws (Gap in the syllabus)
4	4	08-Dec-20	Basics of Thermodynamics -Processes (Gap in the syllabus)
5	4	11-Dec-20	Carnot Cycle & Otto Cycle
6	4	15-Dec-20	Diesel Cycle
7	4	16-Dec-20	Problems - Cycles (Calculate heat added, heat rejected, net work and efficiency)
8	4	18-Dec-20	IC Engines - Basic Terms, Parts and Classification
9	1	28-Dec-20	Building components and explaining each part of the building.
10	4	29-Dec-20	SI and CI Engines
11	4	30-Dec-20	4 stroke and 2 stroke engines
12	1	30-Dec-20	Explaining Plinth area, Plot area, Floor area, Carpet area ,Floor area ratio . A problem is also done including all the areas
13	4	01-Jan-21	Air, Cooling and Lubrication Systems
14	2	04-Jan-21	Surveying, purpose of surveying and classification of surveying
15	1	05-Jan-21	CRZ rules and regulations, classifications of CRZ , permissible activities in each zone
16	4	05-Jan-21	Fuel System - CRDI and MPFI: Hybrid Engines
17	4	06-Jan-21	extra class/ quiz/assignment test
18	1	07-Jan-21	KMBR rules and regulations. Exterior and Interior

19	5	08-Jan-21	Refrigeration - Units, Reversed Carnot Cycle, COP
20	1	11-Jan-21	Revising for series 1
21	5	12-Jan-21	Vapour Compression Cycle
22	5	13-Jan-21	Terms and processes in Psychrometry; Layout and working of unit and central air conditioners
23	5	15-Jan-21	Parts and working of Reciprocating and Centrifugal Pumps
24	1	18-Jan-21	Revising for series 1
25	1	18-Jan-21	Types of buildings according to NBC. Explaining each in detail. Planning and site selection for buildings
26	5	19-Jan-21	Working of Pelton, Francis and Kaplan Turbines
27	5	20-Jan-21	extra class/ quiz/assignment test
28	2	21-Jan-21	SURVEYING, PURPOSE AND OBJECTIVES OF SURVEYING
29	2	25-Jan-21	Different Classifications Of Surveying, Principles Of Surveying
30	2	28-Jan-21	Different building materials used for construction. Bricks, cement, concrete, steel, stone, sand and timber.
31	5	29-Jan-21	Problems - Pumps and Turbines (Efficiency, input and output power)
32	2	01-Feb-21	TYPE ,CONSTRUCTION AND PROPERTIES OF BRICKS
33	5	02-Feb-21	Belt and Chain drives, Gears
34	5	03-Feb-21	Gear Trains, Single plate clutch
35	2	04-Feb-21	CLASSIFICATION OF BRICKS, TESTS ON BRICKS
36	6	05-Feb-21	Sand Casting & forging Process
37	2	08-Feb-21	PROPERTIES, MANUFACTURING OF CEMENT
38	6	09-Feb-21	Rolling & Extrusion Process

39	6	10-Feb-21	extra class/ quiz/assignment test
40	2	11-Feb-21	CLASSIFICATION OF CEMENT,USES AND GRADES OF CEMENT
41	6	12-Feb-21	Welding - types, Arc Welding
42	2	15-Feb-21	Types and properties and classification of stones and timber
43	6	16-Feb-21	Soldering and Brazing
44	6	17-Feb-21	Turning, Drilling and their machines
45	2	18-Feb-21	Types and classification and properties of steel and concrete
46	6	19-Feb-21	Milling, Grinding and their machines
47	3	22-Feb-21	BEARING CAPACITY OF SOIL,, TYPES OF FOUNDATION,FUNCTIONS
48	6	23-Feb-21	Milling, Grinding and their machines
49	6	24-Feb-21	extra class/ quiz/assignment test
50	3	25-Feb-21	BRICK MASONRY-ENGLISH BOND AND FLEMISH BOND-PLAN AND ELEVATION
51	6	26-Feb-21	CNC Machines
52	3	04-Mar-21	FUNCTIONS OF ROOFS AND FLOORS
53	6	05-Mar-21	CAD/CAM Principles
54	3	08-Mar-21	BASIC INFRASTRUCTURE SERVICES MEP,HVAC
55	6	09-Mar-21	Rapid and additive manufacturing

Assignment

(Based on Module 4 & Module 5)

1	Draw neat sketches of flow diagram showing a) Air intake system of I C engines b) Fuel system of I C engines	5 marks
2	Draw the neat sketches of a) Air cooling system b) Liquid cooling system (line diagram)	5 marks each
3	Draw neat sketches of a) Splash lubrication system b) Pressure feed lubrication system	5 marks each
4	Draw neat sketches showing a) MPFI technology b) CRDI technology	5 marks each
5	Using a block diagram represent hybrid vehicles which receives power from IC engine and electric motor (commonly used)	5 marks
6	Draw neat sketches of a) Window air conditioner b) Split air conditioner c) Central air conditioning system	5 marks each
7	Draw neat sketches of (FV. TV combination for b & c) a) Pelton wheel turbine b) Francis turbine c) Kaplan turbine	5 marks each
8	Draw neat sketches of a) Centrifugal pump b) Reciprocating pump	5 marks each

Total marks: 80 marks

Date of submission: 24.02.2021, 11:59 pm

Assignment
(Based on Module 5)

