MANAKULA VINAYAGAR
INSTITUTE OF TECHNOLOGY

Approved by the AICTE, New Delhi - Affiliated to Pondicherry University
Accredited by NAAC WITH 'A' Grade and NBA (National Board of Accreditation)
Kalitheerthalkuppam, Puducherry - 605 107
Ph: 0413 2643007 / Website: www.mvit.edu.in

DEPARTMENT OF MECHANICAL ENGINEERING

B.Tech -MECH

REGULATION- 2025 (Autonomous)

(2nd Yr-Curriculum& Syllabus)

Approved copy

DEPT OF MECHANICAL ENGG. PUDUCHERRY * MIT *

2/7/26

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Department of Mechanical Engineering

B.Tech. MECH

REGULATION- 2025

(Curriculum-Autonomous)

III Semester							
Sl.No	Subject Code	Course Title	Category	Periods			Credits
				L	T	P	
Theory							
01	25UMAT35	Applications of Fourier series and Z-Transforms	BS	3	1	0	04
02	25UMET31	Mechanics of Solids	PC	3	1	0	04
03	25UMET32	Fluid Mechanics and Machinery	PC	3	1	0	04
04	25UMET33	Applied Thermodynamics	PC	3	1	0	04
Integrated Course (Type- 6)							
05	25UMEI31	Metallurgy, Material Science & Lab	PC	3	0	2	04
Practical							
06	25UMEP31	Advanced Manufacturing Process Lab	PC	0	0	2	01
07	25UMEP32	Fluid Mechanics and Machinery Lab	PC	0	0	2	01
Employability Enhancement Course							
08	25UPCE31	Personality development	EEC	0	0	2	0
09	25UCCC03	Certificate course II Web Application Development (HTML)	CCC				0
Mandatory Course							
10	25UMCC31	Indian constitution & Human Rights	MCC	0	0	2	0
Total				**15**	**4**	**10**	**22**

IV Semester							
S. No.	Subject Code	Course Title	Category	Periods			Credits
				L	T	P	
Theory							
01	25UMAT41	Statistical And Numerical Methods	BS	3	1	0	04
02	25UMET41	Kinematics and Dynamics of Machinery	PC	3	1	0	04
03	25UMET42	Thermal Engineering	PC	3	1	0	04
04	25UMET43	Mechatronics, Robotics & Control	PC	3	0	0	03
Integrated Course (Type- 4)							
05	25UMEI41	Computer aided machine drawing theory & Lab	PC	2	0	2	03
Practical							
06	25UMEP41	Thermal Engineering Lab	PC	0	0	2	01
07	25UMEP42	Dynamics of Machinery Lab	PC	0	0	2	01
08	25URAP43	Robotics Lab	PC	0	0	2	01
Core Enrichment Course							
09	25UMEW49	Mini-Project-1	CEC	0	0	2	01
Employability Enhancement Course							
10	25UPCE41	Professionalism and Basic Aptitude	EEC	3	0	0	0
11	25UCCC05	Certificate course III Autodesk Auto CAD- ACU	CCC				0
Mandatory Course							
12	25UMCC41	Entrepreneurial skills and concepts	MCC	2	0	0	0
Total				**19**	**3**	**10**	**22**

SEMESTER-III

APPLICATIONS OF FOURIER SERIES AND Z-TRANSFORMS			
Course Code:	25UMAT34	**Course Type:**	Theory
Teaching Periods / Week (L:T:P):	3:1:0	**Credits:**	04
Total Teaching Periods:	60	**CAM+ ESE Mark:**	40+60
Teaching Department:	Mathematics		

Course Objectives:

The students will be able to

- To learn the Dirichlet's conditions and expand periodic functions into Fourier series.
- To understand the concept of Root Mean Square value and apply Parseval's theorem on Fourier coefficients.
- To apply the method of separation of variables to classify partial differential equations and solve the one-dimensional wave equation.
- To gain the knowledge of one-dimensional heat conduction and two-dimensional steady state heat equations.
- To apply the concept of Z-transforms and solve difference equations using inverse Z-transforms

Unit 1	**FOURIER SERIES**	**12 Periods**

Dirichlet ‘s conditions – General Fourier series - Expansion of periodic function into Fourier series – Fourier series for odd and even functions – Half-range Fourier cosine and sine series – Change of interval – Related problems.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: K3

Unit 2	**PARSEVAL’S THEOREM & HARMONIC ANALYSIS**	**12 Periods**

Root Mean Square Value – Parseval ‘s theorem on Fourier Coefficients. Complex form of Fourier series – Harmonic Analysis.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: K3

Unit 3	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**	**12 Periods**

Method of separation of variables – Classification of PDE – Fourier Series Solutions of one-dimensional wave equation.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: K3

Unit 4	**ONEAND TWO-DIMENSIONAL HEAT EQUATIONS**	**12 Periods**

One-dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Cartesian form only).		
Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving	
	RBT Level: K3	
Unit 5	**Z - TRANSFORMS AND DIFFERENCE EQUATIONS**	**12 Periods**
Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.		
Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving	
	RBT Level: K3	
Total		**60 Periods**

Suggested Activities and Evaluation Methods:

Tutorials, / MCQ (Gate Related Questions), Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1-Construct Fourier series expansions of periodic functions including odd, even and half-range series with change of interval.

CO2- Compute RMS values and Fourier coefficients using Parseval's theorem and harmonic analysis in complex form.

CO3- Classify PDEs and **solve** the one-dimensional wave equation by applying separation of variables and Fourier series.

CO4-Determine the solution of one-dimensional heat conduction equation and **calculate** the steady state solution of two-dimensional heat equation.

CO5-Apply Z-transform properties and convolution theorem to **formulate** and **solve** difference equations using inverse Z-transforms.

Textbooks:

T1: H.K. Dass, "Advanced Engineering Mathematics", S. Chand & Co. New Delhi, 2019.

T2: Balaji, "Engineering Mathematics II and Transforms and Partial Differential Equations", Balaji publishers, 18thEdition, 2018.

T3:B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 4th Edition, 2020**.**

References:

R1: Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 11th Edition 2025.

R2:B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi 2018.

R3:N.P Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New

Delhi, 10th Edition, 2021.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/111105121
2. https://nptel.ac.in/courses/111105035
3. https://nptel.ac.in/courses/111105093
4. https://onlinecourses.nptel.ac.in/noc23_ma90/preview
5. https://nptel.ac.in/courses/111106111

CO-PO& PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2
CO1	3	2	2	1	1	-	-	-	1	-	1	-	-
CO2	3	2	2	1	1	-	-	-	1	-	1	-	-
CO3	3	2	2	1	1	-	-	-	1	-	1	-	-
CO4	3	2	2	1	1	-	-	-	1	-	1	-	-
CO5	3	2	2	1	1	-	-	-	1	-	1	-	-
AVG	3	2	2	1	1	-	-	-	1	-	1	-	-

1 – Low, 2 – Medium, 3 – High, '-' – No correlation

MECHANICS OF SOLIDS			
Course Code:	25UMET31	**Course Type:**	Theory
Teaching Periods / Week (L:T:P):	3 : 1 : 0	**Credits:**	04
Total Teaching Periods:	60	**CAM+ ESE Mark:**	40+60
Teaching Department:	Mechanical Engineering		

Course Objectives:

To equip students with the fundamental knowledge and analytical skills to evaluate stresses, strains, deflection, torsion, and stability in structural and mechanical components such as beams, shafts, springs, columns, and pressure vessels.

Unit 1	**Simple Stress, Strain and Bending Theory**	**12 Periods**

Simple Stresses and Strain – Relation between three modulus and Poisson's ratio – Thermal Stress – Principal stress and Principal planes - Shear Force – Bending Moment – Cantilever and simply supported beams subjected to point loads and uniformly distributed loads

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: K3

Unit 2	**Bending and Shear Stresses in Beams**	**12 Periods**

Theory of simple bending-stress variation in beam cross Section, Normal and Shear stress in Beams – Beam of uniform strength for bending, combined direct and bending stresses.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: K4

Unit 3	**Deflection of Beams**	**12 Periods**

Deflection of beams - Double integration method –moment area method

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: K4

Unit 4	**Torsion and Springs**	**12 Periods**

Torsion of circular solid and Hollow shafts–Shafts in Series and parallel–Combined bending and torsion-Application of Torsion in helical springs–Open and closed coil springs, Leaf Springs.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory: K4

Unit 5	**Columns and Pressure Vessels**	**12 Periods**

Theory of columns – Long column and short column - Euler's formula – Rankine's formula. Introduction to thin cylinder – Thick cylinder –Spherical shells – Lame's Equation

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: Theory:K4
Total	**60 Periods**

Suggested Activities and Evaluation Methods:

Tutorials, Demo, Quiz / MCQ (Gate Related Questions),
Students' performance in continuous Assessment / Student Presentations,
Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Apply the fundamental concepts of stress and strain, including thermal stresses and principal stresses, and analyze shear force and bending moment in various beam configurations.

CO2: Analyze normal and shear stress distributions in beams using the theory of simple bending and design beams of uniform strength under combined loading conditions.

CO3: Solve deflection problems in beams using double integration and moment area methods, and apply energy methods such as strain energy and virtual work principles.

CO4: Analyze torsional behavior of solid and hollow circular shafts, analyze shafts in series and parallel, and apply torsion theory to design various types of springs.

CO5: Analyze the stability of columns using Euler's and empirical formulae, and determine stresses in thin and thick-walled cylinders using Lame's theory including compound cylinders with interference fit.

