SREEPATHY INSTITUTE OF MANAGEMENT AND TECHNOLOGY

COURSE HANDBOOK

DEPARTMENT OF MECHANICAL ENGINEERING

SEMESTER III

SREEPATHY INSTITUTE OF MANAGEMENT AND TECHNOLOGY

VISION

"Strive for excellence in generation and dissemination of knowledge."

MISSION

- To mould engineers of tomorrow, who are capable of addressing the problems of the nation and the world, by imparting technical education at par with international standards.
- To instil a desire in students for research, innovation, invention and entrepreneurship.
- To strive for creative partnership between the industry and the Institute.
- To impart the values of environment awareness, professional ethics, societal commitment, life skills and a desire for lifelong learning.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To act as quality knowledge center for creating technologically competent Mechanical Engineering professionals who will cater to the needs of emerging and interdisciplinary industry and research fields.

MISSION

- To provide theoretical and conceptual knowledge in Mechanical engineering stream and enhance lifelong learning.
- To work in close association with stakeholders in industry by enhancing industry-institute interaction, to take up need-based research and industry specific programs.
- To infuse professional, social and economic responsibilities along with ethical values to graduates.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

The graduates from Mechanical Engineering program are expected to achieve the following Program Educational Objective within a few years of graduation

PEO1: Have an overall knowledge in Mechanical Engineering and also in the fields of Mathematics, Science, Communication and Computing skills.

PEO2: Design machines, analyze thermo-fluid problems and optimize the quality of products and services.

PEO3: Implement ideas of Mechanical Engineering for the challenging task in the interdisciplinary areas like Electrical, Electronics, Computer Science, Civil, Bio-Technology and allied branches.

PROGRAM OUTCOMES (PO):

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

2. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.

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

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

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

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

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

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

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

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

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

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

PROGRAM SPECIFIC OBJECTIVES (PSO)

The **Mechanical Engineering** program graduates will be able to:

PSO1: Solve real-time problems in Design, Fluids, Thermal, Manufacturing and allied Engineering sectors of Mechanical Engineering.

PSO2: Recognize the importance of self-learning and engage in continuous independent learning to become experts in either as entrepreneurs or employees in the field.

BL	**BLOOM'SLEVEL**		
L1	Level -1	Remembering	Recalling from memory of previously learned material
L2	Level -2	Understanding	Explaining Ideas or Concepts
L3	Level -3	Applying	Using information in another familiar situation
L4	Level -4	Analyzing	Breaking information into part to explore understandings and relationships
L5	Level -5	Evaluating	Justify a decision or course of action
L6	Level -6	Creating	Generating new ideas, products or new ways of viewing

MA201 LINEAR ALGEBRA AND COMPLEX ANALYSIS

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Linear Algebra and Complex Analysis**	Course code**: MA 201**
L-T-P**: 3-0-1**	Credit**: 4**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Complex differentiation Limit, continuity and derivative of complex functions Analytic Functions Cauchy-Riemann Equation (Proof of sufficient condition of analyticity & C R Equations in polar form not required)-Laplace's Equation Harmonic functions, Harmonic Conjugate	9	15
II	Geometry of Analytic functions, conformal mapping, Mapping $w=z^2$, conformality of $w=e^z$ The mapping $w=z+1/z$ Properties of $w=1/z$ Circles and straight lines, extended complex plane, fixed points Special linear fractional transformation, cross ratio, cross ratio property-mapping of disks and half planes Conformal mapping by w=sin z, w=cos z	9	15
III	Complex Integration Definition of Complex Line integrals, first evaluation method, second evaluation method, Cauchy's integral theorem, Independence of path, Cauchy's integral theorem for multi connected domains, Cauchy's integral formula-Derivatives of analytic functions, application of Derivatives of analytic functions, Taylor and Maclaurin series, Power series as Taylor series, Laurent's series.	10	15
IV	Residue theorem Singularities, Zeros, Poles, Essential singularity, Zeros of an analytic functions, Residue integration method, formulas, several singularities inside the contour residue theorem, Evaluation of real integral	10	15
V	Linear system of equations Linear system of equations, Coefficient matrix, Augmented matrix, Gauss Elimination and back substitution, Elementary row operations, Row equivalent systems, Gauss elimination –three possible cases, Row echelon form and information from it, Linear independence –rank of a matrix, vector Space Dimension-basis, Vector space R3, Solution of linear systems, Fundamental theorem of non-homogeneous linear systems, homogeneous linear systems	9	20
VI	Matrix Eigen value Problem Determination of Eigen values and Eigen vectors, Eigenspace, Symmetric, skew-symmetric and Orthogonal Matrices-Simple properties, Basis of Eigen vectors, Similar matrices, Diagonalization of a matrix, Principal axis theorem Quadratic forms	9	20

TEXT BOOKS:

1	Erin Kreyszig: Advanced Engineering Mathematics, 10th edition, Wiley

REFERENCES:

1	Dennis G Zill & Patric D Shanahan, A first course in complex analysis with applications-Jones & Bartlet publishers
2	B.S Grewal-Higher Engineering Mathematics, Khanna Publishers, New Delhi
3	Lipschutz, Linear Algebra, 3e (Schaums Series), McGraww Hill Education India 2005
4	Complex variables introduction and applications- Second edition- Mark.J.Owitz-Cambridge publication.

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To equip the students with methods of solving a general system of linear equations
2	To familiarize them with the concept of Eigen values and diagonalization of a matrix which have many applications in Engineering
3	To understand the basic theory of functions of a complex variable and conformal Transformations

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Solve any given system of linear equations
2	Find the Eigen values of a matrix and how to diagonalise a matrix
3	Identify analytic functions and harmonic functions.
4	Evaluate real definite Integrals as application of Cauchy integral theorem.
5	Evaluate real definite Integrals as application of Residue Theorem.
6	Identify conformal mappings and find regions that are mapped under certain Transformations

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-		-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-		-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-		-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-		-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-		-	-
CO6	3	3	-	-	-	-	-	-	-	-	-	-		-	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Apply the knowledge of mathematics, science and engineering fundamentals and engineering specialization to the complex engineering problems
	PO2	3	Identify, formulate and analyze engineering problems using first principle of mathematics and engineering sciences
CO2	PO1	3	Apply the knowledge of mathematics, science and engineering fundamentals and engineering specialization to the complex engineering problems
	PO2	3	Identify, formulate and analyze engineering problems using first principle of mathematics and engineering sciences
CO3	PO1	3	Apply the knowledge of mathematics, science and engineering fundamentals and engineering specialization to the complex engineering problems
	PO2	3	Identify, formulate and analyze engineering problems using first principle of mathematics and engineering sciences
CO4	PO1	3	Apply the knowledge of mathematics, science and engineering fundamentals and engineering specialization to the complex engineering problems
	PO2	3	Identify, formulate and analyze engineering problems using first principle of mathematics and engineering sciences
CO5	PO1	3	Apply the knowledge of mathematics, science and engineering fundamentals and engineering specialization to the complex engineering problems
	PO2	3	Identify, formulate and analyze engineering problems using first principle of mathematics and engineering sciences
CO6	PO1	3	Apply the knowledge of mathematics, science and engineering fundamentals and engineering specialization to the complex engineering problems
	PO2	3	Identify, formulate and analyze engineering problems using first principle of mathematics and engineering sciences

ME 201 MECHANICS OF SOLIDS

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Mechanics of Solids**	Course code**: ME 201**
L-T-P**: 3-1-0**	Credit**: 4**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction to analysis of deformable bodies – internal forces – method of sections – assumptions and limitations. Stress – stresses due to normal, shear and bearing loads – strength design of simple members. Definition of linear and shear strains. Material behavior – uniaxial tension test – stress-strain diagrams concepts of orthotropy, anisotropy and inelastic behavior – Hooke's law for linearly elastic isotropic material under axial and shear deformation. Deformation in axially loaded bars – thermal effects – statically indeterminate problems – principle of superposition - elastic strain energy for uniaxial stress.	10	15
II	Definition of stress and strain at a point (introduction to stress and strain tensors and its components only) – Poisson's ratio – biaxial and triaxial deformations – Bulk modulus - Relations between elastic. Torsion: Shafts - torsion theory of elastic circular bars – assumptions and 15% limitations – polar modulus - torsional rigidity – economic cross-sections – statically indeterminate problems – shaft design for torsional load.	8	15
III	Beams- classification - diagrammatic conventions for supports and loading - axial force, shear force and bending moment in a beam. Shear force and bending moment diagrams by direct approach. Differential equations between load, shear force and bending moment. Shear force and bending moment diagrams by summation approach – elastic curve – point of inflection.	10	15
IV	Stresses in beams: Pure bending – flexure formula for beams assumptions and limitations – section modulus - flexural rigidity - economic sections – beam of uniform strength. Shearing stress formula for beams – assumptions and limitations – design for flexure and shear.	8	15
V	Deflection of beams: Moment-curvature relation – assumptions and limitations - double integration method – Macaulay's method - superposition techniques – moment area method and conjugate beam ideas for simple cases. Transformation of stress and strains: Plane state of stress - equations of transformation - principal planes and stresses.	10	20

VI	Mohr's circles of stress – plane state of strain – analogy between stress and strain transformation – strain rosettes. Compound stresses: Combined axial, flexural and shear loads – eccentric loading under tension/compression - combined bending and twisting loads. loading under tension/compression - combined bending and twisting loads.	7	20

