MITS Kochi
Muthoot Institute of Technology and Science (Autonomous)

B. TECH

MECHANICAL ENGINEERING

CURRICULUM & SYLLABUS

2025 REGULATION

B.Tech

MECHANICAL ENGINEERING

2025 REGULATION

CURRICULUM & SYLLABUS

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SEMESTER II
CURRICULUM

SLOT	COURSE CATEGORY	COURSE CODE	COURSE NAME	L	T	J	P	S	C
A	BST	B250902/MA200A	Mathematics for Physical Science-2	3	1	0	0	2	3
B	BSE	B250902/CH910B	Chemistry for Physical Science	3	0	0	2	3	4
C	EST	B250902/CN200C	Engineering Graphics	2	0	0	2	2	3
D	EST	B250002/ME200D	Material Science and Engineering	4	0	0	0	4	4
E	PCT	B250002/ME200E	Engineering Thermodynamics	4	0	0	0	4	4
F	ESB	B250908/CN220F	Entrepreneurship and IPR	2	0	1	0	3	3
K	HMT	B250908/CN910K	Health and wellness	1	0	0	1	0	1
U	ESL	B250002/CN230U	Electrical and Electronics Fundamentals Lab	0	0	0	2	0	1
	SEC		Skill Enhancement Course						1

(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work, C- Credit)

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-2**	**Version**	**25/0**	**Credits**	**3**
Course Code	**Course Name**						**Course Category**
B250902/ MA200A	**MATHEMATICS FOR PHYSICAL SCIENCE-2**						**BST**
Pre-requisite							
Sound knowledge in calculus of one real variable.							
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

COURSE OBJECTIVES	
1	To enable the students to apply multivariable differentiation techniques—including chain rule, implicit differentiation and optimization methods for solving engineering-related problems.
2	To equip students with the skills to evaluate double and triple integrals and to apply coordinate transformations for computing areas, volumes, and related quantities in engineering applications.
3	To develop a deep understanding of vector fields through the analysis of gradient, divergence, curl, and line integrals, and to apply these in evaluating conservative fields and constructing potential functions in physical systems.
4	To enable the students to apply vector integral theorems in the evaluation of line, surface and flux integrals and to solve engineering problems involving circulation, flux and work.

COMPETENCY & OUTCOMES		
Competency Statements	CC 1	Demonstrate the ability to analyze mathematical models of physical systems and find its solution using appropriate calculus-based methods.

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Statement Mapping	Cognitive (C)	Psychomotor (P)	Affective (A)
CO 1	**Apply** the concept of partial derivatives to find maxima and minima of multivariable functions.	CC 1	A	–	Rs
CO 2	**Use** the concept of multiple integrals to find area and volume of geometrical shapes.	CC 1	A	_	Rs
CO 3	**Apply** the calculus of vector valued functions to solve physical problems.	CC 1	A	_	Rs
CO 4	**Apply** vector integral theorems in the evaluation of line integrals, surface integrals and volume integrals.	CC 1	A	_	Rs

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*
Psychomotor Domain (Dave's): *- **I**-Imitation, **M**-Manipulation, **P**-Precision, **Ar**-Articulation, **N**-Naturalisation*
***Affective (Krathwohl)**: - **Re**-Receiving, **Rs**-Responding, **V**-Valuing, **O**-Organization, **Ch**-Characterization*

Program Outcomes & Program Specific Outcomes Correlation Matrix														
	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	2	2									1			
2	2	2									1			
3	2	2									1			
4	2	2									1			
	2	2									1			
Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"														

TEACHING AND ASSESSMENT SCHEME													
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme						
							Theory			Practical			Total
L	T	J	P	S	C		CIA	ESE	Total	CIA	ESE	Total	
3	1	0	0	2	3	90	40	60	100	-	-	-	100
***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*													

SYLLABUS (Major Topics)			
Module	**Title**	**Major Topics**	**Contact Hours**
1	**Multivariable Calculus-Differentiation**	Limits and Continuity, Partial derivatives, Local linear approximation, The Chain Rule, Maxima and Minima of functions of Two variables. **(Relevant topics from sections 13.2,13.3, 13.4,13.5, 13.8 of Text 1)**	**11**
2	**Multivariable Calculus-Integration**	Double Integrals, Reversing the order of integration, Converting Double integrals from Cartesian Coordinates to Polar Coordinates, Triple Integrals, Converting Triple integrals in Cartesian coordinates to Cylindrical coordinates. **(Relevant topics from sections 14.1,14.2,14.3, 14.5,14.6 of Text 1)**	**11**
3	**Calculus of Vector Functions**	Vector valued function of a single variable, Concept of scalar and vector field, Gradient and its properties, Directional Derivatives, Divergence and Curl of vector fields, Line integral of vector fields, Conservative vector fields, Potential function. **(Relevant topics from sections 12.1,12.2,13.6, 15.1,15.2,15.3 of Text 1)**	**12**
4	**Vector Integral Theorems**	Green's theorem for simply connected region (without proof), Applications of Green's theorem, Surface integrals, Flux integrals, Divergence theorem (without proof), Stokes' theorem (without proof), finding work done using Stokes' theorem. **(Relevant topics from sections 15.4,15.5,15.6, 15.7,15.8 of Text 1)**	**11**

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning Topics / Team Work Description	Hrs/Semester (30)
1	Differentiability (1 Hour)	7
2	Practice problems on Partial Derivatives, Local linear approximation, Chain Rule and Maxima and Minima of functions of Two variables (5 Hours)	
3	**Team Work** - Contour plot, Graphing functions of two variables using GeoGebra/ Python (1 Hour)	
4	Center of gravity using Multiple integrals-Mass and Center of gravity of inhomogeneous laminas, Center of gravity and Centroid of a solid (2 Hours)	8
5	Practice problems on double integrals and triple integrals (5 Hours)	
6	**Team Work** – Visualizing solids and their intersections using GeoGebra/ Python (1 Hour)	
7	Motion along a curve-velocity, acceleration, speed, displacement and distance travelled (1 Hour)	7
8	Practice problems on Gradient and Directional Derivative of scalar fields, Curl and Divergence of vector fields, Line Integrals and Conservative vector fields. (5 Hours)	
9	**Team work** – Visualizing gradient and its properties using GeoGebra/ Python, visualizing vector fields using GeoGebra/ Python and presenting their applications. (1 Hour)	
10	Curl viewed as circulation (2 Hour)	8
11	Practice problems on Line integrals using Green's theorem, Surface integrals, Flux integrals, Flux integrals using Divergence theorem, Work done using Stokes' theorem. (5 Hours)	
12	**Team Work –** Visualizing Curl and Divergence using GeoGebra/ Python (1 Hour)	

SUGGESTED LEARNING RESOURCES

Sl. No.	Title of Book	Author	Publication
Text Book			
1	Calculus	H. Anton, I. Biven, S. Davis	Wiley, 12th edition, 2024
Reference			
1	Advanced Engineering Mathematics	Dennis G Zill, Warren S. Wright	Jone's and Bartlett Learning, 4th edition,2011
2	Thomas' Calculus	Maurice D. Weir, Joel Hass, Christopher Heil, Przemyslaw Bogacki	Pearson 15th edition, 2023
3	Engineering Mathematics (Vol. 2)	S S Sastry	PHI, 2011
4	Advanced Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons 10th edition, 2016
5	Higher Engineering Mathematics	B V Ramana	Mc Graw Hill,2021
6	Engineering Mathematics (Vol. I)	A.C. Srivastava, P. K. Srivastava	PHI,2010

Web Resource		
1	https://nptel.ac.in/courses/111107108	**NPTEL**

DETAILED SYLLABUS *(Self-learning if any to be marked)*								
Mod.	Title	Major Topic & Sub Topic	Mode of Delivery	COs	Learning Domain Level			Teaching Hours
					C	P	A	
1	**Multivariable Calculus-Differentiation**	Limits and Continuity	**L**	**1**	**3**			**1**
		Partial derivatives of functions of two variables, Partial derivatives viewed as rate of change and slopes	**L**	**1**	**3**			**2**
		Tutorial	**T**	**1**	**3**		**2**	**1**
		Partial derivatives of functions with more than two variables, Higher order partial derivatives	**L**	**1**	**3**			**2**
		Tutorial	**T**	**1**	**3**		**2**	**1**
		Local linear approximation	**L**	**1**	**3**			**2**
		Tutorial	**T**		**3**		**2**	**1**
		The Chain Rule, Implicit partial differentiation	**L**	**1**	**3**			**2**
		Maxima and Minima of functions of Two Variables-Finding relative extrema.	**L**	**1**	**3**			**2**
		Tutorial	**T**		**3**		**2**	**1**
2	**Multivariable Calculus-Integration**	Double Integrals, Evaluating double integrals over rectangular regions	**L**	**2**	**2**			**1**
		Evaluating double integrals over nonrectangular regions	**L**	**2**	**3**			**2**
		Reversing the order of integration	**L**	**2**	**3**			**1**
		Tutorial	**T**		**3**		**2**	**1**
		Converting Double integrals from Cartesian Coordinates to Polar Coordinates	**L**	**2**	**3**			**1**
		Area calculated as a double integral, finding volumes using double integration	**L**	**2**	**2**			**2**
		Triple Integrals-Evaluating triple integrals over rectangular boxes	**L**	**2**	**2**			**1**
		Evaluating triple integrals over more general regions	**L**	**2**	**3**			**1**
		Tutorial	**T**	**2**	**3**		**2**	**1**
		Volume calculated as a triple integral	**L**	**2**	**3**			**1**
		Converting Triple integrals in Cartesian coordinates to Cylindrical coordinates	**L**	**2**	**3**			**1**
		Tutorial	**T**	**2**	**3**		**2**	**1**
3		Vector valued function of a single variable	**L**	**3**	**2**			**1**

	Calculus of Vector Functions	Limit, continuity and derivatives of vector valued function of a single variable	**L**	**3**	**2**			**1**
		Tutorial	**T**	**3**	**3**		**2**	**1**
		Concept of scalar and vector field	**L**	**3**	**2**			**1**
		Gradient and Directional Derivatives of a scalar field and its properties.	**L**	**3**	**3**			**2**
		Tutorial	**T**	**3**	**3**		**2**	**1**
		Divergence and curl of a vector field	**L**	**3**	**2**			**2**
		Line integral of vector fields	**L**	**3**	**3**			**2**
		Work as line integral	**L**	**3**	**3**			**1**
		Tutorial	**T**	**3**	**3**		**2**	**1**
		Conservative vector fields, Independence of path and Potential function(results without proof)	**L**	**3**	**3**			**2**
		Tutorial	**T**	**3**	**3**		**2**	**1**
4	**Vector Integral Theorems**	Green's theorem for simply connected region	**L**	**4**	**2**			**2**
		Applications of Green's theorem	**L**	**4**	**3**			**1**
		Tutorial	**T**	**4**	**3**		**2**	**1**
		Surface integrals over surfaces of the form $z = g(x, y)$.	**L**	**4**	**3**			**1**
		Flux integrals over surfaces of the form $z = g(x, y)$.	**L**	**4**	**3**			**2**
		Tutorial	**T**	**4**	**3**		**2**	**1**
		Divergence theorem (without proof)	**L**	**4**	**2**			**1**
		Finding flux using Divergence theorem, Sources and sinks	**L**	**4**	**3**			**2**
		Tutorial	**T**	**4**	**3**		**2**	**1**
		Stokes' theorem (without proof)	**L**	**4**	**2**			**1**
		Finding work done using Stokes' theorem	**L**	**4**	**3**			**1**
		Tutorial	**T**	**4**	**3**		**2**	**1**

TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)								
Module	Module Title	Distribution of Marks (RBL)						Total Marks
		R	U	A	An	E	C	
1	**Multivariable Calculus-Differentiation**	√	√	√				15
2	**Multivariable Calculus-Integration**	√	√	√				15
3	**Calculus of Vector Functions**	√	√	√				15
4	**Vector Integral Theorems**	√	√	√				15
This ToS shall be treated as a general guideline for students and teachers for distribution of marks.								

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
1. Internal Examination	**20**
2. Learning Activity	**15**
3. Attendance	**5**
4. Course Project	**0**
End Semester Examination	**60**
Total	**100**

			Total Pages: …….
Register No.:	……	Name:	……

SECOND SEMESTER B. TECH DEGREE (REGULAR) EXAMINATION, DECEMBER 2025 (2025 SCHEME)			
Course Code:	**B250902/MA200A**		
Course Name:	**MATHEMATICS FOR PHYSICAL SCIENCE -2**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Common to CE and ME			

PART A

(Answer all questions. Each question carries 3 marks)

No.	*Question*	*CO*	*Marks*
1	Find the slope of the surface $z = 3ye^x + e^{4y-x}$ in the x-direction at the point (3,0).	CO1	(3)
2	Show that the function $z = e^x \cos y + e^y \sin x$ satisfies Laplace's equation $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial y^2} = 0$.	CO1	(3)
3	Use a double integral to find the volume of the solid that is bounded above by the plane $z = 2 - x^2 - y^2$ and below by the rectangle $R = [-1,-1] \times [1,1]$.	CO2	(3)
4	Use polar co-ordinates to evaluate $\iint_R e^{-(x^2+y^2)} dA$, where R is the region enclosed by the circle $x^2 + y^2 = 1$.	CO2	(3)
5	Find a unit vector in the direction in which $f(x,y) = 3x - \log y$ increases most rapidly at the point (2, 4). Also, find the rate of change of $f(x,y)$ at (2, 4) in that direction.	CO3	(3)
6	Determine the value of a so that the vector field, $\vec{F}(x,y,z) = (x+3y)\,\hat{\imath} + (y-2z)\,\hat{\jmath} + (x+az)\hat{k}$ is solenoidal.	CO3	(3)
7	Determine whether the vector field, $\vec{F}(x,y,z) = x^3\hat{\imath} + y^3\hat{\jmath} + z^3\hat{k}$ is free of sources and sinks. If it is not, locate them.	CO4	(3)
8	Use Green's theorem to find the area enclosed by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.	CO4	(3)

PART B

(Answer any one full question from each module, each question carries 9 marks)