Textbooks:

T1: Strength of Materials- R.K.Bansal - Laxmi Publications, New Delhi, 2020

T2: Strength of Materials- R.K. Rajput - S.Chand and Company Ltd., New Delhi, 2022

T3: Strength of Materials- Bhavikatti. S. S - Vikas Publishing House (P) Ltd., New Delhi, 2021

References:

R1: Mechanics of Materials- Beer F, Jonston E R, DeWolf J- McGraw-Hill Publications, 2020

R2: Strength of Materials- U.G.Jindal- Galgotia Publication Pvt. Ltd., New Delhi, 2018

Web links and Video Lectures (e-Resources):

1. http://nptel.ac.in/courses/105106116
2. http://nptel.ac.in/courses/105102090
3. http://nptel.ac.in/courses/112107147

CO-PO& PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2
CO1	3	3	-	-	-	-	-	-	-	-	2	-	3
CO2	3	2	3	2	-	-	-	-	-	-	2	-	3
CO3	2	2	-	1	-	-	-	-	-	-	1	-	3
CO4	3	3	3	-	-	-	-	-	-	-	2	-	3
CO5	3	3	3	2	-	-	-	-	-	-	2	-	3
AVG	2.8	2.6	1.8	1							1.8		3

1 – Low, 2 – Medium, 3 – High, '-' – No correlation

FLUID MECHANICS AND MACHINERY			
Course Code:	25UMET32	**Course Type:**	Theory
Teaching Periods / Week (L:T:P):	3:1:0	**Credits:**	4
Total Teaching Periods:	60	**CAM+ ESE Mark:**	40+60
Teaching Department:	Mechanical Engineering		

Course Objectives:

1. The properties of fluids and concept of control volume are studied
2. To understand the importance of dimensional analysis
3. The applications of the conservation laws to flow through pipes are studied
4. To understand the importance of various types of flow in turbines.
5. To understand the importance of various types of flow in pumps.

Unit 1	**FLUID PROPERTIES AND FLOW CHARACTERISTICS**	**12 Periods**

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching
	RBT Level:K3

Unit 2	**FLOW THROUGH CIRCULAR CONDUITS**	**12 Periods**

Hydraulic and energy gradient - Introduction to Laminar and Turbulent flow - Laminar flow through circular conduits and circular annuli Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation – friction factor- Moody diagram- commercial pipes- minor losses – Flow through pipes in series and parallel.

Teaching Learning Process	**Pedagogy:** Laboratory Demonstrations
	RBT Level: K3

Unit 3	**DIMENSIONAL ANALYSIS**	**12 Periods**

Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.

Teaching Learning Process	**Pedagogy:**
	RBT Level: K4

Unit 4	**PUMPS**	**12 Periods**

Impact of jets - Euler's equation - Theory of roto-dynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps– working principle - work done by the impeller - performance curves - Reciprocating pump working principle – Rotary pumps –classification.

Teaching Learning Process	**Pedagogy:** Laboratory Demonstrations, Case Studies & Industrial Applications
	RBT Level: K3

Unit 5	**TURBINES**	**12 Periods**

Classification of turbines – heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner – draft tube. Specific speed - unit quantities – performance curves for turbines – governing of turbines.

Teaching Learning Process	**Pedagogy:** Laboratory Demonstrations, Case Studies & Industrial Applications
	RBT Level: K3

Total	**60 Periods**

Suggested Activities and Evaluation Methods:

- Tutorials, Demo, Industrial Visit, Quiz / MCQ (Gate Related Questions), Case Study
- Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Explain the properties of fluids and apply the concept of control volume to analyze fluid flow problems.

CO2: Apply dimensional analysis and similitude principles to solve and correlate fluid flow and hydraulic system problems.

CO3: Analyze the application of conservation laws of mass, momentum, and energy to fluid flow through pipes.

CO4: Evaluate the significance of different types of fluid flow in turbines and analyze their effect on performance.

CO5: Evaluate the significance of different types of fluid flow in pumps and analyze their effect on performance.

Textbooks:

T1: Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2013.

T2: Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011

T3: Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016.

References:

R1: Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", 2011.

R2: Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010

Web links and Video Lectures (e-Resources):

1. https://onlinecourses.nptel.ac.in/

CO-PO& PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2
CO1	3	3	3	-	-	3	3	2	-	-	3	-	-
CO2	3	3	3	-	-	3	3	2	-	-	3	-	-
CO3	3	3	3	-	-	3	3	2	-	-	3	-	-
CO4	3	3	3		-	3	3	3	-	-	3	3	3
CO5	3	3	3	-	-	3	3	3	-	-	3	3	3
AVG	3	3	3	-	-	3	3	2	-	-	3	-	-

1 – Low, 2 – Medium, 3 – High, '-' – No correlation

APPLIED THERMODYNAMICS			
Course Code:	**25UMET33**	**Course Type:**	Theory
Teaching Periods / Week (L:T:P):	3:1:0	**Credits:**	4
Total Teaching Periods:	60	**CAM+ ESE Mark:**	40+60
Teaching Department:	Mechanical Engineering		

Course Objectives:

To impart knowledge on thermodynamic principles and enable analysis of energy, entropy, steam power cycles, and psychrometric processes for practical engineering applications.

Unit 1	**Basic concepts: Thermodynamics**	**12 Periods**

Ideal and Real gases: Laws of perfect gases – Boyle's law – Charle's law – Gay Lussac law – Joule's law – Avogadro's law – state equation of gases – specific heat of gases. VanderWalls equation, Redlich Kwong equation, Dieterici equation, compressibility charts. Gas mixtures: Mole fraction, mass fraction – calculation of mixture properties.

Teaching Learning Process	**Pedagogy:** Lecture method & Problem-solving sessions
	RBT Level: K1, K2

Unit 2	**Energy and Entropy**	**12 Periods**

Energy and Entropy: I law of thermodynamics – energy balance of closed and open systems. Steady and unsteady flow systems. II Law of thermodynamics – Entropy generation principle, its application, entropy balance of closed and open systems.

Teaching Learning Process	**Pedagogy:** Lecture method & Problem-solving sessions
	RBT Level: K2,K3

Unit 3	**Steam & Power Cycles**	**12 Periods**

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. P-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods – Reheat and Regenerative cycles, Binary and Combined cycles.

Teaching Learning Process	**Pedagogy:** Lecture method & Problem-solving sessions
	RBT Level: Theory: Practical:

Unit 4	**Thermodynamic Relations**	**12 Periods**

General thermodynamic property relations: Maxwell equations – Tds equations – property relations of gases – Clausius-Clapeyron equation – Joule-Thomson coefficient – Gibbs phase rule – equilibrium condition.

Teaching Learning Process	**Pedagogy: Lecture method** & **Problem-solving sessions**
	RBT Level: K2, K3

Unit 5	**Introduction to Refrigeration Cycles**	**12 Periods**

Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications.

Teaching Learning Process	**Pedagogy: Lecture method & Problem-solving sessions**
	RBT Level: K2, K3,
Total	**60 Periods**

Suggested Activities and Evaluation Methods:

- Tutorials, Demo, Industrial Visit, Quiz / MCQ (Gate Related Questions), Case Study.
- Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Explain the behavior of ideal and real gases using gas laws and equations of state, and compute thermodynamic properties of pure gases and gas mixtures.

CO2: Apply the First and Second Laws of Thermodynamics to analyze energy and entropy balances in closed and open systems under steady and unsteady flow conditions

CO3: Determine thermodynamic properties of steam using steam tables and diagrams, and analyze Rankine cycle performance including reheat, regenerative, and combined cycles.

CO4: Analyze thermodynamic property relations and phase equilibrium using Maxwell relations, Tds equations, Clausius–Clapeyron equation, and Gibbs phase rule.

CO5: Evaluate psychrometric properties and processes using psychrometric charts and equations, and solve practical air–vapour mixture problems in engineering applications.

Textbooks:

T1: P.K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publishing Co. Ltd., New Delhi,2020.

T2: R.K. Rajput, *A Textbook of Engineering Thermodynamics*, Laxmi Publications Pvt. Ltd., New Delhi, 2021.

References:

R1: Richard E. Sonntag, Claus Borgnakke and Gordon J. Van Wylen, *Fundamentals of Thermodynamics*, John Wiley & Sons, 9th Edition, 2021

R2: Yunus A. Çengel and Michael A. Boles, *Thermodynamics: An Engineering Approach*, McGraw Hill Education, 9th Edition, 2019

Web links and Video Lectures (e-Resources):

1. https://onlinecourses.nptel.ac.in/noc22_me113/preview

CO-PO& PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2
CO1	3	2	-	-	-	-	-	-	-	-	2	-	3
CO2	3	3	-	2	-	-	-	-	-	-	2	-	3
CO3	3	3	2	-	-	-	-	-	-	-	3	2	3

CO4	3	3	-	2	-	-	-	-	-	-	2	-	3
CO5	2	3	2	-	-	-	-	-	-	-	2	-	2
AVG	3	2.8	0.5	0.5	-	-	-	-	-	-	2.2	-	3
1 – Low, 2 – Medium, 3 – High, '-' – No correlation													

METALLURGY AND MATERIALS SCIENCE& LAB			
Course Code:	25UMEI31	**Course Type:**	Integrated
Teaching Periods / Week (L:T:P):	3:0:2	**Credits:**	04
Total Teaching Periods:	60 Periods	**CAM+ ESE Mark:**	40+60
Teaching Department:	Mechanical Engineering		

Course Objectives:

To impart knowledge on

- To acquaint students with the basic concepts and properties of materials science.
- To impart fundamental knowledge of ferrous and non-ferrous metal processing.
- To help students select appropriate materials for designing engineering components.
- To familiarize students with various testing methods performed on metals.
- To develop futuristic insight into metals, alloys, and their applications.

Unit 1	**Crystal Structures and Metallography**	**12 Periods**

Crystal structures; Solid solutions – Types; Metallography; Metallurgical microscopes; Specimen preparation; Cooling curves; Allotropy concept

Practicals: Study of metallurgical microscope, Preparation of specimen for microscopic examination

Teaching Learning Process	**Pedagogy:** Lecture (chalk & board), PPT, Demonstration of microscopes, Case discussions
	RBT Level: Theory: K1–K2 Practical: K3–K4

Unit 2	**Phase Diagrams and Ferrous Materials**	**12 Periods**

Binary phase diagrams – construction & interpretation; Types – Eutectic, Eutectoid, Peritectic, Peritectoid; Iron-Carbon equilibrium diagram; Classification of steels & alloy steels; Cast irons

Practicals: Identification of Metal 1, Identification of Metal 2, Identification of Metal 3

Teaching Learning Process	**Pedagogy:** Lecture + PPT + Graphical construction of diagrams + Case studies
	RBT Level: Theory: K1–K3 Practical: K3–K4

Unit 3	**Heat Treatment of Steels**	**12 Periods**

Objectives of heat treatment of steel, Critical temperature; TTT diagram; Annealing, Normalizing, Hardening; Hardenability tests; Tempering; Martensitic transformation; Surface hardening processes

Practicals: Study of heat treatment processes, Study of quenching mediums, Hardening of steel, Normalizing of steel, Annealing of steel, Jominy end quenching test

Teaching Learning	**Pedagogy:** Lecture + PPT + Demonstration of heat treatment

Process	setups + Numerical exercises
	RBT Level: Theory: K2–K4 Practical: K3–K4

Unit 4	**Non-Ferrous Metals, Alloys, and Mechanical Testing**	**12 Periods**

Non-ferrous metals & alloys: Cu, Al, Ni, Zn, Pb-based alloys; Metal matrix composites; Mechanical properties; Testing – Tensile, Compression, Torsion, Hardness, Impact

Practicals:

Tension test, Impact test – Izod, Brinell Hardness, Rockwell Hardness, Ductility test (Al, GI, MS), Impact test – Charpy

Teaching Learning Process	**Pedagogy:** Lecture + PPT + Animations + Lab demonstrations
	RBT Level: Theory: K1–K3 Practical: K3–K4

Unit 5	**Plastic Deformation, Fracture, Creep, and Fatigue**	**12 Periods**

Plastic deformation, Slip and Twinning; Hot, Cold, Warm working; Recovery &Recrystallization; Fracture mechanics; Creep & Fatigue failures; Microstructure analysis; Hardness, tensile & impact testing

Practicals:

Compression test, Fatigue test, Creep test.