TEXT BOOKS:

1	Rattan, Strength of Materials, 2e McGraw Hill Education India, 2011
2	S.Jose, Sudhi Mary Kurian, Mechanics of Solids, Pentagon, 2015

REFERENCES:

1	S. H. Crandal, N. C. Dhal, T. J. Lardner, An introduction to the Mechanics of Solids, McGraw Hill, 1999
2	R. C. Hibbeler, Mechanics of Materials, Pearson Education,2008
3	I.H. Shames, J. H. Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India, 2006
4	James M.Gere, Stephen Timoshenko, Mechanics of Materials, CBS Publishers & Distributors, New Delhi,2012
5	F. Beer, E. R. Johnston, J. T. DeWolf, Mechanics of Materials, Tata McGraw Hill, 2011
6	A. Pytel, F. L. Singer, Strength of Materials, Harper & Row Publishers, New York,1998
7	E. P. Popov, T. A. Balan, Engineering Mechanics of Solids, Pearson Education, 2012
8	R. K. Bansal, Mechanics of solids, Laxmi Publications, 2004
9	P. N. Singh, P. K. Jha, Elementary Mechanics of Solids, Wiley Eastern Limited, 2012

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To acquaint with the basic concepts of stress and deformation in solids.
2	To practice the methodologies to analyse stresses and strains in simple structural members, and to apply the results in simple design problems.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Understand the basic concepts of stress and strain and apply this knowledge for the analysis of axially loaded, thermal stress and statically indeterminate structure problems.
2	Apply elastic constant relationship and the torsion theory for shaft size selection.
3	Analyse the shear force and bending moment that develops in a beam for various loads.

4	Determine the bending stress and shear stress in beams and analyse the changes.
5	Develop the governing differential equation for the elastic curve and Apply different techniques for finding out the deflection at required points. Apply stress transformation equation for analysing stress planes.
6	Apply Mohr's circle for finding principal stresses and Calculate the buckling load for columns with different end conditions.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	1	3	2	-	-	-	-	-	-	-	-	-		3	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-		3	-
CO3	3	3	1	-	-	-	-	-	-	-	-	-		3	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-		3	-
CO5	3	3	1	-	-	-	-	-	-	-	-	-		3	-
CO6	3	3	1	-	-	-	-	-	-	-	-	-		3	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	1	Basic concepts and relations of stress and strain enable the students to apply the equations for solving problems in solid mechanics.
	PO2	3	Equations of deformation enable the students to identify, formulate and analyze problems in the Design of components
	PO3	2	Fundamental of stress and strain enable the students to do safe and sound design of structures.
CO2	PO1	3	Knowledge of elastic constants relation will enable the students to apply these equations for solving problems.
	PO2	3	Torsion formula enable the students to analyze complex problems in shaft design
	PO3	3	Torsion theory Enable the students to do safe and sound design of structures.
CO3	PO1	3	Knowledge of shear force bending moment in beams will enable the students to solve complex problems in beam bending.
	PO2	3	Understanding of shear force and bending moment diagram enable the students to identify, formulate and analyze engineering problems.
	PO3	1	Shear force and bending moment study will enable the students to design safe and sound design of structures.
CO4	PO1	3	Knowledge to bending formula will enable the students to solve problems in the design of structures.
	PO2	3	Understanding of nature of stresses developed enable the students to analyze problems in the structural and component design.
	PO3	3	Bending and shear stress analysis enable the students to do safe and sound design of components and structures.
CO5	PO1	3	Knowledge to compute the deflection in beams will enable the students to apply these equations for solve problems in Structural design of beams.
	PO2	3	Clear understanding of stress transformation and principal stresses enable the

			students to analyze the stresses in different planes of a component
	PO3	3	Enable the students to design safe and sound design of components and structures
CO6	PO1	3	Knowledge to use mohr circle will enable the students to apply the method to find out graphical solution to stresses in structures.
	PO2	3	Understanding of Column and compound stress theory will enable the students to identify, formulate and analyze problems in structural mechanics.
	PO3	1	Application of mohr's circle and column deflection formula for solving structural problems enables the students to design safe and sound design of structural members.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	3	Student's knowledge in solid Mechanics will be enhanced by studying fundamental equations of elasticity.
CO2	PSO1	3	Knowledge in elastic constants and torsion theory will enhance Student's capability to solve engineering problems.
CO3	PSO1	3	Knowledge of shear force and bending moment helps in solving basic problems in beams, machine components and structures.
CO4	PSO1	3	Clear understanding of bending stresses and shear stresses developed in beam will enhance student's capability to solve engineering problems.
CO5	PSO1	3	Application of deflection and stress transformation equations will enhance the student's capability to analyze and design mechanical components and structures.
CO6	PSO1	3	Application of mohr's circle and column theory enable student to solve real time problems in structures, beams and mechanical components.

ME 203 MECHANICS OF FLUIDS

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Mechanics of Fluids**	Course code**: ME 203**
L-T-P**: 3-1-0**	Credit**: 4**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction: Fluids and continuum, Physical properties of fluids, density, specific weight, vapour pressure, Newton's law of viscosity. Ideal and real fluids, Newtonian and non-Newtonian fluids. Fluid Statics- Pressure-density-height relationship, manometers, pressure on plane and curved surfaces, center of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to uniform accelerations, measurement of pressure.	8	15
II	Kinematics of fluid flow: Eulerian and Lagrangian approaches, classification of fluid flow, 1-D, 2-D and 3-D flow, steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational, irrotational flows, stream lines, path lines, streak lines, stream tubes, velocity and acceleration in fluid, circulation and vorticity, stream function and potential function, Laplace equation, equipotential lines flow nets, uses and limitations.	8	15
III	Dynamics of Fluid flow: Fluid Dynamics: Energies in flowing fluid, head, pressure, dynamic, static and total head, Control volume analysis of mass, momentum and energy, Equations of fluid dynamics: Differential equations of mass, energy and momentum (Euler's equation), Navier-Stokes equations (without proof) in rectangular and cylindrical co-ordinates, Bernoulli's equation and its applications: Venturi and Orifice meters, Notches and Weirs (description only for notches and weirs). Hydraulic coefficients, Velocity measurements: Pitot tube and Pitot-static tube.	10	15
IV	Pipe Flow: Viscous flow: Reynolds experiment to classify laminar and turbulent flows, significance of Reynolds number, critical Reynolds number, shear stress and velocity distribution in a pipe, law of fluid friction, head loss due to friction, Hagen Poiseuille equation. Turbulent flow: Darcy- Weisbach equation, Chezy's equation Moody's chart, Major and minor energy losses, hydraulic gradient and total energy line, flow through long pipes, pipes in series, pipes in parallel, equivalent pipe, siphon, transmission of power through pipes, efficiency of transmission, Water hammer, Cavitation.	12	15
V	Concept of Boundary Layer: Growth of boundary layer over a flat plate and definition of boundary layer thickness, displacement thickness, momentum thickness and energy thickness, laminar and turbulent boundary layers, laminar sub	10	20

	layer, velocity profile, Von- Karman momentum integral equations for the boundary layers, calculation of drag, separation of boundary and methods of control.		
VI	Dimensional Analysis and Hydraulic similitude: Dimensional analysis, Buckingham's theorem, important dimensional numbers and their significance, geometric, Kinematic and dynamic similarity, model studies. Froude, Reynold, Weber, Cauchy and Mach laws- Applications and limitations of model testing, simple problems only.	8	20

TEXT BOOKS:

1	Balachandran.P, Engineering Fluid Mechanics, PHI,2012
2	A S Saleem, Fluid Mechanics, Fathima Books,2016

REFERENCES:

1	Cengel, Fluid Mechanics, McGraw Hill Education India 2014
2	Bansal R. K., A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications, 2005
3	Modi P. N. and S. M. Seth, Hydraulics & Fluid Mechanics, S.B.H Publishers, New Delhi, 2002
4	Streeter V. L., E. B. Wylie and K. W. Bedford, Fluid Mechanics, Tata McGraw Hill, Delhi, 2010.
5	Joseph Karz, Introductory Fluid Mechanics, Cambridge University press,2010
6	Fox R. W. and A. T. McDonald, Introduction to Fluid dynamics, 5/e, John Wiley and Sons, 2009.
7	Shames I. H, Mechanics of Fluids, McGraw Hill, 1992.
8	White F.M., Fluid Mechanics, 6/e, Tata McGraw Hill, 2008

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To study the mechanics of fluid motion.
2	To establish fundamental knowledge of basic fluid mechanics and address specific topics relevant to simple applications involving fluids.
3	To familiarize students with the relevance of fluid dynamics to many engineering systems.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Calculate pressure variations in accelerating fluids using Euler's and Bernoulli's equations.
2	Become conversant with the concepts of flow measurements and flow through pipes.
3	Apply the momentum and energy equations to fluid flow problems.
4	Evaluate head loss in pipes and conduits.
5	Explain the concept of Boundary layer; analyze flow by boundary layer theory.