No.		*Question*	*CO*	*Marks*
MODULE I				
9	a)	Let f be differentiable function of three variables, and suppose that $w = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$. Show that $x\frac{\partial w}{\partial x} + y\frac{\partial w}{\partial y} + z\frac{\partial w}{\partial z} = 0$.	CO1	(4)
	b)	Find all points on the portion of the plane $3x + 2y + z = 6$ in the first octant at which $w = x^2y^3z$ attains its maximum value.	CO1	(5)
OR				
10	a)	Find the local linear approximation $L(x,y,z)$ to $f(x,y,z) = xy + yz + zx$ at the point (1, 2, 3). Also find the error in the approximation of f at the point (0.99, 2.03, 2.98).	CO1	(4)
	b)	Let $u = ln\,(x^2 + y^2)$, $v = 2\tan^{-1}\left(\frac{y}{x}\right)$ and $x = r\cos\theta$, $y = r\sin\theta$. Show that u and v satisfy the polar form of the Cauchy Riemann equation: $\frac{\partial u}{\partial r} = \frac{1}{r}\frac{\partial v}{\partial \theta}$ and $\frac{\partial v}{\partial r} = -\frac{1}{r}\frac{\partial u}{\partial \theta}$.	CO1	(5)
MODULE II				
11	a)	Use a double integral to find the area of the region between the parabola $y = 2x^2$ and the straight-line $y = 3x$.	CO2	(4)

	b)	Sketch the region of integration and evaluate the integral $\int_0^{\pi} \int_y^{\pi} \frac{\sin x}{x}\, dx\, dy$ by changing the order of integration.	CO2	(5)
		OR		
12	a)	Evaluate $\iint_R y \cos x \; dA$, where R is the triangular region bounded by the lines $y = x, x = 0$ and $y = \pi$.	CO2	(4)
	b)	Find the volume of the solid within the cylinder $x^2 + y^2 = 9$ and between the planes $z = 1$ and $x + z = 5$.	CO2	(5)
		MODULE III		
13	a)	Evaluate the line integral $\int_C (x^2 + y^2)\, dx + 2x\, dy$, where C is the curve $x^2 + y^2 = 1$, traversed counterclockwise from (1,0) to (0,1).	CO3	(4)
	b)	Find the work done by the force field $\vec{F}(x, y) = xy\ \hat{\imath} + x^3 j$ on a particle moving along the curve C, given by $x = y^2$, from (0, 0) to (1, 1).	CO3	(5)
		OR		
14	a)	Find the divergence and curl of the vector field: $\vec{F}(x, y, z) = x^2 y\hat{\imath} + 2y^3 z\, \hat{\jmath} + 3z\, \hat{k}$.	CO3	(4)
	b)	Show that the line integral $I = \int_{(1,4)}^{(3,1)} 2xy^3\, dx + (1 + 3x^2 y^2)\, dy$ is independent of the path. Hence, use the potential function to evaluate the line integral I.	CO3	(5)
		MODULE IV		
15	a)	Find the mass of the lamina that is portion of the cone $z = \sqrt{x^2 + y^2}$, lying between the planes $z = 1$ and $z = 2$, if the density function is $\delta(x, y, z) = 5y^2 z$.	CO4	(4)
	b)	Using Green's theorem, evaluate work done by the force field $\vec{F}(x, y) = (e^{2x} - y^3)\, \hat{\imath} + (\sin y + x^3)\hat{\jmath}$ on a particle that travels once around the circle $x^2 + y^2 = 4$ in the counterclockwise direction.	CO4	(5)
		OR		
16	a)	Use Stokes', theorem to find the circulation of the vector field $\vec{F}(x, y, z) = (x - z)\, \hat{\imath} + (y - x)\, \hat{\jmath} + (z - xy)\ \hat{k}$ around the triangle with vertices A (1,0, 0), B (0, 1, 0) and C (0, 0, 1) oriented counterclockwise, when viewed from the origin towards the first octant.	CO4	(4)
	b)	Use the Divergence theorem to find the outward flux of the vector field, $\vec{F}(x, y, z) = (x^2 + y)\hat{\imath} + z^2\, \hat{\jmath} + (e^y - z)\hat{k}$ across the surface of the rectangular solid bounded by the coordinate planes and the planes $x = 1, y = 2$ and $z = 3$.	CO4	(5)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-0-0-2-3**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							
Course Code	**Course Name**						**Course Category**
B250902/CH910B	**CHEMISTRY FOR PHYSICAL SCIENCE**						**BSE**
Pre-requisite							
Concepts of chemistry introduced at the plus two levels especially Electrochemistry, Polymers, Structure of Molecules, Environmental Pollution and Volumetric Analysis.							

COURSE OBJECTIVES	
1	To equip students with a comprehensive understanding of electrochemical principles and their applications in energy storage, corrosion science, and measurement techniques to solve problems in areas such as battery development, corrosion protection, and pH measurement.
2	To enable students to understand and analyze the properties, characterization, and applications of fuels and lubricants in industrial processes, and to explore the synthesis, structural characteristics, and technological applications of nanomaterials and polymers in energy storage, electronics, and advanced materials.
3	To equip students with a comprehensive understanding of molecular spectroscopy, thermal analysis, and electron microscopic techniques, enabling them to analyse and interpret the structure and properties of materials.
4	To equip students to analyse water quality, treatment methods, waste management practices, and recognize the role of chemistry in promoting environmental sustainability and achieving SDGs.

COMPETENCY	
CC1	Apply fundamental principles of electrochemistry, engineering materials, and spectroscopy to design, analyse, and develop materials and systems for various technological applications, including energy storage, corrosion protection, and advanced materials characterization.
CC2	Apply the principles of water chemistry and waste management to analyse water quality parameters, and implement sustainable strategies for waste reduction and resource recovery.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)	Psychomotor (P)	Affective (A)
CO1	**Apply** the basic concepts of electrochemistry and corrosion to explore the possible applications in various engineering fields.	CC1	A	M	V
CO2	**Identify** the use of various engineering materials like fuels, lubricants, nanomaterials and polymers in different industries.	CC1	A	M	V

CO3	**Apply** the knowledge of spectroscopic techniques and instrumental methods for characterizing different materials in engineering applications.	CC1	A	M	V
CO4	**Select** various water treatment and waste management methods to solve different environmental issues in a sustainable way.	CC2	A	M	V

Cognitive (Revised blooms Level): *-* ***R****: Remember;* ***U****: Understand;* ***A****: Apply;* ***An****: Analyse;* ***E****: Evaluate;* ***C****: Create*
Psychomotor Domain (Dave's): *-* ***I****-Imitation,* ***M****-Manipulation,* ***P****-Precision,* ***Ar****-Articulation,* ***N****-Naturalisation*
Affective (Krathwohl)*: -* ***Re****-Receiving,* ***Rs****-Responding,* ***V****-Valuing,* ***O****-Organization,* ***Ch****-Characterization*

CO	**Program Outcomes & Program Specific Outcomes Correlation Matrix**													
	PO											**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**		**2**			
2	**2**	**2**	**3**	**3**		**3**	**2**	**2**	**1**		**2**			
3	**3**	**3**		**2**	**3**		**2**	**2**	**2**		**2**			
4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**		**3**			

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week					**Credit**	**Hours / Semester**	**Examination Scheme**						
							Theory			**Practical**			**Total**
L	**T**	**J**	**P**	**S**	**C**		**CIA**	**ESE**	**Total**	**CIA**	**ESE**	**Total**	
3	0	0	2	3	4	120	25	60	85	15	0	15	100

L*: Lecture (One unit is of one-hour duration),* ***T****: Tutorial (One unit is of one-hour duration),* ***P****: Practical (One unit is of one-hour duration),* ***J****: Project (One unit is of one-hour duration),* ***S****: Self-Learning & Team Work (One unit is of one-hour duration),* ***CIA****: Continuous Internal Assessment,* ***ESE****: End Semester Examination*

SYLLABUS (Major Topics)

Module	Title	Major Topics	Hrs
1	**Electrochemistry and Corrosion Science**	Electrochemical Cell- Electrode potential- Nernst equation for single electrode and cell (Numerical problems)- Electrochemical series - Applications –Reference electrodes – Glass & Calomel electrode-pH Measurement- using glass electrode-Conductivity- Measurement using Digital conductivity meter. Li-ion battery & H_2-O_2 fuel cell (acid electrolyte only). Corrosion –Electrochemical corrosion mechanism - Galvanic series - Corrosion control methods - Cathodic Protection.	9
2	**Engineering Materials**	Fuels: Calorific value-Experimental determination of calorific value of solid fuels. Analysis of coal – Octane & Cetane Number. Biofuels- Biodiesel-Green Hydrogen. Lubricants: Classification - Properties of lubricants. Nanomaterials: Classification-Synthesis– Sol gel & Chemical Reduction - Applications of nanomaterials – Supercapacitor Materials - Carbon Nanotubes, Fullerenes & Graphene – structure, properties & application. Polymers: ABS & Kevlar -Synthesis, properties and	9

		applications. Conducting Polymers- Classification – Application.	
3	**Instrumental Methods of Analysis**	Molecular Spectroscopy: Types of spectra- Molecular energy levels - Beer Lambert's law – Numerical problems - Electronic Spectroscopy – Principle, Types of electronic transitions –Role of Conjugation in absorption maxima - Instrumentation-Applications – Vibrational spectroscopy – Principle- Number of vibrational modes - Vibrational modes of CO_2 and H_2O – Applications Thermal analysis: –TGA- Principle, instrumentation and applications – TGA of $CaC_2O_4.H_2O$ and polymers. DTA- Principle, instrumentation and applications - DTA of $CaC_2O_4.H_2O$. Electron Microscopic Techniques: SEM - Principle, instrumentation and Applications.	9
4	**Environmental Chemistry**	Water characteristics - Hardness - Disadvantages of hard water -Degree of hardness (Numericals)-Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. – Water disinfection methods – chlorination, Break point chlorination, ozone and UV irradiation. Dissolved oxygen (DO), BOD and COD. Waste Management: Sewage water treatment-Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process. Solid waste-disposal methods- Composting, Landfill & Incineration.	9

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Standard Hydrogen Electrode- Electrolysis-Electroplating of copper - Electroless plating of Copper	12
2	Cement: Manufacture of Portland cement – Theory of setting and hardening of cement.	12
3	Chromatography-Gas Chromatography-Principle-Instrumentation- Application – Analysis of chemical composition of exhaust gases.	12
4	Air Pollution- Sources & Effects- Greenhouse Gases- Ozone depletion. Control methods.	12
5	Pre- lab work.	16

SUGGESTED LEARNING RESOURCES

Sl. No.	Title of Book	Author	Publication
Text Book			
1	Physical Chemistry	P. W. Atkins	Oxford University Press
2	Instrumental Methods of Analysis	H. H. Willard, L. L. Merritt	CBS Publishers
3	Engineering Chemistry	Jain & Jain	Dhanpath Rai Publishing Company
4	Engineering Chemistry	B. L. Tembe, Kamaluddin, M. S. Krishnan	NPTEL Web-book
Reference			
1	Fundamentals of Molecular Spectroscopy	C. N. Banwell	McGraw-Hill
2	Principles of Physical Chemistry	B. R. Puri, L. R. Sharma, M. S. Pathania	Vishal Publishing Co

3	Introduction to Spectroscopy	Donald L. Pavia	Cengage Learning India Pvt. Ltd
4	Polymer Chemistry: An Introduction	Raymond B. Seymour, Charles E. Carraher	Marcel Dekker Inc
5	The Chemistry of Nanomaterials: Synthesis, Properties and Applications	Prof. Dr. C. N. R. Rao, Prof. Dr. h.c. mult. Achim Müller, Prof. Dr.A. K. Cheetham	Wiley-VCH Verlag GmbH & Co.
6	Principles and Applications of Thermal Analysis	Gabbot, P	Oxford: Blackwell Publishing
Web Resource			
1	https://onlinecourses.nptel.ac.in/noc25_mm35/preview		
2	https://onlinecourses.nptel.ac.in/noc25_ch51/preview		

DETAILED SYLLABUS (Self-learning if any to be marked)

Module	Topic	Mode of Delivery	Relevant COs	Learning Domain			Hrs
				C	P	A	
1	**Electrochemical Cell**: Electrochemical Cell- Electrode potential	L	CO1	U		Rs	1
	Nernst equation for single electrode and cell (Numerical problems)	L, P	CO1	A	M	V	1
	Nernst Equation-Numerical Problems	L	CO1	A		Rs	1
	Electrochemical series and applications	L, P	CO1	A	M	V	1
	Reference electrodes – Glass & Calomel electrode –Construction and Working	L	CO1	U		Rs	1
	pH Measurement using Glass Electrode-Conductivity-Measurement using Digital conductivity meter	L, P	CO1	A	M	V	1
	Li-ion battery & H_2-O_2 fuel cell (acid electrolyte only) construction and working.	L	CO1	U		Rs	1
	Corrosion Electrochemical corrosion mechanism (acidic & alkaline medium)	L	CO1	U		Rs	1
	Galvanic series - Corrosion control methods - Cathodic Protection - Sacrificial anodic protection and impressed current cathodic protection.	L	CO1	U		Rs	1
	Standard Hydrogen Electrode- Electrolysis-Electroplating of copper - Electroless plating of Copper	S	CO1	U		Rs	
2	**Fuels**: Calorific value – HCV and LCV –Experimental determination of calorific value of solid fuels.	L	CO2	U		Rs	1
	Analysis of coal – Proximate analysis-Octane & Cetane Number	L	CO2	U		Rs	1