1	Draw neat sketches of following c) Open belt drive d) Cross belt drive e) Flat belt f) V- belt	2 marks each
2	Draw the neat sketches of roller chain	5 marks
3	Draw neat sketches of c) Spur gear d) Helical gear e) Bevel gear f) Worm gear	3 marks each

4	Draw neat sketches showing c) Simple gear train d) Compound gear train e) Reverted gear train f) Epicyclic gear train g) Rack and pinion	4 marks each
5	Draw a neat sketch of single plate clutch	5 marks

Total marks: 50 marks

Date of submission: 10.03.2021, 11:59 pm

Prepared by

Mr. Rathish T R

(Faculty in Charge)

Approved by

Dr. Manoj G Tharian

(HOD, DME)

LIFE SKILLS

LIFE SKILLS

(COMMON TO ALL B.TECH PROGRAMMES)

COURSE INFORMATION SHEET (2020 - 2021)

PROGRAMME: All programmes	**DEGREE: B.TECH**
COURSE: LIFE SKILLS	**SEMESTER: I** **CREDITS: ---**
COURSE CODE: 100908/EN100E **REGULATION: 2019**	**COURSE TYPE: MANDATORY NON-CREDIT**
COURSE AREA/DOMAIN: HUMANITIES	**CONTACT HOURS: 4 hours/week – 2 L + 2P**

SYLLABUS:

UNIT	DETAILS
I	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
II	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.
III	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.
IV	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, Entrepreneurship.

V	Leadership: Leadership framework, entrepreneurial and moral leadership, vision, cultural dimensions. Growing as a leader, turnaround leadership, managing diverse stakeholders, crisis management.
LAB	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.
LAB	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.

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
R	Shiv Khera, "*You Can Win"*, Macmillan Books, New York, 2003
R	Barun K. Mitra, *"Personality Development & Soft Skills*", First Edition; Oxford Publishers, 2011
R	ICT Academy of Kerala, "*Life Skills for Engineers*", McGraw Hill Education (India) Private Ltd., 2016
R	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
R	Kalyana, "*Soft Skill for Managers*"; First Edition; Wiley Publishing Ltd., 2015
R	Larry James , "*The First Book of Life Skills*"; First Edition; Embassy Books, 2016
R	Shalini Verma, *"Development of Life Skills and Professional Practice"*; First Edition; Sultan Chand (G/L) & Company, 2014
R	Daniel Goleman, "*Emotional Intelligence*"; Bantam, 2006
R	Remesh S., Vishnu R.G., "*Life Skills for Engineers*", Ridhima Publications, First Edition, 2016
R	Jeff Butterfield, "*Soft Skills for Everyone*", Cengage Learning India Pvt Ltd; 1 edition, 2011
R	Stephen P. Robbins, Phillip L. Hunsaker*, "Training in Interpersonal Skills: Tips for Managing People at Work"*, Pearson Education, India; 6 edition, 2015
R	Gopalaswamy Ramesh, Mahadevan Ramesh*, "The Ace of Soft Skills: Attitude, Communication and Etiquette for Success"*, Pearson Education; 1 edition, 2013

COURSE PREREQUISITES : NIL

COURSE OBJECTIVES:

1	Enhance the employability and maximize the potential of the students by introducing them to the principles that underlie personal and professional success
2	Help the students acquire the skills needed to apply the principles of personal and professional success in their lives and careers

COURSE OUTCOMES:

NO	DESCRIPTION
CO1	Define and identify different life skills required in personal and professional life
CO2	Develop an awareness of the self and apply well-defined techniques to cope with emotions and stress
CO3	Explain the basic mechanics of effective communication and demonstrate these through presentations
CO4	Take part in group discussions
CO5	Use appropriate thinking and problem-solving techniques to solve new problems
CO6	Understand the basics of teamwork and leadership

MAPPING OF COURSE OUTCOMES TO PROGRAMME OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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**			

JUSTIFICATION:

CO	PO	JUSTIFICATION
CO 1	PO6	Knowledge and mastery of life skills will enable the student to effectively function at both the professional and personal levels
	PO8	The skills of analysis, logical reasoning and problem-solving will enable the student to make the right decision when faced with moral dilemmas in personal and professional life

	PO9	Developing an awareness of the self, learning to work in groups and teams, and learning about leadership enables the student to effectively carry out his responsibilities at both the individual and team level
	PO10	Developing an understanding of oneself, and learning the tools of effective communication enables the student to become a successful communicator
	PO11	Learning about problem-solving and decision making, and individual and team work enables the student to become efficient leaders and managers
	PO12	Understanding the importance of engaging in continuous personal and professional development motivates the student to become a lifelong learner
CO 2	PO9	Gaining an insight into the self and learning to cope with emotions and stress will help the student to be more effective at the individual level and as a team player
	PO12	Understanding one's priorities and learning to set clear goals will motivate the student to engage in lifelong learning
CO 3	PO6	Learning about and practising effective communication strategies will make the student successful in interacting with others in both professional and personal life
	PO9	Effective communication strategies will help the student to be more successful at the individual level and in groups: as a leader and as a team player
	PO10	Mastering the theoretical and practical aspects of communication will lay the foundation for effective personal and professional communication
CO 4	PO10	Taking part in group discussions and developing the skills of listening and responding to others' opinions helps the student to learn the rudiments of effective group communication
	PO12	By engaging in group discussions on contemporary topics the student will realize the need to keep oneself abreast of current developments thereby engaging in lifelong learning
CO 5	PO2	The exposure to effective thinking and problem-solving techniques enables the student to learn the rudiments of problem analysis
	PO3	Having gained an insight into creative and critical thinking techniques, the student will be better equipped to design and develop solutions
	PO4	The student will learn how to apply logical and creative thinking as the situation demands while encountering complex problems
CO 6	PO6	Learning about teamwork and leadership will help the student in both professional and personal life
	PO9	The theoretical framework and practical exposure provided will enhance the efficiency of the student in individual and team contexts