6	Use dimensional analysis to design physical or numerical experiments and to apply dynamic similarity.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	1		3	-
CO2	3	3	3	2	-	-	-	-	-	-	-	1		3	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-		3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-		3	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-		3	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Students will be able to solve complex engineering problems related to fluid mechanics, based on acquired knowledge
	PO2	3	Problem analysis based on first principles of mathematics and research based relevant data is essential to analyze the pressure variations in accelerating fluids.
	PO12	1	The student may recognize the need for lifelong learning in the context of technological changes pertaining to fluid mechanics
CO2	PO1	3	Students will be able to solve complex engineering problems related to flow measuring devices and pipe flow, based on acquired knowledge
	PO2	3	Problem analysis based on first principles of mathematics and research based relevant data is essential to analyze the pipe flow problems.
	PO3	3	In the design/development of solutions for complex pipeflow problems and to design fluid transmission systems that ensures public safety on ground, the knowledge of flow characteristics is essential.
	PO4	2	While conducting investigations of complex problems on pipe system, the student has to use research-based knowledge including analysis and interpretation of data to provide valid conclusions.
	PO12	1	The student may recognize the need for lifelong learning in the context of technological changes pertaining to various applications of fluid mechanics.
CO3	PO1	3	Strong knowledge in mathematics, science and engineering fundamentals helps to apply momentum and energy equations in complex fluid flow problems
	PO2	3	Problem analysis based on first principles of mathematics and research based relevant data is essential to analyze fluid flow problems.
	PO3	2	In designing solutions for complex flow problems and system components, momentum and energy equations need to be applied.
	PO4	2	To conduct investigations of complex problems on experimental analysis of lifting surfaces/aerodynamic bodies in wind tunnels and to generate relevant experimental data, the fundamental background on momentum and energy equations is essential
CO4	PO1	3	Application of basic knowledge in mathematics and engineering fundamentals is essential to evaluate heat losses in pipes and conduits

	PO2	3	Problem analysis in the area of complex system of pipes and conduits requires research-based literature and formulation of engineering problems using principles of mathematics and engineering.
CO5	PO1	3	Students must apply the knowledge of mathematics and engineering fundamentals in the analysis of flow by boundary layer theory for solving complex flow problems in engineering industries.
	PO2	3	Problem analysis using principles of mathematics and engineering is essential to solve boundary layer flow problems.
CO6	PO1	3	Student will be able to apply basic/fundamental knowledge in (engineering) for dimensional analysis, wind tunnel application, design and development of prototypes for solving complex problems fluid machinery.
	PO2	3	Problem analysis based on first principles of mathematics (Rayleigh method, pi theorem etc.) is essential to analyze, evaluate, and recommend appropriate non-dimensional terms for a fluid flow experiment.
	PO3	3	In the design/development of solutions for complex external flow problems in wind tunnel/water tunnel etc. and to design fluid dynamic systems that ensures civilian safety on ground, the knowledge of devising a test model based on dimensional analysis before building a prototype is a must.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	3	The Students will be able to solve real time flow problems and flow measurement problems and design problems in Fluid Mechanics after the successful completion of the course.
CO2	PSO1	3	The Students will be able to solve real time flow problems and flow measurement problems and design problems in Fluid Mechanics after the successful completion of the course.
CO3	PSO1	3	The Students will be able to solve real time flow problems and flow measurement problems and design problems in Fluid Mechanics after the successful completion of the course.
CO4	PSO1	3	The Students will be able to solve real time flow problems and flow measurement problems and design problems in Fluid Mechanics after the successful completion of the course.
CO5	PSO1	3	The Students will be able to solve real time flow problems and flow measurement problems and design problems in Fluid Mechanics after the successful completion of the course.
CO6	PSO1	3	The Students will be able to solve real time flow problems and flow measurement problems and design problems in Fluid Mechanics after the successful completion of the course.

ME 205 THERMODYNAMICS

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Thermodynamics**	Course code**: ME 205**
L-T-P**: 3-1-0**	Credit**: 4**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Role of Thermodynamics in Engineering and Science -- Applications of Thermodynamics Basic Concepts - Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic System and Control Volume, Surrounding, Boundaries, Types of Systems, Universe, Thermodynamic properties, Process, Cycle, Thermodynamic Equilibrium, Quasi – static Process, State, Point and Path function. (Review only- self study) Zeroth Law of Thermodynamics, Measurement of Temperature- Thermometry, reference Points, Temperature Scales, Ideal gas temperature scale, Comparison of thermometers-Gas Thermometers, Thermocouple, Resistance thermometer Energy - Work - Pdv work and other types of work transfer, free expansion work, heat and heat capacity.	7	15
II	Joule's Experiment- First law of Thermodynamics - First law applied to Non flow Process- Enthalpy- specific heats- PMM1, First law applied to Flow Process, Mass and Energy balance in simple steady flow process. Applications of SFEE, Transient flow –Filling and Emptying Process. (Problems), Limitations of the First Law.	8	15
III	Second Law of Thermodynamics, Thermal Reservoir, Heat Engine, Heat pump - Performance factors, Kelvin-Planck and Clausius Statements, Equivalence of two statements, Reversibility, Irreversible Process, Causes of Irreversibility, Corollaries of second law, PMM2, Carnot's theorem and its corollaries, Absolute Thermodynamic Temperature scale. Clausius Inequality, Entropy- Causes of Entropy Change, Entropy changes in various thermodynamic processes, principle of increase of entropy and its applications, Entropy generation in open and closed system, Entropy and Disorder, Reversible adiabatic process- isentropic process.	10	15
IV	Available Energy, Availability and Irreversibility- Useful work, Dead state, Availability function, Availability and irreversibility in open and closed systems - Gouy-Stodola theorem, Third law of thermodynamics. Pure Substances, Phase Transformations, Triple point, properties during change of phase, T-v, p-v and p-T diagram of pure substance, p-v-T surface, Saturation pressure and Temperature, T-h and T-s diagrams, h-s diagrams or Mollier Charts, Dryness Fraction, steam tables. Property	10	15

	calculations using steam tables.		
V	The ideal Gas Equation, Characteristic and Universal Gas constants, Deviations from ideal Gas Model: Equation of state of real substances- Vander Waals Equation of State, Berthelot, Dieterici, and Redlich-Kwong equations of state , Virial Expansion, Compressibility factor, Law of corresponding state, Compressibility charts Mixtures of ideal Gases – Mole Fraction, Mass fraction, Gravimetric and volumetric Analysis, Dalton's Law of partial pressure, Amagat's Laws of additive volumes, Gibbs-Dalton's law - Equivalent Gas constant and Molecular Weight, Properties of gas mixtures: Internal Energy, Enthalpy, specific heats and Entropy, Introduction to real gas mixtures- Kay's rule. *Introduction to ideal binary solutions, Definition of solution, ideal binary solutions and their characteristics, Deviation from ideality, Raoult's Law, Phase diagram, Lever rule (*in this section numerical problems not)	11	20
VI	General Thermodynamic Relations – Combined First and Second law equations – Helmholtz and Gibb's functions - Maxwell's Relations, Tds Equations. The Clapeyron Equation, equations for internal energy, enthalpy and entropy, specific heats, Throttling process, Joule Thomson Coefficient, inversion curve. Introduction to thermodynamics of chemically reacting systems, Combustion, Thermochemistry – Theoretical and Actual combustion processes- Definition and significance of equivalence ratio, enthalpy of formation, enthalpy of combustion and heating value (#in this section numerical problems not included)	10	20

TEXT BOOKS:

1	P.K.Nag, Engineering Thermodynamics, McGraw Hill,2013
2	E.Rathakrishnan Fundamentals of Engineering Thermodynamics, PHI,2005

REFERENCES:

1	Y. A. Cengel and M. A.Boles,Thermodynamics an Engineering Approach,McGraw Hill, 2011
2	G.VanWylen, R.Sonntag and C.Borgnakke, Fundamentals of Classical Thermodynamics, John Wiley & Sons,2012
3	Holman J.P, Thermodynamics, McGraw Hill, 2004
4	M.Achuthan, Engineering Thermodynamics, PHI,2004

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To understand basic thermodynamic principles and laws
2	To develop the skills to analyze and design thermodynamic systems

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Understand the basic concepts of thermodynamics, temperature measurement and techniques used.
2	Understand and apply the first Law of Thermodynamics on closed and control volume systems and to analyze preliminary problems.
3	Understand and apply Second Law of Thermodynamics, reversibility and irreversibility and entropy concepts in analyzing preliminary problems.
4	Understand and apply the concept of availability and irreversibility of a thermodynamic system and also will be able to analyze the properties of pure substances from property diagrams and tables.
5	Understand the concept of real and ideal substances and also will be able understand and analyze the properties of ideal gas mixtures.
6	Understand the general thermodynamic relations used for analyzing properties and also the basic concepts of throttling and combustion process.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	1	1	1	-	-	-	-	-	-	-	-	-		1	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-		3	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-		2	-
CO4	2	3	-	2	-	-	-	-	-	-	-	-		2	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-		2	-
CO6	1	1	-	-	-	-	-	-	-	-	-	-		1	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	1	May able to solve problems regarding temperature measurement from the fundamentals Zeroth law.
	PO2	1	Students will be able to analyze problems using the knowledge in Zeroth law.
	PO3	1	Students will be able to design temperature measuring devices using the knowledge in Zeroth law.
CO2	PO1	3	Students will be able to solve problems regarding compressors, nozzles and turbines etc. with the knowledge of Steady Flow Energy Equation.