	Biofuels- Biodiesel-Green Hydrogen.	L	CO2	U		Rs	1
	Lubricants: Classification - Solid, Semisolid and Liquid lubricants.	L	CO2	U		Rs	1
	Properties of lubricants - Viscosity Index, Flash point, Fire point, Cloud Point, Pour Point & Aniline Point.	L	CO2	U		Rs	1
	Nanomaterials:Classification based on Dimension & Materials.	L	CO2	U		Rs	1
	Synthesis – Sol gel & Chemical Reduction-Applications of nanomaterials.	L	CO2	U		Rs	1
	Supercapacitor Materials - Carbon Nanotubes, Fullerenes, Graphene-– structure, properties & application.	L	CO2	U		Rs	1
	Polymers: ABS & Kevlar - Synthesis, properties and applications-Conducting Polymers-Classification & Applications	L, P	CO2	A	M	V	1
3	**Spectroscopy:** Types of spectra-Molecular energy levels	L	CO3	U		Rs	1
	Beer Lambert's law- Numerical problems	L, P	CO3	A	M	V	1
	Electronic Spectroscopy – Principle, Types of electronic transitions.	L	CO3	U		Rs	1
	Electronic Spectroscopy- Role of conjugation in absorption maxima. – Instrumentation-Applications –	L, P	CO3	A	M	V	1
	Vibrational spectroscopy – Principle	L, P	CO3	A	M	V	1
	Number of vibrational modes - Vibrational modes of CO_2 and H_2O – Applications	L	CO3	U		Rs	1
	Thermal Analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $CaC_2O_4.H_2O$ and polymers.	L	CO3	U		Rs	1
	DTA-Principle, instrumentation (block diagram) and applications - DTA of $CaC_2O_4.H_2O$.	L	CO3	U		Rs	1
	Electron Microscopic Techniques: SEM - Principle, instrumentation and Applications.	L	CO3	U		Rs	1
	Chromatography-Gas chromatography-Principle-Instrumentation- Application – Analysis of chemical composition of exhaust gases.	S	CO3	U		Rs	
4	**Water characteristics** - Hardness - Types of hardness- Temporary and Permanent hardness	L	CO4	U		Rs	1
	Disadvantages of hard water -Degree of hardness.	L, P	CO4	A	M	V	1
	Degree of hardness (Numericals)	L	CO4	A		Rs	1
	Water softening methods-Ion exchange process- Principle, procedure and advantages.	L	CO4	U		Rs	1
	Reverse osmosis – principle, process and advantages	L	CO4	U		Rs	1

	Water disinfection methods – chlorination-Break point chlorination, ozone and UV irradiation.	L	CO4	U		Rs	1
	Dissolved oxygen (DO), BOD and COD- Definition & Significance.	L, P	CO4	A	M	V	1
	Waste Management:Sewage water treatment: Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process.	L	CO4	U		Rs	1
	Solid waste-disposal methods-Composting, Landfill & Incineration.	L	CO4	U		Rs	1
	Air Pollution- Sources & Effects-Greenhouse Gases- Ozone depletion. Control methods.	S					

PRACTICAL SYLLABUS

Topic	Objective	CO	Learning Domain			Hrs
			C	P	A	
Calibration of pH meter and determination of pH of a solution.	To calibrate a digital pH meter using standard buffer solutions and to accurately determine the pH of the given unknown solutions.	CO1	A	M	V	2
Determination of cell constant and conductance of solutions.	To determine the cell constant of a conductivity cell using a standard KCl solution and to measure the conductance of given solutions using a digital conductivity meter.	CO1	A	M	V	2
Verification of Nernst equation for electrochemical cell.	To verify the Nernst equation by measuring the electrode potential of a given electrochemical cell at different ion concentrations and comparing the experimental values with theoretical values.	CO1	A	M	V	2
Estimation of iron in iron ore.	To estimate the percentage of iron present in a given iron ore sample using a redox titration method with potassium permanganate as the titrant.	CO1	A	M	V	2
Synthesis of polymers (a)Urea- formaldehyde resin (b)Phenol-formaldehyde resin.	To synthesise the polymers such as urea formaldehyde resin and phenol-formaldehyde resin and hence to note their yield.	CO2	A	M	V	2
Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution.	To determine the wavelength of maximum absorption of Fe^{3+} using a colorimeter and to estimate the concentration of Fe^{3+} in a given solution based on Beer-Lambert's law.	CO3	A	M	V	2
Determination of molar absorptivity of a compound	To determine the molar absorptivity (ε) of a coloured compound such as potassium	CO3	A	M	V	2

($KMnO_4$ or any water-soluble food colorant).	permanganate by measuring absorbance at its λmax and applying Beer-Lambert's law.					
Analysis of IR spectra.	To analyse the IR spectrum of given compounds based on characteristic absorption bands and to characterize the unknown compounds	CO3	A	M	V	2
Estimation of total hardness of water- EDTA method.	To determine the total hardness of a given water sample by complexometric titration using Ethylene diamine tetra acetic acid (EDTA) as the titrant and Eriochrome Black T as the indicator.	CO4	A	M	V	2
Estimation of dissolved oxygen by Winkler's method.	To estimate the amount of dissolved oxygen (DO) present in a water sample using Winkler's iodometric method, which is essential for assessing water quality and aquatic life sustainability.	CO4	A	M	V	2

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Distribution of Marks (Revised Bloom's Level)						Total Marks
		R	U	A	An	E	C	
1	Electrochemistry and Corrosion Science	√	√	√				15
2	Engineering Materials	√	√	√				15
3	Instrumental Methods of Analysis	√	√	√				15
4	Environmental Chemistry	√	√	√				15

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN

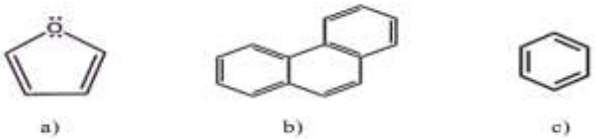
Assessment		Marks
Continuous Internal Assessment		**40**
1	Internal Examination (Theory)	**20**
2	Continuous Lab Evaluation	**10**
3	Internal Examination -Lab	**5**
4	Regularity	**5**
5	Course Project	**0**
End Semester Examination - Lab		**0**
End Semester Examination _ Theory		**60**
Total		**100**

			Total Pages: …….
Register No.:	……	**Name:**	……

SECOND SEMESTER B. TECH DEGREE (REGULAR) EXAMINATION, MAY2026 (2025 SCHEME)			
Course Code:	**B250902/CH910B**		
Course Name:	**Chemistry for Physical Science**		
Max. Marks	**60**	**Duration:**	**2 hours 30 minutes**
Common to CE and ME			

PART A

(Answer all questions. Each question carries 3 marks)

No.	*Question*	*CO*	*Marks*
1	An automotive engineer notices that the battery of electric vehicles degrades faster in tropical countries like India compared to temperate regions. The Li-ion battery voltage drops from 3.7V to 3.2V after 2 years of operation in hot conditions. Taking Nernst equation of Daniel Cell as an example, explain how temperature affects the electrode potential.	CO1	(3)
2	A glass electrode system shows an EMF of 0.428 V when measuring an unknown solution. With standard buffer (pH = 4), EMF = 0.236 V. Calculate the pH of unknown solution if the slope is 0.059 V/pH unit.	CO1	(3)
3	<table><tr><td>Column A(Property)</td><td>Column B (Significance)</td></tr><tr><td>A. Flash Point</td><td>1. Temperature at which lubricant becomes cloudy</td></tr><tr><td>B. Cloud Point</td><td>2. Minimum temperature for continuous combustion</td></tr><tr><td>C. Pour Point</td><td>3. Temperature at which vapours ignite momentarily</td></tr><tr><td>D. Fire Point</td><td>4. Lowest temperature at which oil ceases to flow</td></tr></table> Match the column A with column B. Based on the answer write four characteristics of a good liquid lubricant.	CO2	(3)
4	How do the different types of bonding present in Kevlar contribute to its exceptional mechanical strength and suitability for applications such as bullet proof vests and aerospace materials?	CO2	(3)
5	Which molecule will absorb at longer wavelength in UV? Justify the answer.  a) b) c)	CO3	(3)
6	A pharmaceutical lab is testing drug purity using UV-Visible spectroscopy. Two samples of the same drug show: Sample A: Absorbance = 0.845 at λ_max = 265 nm Sample B: Absorbance = 0.650 at λ_max = 265 nm	CO3	(3)

	Both were measured in 1 cm cells. Sample A is the standard with concentration 5 x 10^{-4} M. Calculate the concentration of sample B.		
7	Compare the disinfection efficiency, mechanism of action, and advantages of ozone and chlorine in water treatment processes.	CO4	(3)
8	What is DO in water? What are the factors which govern the amount of DO in water?	CO4	(3)

PART B

(Answer any one full question from each module, each question carries 9 marks)

No.		***Question***	***CO***	***Marks***
MODULE I				
9	a)	A zinc electrode is immersed in 0.01 M $ZnSO_4$ solution at 25°C. (i) Derive the Nernst equation for this single electrode. (ii) Calculate the electrode potential if $E^0_{Zn^{2+}/Zn}$ = -0.76 V.	CO1	(6)
	b)	Represent an electrochemical cell with Saturated Calomel Electrode and a Glass Electrode. How this system is used for the determination of pH of an unknown solution.	CO1	(3)
OR				
10	a)	Describe the construction and working of Li ion cell. Why full charging is not allowed in this cell?	CO1	(6)
	b)	Write any three applications of Electrochemical series with examples.	CO1	(3)
MODULE II				
11	a)	A coal sample was analysed using bomb calorimeter with the following data: Weight of coal = 0.8 g, Water equivalent of calorimeter = 2500 g, Rise in temperature = 2.4°C, Fuse wire correction = 50 cal, Acid correction = 60 cal. **(i)** Calculate the Higher Calorific Value (HCV) of coal in cal/g. **(ii)** If the coal contains 4% hydrogen, calculate the Lower Calorific Value (LCV). **(iii)** Explain why LCV is more relevant for practical fuel applications than HCV.	CO2	(6)
	b)	What is Biodiesel? Explain the preparation.	CO2	(3)
OR				
12	a)	Two fuel samples are tested: Sample X: Octane number = 92, Cetane number = 25 Sample Y: Octane number = 45, Cetane number = 52 (i) Identify which sample is suitable for petrol engines and which for diesel engines. Justify. (ii) Explain the chemical basis of octane and cetane ratings.	CO2	(6)
	b)	Graphene-based materials are increasingly used in the fabrication of supercapacitors. Explain why graphene is suitable for this application with reference to its surface area, electrical conductivity, and mechanical strength.	CO2	(3)
MODULE III				
13	a)	In the CH_3COOH molecule, various types of electrons contribute to different electronic transitions. Discuss the possible electronic transitions in this molecule and illustrate them using a suitable energy level diagram.	CO3	(5)
	b)	Explain the instrumentation and working of Scanning Electron Microscopy.	CO3	(4)
OR				
14	a)	Explain how DTA differs from TGA. What additional information can DTA provide about $CaC_2O_4.H_2O$ decomposition that TGA cannot?	CO3	(5)
	b)	Calculate the number of vibrational modes in CO_2 and H_2O. Sketch the different vibrational modes and predict the IR activity.	CO3	(4)

MODULE IV				
15	a)	A smart city project requires water supply for 100,000 people (150 L/person/day). Source water analysis gives the following data: $Ca(HCO_3)_2$ = 162 mg/L, $Mg(HCO_3)_2$ = 73 mg/L, $CaSO_4$ = 136 mg/L, $MgCl_2$ = 95 mg/L, SiO_2 = 20 mg/L, Fe^{2+} = 0.8 mg/L, Turbidity = 25 NTU **(i)** Calculate total, temporary, and permanent hardness in ppm. **(ii)** Design a complete disinfection strategy using Break Point Chlorination method.	CO4	(5)
	b)	How is reverse osmosis used for the purification of sea water?	CO4	(4)
OR				
16	a)	A solid waste management facility handles 100 tons of municipal waste daily with the following composition: Biodegradable: 60%, Non-biodegradable: 30% and Hazardous: 10% **(i)** Propose an integrated waste disposal strategy using composting, landfill, and incineration. **(ii)** Explain the scientific principle behind composting and mention two advantages. **(iii)** What precautions are necessary for landfill disposal to prevent groundwater contamination?	CO4	(5)
	b)	Explain the different stages in sewage water treatment with the help of a flow diagram.	CO4	(4)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**4-0-0-0-2**	**Version**	**25/0**	**Credits**	**3**
Course Code	**Course Name**						**Course Category**
B250902/ CN200C	Engineering Graphics						BST
Pre-requisite if any: NIL							
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

COURSE OBJECTIVES	
1	To equip students with the ability to visualize, represent, and interpret engineering designs using technical drawings.
2	To learn the features of CAD software

COMPETENCY & OUTCOMES		
Competency Statements	C1	Demonstrate the ability to interpret, construct, and communicate technical drawings by applying standard conventions and projection techniques, enabling effective visualization and representation of engineering components for design, analysis, and manufacturing applications.
	C2	Develop the ability to use CAD software for 2D drawings.