GAPS/TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

	TOPICS	PROPOSED ACTION
1	Existential, Teaching/Pedagogical, Moral Intelligences	Lecture/Activity
2	Polya's Problem Solving Method	Lecture/Activity
3	Multicultural awareness	Lecture/Presentation/Activity
4	Benjamin Franklin's List of Virtues	Lecture/Activity
5	Social Skills	Presentation/Activity
6	Current Affairs	Activity
7	Industrial Knowledge	Presentation
8	Gender Sensitivity	Presentation/Activity

WEB SOURCE REFERENCES:

1	https://swayam.gov.in/nd2_cec19_hs05/ - Swayam – Developing Life Skills
2	https://www.skillsyouneed.com/general/life-skills.html
3	https://ethicsunwrapped.utexas.edu/
4	Stress management strategies: Ways to Unwind - https://www.youtube.com/watch?v=0fL-pn80s-c
5	Signs of Stress https://www.youtube.com/watch?v=n3G0n7HoTr4
6	What is Civic Virtue? - YouTube https://www.youtube.com › watch?v=ANl4MqtHBxg
7	What Is Six Thinking Hats? - YouTube https://www.youtube.com › watch?v=UZ8vF8HRWE4
8	https://www.verywellmind.com/gardners-theory-of-multiple-intelligences-2795161
9	https://www.youtube.com/watch?v=IHMv6ALNfcs (Levels of Leadership)
10	https://www.youtube.com/watch?v=j6FSaHVufZc (Styles of Leadership)
11	https://www.mayoclinic.org/healthy-lifestyle/stress-management/in-depth/stress-relief/art-20044476
12	https://www.mhanational.org/helpful-vs-harmful-ways-manage-emotions
13	https://www.inc.com/justin-bariso/7-simple-strategies-that-will-help-you-manage-your-emotions.html
14	https://nickwignall.com/self-awareness/
15	http://www.debonogroup.com/six_thinking_hats.php
16	https://www.youtube.com/watch?v=UZ8vF8HRWE4
17	https://icebreakerideas.com/problem-solving-activities/

18	https://www.verywellmind.com/left-brain-vs-right-brain-2795005
19	https://ideadrop.co/creative-vs-strategic-thinking-whats-difference/
20	https://www.youtube.com/watch?v=bEusrD8g-dM
21	https://activecollab.com/blog/collaboration/group-vs-team
22	https://www.youtube.com/watch?v=uG-FLOi4OOU
23	https://www.managementstudyguide.com/virtual-team.htm
24	https://www.youtube.com/watch?v=AcxeMU0I1b4
25	https://www.forbes.com/sites/deeppatel/2017/03/22/11-powerful-traits-of-successful-leaders/
26	https://www.youtube.com/watch?v=eG16EmA2Fe0
27	https://www.investopedia.com/terms/l/leadership-grid.asp
28	https://www.inc.com/peter-economy/44-inspiring-john-c-maxwell-quotes-that-will-take-you-to-leadership-success.html
29	http://psychologyformarketers.com/5-levels-leadership-john-maxwell/

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

√CHALK & TALK	**√STUD. ASSIGNMENT**	**√WEB RESOURCES**	
LCD/SMART BOARDS	**√STUD. SEMINARS**	**ADD-ON COURSES**	

ASSESSMENT METHODOLOGIES-DIRECT

√ASSIGNMENTS	**√STUD. SEMINARS**	**√TESTS/MODEL EXAMS**	**√UNIV. EXAMINATION**
STUD. LAB PRACTICES	**STUD. VIVA**	**MINI/MAJOR PROJECTS**	**CERTIFICATIONS**
ADD-ON COURSES	**OTHERS**		

ASSESSMENT METHODOLOGIES-INDIRECT

√ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	**√STUDENT FEEDBACK ON FACULTY (TWICE)**
ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	**OTHERS**

Prepared by

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COURSE PLAN

Sl.No	Module	Planned Date	Planned
1	3	1-Dec- 2020	Introduction to Life Skills
2	3	2-Dec- 2020	Course Run Down + Syllabus & Assignment Familiarization
3	1	3-Dec- 2020	Introduction to the course Meaning and significance & WHO List
4	3	4-Dec- 2020	21st Century Skills
5	3	7-Dec- 2020	Diagnostic Test- 1
6	3	8-Dec- 2020	Diagnostic Test- 2
7	3	9-Dec- 2020	Introduction to GD
8	3	11-Dec-2020	Introduction to Creativity, Need for Creativity in the 21st Century, Sources of Creativity, Imagination, Intuition & Experience
9	3	14-Dec-2020	Critical vs Creative Thinking, Convergent vs Divergent Thinking, Theory of Left & Right Brain, Lateral Thinking
10	3	15-Dec-2020	Myths of Creativity
11	3	16-Dec-2020	Theory of Multiple Intelligences, Scientific Temper, Critical Reading
12	1	17-Dec-2020	Self Awareness & Empathy, Critical Thinking & Creative Thinking, Decision Making & Problem Solving
13	3	18-Dec-2020	GD