Teaching Learning Process	**Pedagogy:** Lecture + PPT + Case studies + Lab discussions
	RBT Level: Theory: K2–K4 Practical: K4–K5

Total	**60 Periods**

Suggested Activities and Evaluation Methods:

Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: understand fundamental concepts of crystal structures, phase diagrams, and metallography.

CO2: Identify and classify ferrous and non-ferrous metals and alloys.

CO3: Apply heat treatment and testing techniques to improve material properties.

CO4: Analyze microstructures, mechanical properties, and failure mechanisms in metals.

CO5: Evaluate and select suitable materials for engineering applications.

Textbooks:

T1: V. Raghavan, Materials Science and Engineering: A First Course, 6th Edition, PHI Learning Pvt. Ltd., New Delhi, 2015 (Latest Reprint 2023).

T2: Marc A. Meyers and Krishan Kumar Chawla, Mechanical Behavior of Materials, 3rd Edition, Cambridge University Press, 2022.

T3: V. Raghavan, Physical Metallurgy: Principles and Practice, 4th Edition, PHI Learning Pvt.

Ltd., New Delhi, 2020.

References:

R1: Donald R. Askeland and Wendelin J. Wright, *The Science and Engineering of Materials*, 8th Edition, Cengage Learning, 2022.
R2: William D. Callister Jr. and David G. Rethwisch, *Materials Science and Engineering: An Introduction*, 11th Edition, Wiley, 2023.
R3: Sidney H. Avner, *Introduction to Physical Metallurgy*, 2nd Edition, McGraw-Hill, 1974.
R4: George E. Dieter Jr., *Mechanical Metallurgy*, 3rd Edition, McGraw-Hill Book Company, New York, 1986.

Web links and Video Lectures (e-Resources):

2. NPTEL Video Lectures – *Materials Science*

CO-PO& PSO Mapping

CO	PO1	PO2	PO3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2
CO1	3	2	1	-	-	-	-	-	-	-	-	2	-
CO2	3	2	2	-	-	-	-	-	-	-	-	2	-
CO3	2	3	3	2	-	-	-	-	-	-	-	3	-
CO4	2	3	3	2	1	-	-	-	-	-	-	3	2
CO5	2	3	3	2	2	-	-	-	-	-	-	3	2
AVG	2.4	2.6	2.4	1.2	0.6	-	-	-	-	-	-	2.6	0.8

1 – Low, 2 – Medium, 3 – High, '-' – No correlation

ADVANCED MANUFACTURING PROCESS LAB

Course Code:	25UMEP31	**Course Type:**	Practical
Teaching Periods / Week (L:T:P):	0: 0: 2	**Credits:**	1
Total Teaching Periods:	30	**CAM+ ESE Mark:**	60+40
Teaching Department:	**Mechanical Department**		

Course Objectives:

1. To help students gain hands-on experience in operating conventional, CNC, and gear manufacturing machines used in modern manufacturing industries
2. To enable students to understand and apply basic manufacturing, machining, and foundry practices through practical laboratory experiments.

Practical Exercises:	**30 Periods**

List of Experiments:

Lathe Machine:

- Drilling & Boring operation

Drilling Machine:

- Drilling & Tapping operation

Gear cutting:

- Spur gear cutting using a Milling Machine
- Helical gear cutting using a Milling Machine
- Helical gear cutting using a Gear Hobbing Machine

Grinding Machine:

- Grinding a single point cutting tool using a tool & cutter grinding machine

CNC Machine:

- Study of CNC Machines and Part Programming
- Turning operation on a CNC Turning center
- Machining operation on a CNC Machining center

Foundry:

- Preparation of mould cavity using a solid pattern
- Preparation of mould cavity using a split pattern

References:

1.kalpakjain S, Schimd S "Manufacturing Engineering and Tech"Pearson Education, 7th Edition, New Delhi, 2018

2. P.N. Rao "Manufacturing Technology" McGrawhill, Fifth edition, 2018

3. Liam Russell, CNC Programming, Charles M Dominquez,2025

Course Outcomes:

After Successful completion of this course, the student should be able to

1. To perform basic machining operations such as drilling, boring, and tapping

using lathe and drilling machines.

2. To carry out spur and helical gear cutting operations using milling and gear hobbing machines.
3. To Execute CNC turning and machining operations by understanding basic CNC programs and machine controls.
4. To Grind and identify single point cutting tools with correct geometry using a tool grinding machine.
5. To Prepare mould cavities using solid and split patterns by following standard foundry practices.

CO–PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	3	-
CO2	3	2	2	-	2	-	-	-	-	-	-	3	-
CO3	3	2	-	-	3	-	-	-	-	-	-	3	-
CO4	2	1	-	-	2	-	-	-	-	-	-	3	-
CO5	2	2	1	-	1	-	-	-	-	-	-	3	-
AVG	2.6	1.8	0.6	-	2	-	-	-	-	-	-	3	-

1–Low, 2–Medium, 3–High, '-' –No correlation

FLUID MECHANICS AND MACHINERY LABORATORY			
Course Code:	25UMEP32	**Course Type:**	Practical
Teaching Periods / Week (L:T:P):	0:0:2	**Credits:**	1
Total Teaching Periods:	30	**CAM+ ESE Mark:**	60+40
Teaching Department:	**Mechanical Engineering**		

Course Objectives:

1. To identify safe operating practices and requirements for laboratory experiments.
2. To design and conduct an experiment as well as to analyze and interpret data.
3. To cover the elements of fluid mechanics in fluid flow systems.
4. To cover a range of experimental techniques aiming to provide students with a general knowledge and understanding of the subject fluid mechanics and machinery, including recommendations for further studies.

Practical Exercises:	**30 Periods**

List of experiments:

1. Determination of the coefficient of discharge of given Orificemeter.
2. Determination of the coefficient of discharge of given Venturimeter.
3. Determination of the Pipe Friction (Major Losses) and minor losses in pipes due to bends, elbows, sudden contraction, expansion etc.,
4. Calculation of the rate of flow using Rotameter.
5. Conducting experiments and drawing the characteristics curves of centrifugal pump.
6. Conducting experiments and drawing the characteristics curves of submersible pump.
7. Conducting experiments and drawing the characteristics curves of jet pump.
8. Conducting experiments and drawing the characteristics curves of pump in series and parallel.
9. Conducting experiments and drawing the characteristics curves of reciprocating pump.
10. Conducting experiments and drawing the characteristics curves of Gear pump.
11. Conducting experiments and drawing the characteristics curves of Pelton wheel.
12. Conducting experiments and drawing the characteristics curves of Francis turbine.
13. Conducting experiments and drawing the characteristics curves of Kaplan turbine.
14. Conducting experiments and drawing the characteristics curves of hydraulic ram.

Text Books:

1. CWR, Hydraulics Laboratory Manual,2004
2. N. Kumarasamy, Fluid Mechanics and Machinery laboratory manual, Charotar Publishing House Pvt. Ltd.2023.

Reference Books:

1. S K Agrawal, Fluid Mechanics and Machinery, Tata McGraw-Hill Education, 2003
2. Subramanya, Fluid Mechanics and Hydraulic Machines, Tata McGraw-Hill Education,2018.
3. S C Gupta, Fluid Mechanics and Hydraulic Machines, Pearson Education India,2006.
4. Robert W. Fox , Alan T. McDonald , John W. Mitchell , Fox and McDonald's Introduction to Fluid Mechanics, Wiley ,10th Edition , 2020

Web Reference:

1. http://en.wikipedia.org
2. http://www.engineeringtoolbox.com

3. https://onlinecourses.nptel.ac.in/

Course Outcomes:

After Successful completion of this course, the student should be able to

1. Identify and follow safe operating practices, laboratory rules, and standard procedures while performing fluid mechanics and fluid machinery experiments.
2. Design and conduct experiments related to fluid flow and fluid machinery using appropriate experimental setups and instruments.
3. Analyze and interpret experimental data to evaluate fluid flow behavior and performance characteristics of fluid machinery.
4. Apply fundamental elements of fluid mechanics to explain and assess fluid flow systems under various operating conditions.
5. Demonstrate comprehensive knowledge of experimental techniques in fluid mechanics and fluid machinery and relate the learning to practical applications and further studies.

CO–PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	2	-	-	-	2	-	3	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	2	-	3	-
AVG	1	-	-	-	-	-	-	-	-	-	-	-	-

1–Low, 2–Medium, 3–High, '-' –No correlation

PERSONALITY DEVELOPMENT			
(Common to all Branches)			
Course Code:	25UPCE31	**Course Type:**	Employability Enhancement Course
Teaching Periods / Week (L:T:P):	0:0:2	**Credits:**	0
Total Teaching Periods:	30	**CAM+ ESE Mark:**	
Teaching Department:			

Course Objectives:

To impart knowledge on students to develop a well-rounded personality by enhancing essential personal and professional skills. The course aims to foster self-awareness, effective communication, interpersonal abilities, emotional intelligence, confidence, leadership, and goal-setting strategies

Unit 1	**Workplace and Email Etiquette:**	**6 Periods**

Workplace and Email Etiquette: Professional Behavior and Dress Code – Email and Meeting Etiquette

Microsoft office suite: MS Word(Document Creation and Formatting) - MS Excel (Data Analysis and Functions) - MS PowerPoint (Creating Effective Presentations)

Teaching Learning Process	**Pedagogy:**
	RBT Level: Theory: Practical:

Unit 2	**Business Communication**	**6 Periods**

Business Communication: Verbal and Non - Verbal Communication – Written Communication in Business.