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Statement Mapping	Cognitive (C)	Psychomotor (P)	Affective (A)
CO 1	Draw the orthographic projection of points and lines located in different quadrants	C1	A		
CO 2	Generate multi-view orthographic projections of engineering objects by visualizing them in different positions	C1	A		
CO 3	Plot sectional views of engineering solids.	C1	A		
CO4	Develop surfaces of engineering objects.	C1	A		
CO 5	Prepare pictorial drawings using the principles of isometric projection	C1	A		
CO 6	Sketch simple 2D drawings using CAD tools.	C2	A		Rs

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*
Psychomotor Domain (Dave's): *- **I**-Imitation, **M**-Manipulation, **P**-Precision, **Ar**-Articulation, **N**-Naturalisation*
***Affective (Krathwohl)**: - **Re**-Receiving, **Rs**-Responding, **V**-Valuing, **O**-Organization, **Ch**-Characterization*

COURSE ARTICULATION MATRIX																								
CO	**Knowledge Attitude Profile**									**Program Outcomes & Program Specific Outcomes**													
	WK									**PO**											**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1										**3**										**1**			
2										**3**										**1**			
3										**3**										**1**			
4										**3**										**1**			
5										**3**										**1**			
6										**3**				**2**						**1**			
Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"																								

TEACHING AND ASSESSMENT SCHEME										
Teaching Scheme / Week				**Self-Learning (S) / Semester**	**Total Hours / Semester**	**Credits C**	**Examination Scheme**			
L	**T**	**J**	**P**				**Theory**			**Practical**			**Total**
							CIA	**ESE**	**Total**	**CIA**	**ESE**	**Total**	
4				30	90	3	40	60	100				100
***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*										

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Contact Hours
1	**Orthographic projection of points and lines**	Introduction: Relevance of technical drawing in the engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing. (No questions for the end semester examination) Orthographic Projection of points in different quadrants, Projection of straight lines inclined to one plane, and inclined to both planes. Trace of a line. Inclination of lines with reference planes. True length and true inclinations of line inclined to both the reference planes.	**12**
2	**Orthographic projection of solids**	Orthographic Projection of Simple solids such as Triangular, Rectangular, Square, Pentagonal and Hexagonal Prisms and Pyramids, Cube, Cone and Cylinder. Projection of solids in simple position including profile view. Projection of solids with axis inclined to one of the reference planes and with axis inclined to both reference planes.	**12**
3	**Sections of solids and**	Sections of Solids: Sections of Prisms, Pyramids, Cube, Cone and Cylinder with axis in vertical position and cut by different	**12**

	Development of surfaces	section planes. True shape of the sections. (Exclude true shape given problems). Development of Surfaces: Development of surfaces of the solids and solids cut by different section planes. (Exclude problems with through holes)	
4	**Isometric projection**	Isometric Projection: Isometric scale- Isometric View and Projections of Prisms, Pyramids, Cone, Cylinder, Sphere, Hemisphere and their combinations.	**10**
5	**Computer Aided Drawing (CAD)**	Computer Aided Drawing (CAD): Introduction, Role of CAD in design and development of new products, Advantages of CAD. Creating two-dimensional drawing with dimensions using suitable software. (CAD, only internal evaluation)	**14**

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Application problems from projection of lines	**6**
2	Application problems from development of surfaces	**6**
3	https://www.autodesk.in/campaigns/autocad-tutorials	**6**
4	https://knowledge.autodesk.com/support/autocad/getting-started?sort=score	**6**
5	https://all3dp.com/autocad-tutorial-beginners/	**6**

SUGGESTED LEARNING RESOURCES

Sl. No.	Title of Book	Author	Publication
Text Book			
1	Engineering Graphics	Varghese, P. I.	V I P Publishers
2	Engineering Graphics	Benjamin, J.	Pentex Publishers
3	Engineering Graphics	John, K. C.	Prentice Hall India Publishers
4	Engineering Drawing	Bhatt, N., D.	Charotar Publishing House Pvt Ltd.
5	Engineering Graphics	Anilkumar, K. N.	Adhyuth Narayan Publishers
Reference			
1	Engineering Graphics with AutoCAD,	Kulkarni, D. M., Rastogi, A. P. and Sarkar, A. K.,	Prentice Hall India Publishers
2	Engineering Drawing & Graphics	Venugopal, K.	NewAge International Publishers
3	Engineering Drawing	Parthasarathy, N. S., and Murali, V.	Oxford University Press
Web Resource			
1	NPTEL Course – Engineering Drawing (Web) - https://archive.nptel.ac.in/courses/112/102/112102304/		
2	A R STUDY DESK – Engineering Graphics - Introduction Videos		
Online learning App			
1	A R STUDY DESK – Engineering Graphics: Your Animated Notebook (EGYAN)		

DETAILED SYLLABUS *(Self-learning if any to be marked)*								
Module	Title	Major Topic & Sub Topic	Mode of Delivery	Relevant COs	Learning Domain Level			Teaching Hours
					C	P	A	
1		Orthographic projection of points	**CL**	**CO1**	**A**			**2**
1		Orthographic projection of lines	**CL**	**CO1**	**A**			**10**
1		Orthographic projection of lines – self learning	**SL**	**CO1**	**A**			**6**
2		Orthographic projection of solids	**CL**	**CO2**	**A**			**12**
3		Sections of Solids	**CL**	**CO3**	**A**			**6**
3		Development of surfaces	**CL**	**CO4**	**A**			**6**
3		Development of surfaces – self learning	**SL**	**C04**	**A**			**6**
4		Isometric projection	**CL**	**CO5**	**A**			**10**
5		Computer Aided Drawing (CAD)	**CL**	**CO6**	**A**		**Rs**	**14**
5		CAD - self learning	**SL**	**CO6**	**A**		**Rs**	**18**

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN								
Module	Module Title	Distribution of Marks (Revised Bloom's Level)						Total Marks
		R	U	A	An	E	C	
1	Orthographic projections of points and lines			□				15
2	Orthographic projections of solids			□				15
3	Sections of solids and development of surfaces			□				15
4	Isometric projection			□				15
5	Computer aided Drawing (CAD)			□				No ESE
This ToS shall be treated as a general guideline for students and teachers for distribution of marks.								

Assessment	Marks
Continuous Internal Assessment	**40**
Learning Activity (Assignments + CAD)	5 + 10 =15
Regularity	5
Internal Examinations	20
End Semester Examination	**60**
Total	**100**

QUESTION PAPER CODE

			Total Pages: …1….
Register No.:	……	Name:	……

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

FIRST SEMESTER B. TECH DEGREE REGULAR EXAMINATION, DECEMBER 2025 (2025 SCHEME)			
Course Code:	**B250902/CN200C**		
Course Name:	**Engineering Graphics**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
(ME, CE)			

Instructions: Retain all Construction lines. Show necessary dimensions. Answer any ONE question from each module. Each question carries 15 marks

No.	*Question*	*CO*	*Marks*
	MODULE 1		
1	A line 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 45° to the VP. Draw the projections of AB.	CO1	(15)
2	The top view of a line PQ is 60mm long measures 50mm, while the length of its front view is 40mm. Its end P is in the VP and is 10mm below the HP. Draw the projections of the line and find its inclination with HP and VP.	CO1	(15)
	MODULE 2		
3	Draw the projections of a pentagonal prism of 30mm base side and 60mm height which is resting on its base edge on the ground such that its axis is inclined at 45° to HP and the resting base edge at 30° to VP.	CO2	(15)
4	A square prism of base side 30mm and axis length 60mm is resting on HP on one of its base edges with the axis inclined at 45° to HP. The vertical plane containing its axis is inclined at 35° to VP. Draw its projections.	CO2	(15)
	MODULE 3		
5	A pentagonal pyramid 30mm edge of base and 60mm height stands with its base on the ground and an edge of base perpendicular to VP. A section plane perpendicular to HP and inclined at 30° to VP cuts the pyramid at a distance of 5mm from its axis. Draw its sectional views. Also show the true shape of the section.	CO3	(15)
6	A vertical cone of 35mm diameter and axis 50mm is cut by a section plane which makes 45° to HP and bisects the axis of the cone. Draw the development of the lateral surface of the truncated cone.	CO4	(15)
	MODULE 4		
7	A truncated cone is having base diameter 60mm, top diameter 30mm and axis 40mm. A hemisphere 40mm in diameter is resting centrally on top of this, with its flat face facing upward. Draw the isometric view of the combination of solids.	CO5	(15)
8	A cylinder 50mm base diameter and 70mm high is resting on its base on the HP. It is surmounted centrally by a sphere of 30mm diameter. Draw the isometric projection of the solids.	CO5	(15)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**4-0-0-0-0**	**Version**	**25/0**	**Credits**	**4**
Course Code	**Course Name**						**Course Category**
B250002/ ME200D	**MATERIAL SCIENCE AND ENGINEERING**						**EST**
Pre-requisite							
Course Code	**Course Name**						
Nil	Nil						
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Teamwork)							

COURSE OBJECTIVES	
1	To introduce the fundamental concepts of material structure and bonding and relate them to the physical and mechanical properties of engineering materials.
2	To provide an understanding of crystallography, imperfections in crystals, and diffusion mechanisms that influence the behaviour and performance of materials.
3	To familiarize students with mechanical property evaluation, classification of engineering materials including steels, composites, ceramics, and intermetallics, and their selection for specific engineering applications.
4	To develop analytical and problem-solving skills through interpretation of phase diagrams and the understanding of microstructural evolution during alloying and heat treatment processes.

COMPETENCY & OUTCOMES		
Competency Statements	CC1	Understand the physical, chemical and mechanical properties of engineering materials used for industrial applications.
	CC2	Evaluate material failures due to fatigue, corrosion, wear and fracture mechanics and propose suitable material modifications or protective strategies to enhance durability and reliability.

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Statement Mapping	Cognitive (C)	Psychomotor (P)	Affective (A)
CO 1	**Compute** atomic packing factor (APF) and theoretical density of crystal structures using the concepts of structures of solids.	CC1	U	-	-
CO 2	**Analyse** the influence of crystal imperfections, diffusion mechanisms and advanced material characterization on microstructural features of engineering materials.	CC1, CC2	A	-	-
CO 3	**Evaluate** and select engineering materials such as steels, superalloys, composites, functionally graded materials, shape memory alloys and battery materials by analysing their mechanical properties and performance under different service conditions.	CC2	A	-	-

CO 4	**Estimate** material behaviour and microstructural changes during alloying, heat treatment and additive manufacturing processes using phase diagrams, including binary systems, Fe–C diagram and high entropy alloys.	CC1, CC2	A	-	-

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*
Psychomotor Domain (Dave's): *- **I**-Imitation, **M**-Manipulation, **P**-Precision, **Ar**-Articulation, **N**-Naturalisation*
***Affective (Krathwohl)**: - **Re**-Receiving, **Rs**-Responding, **V**-Valuing, **O**-Organization, **Ch**-Characterization*

COURSE ARTICULATION MATRIX

CO	Knowledge Attitude Profile									Program Outcomes & Program Specific Outcomes													
	WK									PO											PSO		
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1										3	2		2							1	3		2
2										3	2		3							1	3		
3										3	3	2			2					1	3	3	2
4										3	3	2	3							1	3		

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week				Self-Learning (S) / Semester	Total Hours / Semester	Credits C	Examination Scheme			
							Theory			Total
L	T	J	P				CIA	ESE	Total	
49	-	-	-	71	120	4	40	60	100	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)

Module	Title	Major Topics	Contact Hours
1	Introduction to Material Science	Classification of materials, atomic bonding, crystallography, Miller indices, deformation mechanisms, Schmid's law.	12
2	Crystal Defects and Diffusion	Grain size effects, crystal imperfections, dislocations, Material characterisation- XRD, SEM, TEM, EBSD, EDS, XRF, ICP-OES, DSC, TGA, FTIR, and Raman Spectroscopy - Grain size determination, diffusion laws and applications.	12
3	Mechanical Properties and Materials	Tensile, hardness, impact, fatigue, creep, super plasticity, Fracture Mechanics; Wear, Roughness and Corrosion; Types of steels; Aluminium, Titanium, Magnesium and their alloys, Superalloys, composites, intermetallic, ceramics, Functionally Graded Materials, Shape Memory Alloys and Materials for Semiconductors and Battery Technology.	11
4	Phase Diagrams and Heat Treatment	Phase diagrams, Iron-Carbon diagram, Hume-Rothery's rules, Iron-carbon equilibrium diagram, heat treatment, TTT/CCT diagrams, hardenability, surface hardening,	14

		Strengthening Mechanisms, High Entropy Alloys and Alloying for Additive Manufacturing.	

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Teamwork Description	Hrs/Semester
1	Early and Present Developments in Atomic Theory	5
2	Bravais Lattices and Crystal Systems	4
3	Material characterisation – ICP-OES, Raman Spectroscopy, AFM, XRF, DSC, TGA and FTIR	7
4	Exploring Material Characterization Techniques through research Journals	5
5	Fracture Mechanics: Fundamentals of fracture behaviour; stress intensity factor, fracture toughness	5
6	Wear - Mechanisms and types of wear; measurement of wear rate; factors influencing wear.	5
7	Roughness - Surface roughness parameters, measurement techniques, and their influence on mechanical performance.	5
8	Corrosion - Types and mechanisms of corrosion; corrosion testing methods.	5
9	Superalloys: Composition, classification and properties of superalloys	5
10	Intermetallic compounds: stoichiometric vs nonstoichiometric, properties and engineering uses	5
11	Functionally Graded Materials and Shape Memory Alloys: Concept and applications.	5
12	Materials for Semiconductors and Battery Technology.	5
13	High Entropy Alloys: Concept, design principles and its advanced engineering applications.	5
14	Alloys for Additive Manufacturing**:** Principles and strategies of alloy design for optimized 3D-printed metal components.	5

SUGGESTED LEARNING RESOURCES

Sl. No.	Title of Book	Author	Publication
Text Book			
1	Materials Science and Engineering	Callister, William D.	John Wiley
2	Engineering Metallurgy Part-I	Higgins, R. A	Arnold
Reference			
1	The Science and Engineering of Materials	Donald R. Askeland	Thomson
2	Introduction to Physical Metallurgy	Avner, H. Sidney	Tata McGraw Hill
3	Material Science and Engineering	Raghavan, V.	Prentice Hall
4	Mechanical Metallurgy	George E. Dieter	McGraw-Hill
Web Resource			
1	https://nptel.ac.in/courses/113107078		
2	https://nptel.ac.in/courses/112107767		
3	https://nptel.ac.in/courses/113106034		

Module	Major Topic & Subtopic	Mode of Delivery	Relevant COs	Learning Domain Level			Teaching Hours
				C	P	A	
1	Introduction to Material Science and Classifications: metals, ceramics, polymers and composites	L	CO1	U			1
	Properties and applications of each class	L	CO1	U			1
	Self-Learning 1	S	CO1	U			
	Atomic bonding: metallic, ionic and covalent	L	CO1	U			1
	Relationship between bonding type and material properties (e.g., melting point, conductivity)	L	CO1	U			1
	Self-Learning 2	S	CO1	U			
	Unit cell: simple cubic (SC), Body-centered cubic (BCC) Face-centered cubic (FCC) and Hexagonal close-packed (HCP)	L	CO1	U			1
	Atomic radius, coordination number, atomic packing factor (APF) – derivations and comparisons	L / T	CO1	U			1
	Calculations of theoretical density with worked examples	L / T	CO1	U			1
	Crystal systems and lattice parameters	L	CO1	U			1
	Miller indices of directions and planes – procedure, examples and visualization	L / T	CO1	U			1
	Inter-planar spacing and its importance -Elastic vs plastic deformation	L	CO1	U			1
	Mechanism of slip and twinning	L	CO1	U			1
	Critical resolved shear stress and conditions for slip	L	CO1	U			1
2	Solidification process: nucleation and grain growth Factors affecting grain size	L	CO2	A			1
	Grain boundaries and their effect on mechanical properties- Hall-Petch relationship: derivation, significance and numerical problems	L	CO2	A			1
	Point defects: vacancies and interstitials - Frenkel and Schottky defects	L	CO2	A			1
	Line defects: edge and screw dislocations, dislocation movement - Burgers vector – definition and significance	L	CO2	A			1