14	3	28-Dec-2020	GD
15	3	29-Dec-2020	GD
16	3	30-Dec-2020	Introduction to Problem Solving, Steps involved in Problem Solving, Techniques: Brainstorming, Introduction to Mind Map
17	1	31-Dec-2020	Effective Communication & Interpersonal Relationships, Coping with Stress & Coping with Emotions
18	3	1-Jan- 2021	Mind Map vs Spider Diagrams, Advantages of Mind Maps, Forced Connection, Six Thinking Hats
19	3	4-Jan- 2021	Mind Map Assignment
20	3	5-Jan- 2021	GD
21	3	6-Jan- 2021	Revision Test- Module 3
22	1	7-Jan- 2021	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
23	2	8-Jan- 2021	Introduction to Self Awareness, Need for Self Awareness, Tools and Techniques to Develop Self Awareness
24	2	11-Jan-2021	Introduction to Stress Management, Need, 4 A's of Stress Management, Approaches towards Stress Management, Gratitude Training, Stress Diary
25	2	12-Jan-2021	Introduction to Coping with Emotions, Effective ways, Harmful ways, Tools and Techniques

26	2	13-Jan-2021	Myers-Briggs Personality Test
27	2	15-Jan-2021	GD
28	2	18-Jan-2021	GD
29	2	19-Jan-2021	Revision Test- Module 2
30	2	20-Jan-2021	GD
31	2	21-Jan-2021	Morals, Values & Ethics, Integrity, Honesty, Courage, Cooperation, Commitment
32	2	22-Jan-2021	Case Studies
33	2	29-Jan-2021	Internal Examination 1 Question Paper Discussion
34	4	1-Feb-2021	Introduction to Groups and Teams- Composition, Formation, Cycle, Thinking
35	4	2-Feb- 2021	Clarifying Expectations, Problem Solving, Consensus, Dynamics Techniques
36	4	3-Feb-2021	GD
37	2	4-Feb-2021	Civic Virtue, Respect for others, Living Peacefully, Caring, Sharing, Self-confidence, Character, Spirituality
38	4	5-Feb- 2021	Groups vs Teams, Team Dynamics
39	4	8-Feb-2021	Virtual Teams. Managing team performance and managing conflicts, Entrepreneurship
40	4	9-Feb- 2021	Revision Test- Module 4

41	4	10-Feb-2021	GD
42	2	11-Feb-2021	Engineering Ethics and its Senses
43	5	12-Feb-2021	Leadership: Leadership framework, entrepreneurial and moral leadership, vision, cultural dimensions
44	5	15-Feb-2021	Growing as a leader, turnaround leadership, managing diverse stakeholders, crisis management
45	5	16-Feb-2021	Types of Leadership, Traits, Styles, VUCA Leadership, Levels of Leadership
46	5	17-Feb-2021	GD
47	5	19-Feb-2021	Transactional vs Transformational Leaders
48	5	22-Feb-2021	Leadership Grid, Effective Leaders
49	5	23-Feb-2021	Revision- Module 5
50	5	24-Feb-2021	GD
51	5	26-Feb-2021	Revision- Module 4 & 5
52	1	2-Mar-2021	Second Internal Examination
53	5	5-Mar-2021	QP DISCUSSION
54	5	8-Mar-2021	REVISION

ASSIGNMENTS (S1 AI & DS, S1 MEA, S1AEI)

- **ASSIGNMENT 1- GROUP DISCUSSION (9 marks) [CO-4]**

  DATE: December- March 2021

  MODE: Online (Language Lab hours)

  [Communication-3marks + Subject Knowledge- 4marks + Group Dynamics-1 mark+ Behaviour and Mannerisms-1mark= 9marks]

- **ASSIGNMENT 2- PRESENTATIONS (6 marks) [CO-3]**

  DATE: 28th February 2021

  MODE: Online

  [Communication -2marks + Content Clarity-2marks + Presentation Skills-2marks= 6 marks]

ENGINEERING CHEMISTRY LAB

COURSE INFORMATION SHEET

ENGINEERING CHEMISTRY LAB

DEGREE: B.TECH.	**COURSE**: ENGINEERING CHEMISTRY LAB
PROGRAMME: AEI, CE, CSE, EEE, ECE, IT, ME, AI & DS	**COURSE CODE**: 100908/CH922S
COLLEGE: RAJAGIRI SCHOOL OF ENGINEERING & TECHNOLOGY	**CONTACT HOURS**: 2 hours/Week.
SEMESTER: 1 & 2	**CREDITS**: 1

SYLLABUS

SL.NO	EXPERIMENTS
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 wave length of absorption maximum and colori metric 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-formal dehyderesin (b) Phenol-formal dehyderesin
10	Estimation of iron in iron ore
11	Estimation of copper in brass
12	Estimation of dissolved oxygen by Winkler's method
13	(a) Analysis of IR spectra (minimum 3 spectra) (b) Analysis of ^{1}HNMR spectra (minimum 3spectra)
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

TEXT/REFERENCE BOOKS

T/R	BOOK TITLE/AUTHORS/PUBLICATION
R	*G. Svehla, B. Sivasankar,"Vogel's Qualitative Inorganic Analysis", Pearson,2012.*
R	*R.K. Mohapatra, "Engineering Chemistry with Laboratory Experiments", PHI Learning, 2017.*
T	*Muhammed Arif, "Engineering Chemistry Lab Manual", Owl publishers,2019.*
T	*AhadJ., "Engineering Chemistry Lab manual", Jai Publications,2019.*
T	*Roy K Varghese, "Engineering Chemistry Laboratory Manual", Crown plus Publishers, 2019.*
R	*Soney C George, Rino Laly Jose, "Lab Manual of Engineering Chemistry", S. Chand & Company Pvt Ltd, New Delhi,2019.*

