GRADUATION REQUIREMENT FOR THE ACADEMIC YEAR 2022-23
B.Tech. (Mechanical Engineering) - 2022 Batch

A. Pre-Professional Elective Courses

Sl. No.	Course Category	Course No.	Course Name	Credit Hrs. (Load Distribution) Contact Hrs.
1.	BSC	BPP-199	Mechanics	5(3-1-2)6
2.	BSC	BPP-201	Oscillations, Waves and Optics	4(3-1-0)4
3.	BSC	BPM-143	Calculus and Linear Algebra	4(3-1-0)4
4.	BSC	BPM-153	Calculus, ODE & Complex Variables	5(4-1-0)5
5.	BSC	BPC-102	Chemistry I	4(3-0-3)6
6.	BSC	BHS-186	English	3(2-0-2)4
7.	ESC	TEE-104	Basic Electrical Engineering	5(3-1-2)6
8.	ESC	TCE-114	Engineering Graphics & Design	3(1-0-4)5
9.	ESC	TIT-121	Programming for Problem Solving	4(3-0-2)5
10.	ESC	TIP-103	Workshop Practices	3(1-0-4)5
11.	ESC	TEC-227	Basic Electronics Engineering	4(3-0-2)5
12.	ESC	TME-214	Machine Drawing	1(0-0-2)2
13.	MC	BHS-188	Industrial Sociology	3(3-0-0)3
14.	MC	TME-109	Int. Environmental Engineering & Disaster Management	3(3-0-0)3
15.	MC	NSS-201/ NCC-201	NSS /NCC	0(0-0-4)4
16.	MC	NSS-202/ NCC-202	NSS/ NCC	1(0-0-4)4
17.	MC	NSS-301/ NCC-301	NSS / NCC	0(0-0-4)4
18.	MC	NSS-302/ NCC-302	NSS / NCC	1(0-0-4)4
19.	MC	TWP-101	Work Programme	1(0-0-3)3
20.	MC	TME-191	Practical Training I	2 weeks
21.	MC	TME-291	Practical Training II	2 weeks
22.	MC	TME-391	Practical Training III	4 weeks
23.	ESC	BPM-242	PDE, Probability and Statistics	5(4-1-0)5
24.	MC	TIC-100	Induction Programme	2-3 weeks
25.	ESC	TIP-206	Manufacturing Science –I	4(3-0-3)6
26.	ESC	TIP-308	Manufacturing Technology	4(3-0-2)5
27.	ESC	TIP-359	Managerial Economics	3(3-0-0)3

B. Professional Core Courses

Sl. No.	Course Category	Course No.	Course Name	Credit Hrs.
1.	PCC	TME-201	Engineering Mechanics	4(3-1-0)4
2.	PCC	TME-210	Fluid Mechanics	4(3-1-2)5
3.	PCC	TME-206	Instrumentation & Control	4(3-0-2)5
4.	PCC	TME-216	Mechanics of Solids	4(3-1-2)5
5.	PCC	TME-218	Engineering Thermodynamics	4(3-1-0)4
6.	PCC	TME-255	Material Science & Engineering	4(3-0-2)5

7.	PCC	TME-303	Refrigeration and Air Conditioning	4(3-1-2)5
8.	PCC	TME-318	Design of Machine Elements	4(3-1-2)5
9.	PCC	TME-424	Fluid Machinery & Systems	4(3-1-2)5
10.	PCC	TME-322	Kinematics of Machines	3(2-1-2)5
11.	PCC	TME-323	Theory of Machines	4(3-0-2)5
12.	PCC	TME-325	Heat Transfer	4(3-1-2)5
13.	PCC	TME-319	Internal Combustion Engines	4(3-1-2)5
14.	PCC	TME-416	Advanced Solid Mechanics	4(3-1-0)4
15.	PCC	TME-224	Numerical Techniques for Mechanical Engineers	3(2-0-2)4
16.	Project	TME-495 A	Project I	4(0-0-8)
17.	Project	TME-495 B	Project II	8(0-0-16)

C. List of Professional Elective Courses

Sl. No.	**Course Category**	**Course No.**	**Course Name**	**Credit Hrs. (Load Distribution) Contact Hrs.**
1	PEL	TME-457	Gas Dynamic & Jet Propulsion	3(2-1-2)5
2	PEL	TME-458	Finite Element Analysis	3(2-1-2)5
3	PEL	TME-444	Mechanical Vibrations	3(2-1-2)5
4	PEL	TME-459	Advance Machine Design	3(2-1-2)5
5	PEL	TME-465	Experimental Stress Analysis	3(2-1-2)5
6	PEL	TME-466	Non Conventional Energy Source And Systems	3(2-1-2)5
7	PEL	TME-430	Composite Materials	3(2-1-2)5
8	PEL	TME-431	Mechatronics Systems	3(2-1-2)5
9	PEL	TME-463	Computer Aided Design	3(2-1-2)5
10	PEL	TME-464	Automobile Engineering	3(2-1-2)5
11	PEL	TME-467	Power Plant Engineering	3(2-1-2)5
12	PEL	TME-468	Solar Energy Thermal Process	3(2-1-2)5
13	PEL	TME-469	Experimental Methods in Thermal Science	3(2-1-2)5
14	PEL	TME-470	Computational Fluid Dynamics and Heat Transfer	3(2-1-2)5
15	PEL	TME-472	Fatigue, Creep and Fracture	3(2-1-2)5
16	PEL	TME-474	Tribology	3(2-1-2)5
17	PEL	TME-476	Design of Refrigeration Systems	3(2-1-2)5
18	PEL	TME-475	Nano Engineering Materials	3(2-1-2)5
19	PEL	TME-480	Product Innovation and Design	3(2-1-2)5

SEMESTER WISE LOAD DISTRIBUTION FOR 2022 BATCH

Sl. No.	Course Category	Course No.	Course Name	Credit Hrs. (Load Dist.) Contact Hr
I Semester				
1	ESC	TIT-121	Programming for Problem Solving	4(3-0-2)5
2	BSC	BPM-143	Calculus & Linear Algebra	4(3-1-0)4
3	ESC	TEE-104	Basic Electrical Engineering	5(3-1-2)6
4	BSC	BPC-102	Chemistry I	4(3-0-3)6
5	MC	TWP-101	Work Programme	1(0-0-3)3
6	MC	TIC-100	Induction Programme	2-3 weeks
7	MC	TSW-109	Int. Environmental Engg. & Disaster Management	3(3-0-0)3
				Total Credits: 21
II. Semester				
1	BSC	BPM-153	Calculus ODE & Complex Variables	5(4-1-0)5
2	ESC	TIP-103	Workshop Practices	3(1-0-4)5
3	ESC	TCE-114	Engineering Graphics & Design	3(1-0-4)5
4	BSC	BHS-186	English	3(2-0-2)4
5	BSC	BPP-199	Mechanics	5(3-1-2)6
6	MC	BHS-188	Industrial Sociology	3(3-0-0)3
7	MC	TME-191	Practical Training I	2 Weeks
				Total Credits: 22
III. Semester				
1	BSC	BPP-201	Oscillations, Waves and Optics	4(3-1-0)4
2	BSC	BPM-242	PDE, Probability & Statistics	5(4-1-0)5
3	ESC	TEC-227	Basic Electronics Engineering	4(3-0-2)5
4	PCC	TME-201	Engineering Mechanics	4(3-1-0)4
5	PCC	TME-255	Material Science & Engineering	4(3-0-2)5
6	MC	NSS-201/ NCC-201	NSS/NCC	0(0-0-4)4
				Total Credits: 21
IV. Semester				
1	PCC	TME-210	Fluid Mechanics	4(3-1-2)5
2	ESC	TIP-206	Manufacturing Science-I	4(3-0-3)6
3	PCC	TME-224	Numerical Techniques for Mechanical Engineers	3(2-0-2)4
4	PCC	TME-216	Mechanics of Solids	4(3-1-2)5
5	PCC	TME-218	Engineering Thermodynamics	4(3-1-0)4
6	PCC	TME-206	Instrumentation & Control	4(3-0-2)5
7	PCC	TME-214	Machine Drawing	1(0-0-2)2
8	MC	TME-291	Practical Training II	2Weeks
9	MC	NSS-202/ NCC-202	NSS/NCC	1(0-0-4)4
				Total Credits: 25

V. Semester				
1	PCC	TME-325	Heat Transfer	4(3-1-2)5
2	PCC	TME-319	Internal Combustion Engines	4(3-1-2)5
3	PCC	TME-322	Kinematics of Machines	3(2-1-2)5
4	ESC	TIP-308	Manufacturing Technology	4(3-0-2)5
5	PEL	TME-	Elective I	3(2-1-2)5
6	OEL		Open Elective I	3(3-0-0)3
7	MC	NSS-301/ NCC-301	NSS/NCC	0(0-0-4)4
				Total Credits: 21
VI. Semester				
1	PCC	TME-323	Theory of Machines	4(3-0-2)5
2	PCC	TME-318	Design of Machine Elements	4(3-1-2)5
3	PCC	TME-303	Refrigeration and Air Conditioning	4(3-1-2)5
4	ESC	TIP-359	Managerial Economics	3(3-0-0)3
5	PEL	TME-	Elective II	3(2-1-2)5
6	OEL		Open Elective II	3(3-0-0)3
7	MC	NSS-302/ NCC-302	NSS/ NCC	1(0-0-4)4
8	PT	TME-391	Practical Training III	4Weeks
				Total Credits: 22
VII. Semester				
1	PCC	TME-424	Fluid Machinery & Systems	4(3-1-2)5
2	PCC	TME-416	Advanced Solid Mechanics	4(3-1-0)4
3	PEL	TME-	Elective III	3(2-1-2)5
4	PEL	TME-	Elective IV	3(2-1-2)5
5	OEL		Open Elective III	3(3-0-0)3
6	Proj	TME-495 A	Project I	4(0-0-8)
				Total Credits: 21
VIII. Semester				
1	PEL	TME-	Elective V	3(2-1-2)5
2	PEL	TME-	Elective VI	3(2-1-2)5
3	OEL		Open Elective IV	3(3-0-0)3
4	Proj	TME- 495 B	Project II	8(0-0-16)
				Total Credits: 17

Total Credits Degree Programme: 170

Note:

1. *Those students who have not taken Hindi at High School or Equivalent level will also require to register the course BHS-173 Elementary Hindi 2(2-1-0)*
2. *Students can register either in NSS or NCC.*
3. *Semester wise interchange in the course curriculum may be done as per the availability of the experts and lab facilities.*

Graduation requirement for Diploma Holders admitted to 2nd Year B. Tech. (Mechanical Engineering) - 2022 Batch

A. Pre-Professional Courses

Sl. No.	Course Category	Course No.	Course Name	Credit Hrs. (Load Distribution) Contact Hrs.
1.	BSC	BPP-201	Oscillations, Waves and Optics	4(3-1-0)4
2.	ESC	TEC-227	Basic Electronics Engineering	4(3-0-2)5
3.	ESC	TME-214	Machine Drawing	1(0-0-2)2
4.	MC	NSS-201/ NCC-201	NSS /NCC	0(0-0-4)4
5.	MC	NSS-202/ NCC-202	NSS/ NCC	1(0-0-4)4
6.	MC	NSS-301/ NCC-301	NSS / NCC	0(0-0-4)4
7.	MC	NSS-302/ NCC-302	NSS / NCC	1(0-0-4)4
8.	MC	TME-291	Practical Training II	2 weeks
9.	MC	TME-391	Practical Training III	4 weeks
10.	ESC	BPM-242	PDE, Probability and Statistics	5(4-1-0)5
11.	ESC	TIP-206	Manufacturing Science-I	4(3-0-3)6
12.	ESC	TIP-308	Manufacturing Technology	4(3-0-2)5
13.	ESC	TIP-359	Managerial Economics	3(3-0-0)3
14.	MC	TWP-101	Work Programme	1(0-0-3)3

B. Professional Core Courses

Sl. No.	Course Category	Course No.	Course Name	Credit Hrs. (Load Distribution) Contact Hrs.
1.	PCC	TME-201	Engineering Mechanics	4(3-1-0)4
2.	PCC	TME-210	Fluid Mechanics	4(3-1-2)5
3.	PCC	TME-206	Instrumentation & Control	4(3-0-2)5
4.	PCC	TME-216	Mechanics of Solids	4(3-1-2)5
5.	PCC	TME-218	Engineering Thermodynamics	4(3-1-0)4
6.	PCC	TME-255	Material Science & Engineering	4(3-0-2)5
7.	PCC	TME-303	Refrigeration and Air Conditioning	4(3-1-2)5
8.	PCC	TME-318	Design of Machine Elements	4(3-1-2)5
9.	PCC	TME-424	Fluid Machinery & Systems	4(3-1-2)5
10.	PCC	TME-322	Kinematics of Machines	3(2-1-2)5
11.	PCC	TME-323	Theory of Machines	4(3-0-2)5
12.	PCC	TME-325	Heat Transfer	4(3-1-2)5
13.	PCC	TME-319	Internal Combustion Engines	4(3-1-2)5
14.	PCC	TME-416	Advanced Solid Mechanics	4(3-1-0)4
15.	PCC	TME-224	Numerical Techniques for Mechanical Engineers	3(2-0-2)4
16.	Project	TME-495 A	Project I	4(0-0-8)
17.	Project	TME-495 B	Project II	8(0-0-16)

C. Professional Elective Courses

Sl. No.	Course Category	Course No.	Course Name	Credit Hrs. (Load Distribution) Contact Hrs.
1	PEL	TME-457	Gas Dynamic & Jet Propulsion	3(2-1-2)5

2	PEL	TME-458	Finite Element Analysis	3(2-1-2)5
3	PEL	TME-444	Mechanical Vibrations	3(2-1-2)5
4	PEL	TME-459	Advance Machine Design	3(2-1-2)5
5	PEL	TME-465	Experimental Stress Analysis	3(2-1-2)5
6	PEL	TME-466	Non Conventional Energy Source And Systems	3(2-1-2)5
7	PEL	TME-430	Composite Materials	3(2-1-2)5
8	PEL	TME-431	Mechatronics Systems	3(2-1-2)5
9	PEL	TME-463	Computer Aided Design	3(2-1-2)5
10	PEL	TME-464	Automobile Engineering	3(2-1-2)5
11	PEL	TME-467	Power Plant Engineering	3(2-1-2)5
12	PEL	TME-468	Solar Energy Thermal Process	3(2-1-2)5
13	PEL	TME-469	Experimental Methods in Thermal Science	3(2-1-2)5
14	PEL	TME-470	Computational Fluid Dynamics and Heat Transfer	3(2-1-2)5
15	PEL	TME-472	Fatigue, Creep and Fracture	3(2-1-2)5
16	PEL	TME-474	Tribology	3(2-1-2)5
17	PEL	TME-476	Design of Refrigeration Systems	3(2-1-2)5
18	PEL	TME-475	Nano Engineering Materials	3(2-1-2)5
19	PEL	TME-480	Product Innovation and Design	3(2-1-2)5

All other courses of 400 series of any other department of College of Technology subject to the fulfilment of Pre-requisite of the course.