	Surface and volume defects: grain boundaries, stacking faults, voids	L	CO2	A			1
	Sample preparation: cutting, mounting, polishing and etching	Lab demo	CO2	A			1
	Optical microscopy and imaging of microstructures - ASTM grain size number and intercept methods	L	CO2	A			1
	Material characterisation – SEM, EDS, XRD and TEM	L	CO2	A			1
	Self-Learning 3	L	CO2	A			
	Types of diffusion: interstitial vs substitutional-Mechanisms of atomic movement: vacancy and interstitial	L	CO2	A			1
	Self-Learning 4	L	CO2	A			
	Role of temperature and concentration gradient in diffusion - Steady-state and non-steady-state diffusion	L	CO2	A			1
	Fick's First Law – derivation and steady-state diffusion problems	L	CO2	A			1
	Fick's Second Law – basic interpretation and use cases	L	CO2	A			1
3	Tensile strength: stress-strain curve, yield point, ultimate strength, modulus of elasticity	L	CO3	A			1
	Hardness: types of hardness (Brinell, Rockwell, Vickers), testing methods, hardness number	L	CO3	A			1
	Impact resistance: Charpy and Izod tests, ductile vs brittle behavior	L	CO3	A			1
	Fatigue: S-N curve, fatigue limit, factors affecting fatigue life	L	CO3	A			1
	Self-Learning 5	S	CO3	A			
	Creep: creep curve, stages of creep, temperature and stress effects	L	CO3	A			1
	Self-Learning 6	S	CO3	A			
	Self-Learning 7 and 8	S	CO3	A			

	Ductile-to-brittle transition behavior (DBTT): temperature effects on fracture, ductile vs brittle graphs	L	CO3	A			1
	Carbon steels: low, medium, high carbon steel – composition, properties, and usage	L	CO3	A			1
	Alloy steels: types and functions of alloying elements - Stainless steels: types (ferritic, austenitic, martensitic), properties and uses	L	CO3	A			1
	Aluminium, Titanium, Magnesium and their alloys: Properties, classifications, advantages, limitations and applications.	L	CO3	A			1
	Self-Learning 9 and 10	S	CO3	A			
	Self-Learning 11 and 12	S	CO3	A			
	Composites: structure and classification (fibrous, laminated, particulate), applications	L	CO3	A			1
	Ceramics: structure, characteristics (brittleness, heat resistance), common applications in industries	L	CO3	A			1
Phase Diagrams and Heat Treatment	Need for alloying: Classification of alloys: substitutional, interstitial, ordered, disordered	L	CO4	A			1
	Hume-Rothery's rules: atomic size factor, electronegativity, valency, crystal structure	L	CO4	A			1
	Introduction to phase rule and significance - Construction and interpretation of binary phase diagrams	L	CO4	A			1
	Isomorphous system and Eutectic system Eutectic point, invariant reactions	L	CO4	A			1
	Lever rule – application and numerical problems	T / L	CO4	A			1
	Explanation and derivation of Gibbs phase rule-Degrees of freedom, number of phases, components	L	CO4	A			1
	Microstructural development during solidification-Application in determining equilibrium phases	L	CO4	A			1

	Phases: ferrite, austenite, cementite, pearlite, ledeburite - Critical temperatures (A_1, A_3, A_{cm})-Eutectoid, eutectic, peritectic reactions	L	CO4	A			1
	Microstructures at different carbon percentages (hypo-eutectoid and hyper-eutectoid steels) - Property evolution with microstructure	L	CO4	A			1
	Heat treatment processes: annealing, normalizing, quenching and tempering	L	CO4	A			1
	TTT (Time-Temperature-Transformation) diagrams and CCT (Continuous Cooling Transformation) diagrams	L	CO4	A			1
	Self-Learning 13	S	CO4	A			
	Self-Learning 14	S	CO4	A			
	Jominy end quench test – principle and procedure	L	CO4	A			1
	Hardenability and surface hardening methods (carburizing, nitriding, induction hardening)	L	CO4	A			1
	Strengthening Mechanisms**:** Methods to improve material strength, including grain refinement, solid solution strengthening, work hardening, precipitation hardening, and dispersion strengthening.	L	CO4	A			1

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Distribution of Marks (Revised Bloom's Level)						Total Marks
		R	U	A	An	E	C	
1	Introduction to Material Science		√	√				15
2	Crystal Defects and Diffusion		√	√				15
3	Mechanical Properties and Materials		√	√	√			15
4	Phase Diagrams and Heat Treatment		√	√	√			15
This ToS shall be treated as a general guideline for students and teachers for distribution of marks.								

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
Learning Activity	15
Regularity	5
Internal Examination	20
End Semester Examination	**60**
Total	**100**

			Total Pages: …….
Register No.:	……	Name:	……

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER B. TECH DEGREE (REGULAR) EXAMINATION, DECEMBER 2025 (2025 SCHEME)			
Course Code:	**B250002/ME200D**		
Course Name:	**MATERIAL SCIENCE AND ENGINEERING**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes

PART - A			
(Answer all questions. Each question carries 3 marks)			
No.	***Question***	***CO***	***Marks***
1	Interpret the reason behind the anomalous behaviour of ice floating on water using the concept of molecular structure and bonding.	CO1	(3)
2	Sketch within a cubic unit cell the following [111], [110] and (011).	CO1	(3)
3	In what way does the Frank–Read source contribute to the generation of new dislocations during plastic deformation?	CO2	(3)
4	A metal component is exposed to a diffusing gas at high temperature. Explain how Fick's laws help in modelling the diffusion mechanism and determining concentration gradients for steady and non–steady-state diffusion	CO2	(3)
5	Name any three alloying elements used in steels and explain their effects.	CO3	(3)
6	Assess the suitability of superalloys for turbine blade applications based on their mechanical and thermal characteristics.	CO3	(3)
7	Apply Hume-Rothery rules to justify the formation of a substitutional solid solution between Cu and Ni.	CO4	(3)
8	Differentiate pearlite and ledeburite microstructures by analysing their phase composition and mechanical implications.	CO4	(3)

PART – B				
(Answer any one full question from each module, each question carries 9 marks)				
No.		***Question***	***CO***	***Marks***
MODULE I				
5	a)	Describe the procedure for obtaining Miller indices for both crystallographic planes and crystallographic directions with a suitable example.	CO1	(5)
	b)	Apply the concepts of slip and twinning to explain how different crystal structures (FCC, BCC, and HCP) respond to plastic deformation under applied stress. Support your answer with suitable sketches	CO1	(4)
OR				
6	a)	Compute the number of atoms, coordination number and atomic packing factor for an HCP structure and interpret their influence on density	CO1	(5)
	b)	Molybdenum has BCC structure and a density of 10.2 g/cm^3 Calculate its atomic radius. Atomic weight of Molybdenum is 95.94 g/mol.	CO1	(4)
MODULE II				
7	a)	With the help of simple sketches differentiate between edge dislocation and screw dislocation.	CO2	(5)
	b)	The yield strength of mild steel with an average grain size of 0.05mm is 138 MPa. The yield strength of the same steel with a grain size of 0.007mm is	CO2	(4)

		276 MPa. What will be the average grain size of the same steel with a yield stress of 207 MPa? Assume Hall-Petch equation is valid.		
OR				
8	a)	Describe the steps involved in preparing a sample for metallographic examination.	CO2	(5)
	b)	During additive manufacturing, you need to confirm the elemental homogeneity and identify possible contamination. Compare and evaluate EDS, ICP-OES, and XRF for this purpose, highlighting their advantages and limitations	CO2	(4)
MODULE III				
9	a)	Classify the different types of ceramics and describe one real-life application for each type	CO3	(5)
	b)	Explain the mechanisms of fatigue crack initiation and propagation. Using the S–N curve and fracture surface features, analyse how surface finish, mean stress, and environmental conditions affect fatigue life	CO3	(4)
OR				
10	a)	Draw a typical creep curve and explain the various stages involved in creep	CO3	(5)
	b)	Illustrate with examples how composites are used to achieve both light weight and high strength in mechanical structures.	CO3	(4)
MODULE IV				
11	a)	With the help of an iron carbon diagram explain the eutectoid, eutectic and peritectic reaction of iron carbon alloy system.	CO3	(5)
	b)	Give a detailed description about the hardening and tempering process.	CO3	(4)
OR				
12	a)	Based on the CCT diagram, why does slow cooling produce pearlite, and what are the practical implications of this microstructure in mechanical applications?	CO3	(5)
	b)	Explain solid solution strengthening and precipitation strengthening	CO3	(4)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-4**	**Version**	**25/0**	**Credits**	**4**
Course Code	**Course Name**						**Course Category**
B250002/ME200E	**ENGINEERING THERMODYNAMICS**						**PCT**
Pre-requisite							
Course Code	**Course Name**						
NIL	Nil						
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

COURSE OBJECTIVES	
1	Introduce the principles and laws of thermodynamics
2	Apply the laws of thermodynamics to engineering systems
3	Identify systems where laws of thermodynamics are applicable

COMPETENCY & OUTCOMES		
Competency Statements	CC1	Students will be able to explain thermodynamic principles and interpret the laws of thermodynamics to understand the behaviour of thermal systems.
	CC2	Students will be able to apply the first and second laws of thermodynamics to analyze different thermal systems. They will also be able to evaluate thermodynamic properties of pure substances using standard tools such as property tables and diagrams.

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Statement Mapping	Cognitive (C)
CO1	**Illustrate** the fundamental concepts and principles of thermodynamics.	CC1	U
CO2	**Apply** the First Law of Thermodynamics to analyze energy interactions in thermal systems.	CC1, CC2	A
CO3	**Apply** the Second Law of Thermodynamics and Carnot principles to analyze the performance of heat engines, refrigerators, and reversible processes.	CC2	A
CO4	**Employ** steam tables, Mollier charts, and thermodynamic diagrams to evaluate properties during phase changes of pure substances.	CC2	A

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*
Psychomotor Domain (Dave's): *- **I**-Imitation, **M**-Manipulation, **P**-Precision, **Ar**-Articulation, **N**-Naturalisation*
***Affective (Krathwohl)**: - **Re**-Receiving, **Rs**-Responding, **V**-Valuing, **O**-Organization, **Ch**-Characterization*

COURSE ARTICULATION MATRIX

CO	Knowledge Attitude Profile									Program Outcomes & Program Specific Outcomes													
	WK									PO											PSO		
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1										3	1										3		
2										3	1				**2**		**1**	**1**			3		
3										3	1				2		**1**	**1**			3		
4										3	1				**2**		**1**	**1**			3		

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week				**Self-Learning (S) / Semester**	**Total Hours / Semester**	**Credits C**	**Examination Scheme**		
L	**T**	**J**	**P**				**Theory**		**Total**
45	15	-	-	60	120	4	**CIA**	**ESE**	**Total**	100
							40	60	100	
***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*									

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Contact Hours
1	Introduction to Thermodynamics	Basic concepts, thermodynamic systems and properties, Zeroth law, energy forms, heat and work transfer.	15
2	First law of Thermodynamics	Energy balance in closed and open systems, boundary work, enthalpy, SFEE.	15
3	Second law & Carnot Cycle	Second law statements, reversible/irreversible processes, Carnot cycle, entropy, thermodynamic temperature scale, heat engines, refrigerators, COP.	15
4	Phase transformation of pure substances	Phase change, saturated/superheated states, steam tables, T-v, P-v, P-T diagrams, Mollier chart, isentropic processes.	15

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Convert Temperatures Across Scales (°C, K, °F, °R) and Solve Practice Problems. Create Diagrams for Different Thermodynamic Processes (P-V, T-S plots) and derive expressions for work transfer and heat transfer for each process	20
2	Solve Numerical Problems on Work and Heat Transfer for Closed Systems (basic first law applications). Apply SFEE to Solve Problems on Nozzles, Diffusers, and Throttling Devices	20
3	Solve Entropy Change and Carnot Cycle Efficiency Problems with Given Data. Use Steam Tables to Find Thermodynamic Properties and Solve Enthalpy-based Problems	20

SUGGESTED LEARNING RESOURCES

Sl. No.	Title of Book	Author	Publication
Text Book			
1	Thermodynamics: an engineering approach.	Cengel, Yunus A.,Michael A. Boles, and Mehmet Kanoğlu.	McGraw-hill
2	Engineering Thermodynamics	P.K. Nag	McGraw-Hill Education
Reference			
1	Fundamentals of Engineering Thermodynamics	Moran J. Shapiro N. M.	Wiley
2	Fundamentals of Thermodynamics	Richard E. Sonntag, Claus Borgnakke, Gordon J. VanWylen	Wiley
3	Thermodynamics: Principles and Applications	Jean-Philippe Ansermet, Sylvain D. Brechet	Cambridge University Press
Web Resource			

1	Engineering Thermodynamics -Prof. Suman Chakraborty, IIT Kharagpur https://nptel.ac.in/courses/112/105/112105123/
2	Chemical Engineering Thermodynamics - Prof. Dr. Sandip Roy IIT Bombay https://nptel.ac.in/courses/103/101/103101004/