	PO2	3	Helps to identify and analyze complex problems on nozzles, compressors, turbines etc. reaching substantiated conclusions using principles of Steady Flow.
	PO3	2	Helps the students to design steady flow components like nozzle, compressor etc. that satisfy specific needs.
CO3	PO1	2	Students will be able to solve problems regarding heat engines and refrigeration system from the fundamentals of Second Law of Thermodynamics.
	PO2	2	Students will be able to analyze problems regarding heat engines and refrigeration system reaching substantiated conclusions using from the fundamentals of Second Law of Thermodynamics.
CO4	PO1	2	Students will be able to solve problems regarding steam properties with help of property diagrams and tables.
	PO2	3	Students will be able to analyze problems regarding steam properties reaching substantiated conclusions with help of property diagrams and tables.
	PO4	2	Interpretation of properties with the help of property diagram and tables helps the students to provide valid conclusions.
CO5	PO1	2	Students will be able to find out the change in properties of gas mixtures from the fundamentals of Thermodynamics.
	PO2	2	Students will be able to analyze the effect mixing of pure gases reaching substantiated conclusions.
CO6	PO1	1	Students may able to solve problems regarding combustion of fuels.
	PO2	1	May able to analyze throttling process reaching substantiated conclusions

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	1	Students may able to solve real-time problems temperature measurement from the knowledge gained Zeroth law.
CO2	PSO1	3	Students will be able to solve problems on steady flow components like nozzles, compressor etc. in thermal and fluid sectors.
CO3	PSO1	2	Students may able to solve problems regarding heat engine and refrigeration sector from the knowledge of Second Law of thermodynamics.
CO4	PSO1	2	Students may be able to analyze the steam properties in steam powerplant sector.
CO5	PSO1	2	Helps the students to analyze the change in properties due to mixing of gases in thermal & steam power plants.
CO6	PSO1	1	Students may able to solve problems in refrigeration system by analyzing the throttling process from the fundamentals of Joule-Thompson effects.

ME 210 METALLURGY AND MATERIALS ENGINEERING

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Metallurgy and Materials Engineering**	Course code**: ME 210**
L-T-P**: 3-0-0**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Earlier and present development of atomic structure; attributes of ionization energy and conductivity, electronegativity and alloying; correlation of atomic radius to strength; electron configurations; electronic repulsion Primary bonds: - characteristics of covalent, ionic and metallic bond: attributes of bond energy, cohesive force, density, directional and non-directional and ductility. properties based on atomic bonding:- attributes of deeper energy well and shallow energy well to melting temperature, coefficient of thermal expansion - attributes of modulus of elasticity in metal cutting process -Secondary bonds:- classification- hydrogen bond and anomalous behavior of ice float on water, application- atomic mass unit and specific heat, application. *(brief review only, no University questions and internal assessment from these portions).* Crystallography:- Crystal, space lattice, unit cell- BCC, FCC, HCP structures - short and long range order – effects of crystalline and amorphous structure on mechanical properties. Coordination number and radius ratio; theoretical density; simple problems - Polymorphism and allotropy. Miller Indices: - crystal plane and direction *(brief review)*. Attributes of miller indices for slip system, brittleness of BCC, HCP and ductility of FCC - Modes of plastic deformation: - Slip and twinning. Schmid's law, equation, critical resolved shear stress, correlation of slip system with plastic deformation in metals and applications.	6	15
II	Mechanism of crystallization: Homogeneous and heterogeneous nuclei formation, under cooling, dendritic growth, grain boundary irregularity. Effects of grain size, grain size distribution, grain shape, grain orientation on dislocation/strength and creep resistance - Hall – Petch theory, simple problems. Classification of crystal imperfections: - types of dislocation – effect of point defects on mechanical properties - forest of dislocation, role of surface defects on crack initiation. Burgers vector dislocation source, significance of Frank Read source in metals deformation - Correlation of dislocation density with strength and nano concept, applications. Significance high and low angle grain boundaries on dislocation – driving force for grain growth and applications during heat treatment. Polishing and etching to	8	15

	determine the microstructure and grain size. Fundamentals and crystal structure determination by X – ray diffraction, simple problems –SEM and TEM. Diffusion in solids, Fick's laws, mechanisms, applications of diffusion in mechanical engineering, simple problems.		
III	Phase diagrams: - Limitations of pure metals and need of alloying - classification of alloys, solid solutions, Hume Rothery`s rule - equilibrium diagram of common types of binary systems: five types. Coring - lever rule and Gibb`s phase rule - Reactions: - monotectic, eutectic, eutectoid, peritectic, peritectoid. Detailed discussion on Iron-Carbon equilibrium diagram with microstructure and properties changes in austenite, ledeburite, ferrite, cementite, special features of martensite transformation, bainite, spheroidite etc. Heat treatment: - Definition and necessity – TTT for a eutectoid iron–carbon alloy, CCT diagram, applications - annealing, normalizing, hardening, spheroidizing. Tempering:- austermpering, martempering and ausforming - Comparative study on ductility and strength with structure of pearlite, bainite, spherodite, martensite, tempered martensite and ausforming. Hardenability, Jominy end quench test, applications- Surface hardening methods:- no change in surface composition methods :- Flame, induction, laser and electron beam hardening processes- change in surface composition methods :carburizing and Nitriding; applications.	8	15
IV	Types of Strengthening mechanisms: - work hardening, equation - precipitation strengthening and over ageing dispersion hardening. Cold working: Detailed discussion on strain hardening; recovery; re-crystallization, effect of stored energy; recrystallization temperature - hot working Bauschinger effect and attributes in metal forming. Alloy steels:- Effects of alloying elements on steel: dislocation movement, polymorphic transformation temperature, alpha and beta stabilizers, formation and stability of carbides, grain growth, displacement of the eutectoid point, retardation of the transformation rates, improvement in corrosion resistance, mechanical properties Nickel steels, Chromium steels etc. - Enhancement of steel properties by adding alloying elements: - Molybdenum, Nickel, Chromium, Vanadium, Tungsten, Cobalt, Silicon, Copper and Lead. High speed steels:- Mo and W types, effect of different alloying elements in HSS Cast irons: Classifications; grey, white, malleable and spheroidal graphite cast iron etc, composition, microstructure, properties and applications. Principal Nonferrous Alloys: - Aluminum, Copper, Magnesium, Nickel, study of composition, properties, applications, reference shall be made to the phase diagrams whenever necessary.	7	15
V	Fatigue: - Stress cycles – Primary and secondary stress raisers - Characteristics of fatigue failure, fatigue tests, S-N curve. Factors affecting fatigue strength: stress concentration, size effect, surface roughness, change in surface properties, surface residual stress. Ways to improve fatigue life – effect of temperature on fatigue, thermal fatigue and its applications in	6	20

	metal cutting Fracture: – Brittle and ductile fracture – Griffith theory of brittle fracture – Stress concentration, stress raiser – Effect of plastic deformation on crack propagation. trans granular, intergranular fracture - Effect of impact loading on ductile material and its application in forging, applications - Mechanism of fatigue failure. Structural features of fatigue: - crack initiation, growth, propagation - Fracture toughness (definition only) – Ductile to brittle transition temperature (DBTT) in steels and structural changes during DBTT, applications.		
VI	Creep: - Creep curves – creep tests - Structural change:- deformation by slip, sub-grain formation, grain boundary sliding Mechanism of creep deformation - threshold for creep, prevention against creep - Super plasticity: need and applications Composites:- Need of development of composites - geometrical and spatial Characteristics of particles – classification - fiber phase: - characteristics, classifications - matrix phase:- functions – only need and characteristics of PMC, MMC, and CMC – applications of composites: aircraft applications, aerospace equipment and instrument structure, industrial applications of composites, marine applications, composites in the sporting goods industry, composite biomaterials. Modern engineering materials: - only fundamentals, need, properties and applications of, intermetallics, maraging steel, super alloys, Titanium – introduction to nuclear materials, smart materials and bio materials. Ceramics:-coordination number and radius ratios- AX, A_mX_p, $A_mB_mX_p$ type structures – applications.	7	20

TEXT BOOKS:

1	Raghavan V, Material Science and Engineering, Prentice Hall,2004
2	Jose S and Mathew E V, Metallurgy and Materials Science, Pentagon, 2011

REFERENCES:

1	Anderson J.C. *et.al*., Material Science for Engineers,Chapman and Hall,1990
2	Clark and Varney, Physical metallurgy for Engineers, Van Nostrand,1964Wiley & Sons,2012
3	Reed Hill E. Robert, Physical metallurgy principles, 4th Edn. Cengage Learning,2009
4	Avner H Sidney, Introduction to Physical Metallurgy, Tata McGraw Hill,2009
5	Callister William. D., Material Science and Engineering, John Wiley,2014
6	Dieter George E, Mechanical Metallurgy,Tata McGraw Hill,1976
7	Higgins R.A. - Engineering Metallurgy part - I – ELBS,1998
8	Myers Marc and Krishna Kumar Chawla, Mechanical behavior of materials, Cambridge University press,2008
9	Van Vlack -Elements of Material Science - Addison Wesley,1989