COURSE PRE-REQUISITES

COURSE NAME	DESCRIPTION
Experiments in chemistry introduced at the plus two levels in schools	To develop basic ideas on quantitative and qualitative chemical analysis

COURSE OBJECTIVES

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

COURSE OUTCOMES

SL.NO	DESCRIPTION
CO 1	Understand and practice different techniques of qualitative and 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 various chromatographic techniques like TLC for the identification of drugs and chemical compounds
CO 3	Develop the ability to understand and explain the use of modern spectroscopic techniques for analysing molecular chemical structure by interpreting IR and NMR spectra of 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.
CO 7	An ability to analyze the quality of water by determining its chemical parameters.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Knowledge and skills of various quantitative techniques like colorimetry, potentiometryetc can be used for various chemical analyses				Proper modeling of engineering activities can be done by utilizing knowledge of various analytical techniques							Basic knowledge of analytical techniques helps to engage in independent and lifelong learning of various technologies
2	The practical skills in the				Development and							Knowledge of material synthesis and

	preparation of organic polymers and the usage of chromatographic techniques can be used to develop engineering materials				modeling of engineering materials can be done by using the skills of material synthesis							analysis helps to understand the broadest context of material chemistry by a lifelong learning process
3	Knowledge of spectroscopic techniques like IR and NMR can be used to analyze and predict the structure of materials used in engineering activities				An ability to use modern techniques of structural analysis and its interpretation is inevitable in analyzing engineering materials							An awareness about the fundamental concepts of structural analytical techniques helps to apply the concept to solve complex molecular structures
4	Basic knowledge of various instrumental techniques is inevitable for measuring chemical parameters which is essential in finding solutions for many engineering				Appropriate modeling of various engineering activities can be done by using the knowledge of handling various							An understanding and usage of instrumental techniques can be applied in the lifelong learning process of technological change

	problems				instrumental techniques							
5	Accurate design, record and interpretation of experimental data are very essential to solve scientific problems				Solutions to complex problems always demand proper planning and conduct of experiments							Understanding of new technologies requires designing and modifications of scientific experiments
6	Knowledge of the basic principles of chemistry and proper team work helps to solve various social, economic and environmental problems				Proper team work is essential to design complex engineering activities							The continuous development of technological innovations always demand proper team work and modification of basic knowledge in various fields
7	Knowledge to conduct experiments to analyze quality of water helps to solve societal and environmental problems			Measurement of water quality parameters meet the specifications with consideration for the public health and safety		Solutions to societal, health and safety issues can be sorted out by analysing chemical param	Improving water quality by analysing chemical parameters is essential for sustainable develo					

						eters of water	pment					

MAPPING OF COURSE OUTCOMES WITH PROGRAM SPECIFIC OUTCOMES

	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4	1	1	
CO5			
CO6			
CO7			

	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4	Basic Knowledge on science helps to design softwares with intelligent systems for the working of analytical instruments	Knowledge to design softwares with intelligent systems for the working of analytical instruments	
CO5			
CO6			
CO7			

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS

SL.NO	DESCRIPTION	PROPOSED ACTIONS
1	Construction and working of Daniel cell	Assignment, Reading, Lab work
2	Determination of molar and equivalent conductivity	Assignment, Reading, Lab work
3	Analysis of compounds using UV-Visible spectroscopy	Assignment, Reading, Lab work
4	Column chromatography	Assignment, Reading, Lab work
5	Synthesis of advanced polymers and	Assignment, Reading, Lab

	conducting polymers	work
6	Determination of BOD and COD of water	Assignment, Reading, Lab work

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS

SL.NO	DESCRIPTION	PROPOSED ACTIONS
1	Conductometric titrations	Assignment, Reading, Lab work
2	Determination of molecular weight of polymers	Assignment, Reading, Lab work
3	Determination of calorific values of fuel	Assignment, Reading, Lab work
4	Determination of flash and fire point of lubricant	Assignment, Reading, Lab work
5	Determination of alkalinity of water sample	Assignment, Reading, Lab work

WEB SOURCE REFERENCES

1	https://www.youtube.com/watch?v=Q70PgxkjH5E
2	https://www.youtube.com/watch?v=LxgZsMhuyNM
3	https://www.youtube.com/watch?v=gd1YQr-74sw

DELIVERY/INSTRUCTIONAL METHODOLOGIES

☐ **CHALK & TALK**	☐ **STUD. ASSIGNMENT**	☐ **WEB RESOURCES**	
☐ **LCD/SMART BOARDS**	☐ **STUD. SEMINARS**	☐ **ADD-ON COURSES**	

ASSESSMENT METHODOLOGIES-DIRECT

☐ **ASSIGNMENTS**	☐ **STUD. SEMINARS**	☐ **TESTS/MODEL EXAMS**	☐ **UNIV. EXAMINATION**
☐ **STUD. LAB PRACTICES**	☐ **STUD. VIVA**	☐ **MINI/MAJOR PROJECTS**	☐ **CERTIFICATIONS**
☐ **ADD-ON COURSES**	☐ **OTHERS**		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ **ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)**	☐ **STUDENT FEEDBACK ON FACULTY (TWICE)**
☐ **ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS**	☐ **OTHERS**

Prepared by **Approved by**

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ENGINEERING CHEMISTRY LAB - 100908/CH922S