DETAILED SYLLABUS *(Self-learning if any to be marked)*							
Module	Topic	Mode of Delivery	CO	Learning Domain			Hrs
				C	P	A	
1	Role of Thermodynamics in Engineering and Science, Applications of Thermodynamics	**L**	**1**	**U**			**2**
	Thermodynamic System and Control Volume, Surroundings. Macroscopic and Microscopic Analysis. Definition of Property, Properties of systems, Intensive and Extensive	**L**	**1**	**U**			**2**
	Mathematical Representation of Property, State of substance. Thermodynamic Equilibrium, Concept of Quasi-Equilibrium Process. Cycle	**L**	**1**	**U**			**2**
	Fundamental Units, Units of Force, Energy, Specific Volume, Pressure, etc	**L**	**1**	**U**			**2**
	Tutorial 1	**T**	**1**	**U**		Rs	**1**
	Equality of Temperature, The Zeroth Law of Thermodynamics, Temperature Scales. Forms of energy, physical insight into internal energy.	**L**	**1**	**U**			**2**
	Tutorial 2	**T**	**1**	**U**		Rs	**1**
	Heat and Work: Definition of Thermodynamic Work, Forms of Work. Definition of Heat, Inter Convertibility of Heat/work into Work/heat, Governing Principles, Sign Convention.	**L**	**1**	**U**			**2**
	Tutorial 3	**T**	**1**	**U**		**Rs**	**1**
2	First Law for Cyclic Process, First Law for Change of State of a System, Internal Energy, Enthalpy.	**L**	**2**	**U**			**2**
	Isochoric, Isobaric, and Isothermal Processes	**L**	**2**	**A**			**2**
	Isentropic and polytropic processes	**L**	**2**	**A**			**2**
	Tutorial 4	**T**	**2**	**A**		**Rs**	**1**
	Mass and energy analysis of control volumes	**L**	**2**	**U**			**1**
	Introduction to the steady flow energy equation for open systems	**L**	**2**	**U**			**1**
	Application of SFEE to steady-flow devices such as nozzles and diffusers, throttling valves, mixing chambers	**L**	**2**	**A**			**2**
	Tutorial 5	**T**	**2**	**A**		**Rs**	**1**
	Tutorial 6	**T**	**2**	**A**		**Rs**	**1**
	Definition of Heat Engine, thermal energy reservoirs, and thermal efficiency, Refrigerators and heat pumps, Coefficient of Performance	**L**	**2**	**U**			**2**
3	Second Law of Thermodynamics: Definition of Heat Engine and Reservoirs, Kelvin-Planck and Clausius Statements of the Second Law	**L**	**3**	**U**			**2**
	Tutorial 7	**T**	**3**	**A**		**Rs**	**1**
	Tutorial 8	**T**	**3**	**A**		**Rs**	**1**
	Equivalence of the two statements, Perpetual-motion machines	**L**	**3**	**U**			**2**
	Tutorial 9	**T**	**3**	**A**		**Rs**	**1**

	Reversible and Irreversible Engines and Processes, Causes of Irreversibility, Internal and External Irreversibility. (simple problems only)	**L**	**3**	**A**			**2**
	Tutorial 10	**T**	**3**	**A**		**Rs**	
	Entropy - A Property of a System, Clausius Inequality (theory only)	**L**	**3**	**U**			**2**
	Entropy of a Pure Substance, Third law of thermodynamics, (theory only)	**L**	**3**	**U**			**2**
	Entropy Change in Reversible Process, Principle of Increase of Entropy (theory only)	**L**	**3**	**U**			**2**
4	Phase transformations of a pure substance Saturated liquid, saturated vapour, and superheated vapor.	**L**	**4**	**U**			**2**
	Triple point, properties during change of phase, T-v, p-v, and p-T diagram of a pure substance	**L**	**4**	**U**			**2**
	Introduction to steam tables and Mollier diagrams, dryness fraction	**L**	**4**	**A**			**2**
	Property calculations using steam tables	**L**	**4**	**A**			**2**
	Tutorial 11	**T**	**4**	**A**		**Rs**	**1**
	Isentropic efficiency of steam turbines and nozzles (basic ideas only)	**L**	**4**	**A**			**2**
	Tutorial 12	**T**	**4**	**A**		**Rs**	**1**
	Ideal gas equation, gas constants, deviations from the ideal gas model, compressibility	**L**	**4**	**U**			**2**
	Van-der-Waals equation of state	**L**	**4**	**U**			**1**

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Distribution of Marks (Revised Bloom's Level)						Total Marks
		R	U	A	An	E	C	
1	Introduction to Thermodynamics		√					15
2	First law of Thermodynamics		√	√				15
3	Second law & Carnot Cycle		√	√				15
4	Phase transformation of pure substances		√	√				15

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
Learning Activity	15
Regularity	5
Internal Examination	20
End Semester Examination	**60**
Total	**100**

			Total Pages: 2
Register No.:	……	Name:	……

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER B. TECH DEGREE (REGULAR) EXAMINATION, MAY 2026 (2025 SCHEME)			
Course Code:	**B250002/ME200E**		
Course Name:	**ENGINEERING THERMODYNAMICS**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Use of Steam tables are permitted			

PART B				
MODULES 1-4				
(Answer any one full question from each module, each question carries 9 marks)				
No.		***Question***	***CO***	***Marks***
MODULE I				
5	a)	A laboratory has three metal blocks A, B, and C. A thermometer reads 40°C when placed in block A and 60°C in block C. The ambient temperature of the laboratory is 20^0C. After a sufficiently long time, the temperatures of the blocks are measured with a thermometer. What will the temperatures of the block display on the thermometer.	CO1	(5)
	b)	A sealed container holds 4 kg of gas at 300 K. Heat of 500 kJ is supplied, and the gas does 200 kJ of work on a piston. Calculate the change in internal energy of the gas. Identify the types of energy transfer involved in this process.	CO1	(4)
OR				
6	a)	Explain the terms state, change of state, path, process, cycle and quasistatic process. Represent them in a p-v diagram.	CO1	(9)
MODULE II				
7	a)	Air flows steadily at the rate of 0.5 kg/s through an air compressor, entering with a velocity 7m/s, pressure 100 kPa, and specific volume 0.95 m^3 /kg. The corresponding values at the exit are 5 m/s, 700 kPa, and 0.19 m^3/kg respectively. The internal energy of the air leaving is 90 kJ/kg greater than that of the air entering. Cooling water in the compressor jackets absorbs heat from the air at the rate of 58 kW. (a) Compute the rate of shaft work input to the air in kW. (b) Find the ratio of the inlet pipe diameter to outlet pipe diameter.	CO2	(9)
OR				
8	a)	A system has a capacity at constant volume $Cv=AT^2$ where A= 0.042J/K^3. The system is originally at 200 K, and a thermal reservoir at 100 K is available. What is the maximum amount of work that can be recovered as the system is cooled down to the temperature of the reservoir?	CO2	(9)
		MODULE III		
9	a)	A rigid tank contains 2 kg of saturated water vapor at a pressure of 200 kPa. The tank is cooled until the pressure inside drops to 100 kPa. Determine (a) the final quality of the mixture, (b) the final temperature of the steam, and (c) the change in specific volume during the process.	CO3	(5)
	b)	Can any process in this world be irreversible? Comment on this statement, citing real-world examples.	CO3	(4)
		OR		
10	a)	A refrigerator operates between a cold space at 270 K and the surroundings at 300 K. The refrigerator removes 600 kJ of heat from the cold space. Determine the maximum coefficient of performance (COP) for this refrigerator. Calculate the minimum work required to operate the refrigerator.	CO3	(5)
	b)	A Carnot engine operating between two reservoirs has efficiency 1/3. When the temperature of cold reservoir raised by x, its efficiency decreases to 1/6. Determine the value of x, if the temperature of hot reservoir is 99 ^{o}C.	CO3	(4)

		MODULE IV		
11	a)	What is Mollier Chart? Why do the isobars on Mollier diagram diverge from one another?	CO4	(4)
	b)	Steam initially at 1.5 MPa and 300°C expands reversibly and adiabatically in a steam turbine to 40°C. Determine the ideal work output of the turbine per kg of steam.	CO4	(5)
		OR		
12	a)	Steam enters an adiabatic nozzle at 1 MPa and 300 °C, and leaves at a pressure of 100 kPa. Neglect inlet velocity. Using the Mollier chart (h–s diagram), determine: The exit enthalpy of the steam and the exit velocity.	CO4	(5)
	b)	With the help of suitable diagrams, demonstrate the different phases of a pure substance and the changes it undergoes during heating at constant pressure.	CO4	(4)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**2-0-1-0-0**	**Version**	**25/0**	**Credits**	**3**
Course Code	**Course Name**						**Course Category**
B250908/ CN220F	**ENTREPRENEURSHIP AND IPR**						**ESB**
Pre-requisite							
Course Code	**Course Name**						
Nil	Nil						
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Teamwork)							

COURSE OBJECTIVES
The course introduces the fundamentals of entrepreneurship and innovation, focusing on how ideas develop into ventures. It helps students identify and validate business opportunities, understand the role of Intellectual Property Rights (IPR) in protecting innovations and learn basic procedures for managing and commercializing intellectual property.

COMPETENCY & OUTCOMES		
Competency Statements	CC1	Develop entrepreneurial thinking and the ability to conceptualize, plan, and implement new ventures.
	CC2	Apply knowledge of Intellectual Property Rights (IPR) to protect and commercialize innovative ideas.

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Statement Mapping	Cognitive	Psychomotor	Affective
CO 1	**Explain** the fundamentals of entrepreneurship and innovation.	CC1	U	-	Re
CO 2	**Analyse** business models and plans for technology-based startups.	CC1	An	-	V
CO 3	**Explain** various forms of intellectual property.	CC2	U	-	Re
CO 4	**Apply** IPR concepts to protect, manage, and commercialize innovations.	CC2	A	-	Rs
CO 5	**Present** a project that evaluates business potential by applying suitable IP protection measures.	CC1, CC2	E	Ar	O

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*
Psychomotor Domain (Dave's): *- **I**-Imitation, **M**-Manipulation, **P**-Precision, **Ar**-Articulation, **N**-Naturalisation*
***Affective (Krathwohl)**: - **Re**-Receiving, **Rs**-Responding, **V**-Valuing, **O**-Organization, **Ch**-Characterization*

COURSE ARTICULATION MATRIX

CO	Knowledge Attitude Profile									Program Outcomes & Program Specific Outcomes													
	WK									PO											PSO		
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1										3					1		1	1		2			
2										3			2	1	2	1	2	2	2	3			
3										2			1	2	2	2	1	1	2	3			

4										3			2	2	2	2	2	1	2	3			
5										3			2	3	3	2	2	3	3	3			
Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"																							

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week				**Self-Learning (S) / Semester**	**Total Hours / Semester**	**Credits C**	**Examination Scheme**		
L	**T**	**J**	**P**				**Theory**		**Total**
32	-	28	-	30	90	3	**CIA**	**ESE**	**Total**	100
							60	40	100	
***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*									

SYLLABUS (Major Topics)			
Module	**Title**	**Major Topics**	**Contact Hours**
1	Entrepreneurship Fundamentals	Introduction to Innovation and Entrepreneurship – Entrepreneurial mindset – Types of entrepreneurs – Idea generation – Design thinking – Startup ecosystem – Government initiatives.	8
2	Business Planning and Startup Management	Market research and validation – Business model canvas – Revenue and pricing strategies – Business plan preparation – Prototype and MVP development – Risk management.	8
3	Fundamentals of IPR	Introduction to IPR – Patents, Trademarks, Copyrights, Industrial Designs – Patentability, filing procedures – Patent databases and search – Infringement-Rights and obligations – Case studies.	8
4	IPR Management and Commercializatio n	IP strategy for startups – Licensing, technology transfer – IPR in digital era – Emerging trends in AI and software patents – Ethical issues and Indian IP policy framework.	8

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Analysis of government initiatives for startups (Startup India, Kerala Startup Mission, MSME schemes) and their impact on young entrepreneurs.	3
2	Case study on successful Indian startups and analysis of their innovation and growth journey.	3
3	Survey on entrepreneurial mindset among students and analysis of key motivating factors.	3
4	Preparation of a Business Model Canvas (BMC) for a technology or engineering-based idea.	3
5	Role-play exercise on negotiation between inventor and investor for licensing a technology	3
6	Comparative study of patents, trademarks, and copyrights through real-world Indian examples.	3
7	Patent search activity using the Indian Patent Advanced Search System (InPASS) or Google Patents.	3
8	Study on IPR infringement cases in India (e.g., Ilaiyaraaja vs *Manjummel Boys*, Novartis vs Union of India) and lessons learned.	3
9	Case study on the commercialization of academic research through technology transfer.	3

10	Seminar or debate on AI-generated content and copyright ethics in the digital era.	3

SUGGESTED LEARNING RESOURCES

Sl. No.	Title of Book	Author	Publication
Text Book			
1	The Engineering Handbook	Richard C.Dorf	CRC Press
2	Business Model Generation	Alexander Osterwalder & Yves Pigneur	Wiley
3	Innovation and Entrepreneurship for Engineers	Bharat Bhushan and Seema Bhushan	CRS Press
4	Indian Patent Law	P. Narayanan	Eastern Book Company
5	The Law of Copyright and Designs	B.L. Wadehra	Universal Law
6	Intellectual Property Rights (Including IPR in the Digital Age)	Prabuddha Ganguli	Tata McGraw-Hill Education
Web Resource			
1	https://onlinecourses.nptel.ac.in/noc25_mg81		
2	https://nptel.ac.in/courses/110107094		
3	https://onlinecourses.nptel.ac.in/noc22_hs59		

Module	Major Topic & Sub Topic	Mode of Delivery	Relevant COs	Learning Domain Level			Teaching Hours
				C	P	A	
1	Introduction to Innovation and Entrepreneurship – Meaning, need, and importance	L	CO1	U		Re	1
	Entrepreneurial mindset – Characteristics and motivation of entrepreneurs	L	CO1	U		Re	1
	Types of entrepreneurs – Intrapreneurs, social, tech-based, women entrepreneurs	L	CO1	U		Re	1
	Idea generation techniques – Creativity, brainstorming, problem identification	L	CO1	U		Re	1
	Design thinking – Empathy, define, ideate, prototype, and testing	L	CO1	U		Re	1
	Startup ecosystem – Incubators, accelerators, funding agencies	L	CO1	U		Re	1
	Government initiatives for startups – Startup India, Make in India, MSME schemes	L	CO1	U		Re	1
	Self-Learning 1	S	CO1	U		Re	
	Self-Learning 2	S	CO1	U		Re	
	Case study / activity – Successful Indian startups and their founders	L	CO1	U		Re	1
2	Market research and validation – Identifying customer needs	L	CO2	An		V	1