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To provide fundamental science relevant to materials
2	To provide physical concepts of atomic radius, atomic structure, chemical bonds, crystalline and non-crystalline materials and defects of crystal structures, grain size, strengthening mechanisms, heat treatment of metals with mechanical properties and changes in structure.
3	To enable students to be more aware of the behavior of materials in engineering applications and select the materials for various engineering applications.
4	To understand the causes behind metal failure and deformation.
5	To determine properties of unknown materials and develop an awareness to apply this knowledge in material design.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Identify the crystal structures of metallic materials.
2	Analyze the binary phase diagrams of alloys.
3	Analyze the microstructure with properties, processing and performance of metals.
4	Analyze the failure of metals with structural change.
5	Recommend materials for design and construction.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	3	-	-		-	-
CO2	-	3	3	2	-	-	-	-	-	-	-	-		-	-
CO3	-	3	3	-	-	2	-	2	-	-	-	-		-	-
CO4	-	3	3	-	-	2	-	2	-	-	-	-		-	-
CO5	-	3	3	-	-	-	-	-	-	-	-	-		3	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	As they could apply their knowledge of engineering fundamentals to the solution of complex engineering problems.
	PO10	3	Students will be able to communicate to the engineering community regarding the structure of materials.
CO2	PO2	3	As they could analyze phase diagrams to arrive at substantiated conclusions.
	PO3	3	As they could design solutions with the help of phase diagrams to meet the specifications with consideration for the public health and safety.
	PO4	2	As they could interpret data and synthesis of the information to provide valid conclusions.
CO3	PO2	3	As they could analyze phase diagrams to arrive at substantiated conclusions.

	PO3	**3**	As they could design solutions with the help of phase diagrams to meet the specifications with consideration for the public health and safety.
CO4	PO2	**3**	As they could analyze failure of engineering materials and arrive at substantiated conclusions.
	PO3	**3**	With the knowledge gained they could develop solutions by considering the societal and environmental impacts.
CO5	PO2	**2**	Students will be able to identify and arrive at conclusions regarding the type of material to be used for a particular application.
	PO3	**2**	With the knowledge gained they can design components by considering the public health and safety.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO5	PSO1	**3**	Students will be able to select materials depending upon the application for designing components.

HS210 LIFE SKILLS

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Life Skills**	Course code**: HS 210**
L-T-P**: 2-0-2**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS L-P
I	Need for Effective Communication, Levels of communication; Flow of communication; Use of language in communication; Communication networks; Significance of technical communication, Types of barriers; Miscommunication; Noise; Overcoming measures, Listening as an active skill: Types of Listeners; Listening for general content; Listening to fill up information; Intensive Listening; Listening for specific information; Developing effective listening skills; Barriers to effective listening skills. Technical Writing: Differences between technical and literary style, Elements of style; Common Errors, Letter Writing: Formal, informal and demi-official letters; business letters, Job Application: Cover letter, Differences between bio-data, CV and Resume, Report Writing: Basics of Report Writing; Structure of a report; Types of reports. Non-verbal Communication and Body Language: Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language Interview Skills: Types of Interviews; Ensuring success in job interviews; Appropriate use of non-verbal communication, Group Discussion: Differences between group discussion and debate; Ensuring success in group discussions, Presentation Skills: Oral presentation and public speaking skills; business presentations, Technology-based Communication: Netiquettes: effective e-mail messages; power-point presentation; enhancing editing skills using computer software.	5-10
II	Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence. Steps in problem solving, Problem Solving Techniques, Problem Solving through Six Thinking Hats, Mind Mapping, Forced Connections. Problem Solving strategies, Analytical Thinking and quantitative reasoning expressed in written form, Numeric, symbolic, and graphic reasoning, Solving application problems.	4-4
III	Introduction to Groups and Teams, Team Composition, Managing Team Performance, Importance of Group, Stages of Group, Group Cycle, Group thinking, getting acquainted, Clarifying expectations. Group Problem Solving, Achieving Group Consensus. Group Dynamics techniques, Group vs Team, Team Dynamics, Teams for enhancing productivity, Building & Managing Successful Virtual Teams. Managing Team Performance & Managing Conflict in Teams. Working Together in Teams, Team Decision-Making, Team Culture & Power, Team Leader Development.	6-4

IV	Morals, Values and Ethics, Integrity, Work Ethic, Service Learning, Civic Virtue, Respect for Others, Living Peacefully. Caring, Sharing, Honesty, Courage, Valuing Time, Cooperation, Commitment, Empathy, Self-Confidence, Character Spirituality, Senses of 'Engineering Ethics', variety of moral issued, Types of inquiry, moral dilemmas, moral autonomy, Kohlberg's theory, Gilligan's theory, Consensus and controversy, Models of Professional Roles, Theories about right action, Self-interest, customs and religion, application of ethical theories. Engineering as experimentation, engineers as responsible experimenters, Codes of ethics, Balanced outlook on. The challenger case study, Multinational corporations, Environmental ethics, computer ethics, Weapons development, engineers as managers, consulting engineers, engineers as expert witnesses and advisors, moral leadership, sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers(India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers(IETE), India, etc.	12-4
V	Introduction, a framework for considering leadership, entrepreneurial and moral leadership, vision, people selection and development, cultural dimensions of leadership, style, followers, crises. Growing as a leader, turnaround leadership, gaining control, trust, managing diverse stakeholders, crisis management. Implications of national culture and multicultural leadership Types of Leadership, Leadership Traits. Leadership Styles, VUCA Leadership, DART Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders, making of a Leader, Formulate Leadership	6-4

TEXT BOOKS:

1	Life Skills for Engineers, Complied by ICT Academy of Kerala, McGraw Hill Education (India) Private Ltd., 2016

REFERENCES:

1	Barun K. Mitra; (2011), "Personality Development & Soft Skills", First Edition; Oxford Publishers.
2	Kalyana; (2015) "Soft Skill for Managers"; First Edition; Wiley Publishing Ltd.
3	Larry James (2016); "The First Book of Life Skills"; First Edition; Embassy Books.
4	Shalini Verma (2014); "Development of Life Skills and Professional Practice"; First Edition; Sultan Chand (G/L) & Company

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To develop communication competence in prospective engineers.
2	To enable them to convey thoughts and ideas with clarity and focus.
3	To develop report writing skills.
4	To equip them to face interview & Group Discussion.

5	To inculcate critical thinking process.
6	To prepare them on problem solving skills.
7	To provide symbolic, verbal, and graphical interpretations of statements in a problem description.
8	To understand team dynamics & effectiveness.
9	To create an awareness on Engineering Ethics and Human Values.
10	To instill Moral and Social Values, Loyalty and also to learn to appreciate the rights of others.
11	To learn leadership qualities and practice them.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Students will be able to realize the important factors involved in verbal/non-verbal communication in a professional context.
2	Students will be able to apply creative and critical thinking while approaching different types of problems.
3	Students should be able to become an adaptable team member as well as a leader who could successfully manage any team/group.
4	Students in future would become a professional who has inculcated integrity, values, ethics and realize his/her commitment to the society.
5	Students will realize the factors involved in the growth of an effective leader and become one in the future.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	-	-	-	-	-	-	3	-	-	-	-	-		-	-
CO2	-	1	-	-	-	-	-	-	-	-	-	-		-	-
CO3	-	-	-	-	-	3	-	-	-	-	-	-		-	-
CO4	-	-	-	-	-	-	-	3	3	1	1	-		-	-
CO5	-	-	-	-	-	3	-	-	-	-	-	-		-	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO7	3	Apply the knowledge of mathematics, science and engineering fundamentals and engineering specialization to the complex engineering problems.
CO2	PO2	1	Students should be able to apply their creative and critical thought process to solve complex problems.
CO3	PO6	3	Students are familiarized with the stages of group formation, types of groups and teams, their differences, team performance management and group problem solving methods.

CO4	PO8	3	Students are familiarized with many case studies which effectively conveys the role of an engineer in a society and the paramount importance of public. health and safety an engineer should be concerned with.
	PO9	3	Students should not ignore the importance of ethics and morality as professionals.
	PO10	1	Environmental ethics, computer ethics professional ethics professed by certain professional associations are to be familiarized by students.
	PO11	1	Students must understand the theory of moral development as well as the responsibilities of an engineer as a manager, expert witness and consulting engineer.
CO5	PO6	3	Different leadership styles based on different contexts and the growing stages of a leader must be familiarized by the students.