SEMESTERWISE COURSE DISTRIBUTION

for Diploma Holders admitted to 2nd Year

B. Tech. (Mechanical Engineering) - 2022 Batch

Sl. No.	Course Category	Course No.	Course Name	Credit Hrs. (Load Dist.) Contact Hr
I. Semester				
1	BSC	BPP-201	Oscillations, Waves and Optics	4(3-1-0)4
2	BSC	BPM-242	PDE, Probability & Statistics	5(4-1-0)5
3	ESC	TEC-227	Basic Electronics Engineering	4(3-0-2)5
4	PCC	TME-201	Engineering Mechanics	4(3-1-0)4
5	PCC	TME-255	Material Science & Engineering	4(3-0-2)5
6	MC	NSS-201/ NCC-201	NSS/NCC	0(0-0-4)4
7	MC	TWP-101	Work programme	1(0-0-3)3
				Total Credits: 22
II. Semester				
1	PCC	TME-210	Fluid Mechanics	4(3-1-2)5
2	ESC	TIP-206	Manufacturing Science-I	4(3-0-3)6
3	PCC	TME-224	Numerical Techniques for Mechanical Engineers	3(2-0-2)4
4	PCC	TME-216	Mechanics of Solids	4(3-1-2)5
5	PCC	TME-218	Engineering Thermodynamics	4(3-1-0)4
6	PCC	TME-206	Instrumentation & Control	4(3-0-2)5
7	PCC	TME-214	Machine Drawing	1(0-0-2)2
8	MC	TME-291	Practical Training II	2Weeks
9	MC	NSS-202/ NCC-202	NSS/NCC	1(0-0-4)4
				Total Credits: 25
III. Semester				
1	PCC	TME- 325	Heat Transfer	4(3-1-2)5
2	PCC	TME-319	Internal Combustion Engines	4(3-1-2)5
3	PCC	TME-322	Kinematics of Machines	3(2-1-2)5
4	ESC	TIP-308	Manufacturing Technology	4(3-0-2)5
5	PEL	TME-	Elective I	3(2-1-2)5
6	OEL		Open Elective I	3(3-0-0)3
7	MC	NSS-301/ NCC-301	NSS/NCC	0(0-0-4)4
				Total Credits: 21
IV. Semester				
1	PCC	TME-323	Theory of Machines	4(3-0-2)5
2	PCC	TME-318	Design of Machine Elements	4(3-1-2)5
3	PCC	TME-303	Refrigeration and Air Conditioning	4(3-1-2)5
4	ESC	TIP-359	Managerial Economics	3(3-0-0)3
5	PEL	TME-	Elective II	3(2-1-2)5
6	OEL		Open Elective II	3(3-0-0)3
7	MC	NSS-302/ NCC-302	NSS/ NCC	1(0-0-4)4
8	PT	TME-391	Practical Training III	4Weeks
				Total Credits: 22

V. Semester				
1	PCC	TME-424	Fluid Machinery & Systems	4(3-1-2)5
2	PCC	TME-416	Advanced Solid Mechanics	4(3-1-0)4
3	PEL	TME-	Elective III	3(2-1-2)5
4	PEL	TME-	Elective IV	3(2-1-2)5
5	OEL		Open Elective III	3(3-0-0)3
6	Proj	TME-495 A	Project I	4(0-0-8)
				Total Credits: 21
VI. Semester				
1	PEL	TME-	Elective V	3(2-1-2)5
2	PEL	TME-	Elective VI	3(2-1-2)5
3	OEL		Open Elective IV	3(3-0-0)3
4	Proj	TME- 495 B	Project II	8(0-0-16)
				Total Credits: 17

Total Credits Degree Programme: 128

PEL	TME- 214	Machine Drawing	1(0-0-2)2

Course Objective

1. To prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
2. To prepare you to communicate effectively
3. To prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice

Course Content:

Unit I

Layout of drawing sheet, Conventional Representation of common features.

Orthographic projection- Ist angle and 3rd angle Projections Missing line problems, Isometric views.

Unit II

Rivet heads and riveted joints

Nuts and Bolts: Nut, bolt and washer assembly.

Unit III

Sectioning methods and types. Sectioning problems for Footstep bearing, Cone pulley and stepped pulley.

Unit IV

Cotter Joint, Stuffing Box, Screw Jack, Couplings, Brackets, Stop valves,

Unit V

Assembly drawings of Footstep Bearing, Knuckle Joint, Plumber Block, Connecting rod

Outcomes:

1. Introduction to engineering design and its place in society
2. Exposure to the visual aspects of engineering design
3. Exposure to engineering graphics standards
4. Able to understand how to assemble various components

TEXT BOOKS:

1. Machine Drawing by N.D. Bhatt and V.M. Panchal

REFERENCE BOOKS:

1. Engineering Drawing by A.C, Parkinson
2. Text Book of Machine Drawing by Laxminarayana and M.L. Mathur
3. Elementary Engg. Drawing by N.D. Bhatt

PCC	TME-201	Engineering Mechanics	4(3-1-0)4

Course Objectives:

1. To understand the concept of statics and apply them to structural problems
2. To understand the concept of frication and moment of inertia
3. To understand the theory of virtual work and energy methods
4. To understand the kinematics and kinetics involved with rigid bodies

Unit I: Basics of Statics:

Fundamental principles & concepts: Vector algebra, Newton's laws, gravitation, force (external and internal, transmissibility), couple, moment (about point and about axis), Varignon's theorem, resultant of concurrent and non-concurrent coplanar forces, static equilibrium, free body diagram, reactions. Problem formulation concept; 2-D statics, two and three force members, alternate equilibrium equations, constraints and static determinacy; 3-D statics.

Unit II: Analysis of structures:

Trusses: Assumptions, rigid and non-rigid trusses; Simple truss (plane and space), analysis by method of joints, Analysis of simple truss by method of sections; Compound truss (statically determinate, rigid, and completely constrained). Analysis of frames and machines. Internal forces; Beams: types of loading and supports; shear force, bending moment, and axial force diagrams. Beams (contd): shear force and bending moment diagrams and equations relating them with external load. Cables (coplanar): assumptions, parabolic and catenary cables.

Unit III: Friction and Moment of Inertia

Coulomb dry friction laws, simple surface contact problems, friction angles, types of problems, wedges.Disk friction (thrust bearing); Belt friction (flat, V).Square-threaded screw (self locking, screw jack).Journal bearings (axle friction).Wheel friction and rolling resistance.First moment of mass and center of mass, centroids of lines, areas, volumes, composite bodies.Area moments- and products- of inertia, radius of gyration, transfer of axes, composite areas.Rotation of axes, principal area-moments-of-inertia, Mohr's circle.Second moment of mass, Mass moments- and products- of inertia, radius of gyration, transfer of axes, flat plates (relation between area- and mass- moments- and products- of inertia), composite bodies.Rotation of axes, principal mass-moments-of-inertia.

Unit IV: Virtual Work and Energy Method

Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

Unit V: Plane kinematics and kinetics of rigid bodies

Rotation; Parametric motion. Relative velocity, instantaneous center of rotation. Relative acceleration, rotating reference frames. Rotating reference frames, 3-part velocity and 5-part acceleration relations, Coriolis acceleration. Applications of rotating reference frames. Kinetics of system of particles and derivation of moment equation. Translation.Fixed axis rotation; General planar motion. General planar motion. Work – kinetic energy, potential energy. Potential energy (contd.), power; Impulse-momentum. Impulse-momentum (contd.), impact; Combination problems.

TEXT BOOKS

1. Irving H. Shames , Engineering Mechanics, Prentice Hall
2. Bansal R.K. A Text Book of Engineering Mechanics, Laxmi Publications

REFERENCE BOOKS

1. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, –Dynamics, 9th Ed, Tata McGraw Hill
2. R.C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.

Course Outcomes:

1. Students will able to make free body diagrams and solve structural problems.
2. Students will be able to apply virtual work and energy theorems for solution of structural problems.
3. Students will be able to apply the concepts of kinematics and kinetics to rigid body mechanisms.

PCC	TME-210	Fluid Mechanics	4(3-0-2)5

Course Objectives:

1. To learn about the application of mass and momentum conservation laws for fluid flows
2. To understand the importance of dimensional analysis
3. To obtain the velocity and pressure variations in various types of simple flows

Unit I

Concept of basic principles of Fluid Flow, Kinematics of Fluid Flow, Dynamics of Fluid Flow, Incompressible Flow Principles, Boundary Layer Theory, Application of Hydrodynamics, Compressible Flow Principles, Mach Number, Flow Regimes, Normal shock, shock wave, Measurement of Compressible Flow. Definition of Fluid, Properties of Fluid, Types of Fluids, Rheological diagram, Fluid Particle, No Flow, Basic Equations, Methods of Analysis, Dimensions and Units.

Unit II

Continuum, Velocity Field, Surface and body forces, Point Force, Line Force, Forces Influencing Hydraulic Phenomena- Inertia Force, Viscous Force, Gravity Force, Pressure Force, Elastic Force, Surface Tension Force, Stress at a point, Fluid statics, Description and Classification of Fluid Flows-Steady and unsteady Flow, Ideal and Real Flow, Rotational and Irrotational Flow, one, two and three- dimensional Flows, Pressure and Pressure less Flow, Sub Critical, Critical, and Super Critical Flow, Isothermal, Adiabatic, and Isentropic Flow.

Unit III

Pressure and centre of pressure, Hydrostatic forces on plane and curved surface, Metacentric height, Principle of buoyancy and floating, Stability of floating and submerged bodies.

Methods of describing Fluid Motion, Lagrangian Method, Eulerian Method, Total Derivative (Material Change), Equation for acceleration, Components of Acceleration in Cartesian Coordinates and Cylindrical Coordinates, Tangential and Normal Components of Acceleration, Lines of Flow-Streamlines, Pathlines and Streak lines, streamtube, Different Types of Displacement of Fluid Particle, Circulation, Vorticity, Vorticity Components in Cartesian, Cylindrical, polar, and Curvilinear orthogonal coordinates, Irrotational and Rotational Flow.

Unit IV

Differential Form of General Continuity Equation in Cartesian and Cylindrical Coordinates, Reynolds Transport Theorem, Integral Form of Continuity Equation, Velocity Potential Function & Stream Function in Cartesian and Polar Coordinates, Relation Between Stream Function and Velocity Potential Function, Stream Surface, Flow Net, Navier stokes equation of motion, Equation

of Motion, Euler's Equation of Motion; Bernoulli's Equation, Applications of Bernoulli's Equation, Linear Momentum Equation, Energy Equation, Vortex Flow, Vortex Lines, Vortex Tube, Free Vortex and Forced Vortex.

Unit V

Basic Flow Fields, Rectilinear Flow, Source and Sink Flow, Combining flows by Superposition, Rankine method of Constructing Streamlines, Combined Flow Fields-Source in a Rectilinear Flow, Source and Sink pair Flow, Source and Sink Pair in a Uniform Flow, Doublet (Dipole), Doublet in a Uniform Flow, Doublet and Free Vortex in Uniform Flow, D'Alembert Paradox, Kutta-Joukowski Theorem and Magnus Effect, Flow in a porous medium.

Unit VI

Reynolds' Experiments and their Significance, Lift and Drag, Pressure Drag, Skin Friction Drag, Flow Around a Circular Cylinder, Concept of boundary layer; boundary layer along a thin flat plate, boundary layer Equation in 2-D Flow; Boundary layer thickness and Displacement thickness, Momentum thickness; Momentum Correction Factor, Energy thickness; Momentum Equation for boundary layer by Von-Karmann; Laminar boundary layer, Transition in boundary layer, Turbulent Boundary Layer; Boundary Layer Separation.

Course Outcomes

1. Upon completion of this course, students will be able to mathematically analyze simple flow situations.
2. They will able to apply principle of continuity, momentum and energy to various flow problems.
3. They will be able to diagnose flow problems and concept of boundary layer help to calculate and drag and lift force in various flow bodies.

Text Books

1. Engineering Fluid Mechanics by Dr. D.S. Kumar.
2. Fluid Mechanics by Dr. S. S. Rattan

Reference Books:

1. Introduction to Fluid Mechanics by Fox and Mcdonald.
2. Mechanics of Fluids by I.H. Shames
3. Fluid Mechanics by Yuan
4. Fluid mechanics by F.M.White
5. Fluid mechanics by Cengel and Cimbala.

List of Practical:

1. Experiments on study of drag and lift of aerofoil.
2. Reynolds experiments to verify Bernoulli theorem.
3. Viscosity measurement apparatus.
4. Study of Free and forced vortex flow
5. Study of Optical measurement like Schileren, Interferometry, shadowgraph.
6. Measurement of static and dynamic pressure with pitot static tube.
7. Flow meter measurement.

PCC	TME-206	Instrumentation & Control	4(3-0-2)5

Course Objective:

1. To understand the principles of measurement systems and static and dynamic characteristics of measurement systems
2. To understand the principles of various types of transducers and recording equipments
3. To understand the basic principles of pressure, temperature, force and torque measurement
4. To understand the basic principles of strain measurement and the circuitry involved
5. To understand the concepts of control theory and to characterize different control systems
6. To apply the measurement systems studied in practical applications

Course Content:

Unit I: Measurement Systems and their characteristics:

Significance of measurement, methods of measurement, classification of measurement systems, elements of generalized measurement system, input-output characteristics of measurement systems, methods of correction for modifying and interfering inputs. Static characteristics of systems, dynamic characteristics of systems, error involved in measurement.

Unit II: Transducers and Recording Equipments

Introduction to transducers, their classification and study of various types of transducers viz. capacitive, resistive, inductive and optical. Various kinds of recording equipments- CRO's; digital Voltmeters Magnetic Tape recorders etc..introduction to intermediate elements like amplifiers, compensators etc.

Unit III: Pressure, temperature and flow measurement

Study of various kinds of pressure, temperature and force measurement systems

Unit IV: Strain, force, torque and power measurements

Study of various kinds of strain, force, torque and power measurements systems

Unit V: Control Systems

Control-definition, elements of control system-open loop and closed loop system. Concept of feedback control system. Basic concept of stability, Routh's criteria Root locus technique, curve plotting for various control systems. Frequency response- Bode plot, Polar plot. control method – P, PI, PID

Course Outcomes:

1. Upon completion of this course, the students will be able to understand various systems related to measurement of mechanical parameters and design the measurement system for the same.

2. Upon completion of this course, the students will be able to understand the basic concepts of control, able to use various controllers and analyse their performance like stability and time response

Text Books

1. Control System Engg.-Nagrath & Gopal
2. Instrumentation, Measurement and Analysis- Nakra and Chaudhary

Reference Book

1. Instrumentation- Sharma, Rangan& Mani
2. Physical Measurement & Analysis Cook &Rabnowicz
3. Engineering Control System - K. Ogata
4. Mechanical Measurement - Buck & Beckwith
5. Mechanical Measurements - System and Design Deobelin

Lab Experiments:

1. Measurement of temperature using a thermocouple.
2. Measurement of temperature using a RTD.
3. Measurement of strain in a cantilever beam using strain gauges.
4. To measure the force applied to a system using a load cell.
5. To measure linear displacements using a LVDT
6. To measure time constant of various types of fluids.
7. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
8. Calibration of capacitive transducer for angular displacement
9. To study the performance characteristic of a controller.

PCC	TME-216	Mechanics of Solids	4(3-0-2)5

Objectives:

To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.