Open Questions

- Acid-base potentiometric titration
- Estimation of permanent hardness
- Study of corrosion of metals in medium of different pH
- Separation of a mixture by column chromatography
- Estimation of CaO in cement solution by rapid EDTA method
- Estimation of Copper colorimetrically

Advanced Questions

- Synthesis of advanced polymer composites
- Determination of molecular weight of polymers by viscometry
- Determination of COD of waste water
- Conductometric titration of a mixture of strong acid vs strong base

Engineering Chemistry Lab – Course Plan

Day-1	**Cycle-1**	Preparation of urea formaldehyde
Day-2		Estimation of total hardness - EDTA method
Day-3		Potentiometric redox titration
Day-4	**Cycle-2**	Preparation of phenol formaldehyde
Day-5		Estimation of chloride in water
Day-6		Colorimetric estimation of Fe^{3+} in solution
Day-7	**Cycle-3**	Analysis of IR spectra of organic compounds
Day-8		Analysis of ^{1}H-NMR spectra of organic compounds

ENGINEERING CHEMISTRY LAB (100908/CH922S)

CYCLE-1	Preparation of urea formaldehyde Estimation of total hardness - EDTA method Potentiometric redox titration
CYCLE-2	Preparation of phenol formaldehyde Estimation of chloride in water Colorimetric estimation of Fe^{3+} in solution
CYCLE-3	Analysis of IR spectra of organic compounds Analysis of ^{1}H-NMR spectra of organic compounds

CIVIL & MECHANICAL WORKSHOP

COURSE INFORMATION SHEET

PROGRAMME: AI&DS	DEGREE: BTECH
COURSE: CIVIL ENGINEERING WORKSHOP	SEMESTER: S1 CREDITS: 1
COURSE CODE: 100908/CO922T-B2 REGULATION: 2019	COURSE TYPE: REGULAR
COURSE AREA/DOMAIN: CIVIL ENGINEERING	CONTACT HOURS: 1 HOUR/WEEK.

SYLLABUS:

UNIT	DETAILS	HOURS
I	Calculate the area of a built-up space and a small parcel of land- Use standard measuring tape and digital distance measuring devices	2
II	(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	2
III	Find the level difference between any two points using dumpy level	2
IV	(a) Construct a One and a half 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.	2
V	(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	2

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Khanna P.N, "Indian Practical Civil Engineering Handbook", Engineers Publishers.
T2	Bhavikatti. S, "Surveying and Levelling (Volume 1)", I.K. International Publishing House
T3	Arora S.P and Bindra S.P, " Building Construction", Dhanpat Rai Publications
T4	Satheesh Gopi, Basic Civil Engineering, Pearson Publishers
T5	Rangwala, Essentials of Civil Engineering, Charotar Publishing House
T6	Anurag A. Kandya, Elements of Civil Engineering, Charotar Publishing house
T7	Rangwala S C and Ketki B Dalal, Engineering Materials, Charotar Publishing house
T8	Rangwala S C and Ketki B Dalal, Building Construction, Charotar Publishing house

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
	MATHEMATICS	FUNDAMENTAL KNOWLEDGE OF TRIGONOMETRY	SECONDARY SCHOOL LEVEL
	PHYSICS	BASIC KNOWLEDGE ABOUT DIMENSIONS, UNITS, STRESS,	PLUS-TWO

		MOMENT OF INERTIA	

COURSE OBJECTIVES:

1	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. To inculcate the essentials of Civil Engineering field to the students of all branches of Engineering.

COURSE OUTCOMES:

S NO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Name different devices and tools used for civil engineering measurements	1				1	1			2	2		
2	Explain the use of various tools and devices for various field measurements	1				1	1			2	2		
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.	1				1	1		2	2	2	1	
4	Choose materials and methods required for basic civil engineering	1				1	1		2	2	2	1	1

	activities like field measurements, masonry work and plumbing.												
5	Compare different techniques and devices used in civil engineering measurements	1				1	1			2	2		1

WEB SOURCE REFERENCES:

1	https://www.youtube.com/watch?v=B1JeDU7ssb0&ab_channel=NITTTRCHENNAIEDUCATIONALVIDEOS
2	https://www.youtube.com/watch?v=lR9bA1C8Nks&ab_channel=NITTTRCHENNAIEDUCATIONALVIDEOS
3	

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☐ **CHALK & TALK** √	☐ **STUD. ASSIGNMENT** √	☐ WEB RESOURCES	
☐ LCD/SMART BOARDS	☐ STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

☐ **ASSIGNMENTS** √	☐ STUD. SEMINARS	☐ **TESTS/MODEL EXAMS** √	☐ **UNIV. EXAMINATION** √
☐ **STUD. LAB PRACTICES** √	☐ **STUD. VIVA** √	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ **ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)** √	☐ **STUDENT FEEDBACK ON FACULTY** √
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by

Ms Anitha Varghese

Approved by
Prof Vincent K John

COURSE PLAN:

HOUR 1	INTRODUCTION
HOUR 2	TO SET OUT ONE ROOM BUILDING WITH GIVEN PLAN AND MEASURING TAPE.
HOUR 3	TO CALCULATE THE AREA OF A BUILT UP SPACE AND A SMALL PARCEL OF LAND USING STANDARD MEASURING TAPE AND DIGITAL DISTANCE MEASURING DEVICES.
HOUR 4	USE SCREWGAUGE AND VERNIER CALIPERS TO MEASURE THE DIAMETER OF A STEEL ROD AND THICKNESS OF A FLAT BAR.TO TRANSFER THE LEVEL FROM ONE POINT TO ANOTHER POINT USING A WATER LEVEL.
HOUR 5	TO CONSTRUCT A 1 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. TO ESTIMATE THE NUMBER OF DIFFERENT TYPES OF BUILDING BLOCKS TO CONSTRUCT THIS WALL.
HOUR 6	TO CONDUCT LEVELLING AND TO FIND OUT THE REDUCED LEVEL OF THE GIVEN POINTS
HOUR 7	TO INTRODUCE THE PLUMBING EQUIPMENTS
HOUR 8	FINAL VIVA
HOUR 9	LAB EXAM

OPEN QUESTIONS

1. What are the different types of surveying based on instrument?
2. Enumerate the two principles of surveying?
3. Explain the different steps of setting out the building?
4. Define field book, formats used in different types of survey?
5. Give the standard size of bricks and nominal size of bricks
6. Write the procedure of determining the number of bricks for a given room?
7. Enumerate the rules of bond in brick work? Draw the elevation and plan of English bond one and half brick wall?
8. Differentiate between carpet area, plinth area and coverage?
9. What is a benchmark? Explain the different types of benchmarks.
10. What is meant by inverse levelling? When is it carried out?

ADVANCED QUESTIONS

1. Write the different steps involved in the completion of a building project?
2. Explain KMBR Rules and its significance?
3. What is the significance of mass moment of inertia and second moment of area?
4. Define compressive strength?
5. List out the modern survey equipments and its applications?
6. What is the importance of calculating coverage percentage?
7. Define cross staff surveying?
8. What are the different types of foundations?
9. Explain why English bonds are stronger than Flemish bonds in brick masonry.

COURSE INFORMATION SHEET

PROGRAMME: Common to All Branches	*DEGREE:* BTECH
COURSE: MECHANICAL ENGINEERINGWORKSHOP	SEMESTER: 1 CREDITS: 1
COURSE CODE: 100908/C0922T *REGULATION:* 2020	COURSE TYPE: CORE
COURSE AREA/DOMAIN: BASIC SCIENCE	CONTACT HOURS: 2(Practical) Hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME: NA

SYLLABUS:

SL.NO.	*NAME OF SHOP FLOOR*	*DETAILS*	*HOURS*
1	**General**	Studies of mechanical tools, components and their applications: (a) Tools; Screw drivers, Spanners, Allen keys, Cutting pliers etc. And accessories (b) Components: Bearings, Seals, O-rings, Circlips, Keys etc.	1
2	**Carpentry**	Any one model from the following; 1. T-Lap joint 2. Cross lap joint 3. Dovetail joint 4. Mortise joint	2
3	**Smithy**	(a) Demonstrating the forgability of different materials (MS, Al, Alloy steel and Cast steel) in cold and hot states. (b) Observing the qualitative differences in the hardness of these materials. (c) Determining the shape and dimensional variations of Al test specimen due to forging under different states by visual inspection and measurements	2
4	**Foundry**	Any one exercise from the following 1. Bench moulding 2. Floor moulding 3. Core making	2
5	**Sheet metal**	Any one exercise from the following Making 1. Cylindrical 2. Conical 3. Prismatic shaped jobs from sheet metal	2

6	**Welding**	Any one exercise from the following Making joints using Electric arc welding. Bead formation in horizontal, vertical and overhead positions.	2
7	**Fitting and Assembly**	Filing exercise and any one of the following exercises Disassembling and reassembling of 1. Cylinder piston assembly 2. Tail stock assembly 3. Time piece/clock 4. Bicycle or any machine.	2
8	**Machines**	Demonstration and applications of Drilling machine, Grinding machine, Shaping machine, Milling machine and lathe.	2
	TOTAL		**15**

TEXT/REFERENCE BOOKS:

T/R	***BOOK TITLE/AUTHORS/PUBLICATION***
R1	Bawa H S, "Workshop Technology", 2 nd edition, 2017
R2	Chapman W A J, "Workshop Technology", 5th edition, 2001.
R3	John K C, "Mechanical Workshop and Laboratory Manual", 2nd edition, 2010.

COURSE PRE-REQUISITES:

C.CODE	***COURSE NAME***	***DESCRIPTION***	***SEM***
-	**-**	Basic knowledge about use of measuring instruments	-

COURSE OBJECTIVES:

1	Introduction to basic manufacturing process like welding, moulding, fitting, assembling, smithy, carpentry works etc.
2	Familiarization of basic manufacturing hand tools and equipment's like files, hacksaw, spanner chisel hammers, etc.
3	Familiarization of various measuring devises like Vernier height gauge, Vernier calliper, steel rule etc.
4	Study of various machine tools like lathe, drilling machine, milling machine etc.
5	Familiarizing the disassembling and assembling of machine parts.