ME 231 COMPUTER AIDED MACHINE DRAWING LAB

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Computer Aided Machine Drawing Lab**	Course code**: ME 231**
L-T-P**: 0-0-3**	Credit**: 1**

SYLLABUS:

MODULE	CONTENT	HOURS
0	Introduction, Principles of drawing, free hand sketching, manual drawing, CAD drawing etc.	1
I	Drawing standards**:** 2 exercises Code of practice for Engineering Drawing, BIS specifications – lines, types of lines, dimensioning, sectional views, Welding symbols, riveted joints, keys, fasteners –bolts, nuts, screws, keys etc.	5
II	Fits, Tolerances and Surface Roughness**:** 2 exercises Limits, Fits – Tolerances of individual dimensions – Specification of Fits – basic principles of geometric & dimensional tolerances. Preparation of production drawings and reading of part and assembly drawings, surface roughness, indication of surface roughness, etc.	6
III	Introduction to drafting package: Introduction, input, output devices, introduction to drafting software like Auto CAD, basic commands and development of simple 2D and 3D drawings. Drawing, Editing, Dimensioning, Plotting Commands, Layering Concepts, Matching, Detailing, Detailed drawings.	6
IV	Assembly drawings(2D)**:** 10 exercises Preparation of assembled views. (Manually): Shaft couplings – Connecting rod - Machine Vice – Stuffing box – Plummer block. (Using software package, 2D Drawing) :– Universal joint - Screw jack – Lathe Tailstock – Rams Bottom Safety Valve – Steam stop valve. Preparation of Bill of materials and tolerance data sheet.	24

TEXT BOOKS:

1	N. D. Bhatt and V.M. Panchal, Machine Drawing, Charotar Publishing House,2014
2	K C John, Machine Drawing, PHI,2009
3	P I Vargheese and K C John, Machine Drawing, VIP Publishers ,2011
4	K.L.Narayana, P.Kannaiah & K. Venkata Reddy,Machine Drawing, New Age Publishers,2009
5	Ajeet Singh, Machine Drawing Includes AutoCAD, Tata McGraw-hill,2012
6	P S Gill, Machine Drawing, Kataria & Sons,2009

PREREQUISITE: BE 110 ENGINEERING GRAPHICS

COURSE OBJECTIVES:

1	To introduce students to the basics and standards of engineering drawing related to machines and components.
2	To teach students technical skills regarding assembly, production and part drawings.
3	To familiarize students with various limits, fits and tolerances.
4	To help students gain knowledge about standard CAD packages on modeling and drafting.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Explain about the various standards and specifications about standard machine component.
2	Explain about geometric and dimensional tolerances, surface roughness and preparation of production drawings.
3	Apply drawing standards while sketching the assembled views of a mechanical component
4	Construct drawings of mechanical components using CAD package.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	2	-	-	-	-	-	2	-	-	-	-		2	-
CO2	2	3	-	-	2	-	-	-	-	3	-	-		2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-		2	-
CO4	2	-	2	-	3	-	-	-	-	2	-	2		-	2

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Standard way of representing parts is possible while designing and sketching Engineering drawings.
	PO2	2	Use of specified standards in size, material and geometry while designing helps in improving the quality and safety of products.
	PO8	2	Students develop their skill to understand information from standard manual drawings of components.
CO2	PO1	2	Basic knowledge in engineering is helpful in providing the tolerances and surface roughness while preparing the production drawings.
	PO2	3	Knowledge in geometric and dimensional tolerance is necessary for proper design and assembly of mechanical components.
	PO5	2	Will be capable of using appropriate techniques for representing Fits and tolerances in Engineering Drawing.
	PO10	3	Capable of explaining symbols used in apart drawing effectively to others.
CO3	PO1	3	Selection and assembly of mechanical components requires fundamental knowledge in machine components.

	PO2	2	Skill to assembly components and to create assembled views is necessary for designing mechanical systems.
CO4	PO1	2	Modelling of machine components using CAD software require fundamental knowledge in Engineering drawings.
	PO3	2	Use of 2D modelling tools easy and accurate solution for design problems in the industry.
	PO5	3	Capable of using 2D software packages for drafting complex machine components and its assembly.
	PO10	2	Designs of mechanical parts can be easily prepared and communicated effectively with others using CAD packages.
	PO12	2	Lifelong learning is required for becoming an expert in the usage of CAD tools for designing machine component.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	2	Use of standards in design and manufacturing improves the quality of products.
CO2	PSO1	2	Use of fits, tolerances and surface roughness in part modelling helps in standardizing the manufacturing industry.
CO3	PSO1	2	Assembly Drawing of mechanical parts can be prepared by following the drawing standards.
CO4	PSO2	2	Continuous independent learning helps in becoming an expert in the usage of CAD tools for designing machine component.

CE232 MATERIAL TESTING LAB

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Material Testing Lab**	Course code**: CE 232**
L-T-P**:0-0-13**	Credit**: 1**

SYLLABUS:

CONTENT
List of experiments: 1. Tension test on mild steel/ tor-steel/ high strength steel and cast iron using Universal Testing Machine and extensometers. 2. Tests on springs (Open and closed coiled). 3. Torsion pendulum (mild steel, aluminium and brass wires). 4. Hardness test (Brinell, Vickers and Rockwell). 5. Impact test (Izod and Charpy). 6. Torsion test on mild steel rods. 7. Shear test on mild steel rods. 8. Fatigue test – Study of testing machine. 9. Bending test on wooden beams. 10. Strut test (Column buckling experiment). 11. Verification of Clerk Maxwell's law of reciprocal deflection and determination of Young's modulus of steel. 12. Photo elastic methods for stress measurements. 13. Jominy hardenability test. 14. Measurement using strain gauges. 15. Determination of moment of inertia of rotating bodies. Note: A minimum of 10 experiments are mandatory.

REFERENCES:

1	G E Dieter. Mechanical Metallurgy, McGraw Hill,2013
2	Dally J W, Railey W P, Experimental Stress analysis , McGarw Hill,1991
3	Baldev Raj, Jayakumar T, Thavasimuthu M., Practical Non destructive testing, Narosa Book Distributors,2015

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To provide knowledge on mechanical behaviour of materials.
2	To acquaint with the experimental methods to determine the mechanical properties of materials.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Measure tensile and compressive strength of a specimen for applying in a practical design-based project work.
2	Determine hardness, impact strength, fatigue strength to analyze the application of a specific material for a given design requirements for different loading conditions of structures.
3	Judge the capacity of a material to withstand torsional stresses for a safe and sustainable design of machine elements.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	-	-	3	-	-	-	-	-	-	-	-		-	-
CO2	3	-	-	3	-	-	-	-	-	-	-	-		-	-
CO3	3	-	-	3	-	-	-	-	-	-	-	-		-	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Apply the knowledge of engineering fundamentals to find the desired material property.
	PO4	3	Conduct investigation on engineering materials.
CO2	PO1	3	Apply the knowledge of engineering fundamentals to find the desired material property.
	PO4	3	Conduct investigation on engineering materials.
CO3	PO1	3	Apply the knowledge of engineering fundamentals to find the desired material property.
	PO4	3	Conduct investigation on engineering materials.

SREEPATHY INSTITUTE OF MANAGEMENT AND TECHNOLOGY

COURSE HANDBOOK

DEPARTMENT OF MECHANICAL ENGINEERING

SEMESTER IV

SREEPATHY INSTITUTE OF MANAGEMENT AND TECHNOLOGY

VISION

"Strive for excellence in generation and dissemination of knowledge."

MISSION

- To mould engineers of tomorrow, who are capable of addressing the problems of the nation and the world, by imparting technical education at par with international standards.
- To instil a desire in students for research, innovation, invention and entrepreneurship.
- To strive for creative partnership between the industry and the Institute.
- To impart the values of environment awareness, professional ethics, societal commitment, life skills and a desire for lifelong learning.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To act as quality knowledge center for creating technologically competent Mechanical Engineering professionals who will cater to the needs of emerging and interdisciplinary industry and research fields.

MISSION

- To provide theoretical and conceptual knowledge in Mechanical engineering stream and enhance lifelong learning.
- To work in close association with stakeholders in industry by enhancing industry-institute interaction, to take up need based research and industry specific programs.
- To infuse professional, social and economic responsibilities along with ethical values to graduates.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

The graduates from Mechanical Engineering program are expected to achieve the following Program Educational Objective within a few years of graduation

PEO1: Have an overall knowledge in Mechanical Engineering and also in the fields of Mathematics, Science, Communication and Computing skills.

PEO2: Design machines, analyze thermo-fluid problems and optimize the quality of products and services.

PEO3: Implement ideas of Mechanical Engineering for the challenging task in the interdisciplinary areas like Electrical, Electronics, Computer Science, Civil, Bio-Technology and allied branches.

PROGRAM OUTCOMES (POS)

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations
4. **Conduct investigations of complex Problems:** Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions
11. **Project management and finance**: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO)

The **Mechanical Engineering** Graduates will be able to

PSO1: Solve real-time problems in Design, Fluids, Thermal, Manufacturing and allied Engineering sectors of Mechanical Engineering.

PSO2: Recognize the importance of self-learning and engage in continuous independent learning to become experts in either as entrepreneurs or employees in the field.