Sales and Negotiations: Sales Techniques and Strategies – Negotiation Tactics and Styles.

Customer Service: Effective Communication Skills- Customer support channels and Tools

Teaching Learning Process	**Pedagogy:**
	RBT Level: Theory: Practical:

Unit 3	**Decision Making & problem solving**	**6 Periods**

Decision Making: Types of Decision Making – Decision Making models and Techniques – Cognitive Biases and Risk Assessment

Problem Solving: Problem Identification and Analysis – Creative and Critical Thinking techniques – Implementation and Evaluation techniques

Teaching Learning Process	**Pedagogy:**
	RBT Level: Theory: Practical:

Unit 4	**Interview Skills**	**6 Periods**

Interview Skills: Preparation and Research – Effective Communication and Presentation

Resume Building: Resume Formats and Structure – Tailoring Resumes for Specific Jobs

Mannerism: Body Language – Respect and Courtesy in Interactions

Behavioral skills: Emotional Intelligence – Adaptability and flexibility

Teaching Learning Process	Pedagogy:	
	RBT Level: Theory: Practical:	
Unit 5	**Group Discussion& Mock Interview**	**6 Periods**

Group Discussion: Effective communication and Active Listening – Leadership and Participation skills – Critical Thinking and Topic Analysis

Monk Interview: Common Interview Questions and Ideal Responses – Feedback and Self Assessment

Teaching Learning Process	Pedagogy:	
	RBT Level: Theory: Practical:	
Total		**30 Periods**

Suggested Activities and Evaluation Methods:

Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Apply workplace etiquette and use Microsoft Office tools effectively for professional communication and documentation.

CO2: Demonstrate effective communication skills in business contexts, including sales, negotiation, and customer service scenarios.

CO3: Apply structured decision-making and problem-solving techniques in professional and organizational settings.

CO4: Prepare for interviews and present oneself professionally with an effective resume, proper mannerisms, and behavioral skills.

CO5: Demonstrate confidence and clarity in group discussions and interviews through guided practice and feedback.

Textbooks:

T1: Personal Development and Soft Skills By BARUNKMITRA, Oxford Higher Education, 2024

T2: Seven Habits of Highly Effective People by STEPHENCOVEY, 1989

References:

R1: Kumar, Sanjay, & Pushp, Lata. Communication Skills. Oxford University Press (Oxford Higher Education), 2018.

R2: Konar, Nira. Communication Skills for Professionals. PHI Learning Private Limited, 2016.

Web links and Video Lectures (e-Resources):

1.

CO-PO& PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2
CO	-	-	-	-	2	-	-	-	2	2	-	-	-

1													
CO 2	-	-	-	-	-	-	-	2	2	2	-	-	-
CO 3	2	-	-	2	-	-	-	-	-	-	2	-	
CO 4	-	-	-	-	-	-	-	-	2	2	2	-	-
CO 5	-	-	-	-	-	-	-	-	2	2	2	-	-
AVG	0.5	-	-	0.5	2	-	-	0.5	1.6	1.6	1.2	-	-
1 – Low, 2 – Medium, 3 – High, '-' – No correlation													

INDIAN CONSTITUTION AND HUMAN RIGHTS			
(Common to All Branches of UG Engineering Programs)			
Course Code:	25UMCC31	**Course Type:**	Mandatory Course (Audit)
Teaching Periods / Week (L:T:P):	2:0:0	**Credits:**	0 (Zero)
Total Teaching Periods:	30	**CAM+ ESE Mark:**	Pass / Fail (Satisfactory / Unsatisfactory)
Teaching Department:	General Engineering		

Course Objectives:

To impart knowledge on:

1. Historical background, Preamble, and salient features of the Indian Constitution
2. Fundamental Rights, Directive Principles of State Policy, and Fundamental Duties
3. Structure and functioning of Union, State, and Local Self Governments
4. Universal Human Rights principles and international protection frameworks
5. Contemporary human rights issues and remedial mechanisms in India

Unit 1	**INTRODUCTION TO INDIAN CONSTITUTION**	**Periods: 6**

Historical Background: Making of the Constitution - Constituent Assembly and its key members - Draft Committee. Preamble: Philosophy and Core Values - Sovereign, Socialist, Secular, Democratic, Republic - Justice, Liberty, Equality, Fraternity. Salient Features of Indian Constitution: Written Constitution - Lengthy document - Blend of Rigidity and Flexibility - Federal Structure with Unitary Bias - Parliamentary System.

Instructional Activity

Timeline Activity on Constitutional History (or) Preamble Analysis Worksheet

Teaching Learning Process	Pedagogy: Interactive Lecture, Think-Pair-Share, Video-based Learning (Documentary on Constituent Assembly), Group Discussion
	RBT Level: Theory: L1, L2

Unit 2	**FUNDAMENTAL RIGHTS AND DUTIES**	**Periods: 6**

Fundamental Rights (Articles 12-35): Right to Equality (Art. 14-18) - Right to Freedom (Art. 19-22) - Right Against Exploitation (Art. 23-24) - Right to Freedom of Religion (Art. 25-28) - Cultural and Educational Rights (Art. 29-30) - Right to Constitutional Remedies (Art. 32): Writs - Habeas Corpus, Mandamus, Prohibition, Certiorari, Quo Warranto. Directive Principles of State Policy (Articles 36-51): Classification - Socialistic, Gandhian, Liberal-Intellectual Principles. Fundamental Duties (Article 51A): Citizen Responsibilities - 11 Duties. Relationship and Conflict between Fundamental Rights and Directive Principles.

Instructional Activity

Case Study Analysis on Landmark Supreme Court Judgments (or) Mock PIL Filing Exercise (or) Rights Violation Scenario Analysis

Teaching Learning Process	Pedagogy: Case Study Method, Role Play (Mock Court), Jigsaw Activity, Debate Session (FR vs DPSP), Scenario-based Learning, Problem-Based Learning	
	RBT Level: Theory: L1, L2	
Unit 3	**UNION AND STATE GOVERNMENT STRUCTURE**	**Periods: 6**
Union Executive: President - Election, Powers, Position - Vice-President - Prime Minister and Council of Ministers - Cabinet Committees. Union Legislature: Parliament - Lok Sabha and Rajya Sabha - Composition, Functions - Legislative Process - Bill to Act. State Executive: Governor - Chief Minister - State Council of Ministers. State Legislature: Legislative Assembly and Council - State Law-making Process. Centre-State Relations: Legislative, Administrative, and Financial Relations - Role of Finance Commission. Local Self Government: 73rd Amendment (Panchayati Raj) - 74th Amendment (Urban Local Bodies) - Three-tier System.		
Instructional Activity		
Flowchart Creation (Bill to Law) (or) Field Visit Report on Local Panchayat/Municipality		
Teaching Learning Process	Pedagogy: Simulation Exercise, Collaborative Learning, Comparative Analysis (Venn Diagrams), Field Visit/Virtual Tour, Guest Lecture by Government Official	
	RBT Level: Theory: L1, L2	
Unit 4	**HUMAN RIGHTS: CONCEPTS AND FRAMEWORKS**	**Periods: 6**
Evolution of Human Rights: Historical Development - Natural Rights Theory - Magna Carta - French Declaration - American Bill of Rights. Universal Declaration of Human Rights (UDHR) 1948: 30 Articles - Civil, Political, Economic, Social, Cultural Rights. International Human Rights Instruments: ICCPR - ICESCR - CEDAW - CRC - CAT - CERD. Human Rights in Indian Constitution: Part III and Part IV Provisions. National Human Rights Commission (NHRC): Composition - Functions - Powers - Procedure. State Human Rights Commissions - National Commission for Women, SC, ST, Minorities.		
Instructional activities		
NHRC Case Study Analysis		
Teaching Learning Process	Pedagogy: Video Case Study, Seminar Presentation	
	RBT Level: Theory: L1, L2, L3	
Unit 5	**CONTEMPORARY HUMAN RIGHTS ISSUES**	**Periods: 6**
Rights of Vulnerable Groups: Women (POSH Act, Domestic Violence Act) - Children (POCSO, JJ Act) - Elderly (Maintenance Act) - Persons with Disabilities (RPWD Act 2016). Rights of Marginalized Communities: SC/ST (Prevention of Atrocities Act) - Minorities - LGBTQ+ (Navtej Singh Johar Case). Right to Information (RTI Act 2005): Provisions and Application. Right to Education (RTE Act 2009). Environmental Rights: Right to Clean Environment - Sustainable Development - PIL on Environmental Issues. Digital Rights: Right to Privacy (Puttaswamy Case) - Data Protection - Cyber Rights. Human Rights Violations and Remedies: Legal Aid - Grievance Redressal Mechanisms.		
Instructional activities		
RTI Application Drafting Workshop (or) Case Study on HR Violations		

Teaching Learning Process	Pedagogy: Problem-Based Learning, Panel Discussion, RTI Workshop	
	RBT Level: Theory: L1, L2, L3	
Total		**Periods: 30**

Suggested Activities and Evaluation Methods:

Active Learning: Case Studies, Role Play, Mock Court/Parliament, Group Discussions, Debates, Panel Discussions

Practical Activities: RTI Application Drafting, Field Visits to Panchayat/Municipal Offices,

Digital Tools: Kahoot Quizzes, Mentimeter Polls, Online Discussion Forums, Digital Portfolios

Assessment Methods: Entry/Exit Tickets, One-Minute Papers, Peer Review, Reflective Journals, Group Presentations

Evaluation: Continuous Assessment through Formative Activities, End-Semester Viva-voce/Written Test

Course Outcomes:

After successful completion of this course, the student should be able to:

CO1: Explain the historical evolution, Preamble, and salient features of the Indian Constitution.[L2: Understand]

CO2: Describe Fundamental Rights, Directive Principles of State Policy, and Fundamental Duties and explain their interrelationship. [L2: Understand]

CO3: Describe the structure and functions of Union, State, and Local Self Governments in India. [L2: Understand]

CO4: Apply the principles of Universal Human Rights to identify international protection frameworks. [L3: Apply]

CO5: Illustrate contemporary human rights issues and demonstrate the use of remedial mechanisms available in India. [L3: Apply]

Textbooks:

T1: D.D. Basu, "Introduction to the Constitution of India", 24th Edition, LexisNexis, 2020.