To calculate the elastic deformation occurring in various simple geometries for different types of loading

Course Content:

Unit I

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle., Theories of failures for 2D.

Unit II

Beams and transverse loading on beams- shear force and bending moment diagrams-Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

Unit III

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell' reciprocal theorems.

Unit IV

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts, stresses and deflection of helical springs.

Unit V

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure

Unit VI

Columns and Struts, Euler's formula, equivalent length of columns, eccentric loading, struts with transverse loading, empirical formulae

Course Outcomes:

1. After completing this course, the students should be able to recognise various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components.
2. The understanding of material behaviour under two dimensional load system

3. The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading.

Test Book

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.

Reference Books:

1. Singh D. K." Strength of Materials" Ane's Books Pvt. Ltd.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGraw Hill Publishing Co. Ltd., New Delhi 2005.

Experiments:

1. To study of different types material testing of standards of specimen for tensile, compression, impact, flexural tests
2. Preparation of standard specimens for tensile, compression, impact & flexural test
3. To study the Rockwell Hardness testing machine and perform the Rockwell hardness test.
4. To study the Impact Testing machine and Perform impact tests
5. To study and perform the tensile test
6. To study and perform the compressive test
7. To study and perform the three point bending test on UTM

PCC	TME-218	Engineering Thermodynamics	4(3-1-0)4

Objectives:

1. To learn about work and heat interactions, and balance of energy between system and its surroundings
2. To learn about application of I law to various energy conversion devices
3. To evaluate the changes in properties of substances in various processes
4. To understand the difference between high grade and low grade energies and II law
5. limitations on energy conversion

Course Content:

Unit 1

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.

Unit 2

Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.

Unit 3

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.

Unit 4

First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.

Unit 5

Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.

Clausius inequality; Definition of entropy ; Demonstration that entropy as a property; Evaluation of entropy change various processes; Principle of increase in entropy;

Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.

Unit 6

Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.

Course Outcomes:

1. After completing this course, the students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions
2. Students can evaluate changes in thermodynamic properties of substances
3. The students will be able to evaluate the performance of energy conversion devices
4. The students will be able to differentiate between high grade and low grade energies.

Text Books:

1. Nag, P.K, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

Reference Books:

2. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
3. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
4. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.

Objectives:

1. To familiarize with the terminology associated with IC engines.
2. To understand the basics of IC engines.
3. To understand combustion, and various parameters and variables affecting it in various types of IC engines.
4. To learn about various systems used in IC engines and the type of IC engine required for various applications

ESC	TME 429	Numerical Methods for Mechanical Systems	3(2-0-2)4

Course Objectives:

1. To know what are numerical methods, their importance, and applications To understand approximations and errors in computing
2. To compute roots of nonlinear equations To solve syatem of linear equations - directly and iteratively with applications
3. To fit curve - using regression and interpolation with applications
4. To understand numerical - differentiation and integration and apply them in different applications
5. To solve ordinary and partial differential equations To solve initial value and boundary value problems.

Course Content:

UNIT I

Introduction: Definition and importance of Numerical Methods

Approximations and Errors in Computing: Significant Digits & Precision, Introduction to computing Package MATLAB/FreeMat, Types of Errors, Error Propagation & Compound Errors, Conditioning & Stability, Effect of Subtractive Cancellation

UNIT II

Solution of Equations of One Variable/Roots of Nonlinear Equations: Methods of Solution, Starting % stopping an Iterative Process, Bisection Method & its Convergence, False Position Method, Newton-Raphson Method, Secant Method, Fixed Point Method

Direct Solution of Linear Equations: Gauss Elimination, Gauss Elimination with Pivoting, LU Factorization - Dolittle & Crout Algorithms, Cholesky Method

Iterative Solution of Linear Equations: Jacobi Method, Gauss-Seidel Method, Method of Relaxation, Convergence of Iterative Methods - Condition for convergence, Rate of Convergence

UNIT III

Curve Fitting:Regression: Introduction, Fitting Linear Equations, Least Squares Regression, Fitting Nonlinear curves, Fitting a Polynomial Function, Multiple Linear Regression

Curve Fitting:Interpolation: Linear Interpolation, Lagrange Interpolation Polynomial, Newton Interpolation Polynomial, Divided Difference Table, Spline Interpolation - Natural Cubic Spline

UNIT IV

Numerical Differentiation: Differentiating Continuous Functions - Forward, Backward, & Central Difference Quotients, Higher -order Derivatives, Differentiating Tabulated Functions

Numerical Integration: Interpolation with Equidistant Points - Gregory-Newton Forward Difference Formula, Newton-Cotes Methods - Trapezoidal Rule, Simpson's 1/3 Rule - Composite Rules, Gaussian Integration

UNIT V

Numerical Solution of Ordinary Differential Equations(ODEs): Types of ODE, Initial Value Problems - Euler's Method, Heun's Method, Runge-Kutta Methods, Boundary Value Problems - Finite Difference Method

Numerical Solution of Partial Differential Equations: Laplace Equation, Poisson Equation

Course Outcome

After completing this course, the students will be able to understand the importance of numerical methods. They will understand the concepts of root finding techniques, interpolation, regression. They will be able to perform numerical differentiation and integration and solve differential equations.

Text

1. Balagurusamy, E., Numerical Methods, Tata Mcgraw-Hill

Reference

1. Chapra, S.C. and Canale, R.P.,Numerical Methods for Engineers, McGraw-Hill
2. MatLab Student Edition, The Mathworks
3. Press,W.H., Flannery,B.P., Teukolsky,S.A. and Vetterling, W.T. , Numerical Recipies : The Art of Scientific Computing, Cambridge University Press
4. Sastry, S.S.,Numerical Methods, PHI

Laboratory

1) Introduction to MATLAB/FreeMat
2) Practice with MATLAB/FreeMat
3) Solution of Equations of One Variable/Roots of Nonlinear Equations
4) Direct Solution of Linear Equations
5) Iterative Solution of Linear Equations
6) Curve Fitting - Regression
7) Curve Fitting - Interpolation - 2 labs
8) Numerical Integration - 2 labs

Total Number of Labs - 10

PCC	TME-255	Materials Science & Engineering	4(3-0-2)5

Objectives:

1. Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
2. To provide a detailed interpretation of equilibrium phase diagrams
3. Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

Course Content:

Unit I

Introduction, structure of metals and non-metals. Solid solutions, Diffusion, Mechanical, Electrical and Thermal properties of materials. Cast iron, Non-ferrous metals and their alloys.

Unit II

Crystal Structure: Unit cells, Metallic crystal structures, Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Unit III

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

Unit IV

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid reactions. Iron Iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

Unit V

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

Alloying of steel, properties of stainless steel and tool steels,

Course Outcomes:

1. Student will be able to identify crystal structures for various materials and understand the defects in such structures
2. How to quantify mechanical integrity/ various properties of material
3. To understand alloying and how to read and interpret phase diagrams.
4. Understand how to tailor material properties using heat treatment of ferrous and non-ferrous alloys

TEXT Books

1. First course in Materials Science by V. Raghvan
2. Elements of Material Science by Vaan Vlack

REFERENCE BOOKS

1. Material science and engineering: An Introduction by William D. Callister
2. Introduction to Physical Metallurgy by Sidney H. Avner
3. Mechanical Metallurgy by George E. Dieter
4. The structure & Properties of Materials (Vol. 1-IV) by Hayden, Moffat and Wulff.

Practical

1. To study crystal structure using ball model.
2. To study defects and drawing of burger vector using ball model.
3. To study iron carbon equilibrium diagram using a chart.
4. To conduct and design creep test for lead wire
5. To study creep testing machine and drawing of creep curve.
6. To find out the impact strength of mild steel specimen mild steel specimen by fracture using Charpy and Izod test.
7. To determine the hardness of given specimen using Rockwell and Brinell hardness testing machine.
8. To study the fracture of brittle material by Griffith theory with the help of models.
9. To determine the wear loss of a polymer material.

PCC	TME- 303	Refrigeration and Air Conditioning	4(3-0-2)5

Objectives:

1. To familiarize students with the terminology and concepts associated with refrigeration and air conditioning systems
2. To understand basic refrigeration processes
3. To understand the basics of psychrometry and practice of applied psychrometrics
4. To familiarize students with alternate refrigeration systems

Course Content:

Unit I

Review of basic thermodynamic laws, methods of cooling, Basic vapour compression refrigeration cycle; influence of operating conditions on cycle performance, actual vapour compression cycle, Advanced vapour compression cycles; Multistage and multi evaporator systems; cascade systems.

Unit II

Refrigerants and their mixtures: properties and characteristics; thermodynamic, chemical and physical requirements, Ozone layer depletion and global warming issues.

Unit III

System components: compressors, condensers, expansion devices and evaporators, Performance matching of components of refrigeration systems.

Unit IV

Introduction to vapour absorption system and their components, Air cycle refrigeration its performance and application to air craft refrigeration.

Unit VI

Properties of moist air, use of psychrometric charts, Psychrometry of air conditioning processes; sensible, latent and total heat processes, SHF, bypass factor, simple summer air conditioning system. Applications of AC systems, concept of enthalpy potential, air washers, cooling towers, Design conditions, Comfort air conditioning and effective temperature**,** Cooling load calculations.

Course outcome:

1. A student who has done this course will have good understanding of the working principles of refrigeration and air conditioning systems.
2. He will be able to do performance calculations of these systems.

3. The student will be able to apply this knowledge in understanding actual refrigeration and air conditioning systems.
4. The student will become familiar with alternate refrigeration systems other than commercial systems.

Text Book:

1. Arora, C. P., Refrigeration and Air conditioning, Tata McGraw Hill, 3rd Edition, 2009.

Reference Books:

1. Stoecker, W. F. and Jones, J. W., Refrigeration and Air conditioning, McGraw Hill, 2nd Edition, 1986.
2. Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, Prentice Hall, 3rd Edition, 1998.
3. Dossat, R.J., Principles of Refrigeration, Wiley International Edition, 1961.

PCC	TME-416	Advanced Solid Mechanics	4(3-1-0)4

Course Objectives:

The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids

Course Contents:

Unit I

Stress and strain at a point. Cartesian stress components. Notation and sign convention. Stress invariants and principal stresses in three dimensions. Mohr's circle in three dimensions. Strain displacements, rectangular strain components Interpretation of xy, yz, zx as shear strain component, Strain invariants and principal stresses (3D).

Unit II

Generalized statement of hooks law, stress strain relation for isotropic material, relations between the elastic constraints, displacement equations of equilibrium. Theories of failures, significance of theories of failure.

Unit III

Elastic strain energy and Energy methods, Elastic strain energy due to normal and shearing stresses, dilations and distortions strain energy, strain energy due to bending & torsional load, stresses due to suddenly applied loads, Strain energy theorem. Castigliano's theorem, reciprocal theorem. Application of energy methods for determining slope, and deflection in beams.

Unit IV

Unsymmetrical bending. Shear center. Curved beams; Bending of beams having initial curvature beams of large initial curvature, location of neutral axis Distribution of stresses across cross section having rectangular, Circular & trapezoidal shapes. Analysis of springs.

Unit V

Torsion of General Prismatic bars, Torsion of circular and elliptical bars, torsion of equilateral triangular bar and torsion of thin walled cell closed sections, torsion of bars with thin rectangular sections, torsion of rolled sections, multiply connected sections, centre of twist and flexural centre. Symmetric problems; Stresses and displacements in thick cylinder, spherical shell, rotating disc, cylinders.

Course Outcomes:

1. Upon completion of this course, students will be able understand the deformation behavior of solids under different types of loading
2. The understanding three dimensional stress system will developed.
3. Obtain mathematical solutions for simple geometries.

Text Books

1. Advanced Solid Mechanics, By L.S. Srinath
2. Strength of Materials, by Srivastava & Gope

Reference Books:

1. G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press, 2004.
2. Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.
3. Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international, 1969.

PCC	TME-318	Design of Machine Elements	4(3-0-2)5

Objectives:

1. This course seeks to provide an introduction to the design of machine elements commonly encountered in mechanical engineering practices.
2. A strong background in mechanics of materials based failure criteria underpinning the safety-critical design of machine components.
3. An overview of codes, standards and design guidelines for different elements.

Course Contents:

Unit I

1. Mechanical engineering design: Introduction to design procedure, Stages in design, Code and Standardization, Interchangeability, Preferred numbers, Fits and Tolerances, Engineering materials: Ferrous, Non-ferrous, Non-metals, design requirements – properties of materials, Material selection, Use of Data books.

2. Fundamentals of Machine Design: Types of load, Modes of failure, factor of safety concepts, Theories of Failure, concept and mitigation of stress concentration, Fatigue failure and curve, endurance limit and factors affecting it, Notch sensitivity, Goodman, Gerber and Soderberg criteria.

Unit II

3. Machine Element Design: Design of Joints: Rivets, welds and threaded fasteners based on different types of loading, Boiler joints, cotter joints and knuckle joints.

Unit III

4. Design of Keys, Shaft and Couplings: Classification of keys and pins, Design of keys and pins, Design of shafts: based on strength, torsional rigidity and fluctuating load, ASME code for shaft design, Design of couplings: Rigid coupling, Flexible coupling.

5. Design of Mechanical Springs: Types of helical springs, Design of Helical springs, bulking of spring, spring surge, end condition of springs, Design of leaf springs: nipping.

Unit IV

6. Bearings: Types and selection of ball and roller bearings, Dynamic and static load ratings, Bearing life, Design of sliding contact bearings, Journal bearing, foot step bearing.

Unit V

Design of power transmission elements: spur, helical, bevel and worm gears; belt drives

Course Outcomes:

1. Student will develop an understanding of the origins, nature and applicability of empirical design principles, based on safety considerations.

2. Upon completion of this course, students will get an overview of the design methodologies employed for the design of various machine components. An appreciation of parameter optimization and design iteration.
3. An appreciation of the relationships between component level design and overall machine system design and performance of various components.

Text Books:

1. Machine Design: Fundamentals and Applications, PHI Publication

Reference Books

1. Mechanical Engineering Design, Fifth Edition, Shigley, J.E. and Mischke, C.R., McGraw-Hill International; 1989.
2. Design of Mechanical Elements by V.B. Bhandari.
3. Fundamentals of Machine Component Design, Juvinal, R.C., John Wiley, 1994.
4. Design of Machine elements, Spottes, M.F., Prentice-Hall India, 1994.
5. Mechanical Design – An Integrated Approach, R. L. Norton, Prentice Hall, 1998

Design Data Hand Books:

1. P.S.G. Design Data Hand Book, PSG College of Tech Coimbatore
2. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Ed. 2003.

Practical (Design Of Machine Elements)

1. Design & drawing of Riveted joint
2. Design and drawing of Cotter joint
3. Design and drawing of Knuckle joint
4. Design of shafts subjected to combined loading
5. Design and drawing of Flange coupling
6. Design of spring
7. Design of bearing

Drawing should be using CAD software like AutoCad/Pro-E/CATIA/ANSYS

1. Design of any one working model related to Design of machine elements i.e., Unit II to Unit V
2. Design of any one working model related to Design of machine
3. Society needs based Innovative design

PCC	TME-424	Fluid Machinery & Systems	4(3-0-2)5

Course Objectives:

1. Impact of water jet on different Vanes/ plates.
2. Study of different rotors and series of vanes.
3. To analyze the flow in water pumps
4. Various turbines and related lab experiments.
5. Centrifugal Pump study.