	Business model canvas – Key partners, activities, value proposition	L	CO2	An		V	1
	Revenue and pricing strategies – Cost-based and value-based pricing	L	CO2	An		V	1
	Business plan preparation – Structure and key components	L	CO2	An		V	1
	Self-Learning 3	S	CO2	An		V	
	Prototype and MVP development – Concept and significance	L	CO2	An		V	1
	Self-Learning 4	S	CO2	An		V	
	Risk management – Types of risks and mitigation plans	L	CO2	An		V	1
	Startup funding sources – Angel investors, venture capital, crowdfunding	L	CO2	An		V	1
	Self-Learning 5	S	CO2	An		V	
	Case study / activity – Analyze a startup's business model canvas	L	CO2	An		V	1
3	Introduction to IPR – Need, importance, and categories	L	CO3	U		Re	1
	Patents – Concepts, requirements, and types	L	CO3	U		Re	1
	Trademarks and Copyrights – Differences, examples, and protection	L	CO3	U		Re	1
	Industrial Designs and Geographical Indications – Overview	L	CO3	U		Re	1
	Self-Learning 6	S	CO3	U		Re	
	Patentability and filing procedures – Steps involved in India	L	CO3	U		Re	1
	Patent databases and search – Hands-on demonstration (Google Patents)- Infringement	L	CO3	U		Re	1
	Self-Learning 7	S	CO3	U		Re	
	Self-Learning 8	S	CO3	U		Re	
	Rights and obligations of patent holders	L	CO3	U		Re	1
	Case study – Patent disputes and lessons learned	L	CO3	U		Re	1
4	IP strategy for startups – Importance and methods	L	CO4	E	Ar	O	1
	Licensing and technology transfer – Process and agreements	L	CO4	E	Ar	O	1
	IPR in the digital era – Copyrights in AI, software, and digital content	L	CO4	E	Ar	O	1

	Emerging trends – AI-generated inventions, data protection, open-source issues	L	CO4	E	Ar	O	1
	Self-Learning 9	S	CO4	E	Ar	O	
	Self-Learning 10	S	CO4	E	Ar	O	
	Software patents – Challenges and case examples	L	CO4	E	Ar	O	1
	Ethical issues in IPR – Plagiarism, fair use, and data ethics	L	CO4	E	Ar	O	1
	Indian IP policy framework – Overview and updates	L	CO4	E	Ar	O	1
	Case study / seminar – IP commercialization success stories	L	CO4	E	Ar	O	1

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Distribution of Marks (Revised Bloom's Level)						Total Marks
		R	U	A	An	E	C	
1	Entrepreneurship Fundamentals		√	√				10
2	Business Planning and Startup Management			√	√			10
3	Fundamentals of IPR		√	√				10
4	IPR Management and Commercialization			√	√			10

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**60**
Learning Activity	5
Attendance	5
Internal Examination	20
Course Project	30
End Semester Examination	**40**
Total	**100**

			Total Pages: .....
Register No.:	.....	Name:	.....

SECOND SEMESTER B. TECH DEGREE (REGULAR) EXAMINATION, DECEMBER 2025 (2025 SCHEME)			
Course Code:	**B250908/CN220F**		
Course Name:	**ENTREPRENEURSHIP AND IPR**		
Max. Marks	**40**	**Duration**:	2 hours 30 minutes

PART - A

(Answer all questions. Each question carries 2 marks)

No.	***Question***	***CO***	***Marks***
1	The five stages of Design Thinking are _____, Define, Ideate, _____ and Test.	CO1	(2)
2	Compare entrepreneurs and intrapreneurs in terms of their approach to innovation	CO1	(2)
3	Analyse the role of market validation in reducing startup failure risk.	CO2	(2)
4	Evaluate the importance of Minimum Viable Product (MVP) development.	CO2	(2)
5	The criteria for patentability include novelty, _____ step and _____ applicability.	CO3	(2)
6	Analyse how Geographical Indications (GIs) help in protecting regional products such as ***Palakkadan Matta Rice*** from Kerala.	CO3	(2)
7	Match the terms in **Column A** with the appropriate descriptions in **Column B**. **Column A** / **Column B** (a) Licensing vs. Assignment — (i) Assessing economic worth of IP assets (b) Patent Pooling — (ii) Fair use, plagiarism, and data ownership (c) IP Ethics — (iii) Permission vs. complete ownership transfer (d) IP Valuation — (iv) Sharing IP among multiple holders	CO4	(2)
8	Suggest two ways companies like ***Adobe*** and ***Netflix*** can prevent plagiarism and digital piracy.	CO4	(2)

PART - B

(Answer any one full question from each module, each question carries 6 marks)

No.	***Question***	***CO***	***Marks***
	MODULE I		

9	Kerala has witnessed a steady rise in youth-led entrepreneurship through initiatives like **Kerala Startup Mission (KSUM),** which provides incubation, mentorship, and seed funding support. Programs such as **Young Innovators Programme (YIP)** encourage school and college students to identify real-world problems and propose innovative solutions. Many student startups—ranging from agritech to renewable energy—have evolved from these programs and are now scaling globally			
	a)	Analyse how Kerala's startup ecosystem supports the development of an entrepreneurial mindset among students.	CO1	(2)
	b)	Explain how design thinking principles can be applied to initiatives like YIP to improve innovation outcomes		(2)
	c)	Evaluate the challenges faced by youth entrepreneurs in Kerala in accessing funding and markets.		(1)
	d)	Suggest one policy-level improvement that could further strengthen Kerala's entrepreneurial ecosystem.		(1)
		OR		
10	In Kerala, there has been a growing presence of social and women entrepreneurs who are redefining business with a focus on sustainability and inclusivity. Initiatives like **Kudumbashree** and **WE Mission** (Women Entrepreneurship Mission) have empowered thousands of women to start micro and small-scale ventures across sectors like food processing, handicrafts, and local tourism. Meanwhile, social entrepreneurs such as *G. Venu (Natanakairali)* and *Jose Kutty Panackal (Farmvent)* have used innovation to address social and environmental issues. These ventures not only create employment but also promote sustainable development aligned with the UN SDGs.			
	a)	Differentiate between social entrepreneurs and commercial entrepreneurs with suitable examples from Kerala	CO1	(2)
	b)	Analyse how programs like Kudumbashree and WE Mission contribute to women entrepreneurship development.		(2)
	c)	Evaluate the role of social entrepreneurship in achieving sustainable and inclusive growth in Kerala.		(1)
	d)	Suggest one initiative the state government can introduce to strengthen the social entrepreneurship ecosystem.		(1)
		MODULE II		
11	A group of engineering graduates from Kochi developed an **IoT-based smart irrigation system** that optimizes water usage for farmers in Palakkad. With the support of KSUM's incubation center and an angel investor from Thrissur, the team built a Minimum Viable Product (MVP). However, scaling the product across India required a clear business model, pricing strategy, and risk assessment plan**.**			
	a)	Construct the key components of a Business Model Canvas for this smart irrigation startup.	CO2	(3)
	b)	Suggest an appropriate pricing strategy and justify your choice.		(2)

	c)	Analyse two major risks this startup may face during national expansion and suggest mitigation strategies		(1)
		OR		
12	Founded in 2015, **Zomato** evolved from a simple restaurant discovery website to a multi-service platform offering food delivery, dining experiences, and grocery delivery. The startup adopted a commission-based revenue model, where it earned a percentage from restaurant orders, and later diversified into subscription models like Zomato Gold. Despite rapid expansion, Zomato faced major financial and operational challenges, including high delivery costs, customer retention issues, and intense competition from Swiggy. To remain sustainable, the company had to rethink its pricing strategy, manage investor expectations, and explore new sources of income such as advertising and cloud kitchens. This journey demonstrates how startup success depends not only on innovation but also on effective business planning, risk management, and strategic funding decisions.			
	a)	Analyse Zomato's business model and identify how it balances value creation for customers and revenue generation for the company	CO2	(3)
	b)	Evaluate the effectiveness of Zomato's diversification strategy (e.g., Zomato Gold, grocery delivery) in maintaining market competitiveness.		(2)
	c)	Suggest any two alternative revenue model Zomato could adopt to achieve long-term profitability.		(1)
		MODULE III		
13	In 2023, India's Patent Office rejected **Johnson & Johnson's** patent extension request for its popular tuberculosis (TB) drug **Bedaquiline**. The company had sought to extend its patent beyond the original expiry date, claiming a new version of the same compound. However, the Patent Office ruled that the new version did not meet the criteria of novelty and inventive step under the Indian Patent Act, **Section 3(d).** As a result, Indian manufacturers were allowed to produce generic versions of Bedaquiline, reducing the cost of TB treatment from thousands of rupees per month to less than a few hundred. This decision was celebrated by public health organizations and patient-rights groups, as it made life-saving TB medicines affordable to thousands of patients in India and other developing nations.			
	a)	Explain why the Indian Patent Office rejected Johnson & Johnson's patent extension for Bedaquiline.	CO3	(3)
	b)	Analyse how Section 3(d) of the Patent Act helps prevent "evergreening" of pharmaceutical patents.		(2)
	c)	Evaluate the social and economic impact of this decision on TB treatment and Indian healthcare.		(1)
		OR		

14	In early 2024, a major copyright controversy emerged in the Indian film industry when legendary composer **Ilaiyaraaja** issued a legal notice to the producers of the Malayalam film ***Manjummel Boys***, which featured his iconic Tamil song *"Kanmani Anbodu Kaadhalan"* from the 1991 film *Guna*. The song, deeply emotional and nostalgic, was used in a key scene of *Manjummel Boys*, which later became a massive box-office success across India. According to Ilaiyaraaja, the filmmakers had not obtained his personal permission to use the song, even though they had secured a license from the audio label that owned the recording rights. He claimed that under the Indian **Copyright Act, 1957**, a composer retains moral and authorial rights over their work — including the right to be acknowledged and to object to unauthorized or distorted use. He argued that simply acquiring a "sound recording licence" from a music company does not override the composer's ownership of musical and lyrical rights. This case reignited a larger debate in India's creative industry about ownership, moral rights, and licensing practices. Many musicians and lyricists supported Ilaiyaraaja, asserting that composers often lose control of their creations to record labels. Others argued that such disputes could discourage filmmakers from reviving classic songs. Eventually, media reports suggested that the matter was settled out of court, with the *Manjummel Boys* team reportedly compensating Ilaiyaraaja around ₹60 lakhs for the use of the song. The controversy highlighted the urgent need for clearer copyright awareness and ethical licensing practices in Indian cinema.			
	a)	Explain the types of rights Ilaiyaraaja holds under the Copyright Act, 1957, including economic and moral rights	CO3	(2)
	b)	Analyse why obtaining permission from a record label may not be sufficient to legally use a musical composition in a film.		(2)
	c)	Evaluate how this case impacts future relationships between composers, producers, and music companies in the Indian film industry.		(1)
	d)	Suggest one measure — legal, educational, or institutional — that could help prevent such copyright disputes in India's creative sector.		(1)
MODULE IV				
15	With rapid advances in **artificial intelligence (AI)**, India faces new challenges in defining ownership, authorship, and accountability for creative works generated by machines. AI tools such as **ChatGPT, Midjourney, and Bard** are now widely used by students, designers, and businesses. While these tools accelerate creativity and productivity, they also raise legal and ethical questions about originality, plagiarism, and copyright. In 2024, the Indian Ministry of Electronics and Information Technology initiated discussions on a framework for AI-generated content ownership and data protection, emphasising transparency and responsible innovation. Globally, courts and IP offices are divided: some countries allow limited copyright protection for AI-assisted works, while others — including India — still require human authorship as the basis for copyright registration. The debate highlights a social tension: how can society protect creators' rights while encouraging the open, democratic use of emerging technologies? Without clear IP policies, both human creators and innovators risk exploitation, plagiarism, and loss of credit for their work.			
	a)	Explain the challenges India faces in defining copyright ownership for AI-generated works.	CO4	(2)

	b)	Analyse the ethical implications of using AI tools for creative and academic content generation		(2)
	c)	Evaluate whether India should extend partial IP protection to AI-assisted works. Support your view with reasons.		(1)
	d)	Suggest one policy or guideline that could balance innovation and ethical IP use in the AI era.		(1)
		OR		
16	Over the past decade, India has witnessed explosive growth in digital entertainment and online media platforms such as **Netflix, Hotstar, Zee5** and **SonyLIV**. However, this growth has been accompanied by a surge in digital piracy, which severely affects the creative economy. According to a 2024 report by the **Motion Picture Association** (MPA), India ranks among the top five countries in illegal film downloads and streaming site traffic. The Cinematograph (Amendment) Act 2023 introduced strict penalties — including imprisonment — for individuals or groups involved in unauthorised recording or exhibition of films. Despite these legal measures, piracy persists through mirror sites, Telegram channels, and illegal OTT apps. This issue raises broader ethical and social questions: while piracy deprives creators and investors of revenue, it also exposes the affordability gap in India's digital ecosystem. Many argue that reducing piracy requires not only enforcement but also accessible pricing models and awareness among youth about IP ethics.			
	a)	Explain how licensing and distribution rights contribute to fair commercialisation of digital content in India.	CO4	(2)
	b)	Analyse the effectiveness of India's new anti-piracy laws in addressing the social and economic impacts of film piracy.		(2)
	c)	Evaluate the ethical dilemma between access and ownership in the context of digital piracy.		(1)
	d)	Suggest one initiative that could reduce piracy while ensuring affordable access to digital content.		(1)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**1-0-0-1-0**	**Version**	**25/0**	**Credits**	**1**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
B250908/CN910K	**HEALTH AND WELLNESS**	**HMT**
Pre-requisite		

COURSE OBJECTIVES	
1	To provide essential knowledge on physical activity, health and wellness.
2	To ensure students understand body systems, exercise principles, nutrition, mental health, and disease management.
3	To educate students on the benefits of yoga, the risks of substance abuse and basic first aid skil
4	To equip students with the ability to lead healthy lifestyles.
5	To enable students to design effective and personalized exercise programs.