BL BLOOM'S LEVEL

L1	Level -1	Remembering	Recalling from memory of previously learned material
L2	Level -2	Understanding	Explaining Ideas or Concepts
L3	Level -3	Applying	Using information in another familiar situation
L4	Level -4	Analyzing	Breaking information into part to explore understandings and relationships
L5	Level -5	Evaluating	Justify a decision or course of action
L6	Level -6	Creating	Generating new ideas, products or new ways of viewing things

MA202 PROBABILITY DISTRIBUTIONS, TRANSFORM & NUMERICAL METHODS

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree :**B-Tech**
Course**: Probability Distributions, Transform & Numerical Methods**	Course code**: MA202**
L-T-P**:3-1-0**	Credit**:4**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Discrete Probability Distributions. (Relevant topics in section 4.1,4,2,4.4,4.6 Text1) Discrete Random Variables, Probability distribution function, Cumulative distribution function. Mean and Variance of Discrete Probability Distribution. Binomial Distribution-Mean and variance. Poisson Approximation to the Binomial Distribution. Poisson distribution-Mean and variance.	7	15
II	Continuous Probability Distributions. (Relevant topics in section 5.1,5.2,5.5,5.7 Text1) Continuous Random Variable, Probability density function, Cumulative density function, Mean and variance. Normal Distribution, Mean and variance (without proof). Uniform Distribution. Mean and variance. Exponential Distribution, Mean and variance.	7	15
III	Fourier Integrals and transforms. (Relevant topics in section 11.7, 11.8, 11.9 Text2) Fourier Integrals. Fourier integral theorem (without proof). Fourier Transform and inverse transform. Fourier Sine & Cosine Transform, inverse transform.	7	15
IV	Laplace transforms. (Relevant topics in section 6.1,6.2,6.3,6.5,6.6 Text2) Laplace Transforms, linearity, first shifting Theorem. Transform of derivative and Integral, Inverse Laplace transform, Solution of ordinary differential equation using Laplace transform. Unit step function, second shifting theorem. Convolution Theorem (without proof). Differentiation and Integration of transforms.	8	15
V	Numerical Techniques.(Relevant topics in section.19.1,19.2,19.3 Text2) Solution Of equations by Iteration, Newton- Raphson Method. Interpolation of Unequal intervals-Lagrange's Interpolation formula. Interpolation of Equal intervals-Newton's forward difference formula, Newton's Backward difference formula.	7	20
VI	Numerical Techniques. (Relevant topics in section 19.5,20.1,20.3, 21.1 Text2) Solution to linear System-	8	20

	Gauss Elimination, Gauss Seidal Iteration Method. Numeric Integration-Trapezoidal Rule, Simpson's 1/3 Rule. Numerical solution of firstorder ODE-Euler method, Runge-Kutta Method (fourth order)..		

TEXT BOOKS:

1	Miller and Freund's "Probability and statistics for Engineers"-Pearson-Eighth Edition
2	Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley, 2015.

REFERENCES:

1	V. Sundarapandian, "Probability, Statistics and Queuing theory", PHI Learning, 2009.
2	C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics"-Sixth Edition
3	Jay L. Devore, "Probability and Statistics for Engineering and Science"-Eight Edition
4	Steven C. Chapra and Raymond P. Canale, "Numerical Methods for Engineers"-Sixth Edition-Mc Graw Hill.

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in various Engineering and social life situations
2	To know Laplace and Fourier transforms, that has wide applications in all Engineering courses.
3	To enable the students to solve various engineering problems using numerical methods.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	To have a concept of discrete probability density functions and probability distributions like Binomial Distribution and Poisson Distribution
2	To have a concept of continuous probability density functions and probability distributions like Normal, Uniform and Exponential distribution
3	To use Fourier integrals and Fourier transforms in solving various engineering problems
4	To understand the concept of Laplace and inverse Laplace transforms and apply them to solve ordinary differential equations
5	To use the iteration and interpolation methods to solve engineering problems.
6	To use the concept of numerical methods and their applications to solve linear systems and first order ODE's.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	3	3	2	2	3	2								
CO2	3	3	3	2	2	3	2								
CO3	3		3	3	3										
CO4	2		2												
CO5	3		3												
CO6	2		2												

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Students use the knowledge in data analysis
	PO2	3	Helps students to Check for the possibilities
	PO3	3	Helps students to conclude from data distribution
	PO4	2	Help students in interpreting the
	PO5	2	students would be able to predict from the statistical analysis of the data
	PO6	3	Help students to analyze the population interests
	PO7	2	Help students in taking safety measures by past data analysis
CO2	PO1	3	Students use the knowledge in data analysis
	PO2	3	Helps students to Check for the possibilities
	PO3	3	Helps students to conclude from data distribution
	PO4	2	Help students in interpreting the
	PO5	2	students would be able to predict from the statistical analysis of the data
	PO6	3	Help students to analyze the population interests
	PO7	2	Help students in taking safety measures by past data analysis
CO3	PO1	3	Help students in using in signals and image processing
	PO3	3	Help students in using compression and decompression of signals
	PO4	3	Help students to solve some complex mathematics problems
	PO5	3	Like FFT, students can use in communication systems

CO4	PO1	**2**	Help students in solving the differential equations
	PO3	**2**	Help students in using in data interpolation
CO5	PO1	**3**	Help students Analysing the data from interpolation
	PO3	**3**	Help students to provide valid conclusion using the approximation methods
CO6	PO1	**2**	Help students in solving complex integration and differential equations
	PO3	**2**	Help students to provide valid conclusion using the approximation methods

ME 202 ADVANCED MECHANICS OF SOLIDS

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Advanced Mechanics of Solids**	Course code**: ME 202**
L-T-P**: 3-1-0**	Credit**: 4**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction to stress analysis in elastic solids - stress at a point – stress tensor – stress components in rectangular and polar coordinate systems - Cauchy's equations – stress transformation – principal stresses and planes - hydrostatic and deviatoric stress components, octahedral shear stress - equations of equilibrium - Displacement field – engineering strain - strain tensor (basics only) – analogy between stress and strain tensors - strain-displacement relations (small-strain only) – compatibility conditions	10	15
II	Constitutive equations – generalized Hooke's law – equations for linear elastic isotropic solids - relation among elastic constants – Boundary conditions – St. Venant's principle for end effects – uniqueness theorem - 2 -D problems in elasticity - Plane stress and plane strain problems – stress compatibility equation - Airy's stress function and equation – polynomial method of solution – solution for bending of a cantilever with an end load	8	15
III	Equations in polar coordinates (2D) – equilibrium equations, straindisplacement relations, Airy's equation, stress function and stress components (only short derivations for examination) - Application of stress function to Lame's problem and stress concentration problem of a small hole in a large plate (only stress distribution) - Axisymmetric problems – governing equations – application to thick cylinders, rotating discs.	10	15
IV	Unsymmetrical bending of straight beams (problems having c/s with one axis of symmetry only) – curved beams (rectangular c/s only) - shear center of thin walled open sections (c/s with one axis of symmetry only) - Strain energy of deformation – special cases of a body subjected to concentrated loads, moment or torque - reciprocal relation – strain energy of a bar subjected to axial force, shear force, bending moment and torque	9	15
V	Maxwell reciprocal theorem – Castigliano's first and second theorems – virtual work principle – minimum potential energy theorem - Torsion of non-circular bars: Saint Venant's theory - solutions for circular and elliptical cross-sections	9	20
VI	Prandtl's method - solutions for circular and elliptical cross-sections - membrane analogy - Torsion of thin walled	10	20

	tubes, thin rectangular sections, rolled sections and multiply connected sections		

TEXT BOOKS:

1	L. S. Sreenath, Advanced Mechanics of Solids, McGraw Hill,2008
2	S. M. A. Kazimi, Solid Mechanics, McGraw Hill,2008
3	S. Jose, Advanced Mechanics of Materials, Pentagon Educational Services,2013
4	L. Govindaraju ,TG Sitharaman, Applied elasticity for Engineers, NPTEL
5	U. Saravanan, Advanced Solid Mechanics, NPTEL
6	S. Anil Lal, Advanced Mechanics of Solids, Siva Publications and Distributions, 2017

REFERENCES:

1	S. P. Timoshenko, J. N. Goodier, Theory of elasticity, McGraw Hill,1970
2	R.J. Atkin, and N. Fox, An introduction the theory of elasticity, Longman,1980
3	J. P. Den Hartog, Advanced Strength of Materials, McGraw Hill,1987
4	C. K. Wang, Applied Elasticity, McGraw Hill,1983
5	www.solidmechanics.org/contents.htm - Free web book on Applied Mechanics of Solids by A.F. Bower.
6	A. Pytel, F. L. Singer, Strength of Materials, Harper & Row Publishers, New York,1998

PREREQUISITE: ME201 Mechanics of solids

COURSE OBJECTIVES:

1	To impart concepts of stress and strain analyses in a solid.
2	To study the methodologies in theory of elasticity at a basic level.
3	To acquaint with the solution of advanced bending problems.
4	To get familiar with energy methods for solving structural mechanics problems.
5	To familiarize with solution of axisymmetric problems in elasticity
6	To familiarise the solution of torsion problem of non circular bars, thin walled tubes, thin rectangular sections, rolled sections and multiply connected sections

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Apply concepts of stress and strain analysis in solids.
2	Compute the principal stress for a given state of stress and identify principal planes
3	Demonstrate the procedure for solving 2-D problems in elasticity using polynomial method.