Course Content:

Unit I

Entire spectrum of fluid machines, linear momentum and angular momentum equations, Dynamic force exerted by a jet on stationary flat and inclined plates, on curved plates/vanes, Force on moving flat, inclined plates, and curved vanes; Force on series of flat plates; series of curved vanes and series of radial curved vanes; Euler's Equation of Fluid Machines; Degree of Reaction. Dynamic action of fluid on stationary and moving vanes; units and specific quantities, whirling of fluids; Airfoils, Lift and Drag, Hydro-electric power development, Hydro-electric power development, layout and various parts hydro power plants, mini an large plants, pump storage plants, Impulse Turbines, Reaction turbines, Governing and performance of turbines.

Unit II

Unit and specific quantities ,Unit quantities as unit discharge, unit force, unit power, unit speed, unit torque etc., specific quantities; specific speed of pumps and of turbines. Head, Losses and efficiencies of hydraulic turbines.

Unit III

Classification of turbines, Impulse turbines, guide Mechanism; buckets and runner; casing; Hydraulic brake, speed ratio, jet ratio, Different layouts; Design of components of a Pelton turbine, constructional details, velocity components at entry and exit of the rotor, velocity triangles, power and efficiency calculations, governing of turbines.

Francis and Kaplan turbines, constructional details, velocity triangles, power and efficiency calculations, Draft tube theory; types of draft tubes;, cavitation in turbines, Methods to avoid cavitation , runaway speed, unit and specific speed, performance characteristics, governing of turbines.

Unit IV

Centrifugal pumps, Reciprocating pumps, Classifications of centrifugal pumps, manometric head of a pump; Theory of centrifugal pumps; work done and manometric efficiency of centrifugal pump, multi-stage Pumps, pumps in series and parallel operation, NPSH, Selection of centrifugal pumps an impellers , specific speed, cavitation and performance characteristics.

Unit V

Classification, slip and coefficient of discharge, velocity and acceleration of water in reciprocating pumps, Air vessels, Saving in work by air vessels, Theory of working of air vessels.

Unit VI

Hydraulic Systems like Hydraulic lift, Ram, Crane, Press, fluid Coupling, Torque Converters, Pressure accumulator, intensifier and field applications.

Course Outcomes:

Upon completion of the course, the students will be able to understand

1. Impact of Jet on different types of vanes.
2. Working principle of Centrifugal Pump and Reciprocating pump .
3. Working principle of Turbines, types and other hydraulic machines.
4. Function and application of hydraulic systems in the field

Text Books:

1. Hydraulic Machines - Dr. Jagdish Lal
2. Hydraulic Machines - S.S. Rattan

Reference Books:

1. Hydraulics & Fluid Machines - Modi and Seth
2. Fluid Machines and Hydraulic
3. Machines - R. K. Bansal

Lab Experiments:

1. Impact of water jet on different Vanes,
2. Study of Pelton turbine,
3. Study of Francis turbine,
4. Study of Kaplan turbine,
5. Study of Centrifugal Pumps,
6. Study of Reciprocating Pumps.

PCC	TME-322	Kinematics of Machine	3(2-0-2)4

Objectives:

1. To understand the kinematics and rigid- body dynamics of kinematically driven machine components.
2. To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
3. To be able to understand and design belt and rope motion and power transmissions system.
4. Analyze and Design various braking system used in automobile.
5. To understand the kinematics of gear trains.

Course Contents :

Unit I

Machine and Mechanism: Classification of mechanisms, Basic kinematic concepts and definitions, Degree of freedom, Grashof's law, Kinematic inversions of four bar chain and slider crank chains, Description of some common mechanisms, Quick return mechanism, Straight line generators, Universal Joint, Rocker mechanisms.

Unit II

Velocity and Acceleration in Mechanism: Instantaneous Center, Body centrode and space centrode, Properties of Instantaneous Center, Instantaneous center and their types, Kennedy three centers in line theorem, Velocity and acceleration analysis graphically, using instantaneous center method and relative velocity method, Coriolis component of acceleration.

Unit III

Belt and Rope Analysis: Types of belt and materials of belts, Types of flat belt drives, Velocity ratio of belt drive & velocity ratio of a compound belt drive, Slip of belt, Creep of belt, Length of belt in case of open and cross belt drive. Power transmitted by a belt, Ratio of driving tension for flat, V belt and rope. Determination of angle of contact, Centrifugal tension in belts or ropes, Maximum tension in belts, Conditions for transmition of maximum power in case of flat belt drive, Initial tension in the belt, Effect of initial tension on transmission of maximum power for flat belt drive, Design of belt dimension.

Unit IV

Brakes and Dynamometers: Types of Brakes, Materials for brake lining, Single block or shoe brake, Pivoted block or shoe brake, Simple Band brake, Differential Band brake, Band and block brake, Internal expanding shoe brake, Types of Dynamometers, Absorption dynamometers, Transmission dynamometers.

Unit V

Gears and their Analysis: Types of gears, Gear terminology, Law of gearing, Involute and Cycloidal gear profiles and their comparison, System of gear teeth, Path and Arc of contact, Number of pairs of teeth in contact, Interference in Involute gears, Helical Gears, Spiral gears, Centre distance for a pair of Spiral gears, Efficiency of Spiral gears, Simple, Compound, Reverted trains, Determining velocity of gears in epicyclic gear train by tabular method.

Course Outcomes:

1. Describe the concepts of machines, mechanisms and related terminologies.
2. Determine the degrees-of-freedom (mobility) of a mechanism.
3. Analyse planar mechanism for displacement, velocity and acceleration graphically.
4. Analyse various motion transmission elements like gears, gear trains, belt drive and rope drive.
5. Understand and analyse Braking system

Text Books:

1. Thomas Bevan, Theory of Machines, CBS Publishers & Distributors, New Delhi
2. S.S Rattan, Theory of Machines, Tata McGraw-Hill Publishing Company Limited New Delhi

Reference Books:

1. CleghornW.L. , Mechanisms of Machines, Oxford University Press
2. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill
3. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi
4. Rao J.S. and Dukkipati R.V., "Mechanisms and Machines theory", Wil
5. J.Uicker, Gordon R Penstock & J. E. Shigley, "Theory of Machines and Mechanism", Oxford International Edition.
6. P.L Ballaney, Theory of Machines, Khanna Publishers ,New Delhi

LIST OF EXPERIMENTS

1 Study & Analysis of various mechanism in Lab and determine

(1) Number of Kinematic Links

(2) Number of Kinematic Pairs and their types

(3) To Find Degree of Freedom of each mechanism

2 Study the slider crank mechanism, draw the following experimental curves and also plot their theoretical curves and compare them –

(1) Displacement Vs. Time

(2) Velocity Vs. Time

(3) Acceleration Vs. Time

3 Study the quick return mechanism and determine

(1) Experimental ratio of forward stroke to the return stroke

(2) Theoretical ratio of forward stroke to the return stroke compare with experimental ratio.

4 Study the Oldham's coupling and show that

(1) Peripheral velocity of the intermediate disc is proportional to the eccentricity.

(2) Compare the results of velocity with theoretical values.

5 Study the Hook's joint and determine

(1) Experimental ratio of angular velocity of driver and driven shafts.

(2) Theoretical ratio of angular velocity of driver and driven shafts and compare with experimental ratio.

6 To find the coefficient of friction (μ) between

(1) Flat belt and pulley

(2) V-belt and pulley

(3) Rope and pulley

PCC	TME-323	Theory of Machines	4(3-0-2)5

Objectives:

1. Develop the design and practical problem solving skills in the area of equilibrium of mechanisms.
2. To impart knowledge on force analysis of mechanisms, balancing of rotating and reciprocating masses.
3. To build understanding and application of Governor and Cam in mechanism
4. To introduce the fundamentals in Gyroscopes, and it's effect in stability of aeroplane and ship.
5. To develop understanding of Flywheel and it's application

Course Contents:

Unit I

Classification of cams and followers: Terminology and definitions, Displacement diagrams for the follower performing Uniform velocity or Parabolic or Simple harmonic motion or derivatives of follower motions, Specified contour cams: circular and tangent cams, pressure angle and undercutting.

Unit II

Governors and their applications: Difference between governor and Flywheel, Types of governors, Constructional details and analysis of Watt, Porter, Proell, Hartnell and Wilson Hartnell governors, Power and Effort of a Governor, Controlling force curves, Sensitiveness, Stability, Hunting, Isochronism.

Unit III

Introduction to balancing: Static balancing, Dynamic balancing, Balancing of single rotating mass by single mass or by two masses rotating in two different parallel planes, Transference of a force from one plane to another, Balancing of multiple rotating masses rotating in single plane by a mass in the same plane, Balancing of multiple rotating masses rotating in different parallel plane by two masses rotating in two different parallel planes. Primary and secondary unbalanced forces, Unbalance due to reciprocating masses,Partial balancing of primary force, Balancing of locomotive, Hammer-blow, Variation in tractive effort, Hammer blow.

Unit IV

Static force analysis: Static equilibrium, Equilibrium of Two- Force and Three-Force members and member subjected to two forces and torque, Force convention and Free body diagram, Superposition and Principle of Virtual work, Dynamic force analysis: D'Alembert's Principle,

Equivalent offset inertia force, Dynamic force analysis of four link mechanisms, Turning moment diagrams, Coefficient of fluctuation of speed and energy, Flywheel application in Punching Press.

Unit V

Gyroscope: Space motion of rigid bodies, Precessional motion and definitions, Gyroscopic acceleration, Angular momentum, Gyroscopic couple, Effect of gyroscopic couple on aeroplane, Effect of gyroscopic couple on naval ship during steering, pitching and rolling, Gyroscopic stabilization of ship, Davis Steering gear, Ackerman's steering gear, Stability of four wheel and two wheel vehicles moving on curved paths.

Course Outcomes:

1. Introduction to Theory of Machines, To understand and Analyse Cams
2. To understand the Theory of Gearing and Gear Trains
3. To understand the Dynamics of Reciprocating Parts
4. To understand Gyroscopic Motion, To understand Working of Governors
5. To understand Flywheel Motion, To understand Balancing of Rotating and Reciprocating Masses

Text Books:

1 Thomas Bevan, Theory of Machines, CBS Publishers & Distributors, New Delhi

2 S.S Rattan, Theory of Machines, Tata McGraw-Hill Publishing Company Limited New Delhi

Reference Books:

1. CleghornW.L. , Mechanisms of Machines, Oxford University Press
2. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill
3. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi
4. Rao J.S. and Dukkipati R.V., "Mechanisms and Machines theory", Wil
5. J.Uicker, Gordon R Penstock & J. E. Shigley, "Theory of Machines and Mechanism", Oxford International Edition.
6. P.L Ballaney, Theory of Machines, Khanna Publishers ,New Delhi

LIST OF EXPERIMENTS

1. Draw the cam profile with the help of cam and roller follower mechanism and also draw cam profile graphically and compare.
2. To determine input torque on the link of four bar mechanism subjected to forces and torques by Superposition Method and compare it with results of Virtual Work Method.

3. To determine input torque on the crank of slider crank mechanism subjected to forces and torques by Superposition Method and compare it with results of Virtual Work Method.
4. To determine balancing mass for rotating system having unbalance masses in (1) Two parallel planes (2) In same plane (3) In different parallel planes
5. To prepare performance characteristic curves for Proell and Porter Governor, and to find stability & sensitivity of governor
6. To study gyroscopic effects in case of aeroplane and ship and determine gyroscopic couple.

PCC	TME-325	Heat Transfer	4(3-0-2)5

Course Objective:

1. The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
2. Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
3. The course will also briefly cover boiling and condensation heat transfer, and the analysis.
4. This course will introduce the topic of mass transfer.

Course Content:

Unit I

Introduction to : Modes of heat transfer, One and two dimensional steady state heat conduction, heat transfer from extended surface, Unsteady state heat conduction, Natural and forced convection, hydrodynamic and thermal boundary layers, heat transfer with phase change, heat exchanger, radiation properties and laws, diffusive and convective mass transfer.

Unit II

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.

Unit III

Heat transfer by convection, basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow-Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

Unit IV

Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.

Unit V

Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ε-NTU methods. Boiling and Condensation heat transfer, Pool boiling curve. Introduction mass transfer, Similarity between heat and mass transfer.

Course Outcomes:

1. After completing the course, the students will be able to formulate and analyze a heat transfer problem involving any of the three modes of heat transfer
2. The students will be able to obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer
3. The students will be able to design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.

Text Books:

1. Engineering Heat Transfer By C.P. Gupta & Prakash
2. Heat Transfer By J.P. Holman

Reference Books:

1. Heat & Mass Transfer by Incroper & De Witt, Pub.John Wiley & Sons (Asia) Pte.Ltd.
2. Heat Transfer by Bejan

Heat Transfer laboratory

1. Heat flow through logged pipes.
2. Thermal conductivity of insulating powder.
3. Experiment on natural convection.
4. Experiment on force convection.
5. Experiment on fourth power law of radiation.
6. Test on emissivity apparatus.
7. Calibration of thermocouple.
8. Experiment Stephan Boltzmann apparatus.
9. Experiment on critical heat flux apparatus.

PCC	TME-319	Internal Combustion Engines	4(3-0-2)5

Course Contents:

Unit I

Review of ideal cycles; Details of fuel-air cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle, Classification of I.C. Engines, Two and four stroke engines and their working, Valve timing diagrams, Comparison of two stroke and four stroke engines, comparison of S.I. and C.I. engines, Introduction to solid, liquid and gaseous fuels, Petroleum base liquid fuels, Stoichiometry, Rating of S.I. and C.I. engine fuels exhaust gas analysis-

Unit II

First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.

Unit III

Combustion in SI, Flame front propagation, Factors affecting flame speed, Abnormal combustion and variables affecting detonation.

Unit IV

Combustion in CI engines, Ignition delay and knocking, Combustion chamber designs, Fuel injection in CI engines, carburettors, Air-Fuel requirements, Port fuel injection, Direct injection and Common rail injection. Ignition system, Battery, Magneto and electronic ignition systems.

Unit V

Lubrication system and Cooling system. Testing of IC engines, Engine emissions and control. Advanced IC Engine concepts. Supercharging, Thermodynamic cycle for supercharged engines, Supercharging in S.I. and C.I. engines.

Course Outcomes:

1 Students who have done this course will have a good idea of the following:
2 Knowledge about basic components and principles of operations of various parts/ components
3 Knowledge of various operating parameters on the performance characteristics of IC Engines
4 Knowledge about various alternative fuels and their effect on performance of engine
5 Information about emissions from automobile engines and their effect on human beings

Text Books:

1. Obert E. F, "Internal Combustion Engines and Air Pollution", Harper and Row Publication Inc. NY, 1973.
2. Internal Combustion Engines by V. Ganeshan

Reference Books:

1. Heisler H, "Advanced Engine Technology", Edward Arnold, 1995.
2. Heywood J. B, "Internal Combustion Engine Fundamentals", McGraw Hill Book Co. NY, 1989
3. Heldt P. M, "High Speed Combustion Engines", Oxford & IBH publishing Co. India, 1985.
4. Stockel M W, Stockel T S and Johanson C, "Auto Fundamentals", The Goodheart, Wilcox Co. Inc., Illinois, 1996.