T2: M.V. Pylee, "India's Constitution", 16th Edition, S. Chand Publishing, 2017.

T3: S.K. Kapoor, "Human Rights Under International Law and Indian Law", Central Law Agency, 2018.

References:

R1: Granville Austin, "The Indian Constitution: Cornerstone of a Nation", Oxford University Press, 2019.

R2: J.N. Pandey, "Constitutional Law of India", 57th Edition, Central Law Agency, 2020.

R3: K.K. Ghai, "Human Rights", Kalyani Publishers, 2019.

R4: P.M. Bakshi, "The Constitution of India", Universal Law Publishing, 2020.

Web Links and Video Lectures (e-Resources):

1. Constitution of India - https://legislative.gov.in/constitution-of-india

2. National Human Rights Commission - https://nhrc.nic.in 3. United Nations Human Rights - https://www.ohchr.org 4. SWAYAM Course on Indian Constitution - https://swayam.gov.in 5. NPTEL Course on Constitution of India - https://nptel.ac.in 6. Lok Sabha TV Documentaries - https://www.youtube.com/c/LokSabhaTVChannel 7. PRS Legislative Research - https://prsindia.org
CO-PO & PSO Mapping

SEMESTER-IV

STATISTICAL AND NUMERICAL METHODS			
Course Code:	25UMAT41	**Course Type:**	Theory
Teaching Periods / Week (L:T:P):	3:1:0	**Credits:**	04
Total Teaching Periods:	60	**CAM+ ESE Mark:**	40+60
Teaching Department:	Mathematics		

Course Objectives:

- To understand and apply concepts related to discrete and continuous random variables, including important distributions.
- To apply large sample tests, conduct chi-square tests for goodness of fit and independence of attributes and perform one-way and two-way classifications.
- To solve linear systems using iterative and direct methods, and apply the power method to find dominant eigen values and eigen vectors.
- To utilize numerical methods for solving ordinary differential equations.
- To apply numerical techniques for solving partial differential equations.

Unit 1	**Probability and Random Variables**	**12Periods**

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables –Moment generating functions – Binomial distribution – Poisson distribution – Geometric distribution – Uniform distribution – Exponential distribution – Normal distribution.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: K3

Unit 2	**Testing of Hypothesis and Design of Experiments**	**12 Periods**

Large sample test for single proportion– difference of proportions– Tests for single mean– difference of means– difference of standard deviations– Test for ratio of variances – Chi– square test for goodness of fit and independence of attributes, one way and two-way classifications.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: K3

Unit 3	**Solution of Linear System and Numerical Integration**	**12 Periods**

Gaussian elimination and Gauss – Jordan methods – LU – decomposition methods – Crout's method – Jacobi and Gauss – Seidel iterative methods – sufficient conditions for convergence – Power method to find the dominant eigenvalue and eigenvector and Integration By Trapezoidal and Simpson's Rules.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving
	RBT Level: K3

Unit 4	**Numerical Solution of Ordinary Differential Equations**	**12 Periods**

Euler's method – Euler's modified method – Taylor's method and Runge – Kutta method for simultaneous equations and 2nd order equations – Stability analysis of single step methods – Multistepmethods – Milne's and Adams' methods.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving	
	RBT Level: K3	
Unit 5	**Numerical Solution of Partial Differential Equations**	**12 Periods**
Numerical solution of Laplace equation and Poisson equation by Liebmann's method – solution of one-dimensional heat flow equation –Bender – Schmidt recurrence relation – Crank–Nicolsonmethod – Solution of one – dimensional wave equation.		
Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching, Numerical problem-solving	
	RBT Level: K3	
Total		**60Periods**

Suggested Activities and Evaluation Methods:
Tutorials, MCQ (Gate Related Questions), Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Apply probability theory principles and probability distributions such as Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

CO2: Perform large sample tests, test for ratio of variances, chi-square test and one-way and two-way classifications.

CO3: Compute the numerical solution of linear systems using direct and iterative methods and find the dominant eigenvalue and eigenvector of a given matrix using Power method.

CO4: Solve ordinary differential equations numerically using Euler's, Runge-Kutta, Milne's and Adams' methods.

CO5: Solve partial differential equations numerically using Liebmann's, Bender-Schmidt and Crank-Nicolson methods.

Textbooks:

T1:S.C. Gupta and V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.

T2: H.K. Dass, "Advanced Engineering Mathematics", S. Chand & Co., New Delhi,21st Edition 2019.

T3:B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2021.

References:

R1: William Mendenhall, Robert J. Beaver, Barbara M. Beaver: "Introduction to Probability & Statistics", Cengage Learning; 15thEdition 2019.

R2: Atul Goyal, Madhuchanda Rakshit Suchet Kumar, "Numerical Methods", New India publishing Agency, 1st Edition, 2019.

R3: Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 10th Edition 2019.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/111105090
2. https://onlinecourses.nptel.ac.in/noc26_ma41/preview
3. https://nptel.ac.in/courses/111101003

4. https://archive.nptel.ac.in/courses/111/105/111105035/
5. https://nptel.ac.in/courses/111105093

CO-PO& PSO Mapping

CO	PO1	PO 2	PO3	PO 4	PO 5	PO6	PO 7	PO 8	PO9	PO10	PO11	PSO1	PSO 2
CO 1	3	2	2	1	1	-	-	-	1	-	1	-	-
CO 2	3	2	2	1	1	-	-	-	1	-	1	-	-
CO 3	3	2	2	1	1	-	-	-	1	-	1	-	-
CO 4	3	2	2	1	1	-	-	-	1	-	1	-	-
CO 5	3	2	2	1	1	-	-		1	-	1	-	-
AV G	3	2	2	1	1	-	-	-	1	-	1	-	-

1 – Low, 2 – Medium, 3 – High, '-' – No correlation

KINEMATICS AND DYNAMICS OF MACHINERY			
Course Code:	25UMET41	**Course Type:**	Theory
Teaching Periods / Week (L:T:P):	3:1:0	**Credits:**	04
Total Teaching Periods:	60	**CAM+ ESE Mark:**	40+60
Teaching Department:	Mechanical Engineering		

Course Objectives:

To impart knowledge on
- Provide insights into the fundamentals of mechanisms and cams.
- Understand the basics of flywheels and balancing of rotating and reciprocating unbalanced systems.
- Enhance knowledge of single degree of freedom and damped vibrations.
- Provide a detailed overview of forced vibrations.
- Discuss the fundamentals of gyroscopes and governors.

Unit 1	**MECHANISMS AND CAMS**	**12 Periods**

Mechanisms – Terminology and definitions – Kinematics inversions of 4 bars and slider crank chain – Kinematic analysis in simple mechanisms. Types of cams and followers - Terminology and definitions – Displacement diagrams – SHM, uniform velocity, uniform acceleration and retardation. Graphical constructions of cam profiles – Disc cam with knife edge follower, roller follower and flat-faced follower.

Teaching Learning Process	**Pedagogy:** Lecture method, chalk & board, PowerPoint presentations, animations, numerical problem solving, model/video demonstrations.
	RBT Level: Theory: K1, K2,K3, K4

Unit 2	**FLYWHEELS AND BALANCING**	**12 Periods**

Turning moment diagrams – Fluctuation of energy and speed – Energy stored in a flywheel – Mass of flywheel – Dimensions of flywheel.

Balancing – Static and dynamic balancing of rotating masses – Balancing of several masses rotating in the same plane and in different planes – Partial balancing of locomotives – Variation of tractive force, hammer blow, and swaying couple

Teaching Learning Process	**Pedagogy:** Lecture method, chalk & board, PowerPoint presentations, numerical problem solving, analytical derivations, case
	RBT Level: Theory: K1, K2,K3, K4

Unit 3	**FUNDAMENTALS OF VIBRATION**	**12 Periods**

Basic features of vibratory systems – Lumped mass systems – Degrees of freedom – Free vibration of longitudinal, transverse, and torsional single degree of freedom systems – Equations of motion – Natural frequency – Whirling of shafts and critical speed – Dunkerley's method – Torsional vibration of two- and three-rotor systems.

Damped free vibration – Types of damping – Critical damping coefficient – Damping factor – Logarithmic decrement.

Teaching Learning Process	**Pedagogy:** Lecture method, chalk & board, PowerPoint presentations, animations, numerical problem solving, model/video demonstrations.
	RBT Level: Theory: K1, K2,K3, K4

Unit 4	**FORCED VIBRATION**	**12 Periods**

Forced vibration of single degree freedom system with damping- Response to periodic forcing- Harmonic Forcing - Force transmissibility and amplitude transmissibility - Reciprocating and rotating unbalance - vibration isolation and transmissibility - Support motion – self excited vibration with examples

Teaching Learning Process	**Pedagogy:** Lecture method, chalk & board, PowerPoint presentations, animations, numerical problem solving, model/video demonstrations.
	RBT Level: Theory: K1, K2,K3, K4

Unit 5	**GOVERNORS AND GYROSCOPES**	**12 Periods**

Gyroscopes and gyroscopic effects-Effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships gyroscopic couple, (Demonstration of models in video). Governors - types and applications - Watt, Porter and Proell governors-Spring loaded governors Hartnell and Hartung with auxiliary springs. Sensitiveness-isochronisms and hunting.

Teaching Learning Process	**Pedagogy:** Lecture method, chalk & board, PowerPoint presentations, animations, numerical problem solving, model/video demonstrations.
	RBT Level: Theory: K1, K2,K3, K4

Total	**60 Periods**

Suggested Activities and Evaluation Methods:

Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Investigate mechanisms and cams.

CO2: Determine the principles of flywheels and rotating and reciprocating masses.

CO3: Analyze single degree of freedom free and damped vibrations

CO4: Evaluate the force transmitted to the foundation for mechanical systems under forced Vibrations.

CO5: Apply the fundamentals of gyroscopes and governors.