COURSE OUTCOMES:

S.NO.	*DESCRIPTION*	*Bloom's Taxonomy Level*
CO6	Students will be able to understand the various manufacturing processes in the basic mechanical engineering workshop trades.	Level 2 Understand
CO7	Students will be able to use various tools used in the basic mechanical engineering workshop trades.	Level 3 Apply
CO8	Students will be able to select appropriate measuring instruments according to the work.	Level 2 Understand
CO9	Students will be able to understand the operations of various machine tools and advanced manufacturing techniques.	Level 2 Understand
CO10	Students will be able to identify the different components of mechanical devices by assembling & disassembling models.	Level 2 Understand
CO11	Construct models by using various basic mechanical workshop operations	Level6 Create
CO12	Apply appropriate safety measures with respect to the mechanical workshop trades.	Level 3 Apply

CO-PO AND CO-PSO MAPPING

	PO 1	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*	*PO 12*	*PSO 1*	*PSO 2*	*PSO 3*
CO6	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO7	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO8	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO9	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO10	1	-	-	-	-	-	-	-	2	-	-	-	-	-	-
CO11	1	1	1	-	-	-	-	1	1	-	-	-	-	-	-
CO12	2	-	-	-	-	2	-	-	-	-	-	-	-	-	-

JUSTIFICATIONS FOR CO-PO MAPPING

MAPPING	*LOW/MEDIUM/ HIGH*	*JUSTIFICATION*
CO6-PO1	M	While identifying the mechanical workshop operation students are applying their knowledge in the Basic engineering science.
CO6-PO3	L	While understanding the mechanical workshop operation students can apply their knowledge to design solution and develop models
CO7-PO1	L	Applying the tools and instruments with respect to trade students are applying their fundamental knowledge on that specific trade.
CO7-PO2	L	While Applying the tools and instruments with respect to trade students are analysing a particular manufacturing process
CO7-PO3	L	While using the tools and instruments students apply their knowledge to design solutions and develop models
CO8-PO1	L	For selecting appropriate measuring instruments, students apply their fundamental knowledge of engineering science.
CO8-PO2	L	Proper analysis of the work is required for the selection of appropriate measuring instrument.
CO9-PO1	L	Understanding the operations carried out on machine tools and advanced manufacturing techniques will improve their knowledge in machine tools.
CO10-PO1	L	Identifying the different components of mechanical devices by assembling & disassembling models is an application of their knowledge in mechanical engineering.
CO10-PO9	M	As this is a group activity, it will improve their skills to work as a team
CO11-PO1	L	To construct models for their project they can apply their knowledge in the various mechanical workshop operations
CO11-PO2	L	While constructing models for their project they need to analyse the various manufacturing process.
CO11-PO3	L	They can use this experience to design solution considering societal and environmental impact.
CO11-PO8	L	Constructing models ethical principles are to be considered
CO11-PO9	L	As this is a group activity, it will improve their skills to work as a team
CO12-PO1	L	For selecting appropriate safety measures for a particular job they apply their knowledge on different aspects of various operations performed in that trade.
CO12-PO6	L	While practicing safe manufacturing operations they can ensure societal, health and safety issues.

JUSTIFICATIONS FOR CO-PSO MAPPING

MAPPING	*LOW/MEDIUM/ HIGH*	*JUSTIFICATION*

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSIONALREQUIREMENTS:

SNO	*DESCRIPTION*	*RELEVENCE TO PO\PSO*	*PROPOSED ACTIONS*
-	-	-	-

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	**TOPIC**	**RELEVENCE TO PO\PSO**
1	Demonstration of Aluminium Casting	PO3
2	Demonstration of Advanced welding process MIG&TIG	PO3
3	Demonstration of CNC Lathe	PO3

WEB SOURCE REFERENCES:

1	http://www.youtube.com/watch?v=HkjdMdp9KVU
2	http://www.youtube.com/watch?v=WaDsmeB5ywM
3	http://www.youtube.com/watch?v=JEF0_yTTL7w
4	http://www.youtube.com/watch?v=Rn31IEOKgQ8
5	http://www.youtube.com/watch?v=J63dZsw7Ia4
6	http://www.youtube.com/watch?v=dj64QvvbGXM
7	http://www.youtube.com/watch?v=iKizLfzz7GM
8	http://www.youtube.com/watch?v=qOGNnGZqjV4

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

✓CHALK & TALK	☐ STUD. ASSIGNMENT	✓ WEB RESOURCES	☐LCD/SMART BOARDS
☐ STUD. SEMINARS	☐ ADD-ON COURSES		

ASSESSMENT METHODOLOGIES-DIRECT

☐ ASSIGNMENTS	☐ STUD. SEMINARS	✓ TESTS/MODEL EXAMS	☐ UNIV. EXAMINATION
✓STUD. LAB PRACTICES	✓ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐CERTIFICATIONS
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ASSESSMENT METHODOLOGIES-INDIRECT

✓ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	✓ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

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Course Plan

Expt. No.	Topic	Schedule
1	**INTRODUCTION**	Day 1
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	
2	**ASSEMBLY**	Day 2
2.1	Demonstration of assembly and dissembling of multiple parts components	
3	**CARPENTRY**	Day 3
3.1	Understanding of carpentry tools and making minimum one model	
4	**FOUNDRY**	Day 4
4.1	Understanding of foundry tools and making minimum one model	
5	**SHEET METAL**	Day 5
5.1	Understanding of sheet metal working tools and making minimum one model	
6	**FITTING**	Day 6
6.1	Understanding of fitting tools and making minimum one model	
7	**SMITHY**	Day 7
7.1	Understanding of smithy tools and making minimum one model	
8	**WELDING**	Day 8
8.1	Understanding of welding equipments and making minimum one model	
9	**PLUMBING**	Day 9
9.1	Understanding of pipe joints and plumbing tools and making minimum one model	
10	**MACHINES**	Day 10
10.1	Demonstration of various machines	
11	**MODERN MANUFACTURING METHODS**	Day 11
11.1	Demonstrations of: power tools, CNC Machine tools, 3D printing, Glass cutting	