Details of Experiments in I.C. Engines

1. To determine the frictional power and mechanical efficiency of a multi-cylinder petrol engine at different rotational speeds using Morse test.
2. To determine the frictional power of a diesel engine by Willan's line method.
3. To obtain heat balance on single cylinder diesel engine at 0, 1/3, 2/3 and full load at constant r.p.m.
4. To determine the optimum rate of cooling in water cooled twin cylinder diesel engine.
5. To determine the effect of engine speed on volumetric efficiency of a diesel engine.
6. To determine the effect of inlet air heating on volumetric efficiency of a diesel engine.
7. Study of emissions from S.I. Engines
8. Study of emissions from C.I. Engines
9. Determination of indicated power using indicator diagram in I.C. Engine
10. Determination of calorific value of a given fuel and its flash and fire points.

PEL	TME-457	Gas Dynamics & Jet Propulsion	3(2-0-2)4

Course Objectives:

1. To understand the features of compressible isentropic flows and irreversibilities like shocks.
2. To provide a basic knowledge of jet and rocket propulsion technologies.

Course Content:

Unit I

Steady one dimensional isentropic flow, adiabatic flow with friction, flow with heat transfer; Normal shocks; Nozzle flow with shocks, oblique shocks; Aero-thermodynamics of Jet engines; Axial flow compressors and turbines; Rocket propulsion engines. Basic Gas Dynamics

Unit II

Introduction; Dynamics of fluid flow; Continuity equation; Conservation of energy (1 Low of thermodynamics); Momentum Equation; Propagation of small disturbance, velocity of sound; Mach Number; Mach waves; Mach cone; Mach angle; Total or stagnation properties.

Unit III

Horse Flow One dimensional adiabatic flow; Isentropic flow through a passage of varying cross-sectional area; choking in isentropic flow; Operation of nozzles under varying pressure ratios; Converging nozzles; Reynolds Number; Adiabatic flow with friction in constant area ducts; Fanno relations for perfect gases.

Unit IV

Flow with Normal/oblique shock waves Normal shock; Equations with normal shocks; Governing equations; Strength of shock wave, shocks, in a converging- diverging Nozzle; Nature of flow through oblique shockwaves.

Unit V

Jet Propulsion Introduction; Thrust; Thrust horsepower; Efficiencies; Trust equation; Turbojet; Thrust augmentation; Turboprop, Turbofan engines; Ramjet; Pulse jet engines; Ram Rocket; Comparison of various propulsion devices; Effect of forward speed and attitude.

Programme outcomes:

1. They will be able to apply conservation principles to various compressible flow problems.
2. They will be able to understand different types of compressible flow like normal and oblique wave, fanno and Rayleigh flow.
3. They will understand fundamentals of jet and rocket propulsion technologies.

Text Books:

1. Fundamentals of Compressible Flow by S. M. Yahya, Pub.Wiely Eastern Ltd.New Delhi-1991.
2. Introduction to gas dynamics and jet propulsion by E. Radhakrisnan, PHI Learning pvt Ltd.2000.

PEL	TME-458	Finite Element Analysis	3(2-0-2)4

Objectives:

1. To illustrate the principle of mathematical modelling of engineering problems
2. To introduce the basics and application of Finite Element Method

Course Contents:

Unit I

Historical Background, Mathematical modeling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method.

Unit II

One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibration and mode shapes, fourth order beam equation, transverse deflections and natural frequencies.

Unit III

Two dimensional equations, variational formulation, finite element formulation, triangular elements- shape functions, elemental matrices and RHS vectors; application to thermal problems, torsion of non-circular shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate and shell elements.

Unit IV

Natural coordinate systems, isoparametric elements and shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, introduction to FE software.

Course Outcomes:

Upon completion of the course, students will understand the FEM formulation and its application to simple structural and thermal problems

Text Books:

1. Reddy J.N., An Introduction to Finite Element Method, 3rd ed., Tata McGraw Hill, 2005.
2. Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi, 2007.
3. Rao S.S., The Finite Element Method in Engineering, 3rd ed., Butterworth Heinemann, 2004.
4. Chandraputla&Belegundu, Introduction to Finite Elements in Engineering, 3rd ed., Prentice Hall, 1990.

Practical

Hands on experience on ANSYS/Matlab

Pragramming using different languages

PEL	**TME- -344**	**Mechanical Vibrations**	**3(2-0-2)4**

Course Objectives:

1. To understand the basic concepts of vibrations and its terminology, Free Vibrations with and without damping.
2. To understand Forced Vibrations with and without damping, Vibration Isolation and transmissibility, reciprocating and rotating unbalance.
3. To understand and analyze vibrations of multiple degree of freedom systems. To attain the knowledge of vibration measuring instruments, vibration absorbers.
4. To learn different methods to solve vibration problems.
5. To learn how to find various properties of materials and fluids using vibration concepts like, viscosity, natural frequency, moment of inertia, modulus of rigidity, young's modulus, etc.

Course Contents:

Unit I

Periodic and harmonic motions, harmonic analysis, Vector method of representing vibrations. Superposition of simple harmonic motions. Work done in harmonic Motion.

Unit II

Free vibrations without damping, Equilibrium method for solving free vibrations without damping system, Energy method and Rayleigh's method for solving free vibrations without damping system, Effect of mass of spring and shaft on free vibrations without damping system

Unit III

Free vibrations with damping, Viscous damping with Over-damped system, Viscous damping with under-damped system, Viscous damping with critical damped system, Coulomb damping & structural damping, Logarithmic decrement

Unit IV

Forced vibration with constant harmonic excitation, Steady state vibrations, Force Transmission, Forced vibration with rotating and reciprocating unbalance, Forced vibration due to excitation of the support, Forced vibration with coulomb Damping, Forced vibration with coulomb and viscous Damping, Force Vibration with coulomb, viscous Damping structural damping, Vibration Measuring Instruments, Two degree of freedom, torsional systems Combined Rectilinear, Two mass fixed on a tight stretched spring, Double Pendulum.

Unit V

Free vibrations-equations of motion: for spring mass system for multi degree system, Influence coefficients methods to solve free vibrations-equations, Stiffness co-efficient: methods to solve free vibrations-equations, Holzer's Method, Raleigh's Method

Course Outcomes:

1. After completing this course, the students will be able to apply the concepts of mechanical vibration to solve various practical problems which are faced in industries.
2. Further the students would be able to use the knowledge achieved in their project work.
3. The understand the effect of forces on dynamic motion.

Text Books:

1. Singh V.P. " Mechanical Vibrations" Dhanpat Rai & Co.

Reference Books:

1. Church, A.H. "Mechanical Vibration"
2. Thomson, W.T. "Vibration Theory and Applications" Prentice Hall
3. Grover, G.K. "Mechanical Vibration" Nem Chand Publishers, Roorkee.
4. Rao, S.S. "Mechanical Vibrations, Addison-Wesley.

Experiments:

1. To verify the relation $T = 2\pi\sqrt{\frac{l}{g}}$ and find out the value of gravitation acceleration 'g' of the dynamics lab
2. To determine the polar moment of inertia of a rectangular mass.
3. To determine the radius of gyration 'k' of given bar pendulum
4. To determine the radius of gyration'k' of given bar by using Bi-Filer suspension.
5. To study the longitudinal vibrations of helical spring and to determine the frequency or period of vibration (oscillation) theoretically and actually by experiment.
6. To study the undamped free vibration of equivalent spring mass system.
7. To study the Forced Vibrations of Equivalent Spring Mass System
8. To study the Torsional Vibrations (Undamped) of Single Rotor Shaft System.

9. To study the Free Vibrations of Two Rotor System and to determine the Natural Frequency of Vibration Theoretically & Experimentally.
10. To study the damped torsional oscillations and determine the damping co-efficient c_t.
11. To study the forced lateral vibrations of the beam for different damping.
12. To verify the Dunkerley's Rule

PEL	TME-459	Advanced Machine Design	3(2-0-2)4

Course Objectives:

i. To study design concepts in order to enhance the basic design.
ii. To study behaviour of mechanical components under fatigue and creep.
iii. To study statistical techniques and its applications in mechanical design.

Course Content:

Unit I

Introduction: Introduction to Advanced Mechanical Engineering Design. Review of materials & processes for machine elements. Case studies of mechanical engineering design failures. Review of theories of failure

Unit II

Design Against Fatigue: Damage theories, Cycle counting Techniques, Stress based fatigue Analysis & design: one dimensional analysis, multiaxial analysis and Cumulative damage. Fundamentals of LEFM Fatigue, Strain based fatigue Analysis & design: one dimensional analysis, multiaxial analysis .Surface integrity & fatigue life improvement.

Unit III

Design For Large Deflection & Hertz Contact Theory: Design for large deflection and applications, Introduction to Hertz contact theory, The Hertzian Contact, Point Contact - Two Spheres, Line Contact - Two Cylinders.

Unit IV

Design against Creep: creep of material, creep parameters, exponential creep law, hyperbolic sine creep law, etc. Estimated time to rupture, correlation of creep-rupture data, stress relaxation, creep in bending, etc. materials for application at elevated temperatures.

Unit V

Introduction to Finite Element Methods, One and two dimensional problem formulations and solution methods.

Unit VI

Engineering Statistics: Introduction to Probability Distributions, Analysis of variance (ANOVA), factorial design and regression analysis, Reliability theory, design for reliability, Hazard analysis, and fault tree analysis., Test of Hypothesis, F- test, Z- test, T-test, Reliability Theory, Design for Reliability

Course Outcomes:

Upon completion of this course, students will be able to:

1 Analyze mechanical elements critically.

2 Analyze behaviour of mechanical elements under fatigue and creep.

3 Understand applications of statistical techniques in mechanical design.

Text books:

1. P C Gope, Machine Design: Fundamentals and Applications, PHI Publication, New Delhi, India
2. Norton L. R., "Machine Design – An Integrated Approach" Pearson Education, 2005
3. Fundamentals of Machine Component Design Robert C. Juvinall, Kurt M. Marshek, John Wiley & Sons
4. P.S.G. Tech., "Design Data Book", Coimbatore, 2003

Reference books:

1. Joseph E. Shigley, Charles R. Mischke, Richard G. Budynas, "Mechanical Engineering Design", McGraw Hill, 2004.
2. Fatigue Design: life expectancy of machine parts –Eliahu Zahavi & Valdimir Torbilo, CRC Press

Practical/Experimental

1. Computer based design problems
2. Use of Finite element methods for problem solving
3. Use of statistical packages for data analysis

PEL	TME-465	Experimental Stress Analysis	3(2-0-2)4

Course Objectives:

1. To understand the concept of optics and apply them to structural analysis using Photoelasticity
2. To understand the various techniques to obtain stress strain information for a structure
3. To understand the principles of strain gauges and their instrumentation for extraction of stress and strain fields
4. To understand the techniques of brittle coating and Moire fringe methods

Unit I

Introduction to Solid Mechancis: Concepts of stress and strain in three dimensions, stress invariants, compatibility conditions, Cauchy's stress quadric,Airy's stress function etc.

Unit II

Photoleasticity: Introduction to optics, Photoleasticity, basic elements of a polariscope, effect of a model in plane and circular polariscope.Compensation techniques, separation techniques, photoelastic materials, 3-D photoelasticity.

Unit III

Strain Gauges: Strain gauge- working principles, various types, cross senstitvity, gauge factors, measuring circuits. Strain rosettes.

Unit IV

Brittle coating Techniques: Procedure for fringe measurement, brittle lacquer method, lacquer selection, lacquer application method, test procedure, calibration method.

Unit V

Moire fringe and Grid method: Moir'e fringe method; Fundamental properties of Moir'e fringes, Moir'e fringes analysis techniques. Grid Method; Principle of the method, strain Displacement Relation for large strains, Application of Grid.

Course Outcomes:

1 Students will demonstrate a basic understanding of experimental methods (e.g. strain gages, photoelasticity, image correlation) commonly used in experimental solid mechanics.

2 Students will demonstrate the ability to complete a detailed laboratory report and present their findings in a structured, logical manner.

3 Students will demonstrate the ability to analyze experimental data and develop appropriate, logical conclusions based on comparisons to theoretical results and other experimental evidence.

Text Books

1. Experimental stress analysis by Dr. Shadhu Singh

Reference Books

1. Experimental stress Analysis &Motion measurementby Dove & Adams.
2. Experimental Stress Analysis by Dally and Riley.

Lab Experiments:

1. To determine the material fringe value using disc under compression.
2. To determine the fracture parameters of a rectangular specimen using photoelasticty.
3. To use the strain gauges to determine the state of stress in a stressed specimen.
4. To use Tardy's method of compensation to determine the fring order at any point with in the specimen

PEL	TME-466	Non Conventional Energy Source and Systems	3(2-0-2)4

Course Objectives:

1. To familiarize students with various non-conventional energy sources and limitation of environmental energy sources.
2. To impart the knowledge of solar energy and equipments for harnessing solar energy.
3. To understand wind energy ocean thermal tidal power and MHD power etc.

Catalogue Description

Conventional sources of commercial energy fossil fuels, their consumption rates, energy reserves and estimate of time for which conventional energy sources will last, Alternate energy sources, Introduction to photovoltaic and thermoelectric conversion, Introduction to MHD power fuel cells.

The solar-option direct and indirect applications, availability of solar radiation., Energy collection and concentration for photothermal applications. Thermal storage Wind energy, types of wind mills, elementary design principle, Ocean thermal energy conservation, Geothermal energy systems, extent of available resources. Heat transport in geothermal systems. Introduction to tidal and wave energy

Unit I

Conventional sources of energy; fossil fuels and hydro power etc availability in future present status Solar Radiations; Solar constant spectrum, radiation geometry, Beam and diffuse radiations, radiation intensity at tilted surface Electromagnetic radiation black and grey body concept sky radiating characteristics of absorber surfaces, convection and radiation in collectors, heat transfer coefficient.

Unit II

Flat plate collects and concentrating collector. Energy storage; hot water, rocked and Latent heat storage. Water heating, space heating and cooling. Introduction to photovoltaics

Unit III

Mechanism of wind, Type of wind mills, elementary design principles, power in the wind (calculations) power coefficient.Introduction, to Ocean thermal electric conversion system; open cycle, closed and hybrid cycle. Energy from tides; Basic principle of tidal power, Tidal basin, power generation

Unit IV

Wave energy: Introduction, advantages and disadvantages of wave energy. Geothermal energy: Geothermal field, Sources: Hydrothermal, vapour dominated liquid dominated systems, Geopressured resources, Hot dry rocks, magma resources, advantages and disadvantages of Geothermal energy. Introduction to Magneto Hydro Dynamics (MHD) power and fuel cells.

Unit V

Introduction, Biomass conversion technologies, Bio gas generation, Types of biogas plants anaerobic digestion.

Course Outcomes

1. The students will be able to understand about various other non conventional sources of energy and various system used for harnessing the same.

Text Books:

1. Energy Conversion Systems by Rakosh Das Begamudre, Pub: New Age Int.(P) Ltd.
2. Renewable Energy Sources & Conversion Tchnology by N.K.Banoal, M.Kleeman & M.Meliss

Reference Books:

1. Non-Conv.Energy Source by G.D.Rai,
2. Solary Energy by H.P. Garg & J.Prakash
3. Solar energy by J.A Duffie and W.A. Beckman

PEL	TME-430	Composite Materials	3(2-0-2)4

Objectives:

1. To understand the mechanical behaviour of composite materials.
2. To develop an understanding for composite characterization and its performance in various industries
3. To get an overview of the methods of manufacturing composite materials.
4. To understand the mechanics of Fracture and safety measures.