COMPETENCY STATEMENT (CC)	
CC1	Demonstrate a commitment to a healthy lifestyle through regular physical activity and avoidance of addictive substances to promote holistic wellness.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)	Psychomotor (P)	Affective (A)
CO1	Explain the importance of physical activity in maintaining the human metabolic system.	CC1	U		Re
CO2	Practice life style management strategies to improve mental health and wellness.	CC1	U	M	Rs
CO3	Practice healthy life style through regular physical activities and abstaining from addictive substances	CC1	U	M	Ch

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*
Psychomotor Domain (Dave's): *- **I**-Imitation, **M**-Manipulation, **P**-Precision, **Ar**-Articulation, **N**-Naturalisation*
***Affective (Krathwohl)**: - **Re**-Receiving, **Rs**-Responding, **V**-Valuing, **O**-Organization, **Ch**-Characterization*

CO	Program Outcomes (PO) & Program Specific Outcomes (PSO) Correlation Matrix													
	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	**2**					**1**	**1**		**1**		**1**			
2	**2**					**1**	**1**		**1**		**1**			
3	**2**					**1**	**1**		**1**		**1**			
	2					**1**	**1**		**1**		**1**			

Correlation [3 – High, 2 -Medium, 1 – Low]

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
1			1		1	30	50		50

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Physical well-being and fitness.	Human Body Systems. Quantifying Physical Activity Energy Expenditure. FITT principle	4
2	Mental health awareness & balanced diet	Understanding Mental Health, Addiction and Related Issues, Resources for Mental Wellness.	4
3	Health and wellness through lifestyle management	Manage common hypokinetic diseases and disorders. Meaning, Aims and objectives of yoga. Understanding on substance abuse and addiction	4
4	First Aid Essentials	First aid and principles of first aid	2

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Team activities : Group presentations (Sample topics: Addiction /mental health awareness and suicide prevention ,Nutrition concepts, Popular dietary trends, Nutritional needs at different life stages)	4

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Foundations of Nutrition	Bhavana Sabarwal	Commonwealth Publishers 1999
2	Anatomy and physiology in health and illness.	Ross and Wilson	Waugh, A., & Grant, A. 2022
3	The Mental Health Handbook A Cognitive Behavioural Approach	Trevor Powell	Routledge 2009

Reference			
Sl. No.	Title of Book	Author	Publication
1	Fit to be Well Essential Concept	Thygerson, A.L. ,Thygeson , S.M.,& Thygerson, J. S.	Jones & Bartlett Learning 2018
2	Introduction to physical education, fitness, and sports	Siedentop, D., & Van der Mars, H.	Human kinetics. 2022
3	Substance Use Disorders. Manual for Physicians.	Lal,R.,& Ambekar,A. (2005).	National Drug Dependence Treatment Centre , New Delhi 2005
4	The exercise health connection- how to reduce your risk of disease and other illnesses by making exercise your medicine.	Nieman, D. C., & White, J. A	Public Health 1998
5	ACSM's resource manual for guidelines for exercise testing and prescription.	Lippincott Williams & Wilkins.	American College of Sports Medicine. 2012
6	Exercise Physiology: energy, nutrition and human performance	Katch, F. I., Katch, V. L., & McArdle, W. D.	Lippincott Williams & Wilkins 2010

7	Positive Psychology for Improving Mental Health ; Well-Being	Dr.Geetika Patnaik	Notion Press 2019

Web Resource	
1	https://www.nutrition.gov/ #:~:text=Nutrition.gov%20is%20powered%20by,you%20make%20healthful%20eating%20choices
2	https://www.ncbi.nlm.nih.gov/pmc/artic1es/PMC2879108/
3	https:/ /yoga.ayush.gov.in/
4	https:/ /www.mindful.org/

DETAILED SYLLABUS *(Self-learning if any to be marked)*

Module	Topic	Mode of Delivery	CO	Learning Domain			Hrs
				C	P	A	
1	Human Body Systems related to Physical activity and its functions: RespiratorySystem -Cardiovascular System. Musculoskeletal System and the Major Muscle groups of the Human Body.	L	Co 1	u		Re	1
	Quantifying Physical Activity Energy Expenditure and Metabolic equivalent of task (MET). Exercise Continuum :Light-intensity physical activity, Moderate intensity physical activity, Vigorous -intensity physical activity.	L	Co 1	u		Re	1
	Defining Physical Activity, Aerobic Physical Activity, Anaerobic Physical Activity,Exercise and Health-Related Physical Fitness. FITT principle to design an Exercise programme.	L	Col	u		V	1
	Components of Health-related Physical Fitness: - Cardiorespiratory Fitness-Muscular strength- Muscular endurance-Flexibility-Body composition.	L	Col	u		Re	1
2	Concept of Health and Wellness: Health and wellness differentiation, Factors affecting health and wellness.Mental health and Factors affecting mental health Sports and Socialization : Sports and character building -Leadership through Physical Activity and Sports	L	Co2	u		V	2
	Diet and nutrition: Exploring Micro and Macronutrients: Concept of Balanced diet Carbohydrate & the Glycemic Index Animal & Plant -based Proteins and their Effects on Human Health Dietary Fats & their Effects on Human Health Essential Vitamins and Minerals	L	Co2	u		Rs	2
3	Life style management strategies to prevent manage common hypokinetic diseases and disorders-Obesity Cardiovascular diseases -Diabetes -Osteoporosis - Musculoskeletal disorders(e.g., osteoarthritis, Low back pain, Kyphosis, lordosis,flat-foot, Knock knee	L	Co2	u		Re	**1**
	Meaning, Aims and objectives of yoga Classification and importance of Yogic Asanas (Sitting, Standing,lying) Pranayama and Its Types- Active Lifestyle and Stress Management Through Yoga	L	Co2	u		0	1
	Understand on substance abuse and addiction psychoactive substance &its ill	L	Co2	u		0	1

	effects -alcohol opioids- cannabis -sedative - cocaine- other stimulants including caffeine - hallucinogens- tobacco - volatile solvents.						
4	First aid and principles of First Aid**:** Primary survey: ABC(Airway,Breathing, Circulation). Qualities of a Good First Aider First aid measures for: - Cutsand scrapes - Bruises- Sprains Strains- Fractures Burns Nosebleeds.	L	3	u		Rs	1
	First Aid Procedures: Cardiopulmonary Resuscitation (CPR) Heimlich Maneuver - Applying a sling Sports injuries:Classification (Soft Tissue Injuries -Abrasion, Contusion, Laceration, Incision, Sprain & Strain)	L	3	u		Rs	1

Module	Topic	Objective	CO	Learning Domain Level			Teaching Hours
				C	P	A	
	Stretching exercise (V sit and reach)	Improving Flexibility through Stretching Exercises	CO3		M		12
	Strength exercises (Partial Curl Up&Push Up)	Improving Flexibility through Stretching Exercises.	C03		M		
	Endurance Exercises (Run& Walk)	To assess and improve cardiovascular endurance	C03		M		

ASSESSMENT PATTERN		
Assessment		**Marks**
Continuous Internal Assessment		**50**
1	Internal Examination	
2	Activity Evaluation	20
3	Learning Activity	20
4	Regularity	10
5	Course Project	
End Semester Examination		
Total		**50**

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**0-0-0-2-0**	**Version**	**25/0**	**Credits**	**1**
Course Code	**Course Name**						**Course Category**
B250002/ CN230U	**Electrical and Electronics Fundamentals Lab**						**ESL**
Pre-requisite if any							
	NIL						
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

COURSE OBJECTIVES	
1	To impart fundamental knowledge of electrical safety, wiring systems, earthing methods, and motor control principles.
2	To develop practical skills required for electrical installation, testing, and maintenance activities in industrial environments.
3	To enable students to interpret electrical specifications, identify components, and apply safe operating practices in real-world scenarios.
4	To familiarize students with basic electronic components, their identification, symbols, and functions.
5	To develop practical skills in using common electronic instruments and tools for measurement and testing.
6	To provide hands-on experience in simple circuit construction, PCB design, and safe soldering practices.

COMPETENCY & OUTCOMES		
Competency Statements	CC1	Demonstrate the ability to apply electrical safety practices, identify and handle electrical components, perform wiring and earthing operations, and test motor performance in accordance with industrial standards.
	CC2	Demonstrate basic competency in electronics by identifying components, using testing instruments, and assembling simple electronic circuits safely and effectively.

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Statement Mapping	Cognitive (C)	Psychomotor (P)	Affective (A)
CO 1	Identify various electrical components, protective devices, and battery types used in industrial and domestic applications.	CC1	U	M	V
CO 2	Apply safety procedures and proper wiring practices to execute basic electrical installations and earthing systems.	CC1	A	P	V

CO 3	Test and evaluate the performance of DC and 3-phase induction motors using appropriate instruments.	CC1	A	P	V
CO 4	Identify electronic components and describe their basic characteristics and standard symbols.	CC2	U	M	V
CO 5	Apply electronic test instruments and tools for fundamental measurement and testing operations.	CC2	A	P	Rs
CO 6	Construct simple electronic circuits on breadboards or PCBs in accordance with standard practices and safety norms.	CC2	A	P	O

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*
Psychomotor Domain (Dave's): *- **I**-Imitation, **M**-Manipulation, **P**-Precision, **Ar**-Articulation, **N**-Naturalisation*
***Affective (Krathwohl)**: - **Re**-Receiving, **Rs**-Responding, **V**-Valuing, **O**-Organization, **Ch**-Characterization*

COURSE ARTICULATION MATRIX

CO	Knowledge Attitude Profile									Program Outcomes & Program Specific Outcomes													
	WK									PO											PSO		
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1.										3					2					1			
2.										3	1				2		2			1			
3.										3	1				2		2			1			
4.										3	2			1			2	2		1			
5.										2	2			1	2	1	2	2		1			
6.										2	2			1	1	1	2	2		1			

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week				Credit		Hours / Semester	Examination Scheme		
							Practical		
L	T	J	P	S	C		CIA	ESE	Total
0	0	0	24	6	1	30	50	50	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

DETAILED SYLLABUS							
Exercise No.	**Topic**	**Objective**	**CO**	**Learning Domain Level**			**Teaching Hours**
				C	P	A	
PART A							
1	**Electrical Shock Precautionary Measures**	Demonstrate the safety steps and precautions to be followed in the event of electrical shocks.	**CO2**	**U**	**M**	**V**	**1**
2	**Identification of Electrical Components and Ratings**	Identify and familiarize with various cables, wires, switches, fuses, fuse carriers, MCB, ELCB, and MCCB along with their ratings.	**CO1**	**R**	**M**	**Re**	**1**
3	**Battery Specification Identification**	Identify and compare specifications of different battery types including Lead Acid, Li-Ion, and NiCd.	**CO1**	**R**	**M**	**Re**	**1**
4	**Types of Earthing and Ground Enhancing Materials**	Familiarize with different earthing methods (pipe, plate, mat) and the use of ground enhancing materials.	**CO2**	**U**	**M**	**V**	**1**
5	**Wiring a Simple Light and Fan Circuit**	Perform PVC conduit wiring Fco3or a light/fan point and a 6A plug socket with individual control.	**CO2**	**A**	**P**	**V**	**2**
6	**Power Distribution Wiring with MCB and ELCB**	Wire a single-phase power distribution system with an MCB board, ELCB, main switch, and energy meter.	**CO2**	**A**	**P**	**V**	**2**
7	**Load Testing of DC Shunt Motor**	Conduct a load test to evaluate the performance of a DC shunt motor.	**CO3**	**A**	**P**	**V**	**2**
8	**Load Testing of 3-Phase Induction Motor**	Perform load testing on a 3-phase induction motor to determine its operating characteristics.	**CO3**	**A**	**P**	**V**	**2**
PART B							
9	**Identification and Classification of Electronic Components**	Familiarization/Identification of electronic components with specifications (Functionality, type, size, colour coding, package, symbol and cost of - Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.)	**CO4**	**U**	**M**	**V**	**2**
10	**Familiarization with Electronic Testing Instruments and Tools**	Familiarization/Application of testing instruments and commonly used tools. - Multimeter, Function generator, Power supply, CRO, DSO. Soldering iron, Desoldering pump, Pliers,	**CO5**	**A**	**P**	**Rs**	**2**

		Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de-soldering station.					
11	**Testing of Basic Electronic Components Using a Multimeter**	Testing of electronic components using multimeter - Resistor, Capacitor, Diode, Transistor and JFET.	**CO5**	**A**	**P**	**Rs**	**2**
12	**Introduction to Printed Circuit Boards (PCB) and Simple PCB Fabrication**	Printed circuit boards (PCB) - Types, Single-sided, Double-sided, PTH, Processing methods. Design and fabrication of a single-sided PCB for a simple circuit.	**CO6**	**A**	**P**	**O**	**2**
13	**Drawing of Electronic Circuit Diagrams and Data Sheet Interpretation**	Drawing of electronic circuit diagrams using BIS/IEEE symbols and interpreting data sheets of discrete components and IC's.	**CO4**	**U**	**M**	**V**	**2**
14	**Interconnection Techniques and Soldering Practice**	Inter-connection methods and soldering practice. Bread board, Wrapping, Crimping, Soldering - types - selection of materials and safety precautions.	**CO6**	**A**	**P**	**O**	**2**

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Three-phase AC systems with star and delta configurations through the provided material.	**1**
2	Classifications and types of motors and generators from the given study material.	**1**
3	Understand starters and speed control methods for DC shunt and three-phase induction motors through self-learning, followed by a short assessment.	**1**
4	Electronics components- Passive and active components – Resistors, capacitors and inductors, types, specifications, standard values, colour coding.	**1**
5	PN junction code: - Principle of operation, V-I characteristics. Bipolar junction transistors: PNP and NPN structures, principle of operation	
6	Basic electronic circuits: - Rectifiers and power supplies: Block diagram description of a DC power supply, working of a full-wave bridge rectifier, capacitor filter, working of a simple Zener voltage regulator	**1**
7	Quality of measurements – accuracy, precision, sensitivity and resolution. Working principle and applications of sensors – pressure – strain gauge, bourdon gauge, temperature – RTD, thermocouple, proximity – capacitive sensor, ultrasonic sensor and accelerometer.	**1**

SUGGESTED LEARNING RESOURCES

Sl. No.	Title of Book	Author	Publication
Text Book			
1	Electrical Design Estimating and Costing	K B Raina, S K Bhattacharya	New Age International Publishers
2	Principles of Electrical Machines	V K Mehta	S. Chand

		Rohit Mehta	
3	Basic electronics and linear circuits	N N Bhargava, D C Kulshreshtha and S C Gupta	Mcgraw hill
Reference			
1	Theory of Alternating Current Machinery	Alexander S Langsdorf	McGraw Hill Education
2	The performance and design of direct current machines	A E Clayton and N N Hancock	CBS Publishers
3	Electronic Devices and Circuits	David A Bell	Oxford University Press
Web Resource			
1	https://nptel.ac.in/courses/108102146		

ASSESSMENT PATTERN		
Assessment Method		**Marks**
Continuous Internal Assessment		**50**
1	Continuous Lab Evaluation	45
2	Internal Examination	
3	Regularity	5
End Semester Examination		**50**
Total		**100**