Textbooks:

T1: Rattan, S. S., *Theory of Machines*, 5th Edition**,** McGraw Hill Education (India) Pvt. Ltd., 2022**.**
T2: Rao, J. S., and Dukkipati, R. V., *Mechanism and Machine Theory*, 3rd Edition, New Age International Publishers, 2019**.**
T3: Ambekar, A. G., *Mechanism and Machine Theory*, 1st Edition**,** PHI Learning Private Limited, 2009**.**
T4: Khurmi, R. S., and Gupta, J. S., *Theory of Machines*, Revised Edition, S. Chand Publishing, 2021**.**

References:

R1: Pennock, G. R., Papadopoulos, E., and Shigley, J. E., *Theory of Machines and Mechanisms*, 6th Edition, Oxford University Press, 2024**.**
R2: Rao, S. S., *Mechanical Vibrations*, 7th Edition**,** Pearson Education, 2023**.**
R3: Inman, D. J., *Engineering Vibration*, 5th Edition, Pearson Education**,** 2022**.**
R4: Norton, R. L., *Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines*, 7th Edition**,** McGraw Hill Education, 2020**.**

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in

CO-PO& PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO10	PO11	PSO1	PSO 2
CO 1	3	2	2	2	1	–	–	–	–	–	–	2	2
CO 2	3	3	2	2	1	–	–	–	–	–	–	3	2
CO 3	3	3	2	3	1	–	–	–	–	–	–	3	2
CO 4	3	3	2	3	2	–	–	–	–	–	–	3	3
CO 5	3	2	2	2	1	–	–	–	–	–	–	2	3
AVG	3	2.6	2	2.4	1.2	–	–	–	–	–	–	2.6	2.4

1 – Low, 2 – Medium, 3 – High, '-' – No correlation

THERMAL ENGINEERING			
Course Code:	25UMET42	**Course Type:**	Theory
Teaching Periods / Week (L:T:P):	3:1:0	**Credits:**	4
Total Teaching Periods:	60	**CAM+ ESE Mark:**	40+60
Teaching Department:	Mechanical Engineering		

Course Objectives:

- To Study of IC engines
- To Study of combustion in IC engines
- To Understanding of emission, its impact on environment and control
- To Study of compressible fluid flow
- To Study of propulsion system

Unit 1	**IC Engines: Classification ,Operating And Performance Characteristics**	**12 Periods**

Classification of IC engines – petrol and diesel engines; two stroke and four stroke engines – scavenging in two stroke engines - port and valve timing diagram - fuel supply system in SI and CI engines - ignition system and its types – cooling system and its types – lubrication system and its types - lubricants - governing of IC engines– engine operating characteristics – power – cruising – idle and low engine speed – high engine speed – cold start - performance characteristics – heat balance test for IC engines.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching , Laboratory Demonstrations
	RBT Level:K2

Unit 2	**Fuels Combustion And Emissions**	**12 Periods**

Fuels: liquid and gaseous fuel and their characteristics –desirable properties of fuels for SI and CI engines–flashpoint, fire point, calorific value, Combustion process in IC engines – Flame propagation, normal and abnormal combustion, delay period, knocking and detonation, knocking rate of fuel, cetane number, octane number, supercharging and turbo charging – combustion chamber and types. Engine emission -formation of nitrogen oxides, carbon monoxide, hydrocarbon and particulates- emission standards.

Compressor: Introduction to compressors - Rotory and Reciprocating Compressor working and application in Industry (Theory only)

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching ,Laboratory Demonstrations
	RBT Level: K4

Unit 3	**Basic Concepts And Isentropic Flows**	**12 Periods**

Basic principles – stagnation properties – sonic velocity – Mach number – and mach waves – Isentropic flow through variable area - Mach number variation – stagnation and critical states – area ratio as a function of Mach number, mass flow rate, flow through nozzles and diffusers.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching
	RBT Level: K4

Unit 4	**Flow Through Ducts And Shock Waves**	**12 Periods**

Flow in constant area ducts with friction, flow in constant area ducts with heat transfer – multi dimensional flows. Normal shocks – development of a shock wave, governing equations, Mach number after the shock, pressure and temperature across the shock. Oblique shocks–Nature of flow through Oblique shock waves, fundamental relations and equations.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching Case Studies & Industrial Applications
	RBT Level: K5

Unit 5	**Jet And Space Propulsion**	**12 Periods**

Principle of jet propulsion – air craft jet engines – jet engine cycle – turbojet – turbofan– turboprop–turbo fan engines-engine performance–thrust and efficiency, thrust power, propulsion power, propulsion efficiency and thermal efficiency–engine- aircraft matching. Rocket engines – introduction – space missions.

Teaching Learning Process	**Pedagogy:** Lecture-Based Teaching Case Studies & Industrial Applications
	RBT Level: K4

Total	**60 Periods**

Suggested Activities and Evaluation Methods:

- Tutorials, Demo, Industrial Visit, Quiz / MCQ (Gate Related Questions), Case Study
- Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Explain the classification, construction, and working principles of SI and CI engines, and demonstrate the functioning of fuel supply, ignition, cooling, lubrication, and governing systems.

CO2: Analyze the combustion phenomena in IC engines, including flame propagation, abnormal combustion, knocking/detonation, and evaluate the influence of fuel properties and emission formation mechanisms.

CO3: Apply compressible flow relations involving Mach number, stagnation properties, and isentropic processes to nozzles and diffusers, and analyze flow variations through variable-area ducts.

CO4: Examine shock waves (normal and oblique) and evaluate compressible flow behavior in constant-area ducts under friction and heat transfer to predict flow characteristics.

CO5: Describe the principles of jet propulsion and rocket engines, apply performance equations to determine thrust and efficiency, and assess the matching requirements between engine and aircraft operation.

Textbooks:

T1: Collin R. Ferguson–Internal Combustion Engines-Applied Thermo sciences, Wiley,2004.

T2: Yahya S.M., Fundamentals of Compressible Flow, New Age International, New Delhi, 2018.

T3: Hill P. and Peterson C., Mechanics and Thermodynamics of Propulsion, Pearson

Education,2020.

References:

R1: Willard W. Pulkrabek– Internal Combustion Engines, Prentice Hall of India, 2004.

R2: J.B. Heywood– Internal Combustion Engines – fundamentals, McGraw Hill, 2017.

R3: Cambel, A.B. and Jennings, 'Gas dynamics and Compressible Flow", Tata McGraw Hill,1958.

R4: V. Ganesan – Internal Combustion Engines, Tata McGraw Hill,2017.

Web links and Video Lectures (e-Resources):

1. https://www.coursera.org/course/introthermodynamics
2. http://nptel.ac.in/courses/112104033

CO-PO& PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2
CO1	3	3	3	-	-	3	3	2	-	-	3	-	-
CO2	3	3	3	-	-	3	3	2	-	-	3	-	-
CO3	3	3	3	-	-	3	3	2	-	-	3	-	-
CO4	3	3	3		-	3	3	3	-	-	3	3	3
CO5	3	3	3	-	-	3	3	3	-	-	3	3	3
AVG	3	3	3	-	-	3	3	2	-	-	3	-	-

1 – Low, 2 – Medium, 3 – High, '-' – No correlation

MECHATRONICS, ROBOTICS AND CONTROL			
Course Code:	25UMET44	**Course Type:**	Theory
Teaching Periods / Week (L:T:P):	3 : 0: 0	**Credits:**	3
Total Teaching Periods:	45	**CAM+ ESE Mark:**	40+60
Teaching Department:	**Mechanical Department**		

Course Objectives:

- To enable students to understand and describe the fundamental principles of electro-mechanical systems, actuators, control units, and robotics, and explain their applications in various engineering and automation scenarios.

Unit 1	**Introduction**	**09 Periods**

Electro-mechanical systems; Energy domains and system integration; Typical applications; Case studies – automobiles, home appliances, medical instruments, and industrial systems.

Teaching Learning Process	**Pedagogy:** PowerPoint, Video Lecture, Mind Mapping, Experiential Learning
	RBT Level: Theory: K2

Unit 2	**Actuators**	**09 Periods**

Role and requirements of actuators in robotic systems; Electrical actuators for robotics – DC servo motors, BLDC motors, stepper motors (principle of operation, characteristics, control methods, and applications); Mechanical transmission elements used in robots – gear trains, harmonic drives, belt and screw drives; Fluid power actuators – pneumatic and hydraulic actuators for robotic manipulators and grippers**.**

Teaching Learning Process	**Pedagogy:** PowerPoint, Video Lecture, Mind Mapping, Experiential Learning
	RBT Level: Theory: K2

Unit 3	**Machine Controls**	**09 Periods**

Microprocessors – basic architecture and operation; Microcontrollers and their features; Programmable Logic Controllers (PLC) – principle of operation, architecture, and programming basics; Analog and digital input/output modules; Interfacing of sensors and actuators with controllers; Timers, counters, internal relays, and data handling; Overview of industrial automation systems.

Teaching Learning Process	**Pedagogy:** PowerPoint, Video Lecture, Mind Mapping, Experiential Learning
	RBT Level: Theory: K2

Unit 4	**Robotics – Configuration and Kinematics**	**09 Periods**

Introduction to industrial robots; Robot configurations – serial and parallel manipulators; Degrees of freedom and workspace; Coordinate frames and link parameters; Rotation matrices; Homogeneous transformation matrices; Forward (direct) kinematics; Inverse kinematics for position and orientation of robotic manipulators.

Teaching Learning Process	**Pedagogy:** PowerPoint, Video Lecture, Mind Mapping, Experiential Learning	
	RBT Level: Theory: K2	
Unit 5	**Robotics – Sensors, Control and Applications**	**09 Periods**
Robot sensors – position, proximity, force, and vision sensors; Robot vision systems and basic image processing concepts; Motion control of robotic manipulators; Robot programming methods; Introduction to robot control architectures; Industrial robot applications – pick and place, sorting, assembly, welding, inspection, and material handling.		
Teaching Learning Process	**Pedagogy:** PowerPoint, Video Lecture, Mind Mapping, Experiential Learning	
	RBT Level: Theory: K2	
Total		**45**

Suggested Activities and Evaluation Methods:

Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Students' performance in continuous Assessment / Student Presentations, Model Exam.

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Explain the fundamentals of electro-mechanical systems and describe their applications in domains such as automobiles, home appliances, and medical devices.

CO2: Describe the operating principles, characteristics, and selection criteria of various sensors used for engineering measurements.

CO3: Explain the working principles of different actuators, including hydraulic, pneumatic, electrical motors, solenoids, and smart materials.