Course Contents:

Unit I

Introduction: Definition of composite material, Classification based on matrix and topology, Constituents of composites, Interfaces and Interphases, Distribution of constituents, Nano-composites.

Unit II

Characterization Composites: Control of particle/fiber and porosity content, particle/fiber distribution, Interfacial Reaction of matrix-reinforcing component, Coating of reinforcing component, Strength analysis

Performance of Composite in Nonstructural Applications: Composites in Electrical, Superconducting and Magnetic Applications, Nano-composite devices.

Unit III

Fabrication Composites: Fabrication of Metal Matrix Composites: Commonly used Matrices, Basic Requirements in Selection of constituents, solidification processing of composites - XD process, Spray processes - Osprey Process, Rapid solidification processing, Dispersion Processes - Stir-casting & Compo-casting, Screw extrusion, Liquid metal impregnation technique - Squeeze casting, Pressure infiltration, Lanxide process), Pinciple of molten alloy infiltration, rheological behaviour of melt particle slurry.

Unit IV

Synthesis of In situ Composites; Fabrication of Polymer Matrix Composites - Commonly used Matrices Basic Requirements in selection of Constituents, Moulding method, Low pressure closed moulding, pultrusion, Filament winding, Fabrication of ceramic matrix composites - Various techniques of vapour deposition, Liquid phase method and Hot pressing etc., Fabrication of nano-composites

Unit V

Fracture & Safety of Composite : Fracture behaviour of composites, Griffith theory of brittle fracture and modification for structural materials, Basic fracture mechanics of composite.

Text Books:

1. Composite materials, K.K. Chawala, 2nd ed.,(1987) Springer-Verlag, New York.

Reference Books:

1. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
2. Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill, 1998.

Course Outcomes:

1. Upon completion of this course, the students will have an overview of the mechanical behaviour and application of composite materials.
2. They will be able to characterize various composite and required fabrication technique
3. They will develop an understanding regarding various ways too analyse composite and their features.

Practical/Experiments

1. Fabrication of composite materials
2. Fabrication of particulate composite materials
3. Fabrication of fiber reinforced composite materials
4. Fabrication of hybrid composite materials
5. Testing and characterisation of composite materials

PEL	TME-431	Mechatronics System	3(2-0-2)4

Course Objectives:

1. To understand the structure of microprocessors and their applications in mechanical devices
2. To understand the principle of automatic control and real time motion control systems, with the help of electrical drives and actuators
3. To understand the design and working of mechatronics system.

Course Contents:

Unit I

Introduction: Introduction, scope and applications of Mechatronics systems. Design process, measurement systems, Process control automation, Introduction to Programmable logic controller, Classification of control system, Microelectronics

Unit II

Introduction to Sensors and transducers: Classification, different types of transducers, Electro-mechanical transducers, Thermoelectric transducers, Photoelectric Transducers, Acceleration, Force, Torque, Power, Flow and Temperature Sensors, Light Detection, strain gauges.

Unit III

Signal conditioning Systems: Introduction to measurement systems, Signal production, Signal conditioning, signal amplification, amplifier, Data Acquisition, digital signals, Analog to Digital Conversion, Digital to Analog conversion, Data Presentation system.

Unit IV

Introduction to Actuators: Electro-mechanical Actuators, Electrical Machines, Direct current motors, Alternating current motors, stepped motors, Piezoelectric Actuators, Hydraulic Actuators, Hydraulic valves, Pneumatic Actuation Systems.

Unit V

Design of Mechatronics systems: Microprocessors and Microcontrollers, Introduction of mechatronics systems: Home appliances, ABS (anti-lock braking system) and other areas in automotive engineering, Elevators and escalators, Mobile robots and manipulator arms, Computer Numerically Control (CNC) production machines.

Course Outcomes:

1. Upon completion of this course, students will be able to:
2. Understand and analyze mechanical, electrical and electronics systems and their interconnections.
3. Understand the different types of sensors and actuators.
4. Understand the data measurement and signal conditioning and data display system
5. Use of microprocessors and micro-controllers in design of mechatronics system.

6. Develop a simulation model for simple physical systems and explain mechatronics design process

Text Books:

1. A Textbook of Mechatronics, R.K.Rajput, S. Chand & Company Private Limited, 2007
2. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall, 2011

Reference books:

1. Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.)
2. Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education

Lab experiments:

1. Study the following devices (a) Analog & digital multimeter (b) Function/ Signal generators (c) Regulated d. c. power supplies (constant voltage and constant current operations)
2. Study of Speed Measurement System: (a) Magnetic Pick-up (b) Stroboscope
3. Study of Load Measurement System Load Cell
4. Measurement of temperature using thermocouple, thermistor and RTD
5. Measurement of displacement using POT, LVDT & Capacitive transducer
6. Torque measurement using torque measuring devices
7. Strain Measurement using strain gauge
8. Frequency to Voltage Converter and vice versa
9. Study on the application of data acquisition system for industrial purposes
10. Speed control of DC motor using PLC.

PEL	TME-463	Computer Aided Design	3(2-0-2)4

Course Objective:

1. Introduction to CAD, to understand applications and benefits of CAD
2. To understand computer hardware
3. To understand computer software
4. To study and understand various aspects of geometric modelling
5. To understand geometric transformations
6. Introduction to finite element method

Course Content:

Unit I

Introduction to CAD, CAD/CAM Tools, CAD Hardware – input/output devices, CAD Software – graphics standards, data structure, database, database coordinate system

Unit II

Geometric Modeling – introduction

Curve Representation – introduction, analytic curves – line, circle, ellipse, parabola, hyperbola, synthetic curves – Hermite cubic spline, Bezier curve, B-spline curve

Surface Modeling – introduction, analytic surface, synthetic surface

Solid Modeling – introduction, solid entities, half spaces, boundary representation (B-Rep), constructive solid geometry (CSG), various solid representations

Unit III

Geometric Transformations – translation, rotation, scaling, shearing, reflection, homogeneous representation

Projection – orthographic, isometric, perspective

Unit IV

Computer Algorithms – clipping, Bresenham's line algorithm, mid-point circle algorithm

Unit V

Introduction to Finite Element Method – bar, spring, beam elements, applications.

Course Outcomes:

After completing this course, the students will be able to understand the importance of CAD. They will understand software and hardware aspects of CAD. They will learn the geometric modeling and geometric transformations. They will get familiar with finite element method.

Text Book:

1. Zeid, I and Sivasubramanian, R., CAD/CAM Theory & Practice, McGraw Hill Education

Reference Books:

1. Hughes, J.F., van Dam, A., McGuire, M.,Sklar, D.F., Foley, J.D., Feiner, S.K., Akeley, K., Computer Graphics: Principles and Practice, Addison Wesley
2. Hearn, D. D. and Baker, M. P.,Computer Graphics, Pearson
3. Groover, M.P. and Zimmers, W.E., CAD/CAM Computer-Aided Design and Manufacturing, Prentice Hall

Experiments

1) Introduction to Matlab/Freemat
2) Analytic Curves
3) Synthetic Curves
4) Geometric Transformation
5) Projection
6) Computer Algorithms
7) Introduction to CREO
8) Modeling on CREO
9) Modeling on CREO
10) Analysis on CREO

Total number of labs = 10

PEL	TME-464	Automobile Engineering	3(2-0-2)4

Course Objectives:

1. To understand the anatomy and working of various parts of an automobile and its performance.

Course Content:

Unit I

Frame & Body: Layout of chassis, types of chassis frames and bodies, their constructional features and materials. Clutches: single plate, multi-plate, cone clutch, semi centrifugal, electromagnetic, vacuum and hydraulic clutches. Fluid coupling. Brakes: Classification and function; Mechanical, hydraulic, vacuum air and self engineering brakes; Brake shoes and lining materials.

Unit II

Gear Boxes: Sliding mesh, constant mesh, synchromesh and epicyclic gear boxes, Automatic transmission system; Hydraulic torque converter; Drives: Overdrive, Propeller shaft, Universal joints, Differential; Rear axle drives. Hotchkiss and torque tube drives; Rear axle types; Front wheel and All wheel drive

Unit III

Wheels and Tyres: Tyre types, Tyre construction; Tyre inflation pressure, Tyre wear and their causes; Re-treading of the tyre, Steering system: steering gear boxes, Steering linkages, Steering mechanism, Under and Over steering. Steering Geometry, Effect of camber, caster, king pin inclination, toe in and toe out; Power steering; Integral and linkage types, Suspension system: objective and requirements, Suspension spring, front and rear suspension systems, Independent suspension system, Shock absorbers.

Unit IV

Automotive Electrical System: Battery construction, Charging and testing, battery types, Starting and Battery Charging System: Starter motor construction, types of drive, Alternator construction, regulation and rectification. Ignition System: Magneto and coil ignition systems, System components and requirements, Automotive lighting: Wiring systems Electrical instruments; head lamp, electric horn, fuel level indicator.

Unit V

Automotive Air Conditioning: Introduction, Loads, Air conditioning system Components, Refrigerants, Fault Diagnosis. Automotive Safety: Safety requirements, Safety Devices, Air bags, belts, radio ranging, NVS (Night Vision System) GPS (Global Positioning System)

Unit VI

Pollution and Performance: Pollution in our society, Types of pollutants, controlling pollution, and Road performance

Course Outcomes:

Upon completion of this course, students will be able to:

1 Identify the different parts and understand the function of each automobile component
2 Describe how the steering and the suspension and other systems operate
3 Understand the environmental implications of automobile emissions
4 Understand about the vehicle performance

Text books:

1. Kirpal Singh, Automobile Engineering, 13th ed., Standard Publishers, New Delhi, 2012.
2. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.

Reference books:

1. Heisler H., Advanced Vehicle Technology, SAE International Publ., USA, 2002.
2. Crouse &Anglin, "Automotive Mechanics", Tata McGrawHill, New Delhi, 10th Edition 2007.

Lab experiments:

1. To study and prepare report on the constructional details, working principles and operation of the Automotive Clutches.
2. To study and prepare report on the constructional details, working principles and operation of the Automotive Transmission systems.
3. To study and prepare report on working principles and operation of the Multi-cylinder: Diesel and Petrol Engines.
4. To study and prepare report on working principles and operation of the Fuels supply systems.
5. To study and prepare report on working principles and operation of the Engine cooling & lubricating Systems.
6. To study and prepare report on Automotive Emission / Pollution control systems.

PEL	TME-467	Power Plant Engineering	3(2-0-2)4

Course Objectives:

1. To provide an overview of coal fired thermal power plants, equipments and related Cycles.
2. To understand the field application of Nozzles
3. To understand steam turbine power plants and related equipments
4. To understand Gas turbine power plants and related equipments
5. To understand the importance of biofuels and energy conversion systems
6. To understand the Economics of Power Generation
7. Equipments used in power plants and the energy conversion issues and related lab experiments.

Course Contents:

Unit I

Various energy resources, Coal based thermal power plants, Basic Rankine cycle and its modifications like Reheat, Regenerative, Reheat-Regenerative Cycles , Effects of Pressure Temperature Variation at inlet of Turbine on Rankine Cycle, Mean Temperature of Heat addition, layout of modern coal fired power plant, Modern boilers, super critical boilers, FBC boilers. Boiler Efficiency, Heat balance Sheet, Subsystems of thermal power plants, Layout of fuel and ash handling, Boiler Draught systems and Chimney Height Analysis.

Unit II

Steam Nozzle and Types, Flow through Nozzle analysis, Critical Pressure Ratio, Throat and exit areas. Steam Turbines Types, Velocity Diagrams, Degree of Reaction, Various Efficiencies, Losses in Steam Turbine, Compounding of Steam Turbine. Condensers, Advantages, Various Efficiencies of condensers, steam and heating rates, and cooling water requirement. Cooling ponds and cooling towers. Cogeneration systems.

Unit III

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants. Basics of nuclear Power Plant, Layout and subsystems of nuclear power plants, nuclear reactor and its parts. Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor.

Unit IV

Bio-fuels, Use of Bio-Fuels in Engines and Benefits, Diesel Power Plants, Principles of wind, Tidal, solar PV and solar thermal, geothermal and fuel cell, thermo electric power systems.

Unit V

Energy, economics and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, site selection, depreciation. Pollution control technologies including waste disposal for coal fired steam power plants.

Course Outcomes:

Upon completion of the course, the students can understand

1. Different sources of energy and their utilisation.
2. The principles of operation for coal based power plants.
3. Various equipments of boilers and other related equipments.
4. Basic working principle of different types of power plants.
5. Economics of power generation.
6. Pollution control and ash disposal of coal fired power plants

.

Text Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.

Reference Books:

1. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.
2. Thermal Engineering by Arora and Domkundwar

Lab Experiments:

1. Pressure temperature relation on Mercets boiler
2. Study of water tube boiler and mountings
3. Steam Turbine study
4. Condenser Study
5. Nozzle air flow experiment
6. Study of Air Compressor
7. Study of Air blower.
8. Flow visualization around an aerofoil.

PEL	TME-468	Solar Energy Thermal Process	3(2-0-2)4

Course Objective:

1. To understand basic concept of solar energy radiations
2. To understand principle and working of solar flatplate collectors, concentrating collectors, solar distillation etc.
3. To understand principles of solar thermal power generation solar thermal power generation using Stirling cycle, Brayton cycle

Course Content:

Unit I

Historical background, importance and application of solar Energy

The sun, solar constant spectral distribution of extraterrestrial radiation; earth sun angles; angle of incidence of beam radiation, pyranometers and pyrheliometer measurement of duration of sunshine; solar radiation data, attenuation of solar radiation by the atmosphere.

Unit II

Electromagnetic radiation; black and grey body concept, Planck's law and wien's displacement law sky radiation, heat transfer coefficients, optical properties of materials.

Absorptance and emittance; Kirchoff's law reflection from surfaces, relationship among absorptance emittance and reflectance; selective surfaces

Reflection of radiation; absorption of radiation optical properties of cover systems, transmittance of diffuse radiation, transmittance- absorptance product; absorbed solar radiation

Unit III

General description of flat plate collectors Basic energy balance equation, temperature distributors in flat plate collectors; Overall heat transfer coefficient temperature distribution between tubes and collector, efficiency factor, collector heatremoval factor, collector geometric collector performance; method of testing

Unit IV

Focusing Collectors, Solar disk and theoretical solar images, Collector configurations, concentration ratio orientation and sun tracking systems, characteristics of focusing collectors, thermal performance of focusing collectors

Unit V

Types of energy storage, characteristics and capacity of storage systems, solar ponds

Introduction, principles of solar thermal power generation solar thermal power generation using Stirling cycle, Brayton cycle

Solar refrigeration and air conditioning various methods of power generation

Course Outcomes:

1. Students will be able to understand concept of solar radiation and principle and working of various solar radiation measuring instruments
2. Student will be able to design and model various solar energy related devices.
3. Student will be able to learn about the designing of solar flat plate and concentrating collectors.