CO4: Discuss the basic architecture and functioning of microprocessors, microcontrollers, and PLCs in machine control and automation systems.

CO5: Interpret the fundamental concepts of robot configurations, kinematics, vision, and control used in industrial robotic applications.

Textbooks:

T1: W. Bolton, *Mechatronics: A Multidisciplinary Approach*, 7th Edition, Pearson Education, 2018.

T2: John J. Craig, *Introduction to Robotics: Mechanics and Control*, 4th Edition, Pearson Education, 2022.

T3: Gregory K. McMillan and Robert A. Cameron, *McGraw-Hill's Process/Industrial Instruments and Controls Handbook*, 6th Edition, McGraw-Hill Education, 2019.

T4: Alciatore, D.G. and Histand, M.B., Introduction to Mechatronics and Measurement Systems, 6th Edition, McGraw-Hill, 2023.

References:

R1: M. P. Groover, Automation, Production Systems and Computer-integrated Manufacturing, Prentice Hall,2022.

R2: S. Mukherjee, "Essentials of Robotics Process Automation", Khanna Book Publishing, 2021

R3: Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, 5th Edition, Pearson Education, 2023

R4: R.K. Rajput, Robotics and Industrial Automation, Second Revised Edition, S. Chand Publishing, New Delhi, 2014.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/107/106/107106090/
2. https://nptel.ac.in/courses/112/101/112101098/
3. https://nptel.ac.in/courses/112/107/112107289/
4. https://nptel.ac.in/courses/112/104/112104298/

CO-PO& PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	1	-	1	1	1
CO2	3	2	1	-	-	-	-	-	1	-	1	1	2
CO3	3	2	1	-	-	-	-	-	1	-	1	1	2
CO4	3	2	1	-	1	-	-	-	1	-	1	1	2
CO5	3	2	1	-	1	-	-	-	1	-	1	1	2
AVG	3	2	1	-	1	-	-	-	1	-	1	1	2

1 – Low, 2 – Medium, 3 – High, '-' – No correlation

COMPUTER AIDED MACHINE DRAWING THEORY & LAB			
Course Code:	25UMEI41	**Course Type:**	Integrated
Teaching Periods / Week (L:T:P):	2 : 0 : 2	**Credits:**	3
Total Teaching Periods:	45	**CAM+ ESE Mark::**	50+50
Teaching Department:	Mechanical		

Course Objectives:

To impart knowledge on interpret drawings of machine components so as to prepare assembly Drawings manually.

Unit 1	**Conventions**	**09 Periods**

Conventions for sectioning and dimensioning, screw threads, rivets, bolts, nuts, pins, keys, cotter, gear, springs and welds. Component drawing assigning fits and tolerance machine symbol, surface finish geometrical tolerance.

Teaching Learning Process	**Pedagogy:**
	RBT Level: Theory:K2

Unit 2	**Preparation of manual drawings of parts and assembly**	**36 Periods**

Preparation of manual drawings of parts and assembly of:

Joints

- Cotter joints –sleeve

Couplings

- Split muff couplings

Bearing

- swivel bearing

Machine Components

- Screw jack
- Stop valve – steam

Practical: Preparation of 2D Computer aided Drawings for Parts and Assembly

Preparation of 2D Computer aided Drawings for Parts and Assembly of the following,

- Flange coupling
- Knuckle Joint
- Universal Coupling
- Plumber Block
- Foot Step Bearing

Teaching Learning Process	**Pedagogy:**
	RBT Level: Theory: K2 Practical:K3

Total	**45 Periods**

Suggested Activities and Evaluation Methods:

Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study Students' performance in continuous Assessment / Student Presentations, Model

Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Understand the standard conventions of engineering drawing and the significance of dimensions, fits, tolerances, surface finish, and geometrical tolerances in machine component drawings.

CO2: Prepare and interpret assembly drawings of mechanical joints and machine elements using standard drafting practices and CAD software to ensure correct assembly and functionality.

Text books:

T1: Bhatt, N.D "Machine Drawing", Charotar Publishing House.2022

T2: Gopalakrishnan,K.R, "Machine Drawing", SUBHAS Publications,2021

References:

R1: Sidheswar, "Machine Drawing" Tata McGraw Hill edition, 2020

R2: Sadhu Singh and P.L. Sah, Fundamentals of Machine Drawing, PHI, 2019

Web links and Video Lectures (e-Resources):

3. https://nptel.ac.in/courses/112104031
4. https://nptel.ac.in/courses/112103019

CO-PO& PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2
CO1	3	2	2	-	2	-	-	-	2	-	-		
CO2	3	2	3	-	3	-	-	-	2	-	-		
AVG											-		

1 – Low, 2 – Medium, 3 – High, '-' – No correlation

****CONTINUOUS ASSESSMENT-III FOR THEORY AND END SEMESTER EXAMINATION, THE MAXIMUM MARK WILL BE "100"**

****PART A = 3 X 10 = 30; PART B (Either or) 1 X 70 = 70**

THERMAL ENGINEERING LAB			
Course Code:	25UMEP41	**Course Type:**	Practical Course (PC)
Teaching Periods / Week (L:T:P):	0 : 0 : 2	**Credits:**	01
Total Teaching Periods:	30	**IAT + ESE Marks:**	60+40
Teaching Department:	Mechanical Engineering		

Course Objectives:

1. To provide hands-on experience in evaluating the performance of fuels using standard experimental methods.
2. To experimentally analyze air machinery, heat transfer equipment, and internal combustion engines.
3. To assess the performance of refrigeration, air-conditioning systems, and cooling towers.

Practical Exercises: **30 Periods**

PRACTICE EXERCISES:

Fuel Analysis

1. Determination of kinematic viscosity using Redwood viscometer.
2. Determination of flash and fire point using Cleveland open cup apparatus.
3. Determination of calorific value of solid fuel using bomb calorimeter.
4. Determination of calorific value of gaseous fuel using Junker's gas calorimeter.

Air Machinery (Compressors & Blowers)

5. Performance test on reciprocating air compressor.
6. Performance test on centrifugal air blower.

I.C. Engine

7. Valve and port timing diagrams of 4-stroke and 2-stroke IC engines.
8. Performance test on single-cylinder 4-stroke petrol engine.
9. Performance test on multi-cylinder 4-stroke petrol engine.
10. Performance test on single-cylinder 4-stroke diesel engine.
11. Performance test on multi-cylinder 4-stroke diesel engine.

Refrigeration and Air Conditioning

12. Performance test on cooling tower.
13. Performance test on refrigeration system.
14. Performance test on air-conditioning system.

References:

1. P.K. Nag, *Engineering Thermodynamics*, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2020.

2. V. Ganesan, *Internal Combustion Engines*, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2023

Web Resource

1.https://nptel.ac.in/courses/112103262

2.https://nptel.ac.in/courses/112105123

Course Outcomes:

After Successful completion of this course, the student should be able to

1. Determine fuel properties such as viscosity, flash point, fire point, and calorific value using

standard laboratory instruments

2. Evaluate the performance of air machinery including reciprocating compressors and centrifugal blowers

3. Analyze heat transfer processes by determining thermal conductivity, heat transfer coefficients, and heat exchanger performance

4. Conduct performance analysis of internal combustion engines and interpret valve and port timing diagrams

5. Assess the performance of refrigeration, air-conditioning systems, and cooling towers using experimental data

CO–PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	–	–	2	–	–	–	–	–	–	2	–
CO2	3	3	–	2	2	–	–	–	–	–	–	2	–
CO3	3	3	2	–	2	–	–	–	–	–	–	3	2
CO4	3	3	–	2	2	–	–	–	–	–	–	2	–
CO5	2	3	2	–	2	–	–	–	–	–	–	2	–
AVG	3	2	–	–	2	–	–	–	–	–	–	2	–

1–Low, 2–Medium, 3–High, '-' –No correlation

DYNAMICS OF MACHINERY LAB			
Course Code:	25UMEP42	**Course Type:**	Practical
Teaching Periods / Week (L:T:P):	0:0:2	**Credits:**	01
Total Teaching Periods:	30 Periods	**CAM+ ESE Mark:**	60+40
Teaching Department:	Mechanical Engineering		

Course Objectives:

- Teach the principles and working of various governors and their applications.
- Demonstrate the working of different mechanisms, balancing methods, and vibration modes.
- Develop understanding of practical aspects of rotating machinery, stability, and dynamic behavior.

Practical Exercises: **Periods : 30**

UNIT I Mechanisms and Vibrations

1. Demonstration of four bar inversion mechanism
2. Natural frequency of single mass, single helical spring system
3. Natural frequency of combination of springs – springs in parallel, springs in series
4. Natural frequency of undamped torsional single rotor and double rotor system; effect of inertia (I) and stiffness (k)
5. Determination of radius of gyration of a given compound pendulum
6. Determination of radius of gyration, moment of inertia – bifilar suspension method / trifilar suspension method
7. Damping coefficient of torsional single rotor system – effect of depth of immersion in oil and damping ratio
8. Resonance frequency of equivalent spring-mass system – undamped and damped conditions; plot amplitude vs frequency for different damping

UNIT II– Governors, Balancing, and Machinery

9. Determination of characteristic curves of Watt, Porter, Proell, and spring-loaded governors
10. Static and dynamic balancing of rotating masses
11. Whirling of shafts / determination of critical speed with and without rotors
12. Gyroscopic couple verification
13. Journal bearing – pressure distribution for different loads at different speeds
14. Cam motion analysis
15. Generation of involute gear profile
16. Tracing of coupler curves
17. Determination of error in straight line drawn by Watt chain mechanism

SOFTWARE REQUIRED

1. MATLAB / Simulink
2. SolidWorks / CAD software (for gear profile, cam analysis)

3. Any vibration analysis or mechanism simulation software

References:

R1: Bansal, R. K., A Textbook of Theory of Machines, 6th Edition, Laxmi Publications, 2021**.**
R2: Rattan, S. S., Theory of Machines, 5th Edition, McGraw Hill Education (India) Pvt. Ltd., 2022.
R3: Uicker, J. J., Pennock, G. R., and Shigley, J. E., Theory of Machines and Mechanisms, 6th **Edition**, Cambridge University Press, 2023.
R4: Rao, S. S., Mechanical Vibrations, 7th Edition**,** Pearson Education, 2023**.**
R5: Inman, D. J., Engineering Vibration, 5th Edition, Pearson Education, 2022**.**

Course Outcomes:

After Successful completion of this course, the student should be able to

1. Demonstrate the working principles of governors and understand their performance characteristics.
2. Analyze the vibration behavior of mechanical systems and determine natural frequencies.
3. Apply static and dynamic balancing techniques to rotating machinery.
4. Evaluate mechanical systems such as shafts, bearings, cams, and gear profiles using experimental data.
5. Develop practical skills for designing and testing mechanisms and rotating machinery components.

CO–PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	1	–	–	–	–	–	–	2	2
CO2	3	3	2	3	1	–	–	–	–	–	–	3	2
CO3	3	3	2	3	2	–	–	–	–	–	–	3	3
CO4	3	2	2	2	1	–	–	–	–	–	–	2	2
CO5	3	2	2	2	1	–	–	–	–	–	–	2	3
AVG	3	2.4	2	2.4	1.2	–	–	–	–	–	–	2.4	2.4

1–Low, 2–Medium, 3–High, '-' –No correlation

ROBOTICS LAB			
Course Code:	25URAP48	**Course Type:**	Theory
Teaching Periods / Week (L:T:P):	0: 0: 2	**Credits:**	1
Total Teaching Periods:	30	**CAM+ ESE Mark:**	60+40
Teaching Department:	**Robotics and Automation**		

Course Objectives:

- To understand the basics of pneumatic and hydraulic systems and their use in operating cylinders.
- To learn the design and testing of electro-pneumatic and electro-hydraulic circuits using electrical switches and valves.
- To gain practical knowledge of PLC-based automation for controlling single and multi-cylinder operations.

Practical Exercises: **30 Periods**

CYCLE – I: BASIC UNDERSTANDING (PNEUMATICS & HYDRAULICS)

1. Design and Testing of Actuation of a Double-Acting Pneumatic Cylinder Using a Two-Way Pressure Valve.
2. Design and Testing of Basic Hydraulic Circuit for Actuation of a Double-Acting Cylinder.
3. Study of Directional Control Valves Used in Hydraulic Systems.
4. Design and Testing of Electro-Pneumatic Actuation of a Double-Acting Cylinder Using Electrical Push Button Switch in Meter-In Circuit.
5. Design and Testing of Electro-Pneumatic Actuation of a Double-Acting Cylinder Using Electrical Push Button Switch in Meter-Out Circuit.
6. Simulation of Pneumatic Cascade Control Circuit for Two-Cylinder Sequential Operation Using FluidSIM.

CYCLE – II: AUTOMATION & PLC CONTROL

7. Design and Testing of Electro-Hydraulic Actuation of Double-Acting Cylinder Using Electrical Push Button Switch.
8. Design and Implementation of PLC-Based Logic Control of a Double-Acting Cylinder Using Two Push Button Switches
9. Design and Testing of PLC-Based Pneumatic Circuit for Single-Cycle Automation of Multi-Cylinders with Sequence $A^+ \rightarrow B^+ \rightarrow A^- \rightarrow B^-$
10. Design and Testing of PLC-Based Pneumatic Circuit for Single-Cycle Automation of Multi-Cylinders with Sequence $A^+ \rightarrow B^+ \rightarrow B^- \rightarrow A^-$

CYCLE – III PROGRAMMING

11. To study and program basic robotic movements using a Dobot manipulator.
12. To perform automated pick-and-place operations using a Dobot robotic arm.
13. To implement color-based object identification and sorting using a Dobot robot and sensor system.
14. Study and implementation of laser engraving operations using a Dobot robotic manipulator.

Textbooks:

1. James R. Daines, Fluid Power: Hydraulics and Pneumatics, 4th Edition, Goodheart-Willcox Publishers, 2025.
2. Frank D. Petruzella, Programmable Logic Controllers with Ladder Logic, 2023 Edition, McGraw-Hill Education, 2023.
3. Festo Didactic, Electro-Pneumatics Basic Level TP201 Workbook, Latest Edition, Festo Didactic, 2022.

References:

1. Jarosław Stryczek and Urszula Warzyńska (Eds.), Advances in Hydraulic and Pneumatic Drives and Control 2023, Springer, 2024
2. DOBOT Magician User Manual
3. DOBOT Conveyor Belt User Manual
4. Craig, John J. Introduction to robotics: mechanics and control, 4th Edition. Pearson Education India, 2022.
5. Groover, Mikell P., Mitchell Weiss, and Roger N. Nagel. Industrial robotics: technology, programming and application. McGraw-Hill Higher Education, 2017.
6. Niku, Saeed B. Introduction to robotics: analysis, control, applications. John Wiley & Sons, 2020.

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Understand the basic components, symbols, and working of pneumatic and hydraulic systems, including electro-pneumatic and electro-hydraulic actuation of double-acting cylinders.

CO2: Understand the principles of PLC-based automation, sequential control of multi-cylinder systems.

CO3: Apply robotic programming techniques to control a Dobot manipulator for industrial automation tasks including material handling, object sorting, and laser engraving operations.

CO–PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	2	2	1	2	2	-	-	-	-	-	1	3	1	
CO2	2	3	2	2	3	-	-	1	1	1	1	3	2	
CO3	2	2	3	2	3			2	2	1	2	3	3	

1–Low, 2–Medium, 3–High, '-' –No correlation

PROFESSIONALISM AND BASIC APTITUDE			
(Common to all Branches)			
Course Code:	25UPCE41	**Course Type:**	**Employability Enhancement Course**
Teaching Periods / Week (L:T:P):	3:0:0	**Credits:**	0
Total Teaching Periods:	30	**CAM+ ESE Mark:**	
Teaching Department:			

Course Objectives:

To impart knowledge on students improve communication, teamwork, and time management. It teaches how to behave professionally and work well with others. Students will learn problem-solving and leadership skills.

Unit 1	**Attitude, Adaptability& Values**	**06 Periods**

Attitude: Positive thinking and optimism - Growth mindset vs. fixed mindset - Self-motivation and initiative - Managing negative attitudes and stress

Adaptability: Change management - Cognitive flexibility - Continuous learning - Workplace diversity adjustment

Values: Personal vs. professional values - Integrity and honesty - Respect and empathy - Ethical decision-making

Perception and learning: Sensory perception and attention - Factors affecting perception - Types of learning - Learning styles and strategies

Teaching Learning Process	**Pedagogy:**
	RBT Level: Theory: Practical:

Unit 2	**Leadership**	**06 Periods**

Leadership: Leadership styles-Effective communication-Decision-making-Team motivation

Creativity: Brainstorming-Innovation-Problem-solving-Imagination

Reaching your potential: Self-awareness - Goal setting - Time management - Continuous improvement

Teaching Learning Process	**Pedagogy:**
	RBT Level: Theory: Practical:

Unit 3	**General Aptitude**	**06 Periods**

Number System: Types of Numbers - Prime and Composite Numbers -Place Value and Face Value - Conversions between Number Bases

HCF & LCM: Prime Factorization Method - Division Method - Relationship between HCF and LCM - Word Problems on HCF and LCM

Factorial Concepts: Definition and Notation of Factorial - Factorial Identities - Factorial in Permutations and Combinations - Trailing Zeros in Factorials

Teaching Learning Process	**Pedagogy:**
	RBT Level: Theory: Practical:

Unit 4	**Quantitative Aptitude – 1**	**06 Periods**

Profit and Loss: Cost Price and Selling Price - Profit and Loss Percentage - Marked Price and Discount - Successive Transactions

Percentage, Ratio and Proportion: Percentage Basics and Calculations - Ratio Simplification and Comparison - Direct and Inverse Proportion - Percentage to Ratio Conversions

Simple Interest and Compound Interest: Simple Interest Formula and Calculation - Compound Interest Basics - Difference between SI and CI - Time and Rate-Based Problems

Teaching Learning Process	**Pedagogy:**
	RBT Level: Theory: Practical:

Unit 5	**Probability, Permutation and Combination**	**06 Periods**

Probability: Basic Probability - Sample Space - Independent and Dependent Events - Complementary Events

Permutation and Combination: Fundamental Principle of Counting - Permutations - Combinations - Circular Permutations

Pipe and Cistern: Inlet and Outlet Pipes - Filling and Emptying Time - Pipes Working Together - Alternate Inlet–Outlet Problems

Teaching Learning Process	**Pedagogy:**
	RBT Level: Theory: Practical:

Total	**Periods:45**

Suggested Activities and Evaluation Methods:

Tutorials, Mini Projects, Quiz / MCQ (Gate Related Questions), Case Study Students' performance in continuous Assessment / Student Presentations, Model Exam

Course Outcomes:

After Successful completion of this course, the student should be able to

CO1: Apply positive attitude, adaptability, ethical values, and effective perception and learning strategies for personal and professional development.

CO2: Build leadership, creativity, and self-awareness to communicate effectively, solve problems, and achieve continuous growth

CO3: Apply number system concepts, HCF & LCM methods, and factorial principles to solve quantitative problems efficiently

CO4: Calculate profit/loss, percentage, ratio, proportion, and interest problems to make informed financial and quantitative decisions.

CO5: Solve problems on probability, permutations, combinations, and pipe-cistern scenarios using logical and mathematical reasoning

Textbooks:

T1: Aggarwal, R. S. *Quantitative Aptitude for Competitive Examinations*. S. Chand & Company Ltd., **2018**.

T2:Sharma, Arun. *Quantitative Aptitude for CAT*. Tata McGraw-Hill Education Pvt. Ltd., **2014**.

References:

R1: Agarwal, Er. Deepak, & Gupta, D. P. *Rapid Quantitative Aptitude*. S. Chand & Company Ltd., **2019**.

R2: Mittal, P. K. ***Numerical Ability and Quantitative Aptitude for Competitive Examinations*****. Jain Book Agency, 2017**

Web links and Video Lectures (e-Resources):

1. https://quants0.blogspot.com/p/home-quantitative-aptitude.html

CO-PO& PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2
CO1	-	3	-	-	-	3	2	2	2	2	2	-	-
CO2	2	1	1	1	1	1	1	1	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	2	-	-
CO4	2	-	2	-	-	-	-	2	-	-	2	-	-
CO5	2	2	2	-	-	-	-		2	-	2	-	-
AVG	1.6	1.6	1.4	0.2	0.2	0.8	0.6	5	0.8	0.4	1.6	-	-

1 – Low, 2 – Medium, 3 – High, '-' – No correlation