Text Books:

1. Solar Engineering of Thermal Processes by J.A.Duffic & W.A.Beckman, Pub.: John Wiley & Sons

Reference Books:

1. Solar Energy by H.P.Garg & J.Prakash, Pub.Tata Mc Graw Hill
2. Solar Energy Principles of Thermal Collection and storage by S.P.Sukhatme, Pub. : McGraw Hill Education (India) Pvt. Ltd.
3. Principles of Solar Engineering by F.Kreith & J.F.Kreider

PEL	TME-469	Experimental Methods in Thermal Science	3(2-0-2)4

Course Objective:

1. To understand the principles of measurement systems and static and dynamic characteristics of measurement systems.
2. To understand the basic principles of pressure, temperature, force and torque measurement.
3. To understand the principle of optical measurement techniques in thermal science.

Course Content:

Unit I

Introduction: Experiments versus simulation, Experiments versus measurements, Why conduct experiments, Details of an experimental setup, Principles of similarity; Global versus local measurements; Static versus dynamic calibration.

Design of experiments: Issues related to probe selection, factorial design, design of experiments based on sensitivity function and uncertainty analysis. Examples related to (a) determining the duration of the experiment and (b) choosing between steady state and transient techniques. Forward versus inverse measurements, Examples related to wake survey, drag coefficient, and heat transfer coefficient.

Unit II

Uncertainty analysis Nomenclature: precision versus accuracy, measurement errors, sampling, A/D conversion, attenuation, phase lag, signal-to-noise ratio, calibration. scatter, central limit theorem, 95% confidence interval, normal and Student's-t distribution, data outlier detection, uncertainty, combining elemental errors, error propagation.

Temporal response of probes and transducers: Measurement system model, system response, amplitude response, frequency response, zeroth, first and second order systems; examples of thermocouple response and U-tube manometer. Probe compensation in the frequency domain.

Unit III

Probes and transducers: Pressure - pressure transducers; noise measurement Velocity pitot static tube (low as well as high speeds), 5-hole probe, Hotwire anemometer, CCA, CTA, Laser Doppler velocimetry, Particle image velocimetry. Temperature measurement: thermocouples, RTD, thermister, infrared thermography, Heat flux measurement

Unit IV

Refractive index based optical measurement techniques: Introduction to lasers, interference, Interferometry, fringe analysis; Schlieren and shadowgraph techniques; Image analysis using ray tracing technique; Holography

Measurements based on light scattering: Absorption spectroscopy, shadow formation, Mie scattering, Rayleigh, Raman and other scattering methods.

Unit V

Data acquisition systems: Analog input-output communication, analog to digital converter, static and dynamic characteristic of signals, Bits, Transmitting digital numbers, resolution, quantization error, signal connections, single and differential connections, signal conditioning. Digital signal processing compared with digital image processing signal conditioning. Review of numerical

techniques: interpolation; curve fitting (regression), integration, differentiation, root finding, solving a system of linear algebraic equations. Treatment of periodic data; Fourier analysis, FFT algorithm; Inverse FT; Nyquist criterion. Numerical aspects of FFT; probability density function; auto- and cross correlations

Course Outcomes: Upon completion of this course, the students will be able to understand static and dynamic characteristics of instruments

1. Upon completion of this course, the students will be able to understand various systems related to measurement of mechanical parameters and design the measurement system for the same.
2. Upon completion of this course, the students will be able to understand the basic concepts of design of experiments, data acquisition system,refracrive index based easurment techniques.

References Book

1. T.G. Beckwith and N.L. Buck, *Mechanical Measurements*, Addison-Wesley, MA (USA), 1969.
2. E.O. Doeblin, *Measurement Systems*, McGraw-Hill, New York, 1986.
3. R.J. Goldstein (Editor), *Fluid Mechanics Measurements*, Hemisphere Publishing Corporation, New York, 1983; second edition, 1996.
4. F. Mayinger, Editor, *Optical Measurements: Techniques and Applications*, SpringerVerlag, Berlin, 1994.

PEL	TME-470	Computational Fluid Dynamics and Heat Transfer	3(2-0-2)4

Course Objective:

1. The aim of the course is to build a solid foundation in computational heat transfer exposing students to the numerical methods to solve conduction, convection and radiation problems.
2. Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems.

Course Content:

Unit I

Introduction to Computational Fluid Dynamics and Principles of Conservation: Computational Fluid Dynamics: What, When, and Why?, CFD Applications, Numerical vs Analytical vs Experimental, Modeling vs Experimentation, Fundamental principles of conservation, Reynolds transport theorem, Conservation of mass, Conservation of linear momentum: Navier-Stokes equation, Conservation of Energy, General scalar transport equation.

Unit II

Classification of Partial Differential Equations and Physical Behaviour: Mathematical classification of Partial Differential Equation, Illustrative examples of elliptic, parabolic and hyperbolic equations, Physical examples of elliptic, parabolic and hyperbolic partial differential equations.

Unit III

Fundamentals of Discretization: Discretization principles: Preprocessing, Solution, Postprocessing, Finite Element Method, 3 Finite difference method, Well posed boundary value problem,Possible types of boundary conditions, Conservativeness, Boundedness, Transportiveness, Finite volume method (FVM), Illustrative examples: 1-D steady state heat conduction without and with constant source term.

Unit IV

Discretization of Unsteady State Problems: 1-D unsteady state diffusion problems: implicit, fully explicit and Crank-Nicholson scheme.

Unit V

Solution of Systems of Linear Algebraic Equations: Criteria for unique solution, infinite number of solutions and no solution, Solution techniques for systems of linear algebraic equations: Elimination, Iteration and Gradient Search method,Elimination method: Forward elimination and backward substitution,Assessment of number of computations, L-U decomposition technique, Tridiagonal matrix algorithm (TDMA): Thomas algorithm, Illustrative examples, Norm of a vector, Norm of a matrix, Some important properties of matrix norm,Error analysis of elimination methods, Iteration methods: Jacobi's method and Gauss Siedel method, Generalized analysis of the iterative methods,Sufficient condition for convergence, Rate of convergence, Scarborough criteria of sufficient condition for convergence in Gauss Siedel Method, Illustrative examples of Jacobi's

method and GaussSiedel method, Relaxation methods, Preferential characteristics of iterative methods, Multigrid method, Line by line TDMA,ADI(Alternating direction implicit) method, Gradient search methods:Steepest descent method and Conjugate gradient method

Course Outcomes:

1. After completing the course, the students will be able to formulate and analyze a computational heat transfer problem involving any of the three modes of heat transfer.
2. The students will be able to obtain exact solutions for the temperature variation using numerical methods where possible or employ approximate methods .
3. The students will be able to design and simulate heat transfer problems such as heat exchangers, fins, aerofoil, complex geometry flow and heat transfer problems.

References book

1. Anderson, D.A., Tennehill J.C., and Pletecher R.H., Computational Fluid Mechanics and Heat Transfer, Hemisphere, 1984.
2. Patankar, S.V. Numerical Heat Transfer and Fluid Flow, Hemisphere, 1980.
3. Versteeg, H.K. & Malalasekera, W. An introduction to computational fluid Dynamics: The Finite Volume Method, Adison Wesley-Longman, 1995.

PEL	TME-472	Fatigue Creep And Fracture	3(2-0-2)4

Course Objective:

1. To understand the design against fatigue, fracture & Creep.

Unit I

Design philosophy : (i) Infinite life, (ii) Safe life, (iii) Fail safe and (iv) Damage tolerant design concepts. Fatigue Design : Cyclic stress and stress reversals, Fatigue and progressive fracture, Endurance limit, Fatigue Tests : Cantilever and Beam type of Fatigue Tests, Axial Fatigue Tests. Influence of mean stress on fatigue : Gerber, Goodman and soderberg's criteria. Effect of compressive cyclic stress on fatigue. Fatigue design formula for axial, bending, torsional and combined loading. Fatigue controlling factors: Effect of frequency, Temperature, size, form, stress concentration factors, Notch, sensitivity & surface conditions, residual stresses.

Unit II

Improvement of fatigue strength' by chemical/metallurgical processes such as ritriding, flame hardening, case carburizing. Fatigue strength enhancement by mechanical work : cold rolling, peening, shot peening. Effect of environment : Corrosion Fatigue, Concept of cumulative fatigue damage Fracture Mechanics : Ductile and brittle fracture Theoretical cohesive strength of metasl, Griffith Theory of brittle Fracture, Oruron's modification to Griffith Theory.

Unit III

Modes of fracture : Mode I, II and III, fatigue creek growth Behaviour of metals, Linear Elastic Fracture Mechanics (LEFM), Stress Intensity Factor(SIF), Stress field near the crack tip, Critical SIF and Fracture Toughness, Experimental determination of fracture toughness K IC , COD gauges and standard ASTM Tests. Strain Energy Release Rates (SERR), Elasto-Plastic Fracture Mechanics (EPFM), Plastic zone size and its evaluation, J-Integral Method.

Unit IV

Creep Analysis : Definition, Constant stress and constant, strain creep tests. Uniaxial creep tests : Baily's Power Law, Creep relaxation : strain hardening and time hardening creep relaxation. Introduction to Creep bending and deflection of simple problems.

Course Outcomes:

1. To understand the fundamental of logic loading.
2. To understand the fundamental of fracture Machines.
3. To understand the fundamental of creep.

Text Books:

1. George E. Dieter, Mechanical Metallurgy, - Mc Graw Hill, NY, 1988
2. Joseph Marin, Mechanical Behaviour of Engg. Materials, - Prentice Hall of India, 1966
3. Stephens, R.I. and Fuchs, H.O., Metal Fatigue in Engg. ,- Wiley, NY 2001
4. Finnie, I. and Heller, W.R., Creep of Engg. Materials, - Mc Graw Hill Book Co., 1959
5. Prasant Kumar, Fracture Mechanics

Reference Books:

1. L.S. Srinath, Advanced Mechanics of Materials, - Tata Mc Graw Hill Ltd., ND, 2009.
2. Norman E, Dowling, Mechanical Behaviour of Materials, - Prentice Hall, NJ, 1999.
3. Lessells, J.M., strength and resistance of materials, - John wiley & sons, 1954
4. Peterson, R.E., Stress Concentration Design Factors,- John Wiley & Sons, 1953
5. Meguid, S.A., Fracture Mechanics,- John Wiley & Sons, 1996
6. Kare Hellan, Introduction to Fracture Mechanics, - Mc Graw Hill Book Co., 1985

Experiments

1. Fracture testing standards
2. Testing sample preparation
3. Rotating Bending Fatigue testing
4. Crack growth experiments on different materials
5. Creep testing
6. Fracture surface analysis

PEL	TME-474	Tribology	3(2-0-2)4

Course Objective:

1. To understand the theory of lubrication
2. To understand friction, wear and tribological aspects of Machine components
3. To understand types of bearing

Unit I

Introduction : Lubricant and lubrication, Types of bearings, properties and testing of lubricants, Basic equations: Generalized Reynolds equation, Flow and Shear Stress, Energy equation, Equation of state Hydro dynamic lubrication : Mechanism of pressure development and load carrying capacity, Plane-slider bearing, Idealized slider bearing with a pivoted shoe, Step bearing, Idealized journal bearing. – infinitely long journal bearing, Petroffs equation for a lightly loaded bearing, narrow bearing,

Unit II

Friction and wear of metals: Theories of friction, surface contaminants, wear mechanisms, Adhesive Wear, Abrasive, Corrosive Wear, Fretting Wear. Effect of sliding speed on friction, classification and mechanism of wear, Wear resistant materials.

Unit III

Oil flow and thermal equilibrium - Heat balance of lubricants. Hydrostatic Bearing **:** Principles, Component of hydrostatic lubrication , Hydrostatic circular thrust bearing , calculation of pressure, load carrying capacity, flow rate , power loss in bearing due to friction.

Unit IV

Concept of gas lubricated bearing, Concept of Elastohydrodynamic lubrication, Design and selection of antifiction bearing

Course Outcomes

1. Students will understand the lubricants and lubrication theory
2. Understand the lubrication theory of different bearings
3. Understand friction wear of bearings

Text Books

1. Introduction to Tribology of Bearing , B.C .Majumdar , S. Chand & Co

Reference Books

1. Fundamentals of Tribiology , Basu S K., Sengupta A N., Ahuja B. B., , PHI 2006
2. Basic Lubrication theory, A. Cameron, John Wiley & sons
3. Lubrication Fundamentals, D.M.Pirro and A.A.Wessol, CRC Press
4. Theory and Practice of Lubrication for Engineers**,** Fuller, D., New York company 1998

Practicals

1. To study about viscosity of automotive lubricants
2. Study of antifriction bearing
3. Study of hydrodynamic
4. Wear testing of Material and there characterization
5. Scanning electro microscopepick study

PEL	TME-476	Design of Refrigeration Systems	3(2-0-2)4

Course Objectives:

1. To familiarize students with the design of refrigeration and air conditioning system components and to understand complete performance of these systems
2. To make students able to design condenser, evaporator and capillary tube
3. To make students able to understand heat transfer in air conditioning equipment and to design air conditioning ducts
4. To make students able to calculate cooling loads of buildings

Course Content:

Review of vapour compression systems, multistage or compound compression, Performance characteristics of compressors, modeling of heat exchangers, design of condensers, expansion devices, capillary tube, design of evaporators, complete vapour compression system, review of psychrometric processes in air-conditioning, design of air conditioning apparatus, air conditioning duct design, load calculations and applied psychrometrics

Detailed Course Description

Unit-1

Review of vapor compression refrigeration cycle; multistage or compound compression. Flash gas removal and inter-cooling. Complete multistage compression system, multi-evaporator systems, cascade systems, Performance characteristics of reciprocating compressors, rotary compressors, centrifugal compressors. Modeling of heat exchangers, heat transfer in condensers, design of ondensers, Wilson Plot

Unit-2

Expansion valve, types; thermostatic expansion valve, automatic expansion valve, capillary tube characteristics and its design. Evaporators; types, heat transfer in evaporators, design, heat transfer augmentation techniques, Complete vapour compression system and its performance characteristics

Unit-3

Review of psychrometric processes in air-conditioning equipment, enthalpy potential, heat transfer in cooling and dehumidifying coils, air washer, atmospheric cooling towers, air handling system, air conditioning duct design; equal friction method, velocity reduction method, static regain method.

Unit-4

Load calculations and applied psychrometrics; internal heat gains, system heat gains, cooling load and heating load estimation, RSHF, GSHF, ESHF, ADP and dehumidified air quantity

Course Outcome

After studying this course, a student will be able to understand the complete performance of a vapour compression type refrigeration and air conditioning system. He will also be able to design various components of a refrigeration and air conditioning system

Text Book

1. Refrigeration and Air-Conditioning by C.P. Arora, Tata McGraw Hill, 3rd Edition

Reference Books

1. Refrigeration and Air-Conditioning by Stoecker W.F. and Jones, J.W., McGraw Hill International Edition
2. ASHRAE Hand Book of Fundamentals

Practical

1. To design a shell and tube type water cooled condenser
2. To design an air cooled condenser
3. To design a flooded type refrigerant evaporator
4. To design a dry expansion type refrigerant evaporator
5. To design a capillary tube.
6. To design air-conditioning duct.
7. To design cooling and dehumidifying coil.
8. To calculate cooling load of a building.

TME-475	Nano Engineering Materials	3(2-0-2)4

Course Objective

1. Characterisation and properties will provide an overview of nanomaterials including their properties.
2. The hierarchical development from nano to macro length scale and its adaptation in nature will be discussed.
3. Understanding the change in crystal structure and defects, including thermodynamics of nano materials.
4. Structural phase, microstructural and mechanical characterization will also be dealt briefly.

Unit I

Overview of Nanostructures and Nano-materials, Classification, crystalline nano-materials and their defects

Unit II

Multiscale hierarchical structural built out of nanosized building blocks, Nano materials in nature: Nacre, Gecko, Teeth

Unit III

Surfaces and interface in nanostructure, ceramic interface, grain boundaries in nanocrystalline materials, defects associated with interface

Unit IV

Deformation behaviour of nanomaterials, Fracture and creep, Nano-mechanics and Nano-tribology, basic thermodynamics of Nanomaterials

Unit V

Overview of properties of nanomaterials, Electrical, Magnetic and optical properties

Course Outcome:

1. The course is aimed to have an overview of nano materials. The students will develop an understanding of nano materials and their classification.
2. The students will also analyse various crystal structure and their defects as one goes from bulk to nano length scale.
3. Various properties such as electrical, magnetic and optical will be analysed in the light of material application

Text Books:

1. Nanomaterials, nanotechnologies and design: An introduction to Engineers and archietects , D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann 2009

Reference Books:

1. Handbook of Nanophase and Nanostructural Materials (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic 2003

PEL	TME-480	Product Innovation and Design	3(2-0-2)4

Course Objective:

1. To developed creative thinking for product innovation.

Course Content :

Unit I

Need for Innovation and design, User Innovation, Introduction to product and Product Design, Difference between Product development and product design.

Unit II

Need/Problem Identification, User study by contextual enquiry, Questionnaire study, Interview techniques, Persona and scenario mapping, Product Study and market study, Design Brief.

Unit III

Creative techniques and tools for Concept generation, concept evaluation

Unit IV

Importance of Human factors in product design, Physical Ergonomics principles and issues, Ergonomic assessment tool, Cognitive issues in product design.

Unit V

Product prototyping/ model making work flow, tools and techniques for model making and prototyping, introduction to prototype driven innovation, Overview of materials and processes

Unit VI

Evaluation tools and techniques for User-Product interaction

Learning outcomes

1. applying different innovation models and product design
2. identifying and evaluate innovation sources
3. understanding users and their needs and how products can create value to users
4. understanding the key actors and resources involved in product innovation

Practicals/ Experimental work

1. On Design Thinking Skills
2. Identifying Customer Needs
3. Product Specifications
4. Applied Creativity
5. Prototyping
6. Design for Services

7. Product Architecture
8. Financial Analysis
9. Design for Environment
10. Product Development Processes

Suggestive Books :

1. Eppinger, S., & Ulrich, K.(2015). Product design and development. McGraw-Hill Higher Education.
2. Green, W., & Jordan, P. W. (Eds.). (1999).Human factors in product design: current practice and future trends. CRC Press.
3. Sanders, M. S., & McCormick, E. J. (1993). Human factors in engineering and design. McGRAW-HILL book company.
4. Roozenburg, N. F., & Eekels, J. (1995). Product design: fundamentals and methods (Vol. 2). John Wiley & Sons Inc.

ESC	TIP- 103	Workshop Practice	3(1-0-4)5

Syllabus /Catalogue Description:

This is the fundamental course for the engineering branches. This course contains various methods of manufacturing and techniques which is more economical and sophisticated for particular product .This course contain major part in practice or practical hour, which is mainly use for all mechanical production in industries like foundry shop, welding shop, fitting shop, black smithy, machine shop, fabrication shop.

Course Content:

Unit I

General introduction of workshop, Safety Precautions, Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods. Properties of materials, types of materials.

Introduction to various carpentry tools, materials, types of wood, and their characteristics and defects of wood. Processes or operations in wood working. Applications of wood working. Engineering uses of timber, seasoning and preservation.

Unit II

Scope of molding, characteristics of mould materials, types of sands green and dry sand molding methods.Foundry terminology, introduction of pattern, types, materials, allowances, Gateing system, Casting processes, Classification, types of casting, equipment and tools used.solidification process, common casting defects. applications of casting.

Unit III

Introduction to welding, types of welding, Oxyacetylene gas welding, types of flames, welding techniques and equipment. Principle of arc welding, equipment and tools. Soldering and Brazing.General applications of welding in Engineering.

Unit IV

Introduction to Common machine tools, lathe machine, Main operations, parts, tools used on lathe. Cutting tool materials and geometry of single point cutting tool, tool signature. Introduction to Shaper, Planer, drilling and milling – Principle specifications, operations tools etc.

Unit V

Introduction to fitting work, scope and applications. Introduction to Smithy tools and operations.forgingoperations,types, and tools, applications of forging.

Text /Reference Books:

1. Production Technology by R.K. Jain and S. C. Gupta.
2. A course in workshop Technology. Volume 1 and 2. By B.S. Raghuwanshi
3. Hazra, Choudhari S K and Bose S K. 1982. Elements of Workshop technology (Vol. I and II). Media Promoters and Publishers Pvt.Ltd., Mumbai.

4. Chapman W A J. 1989. Workshop Technology (Part I and II). Arnold Publishers (India) Pvt. Ltd., AB/9 Safdarjung Enclave, New Delhi.
5. Raghuwamsi B S. 1996. A Course in Workshop Technology (Vol. I and II). Dhanpat Rai and Sons, 1682 NaiDarak, New Delhi.

List of Experiments:

1. Preparation of simple joints: Cross half Lap joint; Preparation of Dovetail joint
2. Introduction to tools and measuring instruments for fitting;
3. Introduction to welding equipment, processes tools, their use and precautions;
4. Jobs on ARC welding – Lap joint, butt joint; T-Joint and corner joint in Arc welding;
5. Gas welding Practice – Lab, butt and T-Joints;
6. Mould making using one-piece pattern and two pieces pattern;
7. Demonstration of mould making using sweep pattern, and match plate patterns;
8. Introduction to metal casting equipment, tools and their use;
9. Introduction to machine shop machines and tools; Demonstration on Processes in machining and use of measuring instruments;
10. Practical jobs on simple turning, step turning; Practical job on taper turning, drilling and threading;
11. Operations on shaper and planer,
12. Changing a round MS rod into square section with forging.

ESC	TIP-306	Manufacturing Technology	4(3-0-2)5

Syllabus /Catalogue Description:

The course will help students to understand the concepts of machining, tool life, metal cutting, cutting tools and finishing operations. They will also develop skill related to advance research in this field.

Topical Outline:

Unit-I

Introduction to Engineering and Technology, Importance of Manufacturing, Economic Considerations in Manufacturing, Technological Considerations in Manufacturing, Socioeconomic Factors, Some Technical Concepts. Cutting Tool Materials, Surface Treatments of Cutting Tools, Cutting Tool Failure, Tool Wear Measurement, Cutting Tool Life, Tool Life Equation and Factors affecting Tool Life, Machinability, Thermal Aspects in Metal Cutting, Measurement of Tool Tip Temperature, Cutting Fluid.

Unit-II

Types of Chips Produced in Metal Cutting, Types of Metal Cutting, Cutting Speed, Feed and Depth of Cut, Factors Affecting Cutting Speed, Feed and Depth of Cut, Mechanism of Chip Formation, Thick Shear Zone and Thin Shear Plane Models of Metal Cutting, Piispanen's Idealized Card Deck Model of Cutting, Shear Plane Angle and its Measurement, Shear Strain and Shear Strain Rate in Metal Cutting, Mechanics of Metal Cutting, Merchant's Cutting Force Diagram, Prediction of Shear Plane Angle, Cutting Power and Energy Consumed in Metal Cutting, Energy Consumption in Metal Cutting, Dynamometer.

Unit-III

Basics of general purpose machines tools, Hand tools Vs Machine Tools, Definition of a machine tool, types of machine tools, Lathe: Principle of working, types of lathe, specification of lathe, parts of a lathe, lathe operations, lathe accessories, thread terminology, Types of thread, Methods of manufacturing screw threads, thread cutting on lathe machine.

Drill, types of drill, elements of a twist drill, Cutting speed, feed & depth of cut in drilling. Tool holding devices on a drill. Drilling and allied operations. Originating a true hole by drilling and allied operations, Boring and its advantages over drilling Boring Machines, Boring tools.

Unit-IV

Shaper and it's working principle, size of a shaper, construction of a mechanical shaper, classification of shapers, difference between mechanical & hydraulic shapers, quick return mechanisms of shapers, cutting tools used on shapers, shaper operations, speed, feed and depth of cut in shaper.

Slotter machine, differences between a shaper and a slotter, principal parts of a slotter, slotter size, slotter operations, types of slotters.

Planer machine and differences between a shaper & a planer, types of planers, parts of a planer, size of a planer, work holding devices on planer, planer tools, speed, feed & depth of cut in planer operations.

Milling machine and advantages of milling over other conventional machining operations, types of milling machines, construction of a column & knee type of milling machine, mechanisms of milling machines, cutting speed, feed and depth of cut in milling, size of a milling machine, milling cutters, work holding devices on milling machines, milling machine attachments, basic milling processes, milling operations, Indexing head & its types, Indexing methods, Helical milling.

Unit-V

Gear and types of gears, gear tooth forms and their relative advantages and disadvantages, gear tooth nomenclature, gear manufacturing processes, gear shaping & gear hobbing, worm gear manufacture. Grinding, types of grinding machines, types of grinding operations, important terms related to grinding Abrasive types, types of bonds, grinding wheel identification, selection of grinding wheel, manufacturing of grinding wheel. Honing & honing tool, honing machines, advantages & disadvantages of honing, applications of honing.

Lapping & lapping operation, methods of lapping, mechanism of lapping, advantages and disadvantages of lapping. applications of lapping. Super finishing and differences between super finishing and honing, super finishing machines. applications of super finishing. Broaching definition, broach, tool material, special features of broaching, classification of broaches, broaching machines, factors affecting design of a broach tool, advantages & disadvantages of broaching. applications of broaching. Importance of studying the economics of machining, criteria used for analyzing economics of machining, optimization of cutting speed & feed for minimum cost for a single pass turning operation based on the minimum cost per component criterion, the maximum production rate criterion & the maximum profit rate criterion.

Text /Reference Books:

1. Lindberg,"Processes and Materials of Manufacture", Prentice hall India (p) Ltd.
2. P.N.Rao, "Manufacturing Technology", TMH Ltd 1998(Revised edition)
3. SeropeKalpakjian, Steven R.Schmid, "Manufacturing Engineering and Technology". (4th Edition), Prentice Hall 2000-06-15 ISBN:0201361310
4. E.PaulDeGarmo, J.T.Black, Ronald A.Khoser, "Materials and Processes in Manufacturing" Wiley; 9 edition (December6, 2002) ISBN:0471033065

Lab Experiments

1. To perform Lathe machine operations : Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, on given specimens.
2. Manufacture a given component on a Capstan Lathe.
3. Spur Gear cutting on a Column and Knee type of Horizontal Milling machine.
4. Cutting of V-groove/ Dove-tail groove/ Rectangular groove on a Shaper machine.
5. To cut a Keyway of given size on an M.S. hub with a Slotter machine.

6. Drilling a true hole on an Upright Drilling machine and Counter-boring this hole to the given size.
7. Grinding a Tapered Cylindrical shaft on a Universal Cylindrical Grinding machine.
8. Grinding a Flat surface of given size on a Vertical spindle reciprocating table surface Grinding machine.
9. To study the construction and working of a Honing tool.
10. To Lap a given workpiece using manual lapping.

ESC	TIP-305	Manufacturing Processes	4(3-0-2)5

Syllabus /Catalogue Description:

This course contains basic manufacturing techniques or economical job techniques for particular product, and introductory course about finish product like grinding.

Topical outline:

Unit-I

Lathe Machine, Milling Machine, Drilling Machine, Shaper Machine, Planer Machine; types, operations, Structure, drives, Mechanism, Specifications. Indexing; simple and compound. Machining parameters and their effects; Speed, feed and depth of cut, cutting fluids

Unit-II

Introduction to tool materials, geometry of single point cutting tool and multipoint cutting tool, milling cutters, Tool signature

Unit-III

Introduction to sheet metal working, blanking and piercing, types of presses and operation, power hammer. Forming, hot working and cold working, rolling, roll mill arrangements. Extrusion, tube and wire drawing, spinning, stretch forming

Unit-IV

Welding: Gas welding, Electric arc welding, AC and DC welding machines and their characteristics, flux, electrodes, pressure welding, electric, resistance welding, spot, seam welding, submerged arc welding, thermit welding, TIG, MIG, gas cutting

Unit-V

Tool economics, cost, volume, profit analysis, tool life introduction.Introduction to advanced machining processes, micro machining, NC, CNC and DNC machines.

Text /Reference Books:

1. Elements of workshop Technology Vol. I and II By Hazra and Chaudhary.
2. Elements of workshop Technology Vol. I and II By B.S Raghuwalshi.
3. Production technology by R.K Jain.

List of Experiments: NIL

ESC	TIP-403	Automation in Manufacturing	3(3-0-0)3

Syllabus /Catalogue Description:

This subject make the student familiar with advanced technology which now a day's used by many industries in the field of design and automation and help the student to understand basic features of automation.

Topical outline:

Unit-I

Introduction to manufacturing system's concepts, manufacturing automation, flow systems. lines and assemblies, Introduction to CAM; Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends.

Unit-II

Basic concepts in robotics, introduction, numerical control of machine tools, resolution, accuracy, and repeatability, Position representation, Classification and structure of robotic systems, point-to-point and continuous–path systems, control loops of robotic systems, Classification based on arm geometry, coordinate systems, etc.

Unit-III

Drives and control systems, hydraulic systems, direct current servomotors, control approaches of robots, elimination of stationary position errors, control loops of CNC systems

Kinematic analysis and coordinate transformation, forward kinematics problem, Inverse kinematics, Denavit-Hartenberg convention, link description, coordinate system linkages, and joint mechanisms, actuator space, joint space and Cartesian space

Unit-IV

Trajectory interpolators, Introduction, General considerations in path description and generation, Joint space schemes, Cartesian space schemes, Path generation at run Time, Collision free path planning Robot programming, Manual programming, Lead through programming, Programming languages

Unit-V

Sensors and intelligent robots, introduction to robotic sensors, vision systems, range detectors, assembly-aid devices, force and torque sensors, artificial intelligence Computer integrated manufacturing systems, FMS, CAD/CAM systems, Factory of the future.

Applications of robots, handling, loading and unloading, manufacturing cell, welding assembly, machining. Evaluation and economic justification of robotic systems

List of Experiments: NIL

Text /Reference Books:

1. Robotics for Engineers- Yoran Koren, Publisher- McGraw-Hill International Editions
2. Advances in Robotics, Automation and Control - Editor Jesus Aramburo and Antonio Ramirez Trevino
3. **Automation and Robotics by Juan Manuel Ramos Arreguin - InTech , 2008**
4. **Industrial Robotics: Programming, Simulation and Applications - by Low Kin Huat - InTech , 2006**
5. Robotic Systems - Applications, Control and Programming,- Editor Ashish Dutta