4	Compute and evaluate hoop stress, radial stress and radial displacement for thick cylinders
5	Compute the stresses in curved beams subjected to bending and beams subjected to unsymmetrical bending.
6	Comprehend the usage of energy methods for solving structural problems.
7	Solve problem on torsion of non-circular shafts including solid bars, thin walled tubes, rectangular sections, rolled sections and multiply connected sections.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	2	-	-		3	-
CO2	2	2	3	-	-	-	-	-	-	1	-	-		3	-
CO3	3	3	3	-	-	-	-	-	-	1	-	-		3	-
CO4	3	3	3	-	-	-	-	-	-	1	-	-		3	-
CO5	3	3	3	-	-	-	-	-	-	1	-	-		3	-
CO6	2	3	2	-	-	-	-	-	-	1	-	-		3	-
CO7	3	3	3	-	-	-	-	-	-	1	-	-		3	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Will enable the students to apply the equations for solving complex problems in Engineering
	PO2	3	Equations in elasticity enable the students to identify, formulate and analyze complex problems in the Design
	PO3	3	Fundamental of stress and strain enable the students to design safe and sound design of structures.
	PO10	2	Fundamentals enable the students to effectively communicate with engineering community and effectively prepare documentations on design activities.
CO2	PO1	2	Knowledge of Principal stress/strain will enable the students to apply these equations for solving complex problems.
	PO2	2	Understanding of Principal stress/strain enable the students to analyze complex problems
	PO3	3	Enable the students to design safe and sound design of structures.
	PO10	1	Knowledge of Principal stress/strain help to comprehend and write effective reports and design documentation
CO3	PO1	3	Knowledge of plane stress/Plane Strain problems in elasticity will enable the

			students to solve complex plane stress/Plane Strain problems
	PO2	**3**	Understanding of plane stress/Plane Strain problems in elasticity enable the students to identify, formulate and analyze complex plane stress/Plane Strain problems
	PO3	**3**	Application of the plane stress/Plane Strain principles of elasticity in design problems will enable the students to design safe and sound design of structures.
	PO10	**1**	Knowledge of plane stress/Plane Strain problems in elasticity will enable the students to effectively communicate with engineering community
CO4	PO1	**3**	Knowledge to compute hoop stress, radial stress will enable the students to solve complex problems in the design of pressure vessels
	PO2	**3**	Understanding of nature of stresses developed enable the students to analyze complex problems in the Design of Pressure Vessels
	PO3	**3**	Will enable the students to design safe and sound design of Pressure Vessels
	PO10	**1**	Help the students to effectively communicate with engineering community and effectively prepare documentations on design activities related to pressure vessels and rotating discs
CO5	PO1	**3**	Knowledge to compute the stresses in curved beams subjected to bending and beams subjected to unsymmetrical bending will enable the students to apply these equations for solve complex problems in Structural design of beams.
	PO2	**3**	Clear understanding of nature of stresses developed in curved beams enable the students to analyze complex problems in the Design of different types of beams, hooks, chain link etc.
	PO3	**3**	Enable the students to design safe and sound design of beams, Hooks, Chains etc.
	PO10	**1**	Help the students to effectively communicate with engineering community and effectively prepare documentations on design activities related to beams, hooks, chain link etc.
C06	PO1	**2**	Knowledge to use energy methods for solving structural problems will enable the students to apply these equations for solving complex problems in Structural design of beams.
	PO2	**3**	Clear understanding of energy methods for solving structural problems enable the students to identify, formulate and analyze complex problems in structural mechanics.

	PO3	**2**	Application of energy methods for solving structural problems enables the students to design safe and sound design of structural members.
	PO10	**1**	Knowledge of the energy methods for solving structural problems will enable the students to effectively communicate with engineering community and effectively prepare documentations.
C07	PO1	**3**	Knowledge to Solve problem on torsion of non-circular shafts enable the students to apply these equations for solving problems in Structural Mechanics and Design of Machine Elements.
	PO2	**3**	Clear understanding of nature of stress developed during the torsion enable the students to analyze complex torsion problems
	PO3	**3**	Application of the expression for stress developed during the torsion of non-circular shafts will enable the students to design safe and sound design of structures
	PO10	**1**	Knowledge on the nature of stress developed during the torsion of non-circular shafts will enable the students to effectively communicate with engineering community and effectively prepare documentations on design activities related to torsion of non circular shafts

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	**3**	Student's knowledge in Structural Mechanics will be enhanced by studying fundamental equations of elasticity
CO2	PSO1	**3**	Knowledge in Principal stress/strain will enhance Student's capability to solve engineering problems
CO3	PSO1	**3**	Knowledge of two dimensional stresses and polynomial functions helps in solving basic problems in machine components and structures
CO4	PSO1	**3**	Clear understanding of nature of stresses developed in thick cylinders will enhance student's capability to solve engineering problems.
CO5	PSO1	**3**	Application of expression for the calculation of stresses in curved beams subjected to bending and beams subjected to unsymmetrical bending will enhance the student's capability to analyze and design mechanical components.
CO6	PSO1	**3**	Understanding of energy methods for solving structural problems will enhance the student's capability to analyze and design mechanical strucutres.
CO7	PSO1	**3**	Clear understanding of the nature of stress developed during the torsion of non-circular shafts helps in designing machine components

ME 204 THERMAL ENGINEERING

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Thermal Engineering**	Course code**: ME 204**
L-T-P**: 3-1-0**	Credit**: 4**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Steam engineering- T- S diagram, Mollier chart, Steam cycles- Rankine cycle, Modified Rankine cycle, Relative efficiency, Improvement in steam cycles-Reheat, Regenerative and Binary vapor cycle Steam Boilers: Types of boilers –Cochran boiler, Babcock and Wilcox boiler, Benson boiler, La Mont boiler, Loeffler boiler, Velox boiler, Boiler Mountings and Accessories Steam nozzles:- Types of nozzle- Velocity of steam, mass flow rate, critical pressure ratio and its significance, effect of friction, super saturated flow	8	15
II	Steam turbines: classification, compounding of turbines- pressure velocity variation, velocity diagrams, work done, efficiency, condition for maximum efficiency, multistage turbines-condition line, stage efficiency. Steam turbine performance-reheat factor, degree of reaction, cycles with reheating and regenerative heating, governing of turbines	8	15
III	Internal combustion engines: classification of I.C. Engines- four stroke and two stroke I.C. Engines, Comparison of four stroke and two stroke Engine. Wankel Engine, Air standard cycle-Carnot cycle, Otto cycle; Diesel cycle, dual combustion cycle, comparison of Otto, diesel and dual combustion cycles. Stirling and Ericsson cycles, air standard efficiency, specific work output, work ratio, Actual cycle analysis, deviation of actual engine cycle from ideal cycle. Rotary engines, Stratified charge engine , super charging of SI and CI Engines – turbo charging. Variable specific heats.	10	15
IV	Performance Testing of I C Engines: Indicator diagram, mean effective pressure. Torque, Engine power- BHP, IHP. Engine efficiencymechanical efficiency, volumetric efficiency, thermal efficiency and relative efficiency, Specific fuel consumption. Testing of I C enginesMorse test, Heat balance test and Retardation test Fuels and fuel combustion: flash point and fire point, calorific value, Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas. Analysis of fuel combustion-A/F ratio, equivalence ratio, minimum quantity of air, flue gas analysis, excess air.	10	15

V	Air pollution from I.C. Engine and its remedies: Pollutants from S.I. and C.I. Engines, Methods of emission control, alternative fuels for I.C. Engines; the blending of fuels, Bio fuels. Combustion in I.C. Engines: Combustion phenomena in S.I. engines; Ignition limits, stages of combustion in S.I. Engines, Ignition lag, velocity of flame propagation, auto ignition, detonation; effects of engine variables on detonation; theories of detonation, octane rating of fuels; pre-ignition; S.I. engine combustion chambers. Stages of combustion in C.I. Engines; delay period; variables affecting delay period; knock in C.I. engines, Cetane rating; C.I. engine combustion chambers.	10	20
VI	Gas turbines: classification, Thermodynamic analysis of gas turbine cycles-open , closed and semi closed cycle; ideal working cycle- Brayton cycle-P-v and T-s diagram, thermal efficiency. Effect of compressor and turbine efficiencies. Optimum pressure ratio for maximum specific work output with and without considering machine efficiencies. Comparison of gas turbine and IC engines, Analysis of open cycle gas turbine, Improvements of the basic gas turbine cycles-regeneration, intercooling and reheating-cycle efficiency and work output-Condition for minimum compressor work and maximum turbine work. Combustion chambers for gas turbines. pressure loss in combustion process and stability loop.	10	20

TEXT BOOKS:

1	Rudramoorthy , Thermal Engineering, McGraw Hill Education India,2003
2	R.K Rajput, Thermal Engineering, Laxmi publications,2010

REFERENCES:

1	V. Ganesan, Fundamentals of IC engines, Tata McGraw-Hill,2002
2	T.D. Eastop and A McConkey, Applied thermodynamics for engineering technology, Pearson education,1996
3	J.B.Heywood, I.C engine fundamentals. McGraw-Hill,2011
4	Gill, P.W., Smith, JR., J.H., and Ziurys, E.J Fundamentals of internal combustion engines Oxford and IBH,1959
5	Rathore, Thermal Engineering, McGraw Hill Education India, 2010

PREREQUISITE: ME205 Thermodynamics

COURSE OBJECTIVES:

1	To acquire knowledge on the working of steam turbines, IC engines and gas turbines
2	To introduce the combustion process in IC engines
3	To understand air pollution from IC engines and its remedies.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Explain the types and working of different boilers and boiler accessories and also understand and apply different power cycles and nozzles.
2	Explain working and classification of steam turbines and will be able to apply the principle to solve problems related to steam turbines.
3	Explain the working and classification of internal combustion engines and will be able to analyze and apply the thermodynamic cycle related to it
4	Understand performance parameters and fuels used in internal combustion engines and will be able to analyze various performance parameters.
5	Understand combustion characteristics, emission and emission control techniques in internal combustion engines.
6	Understand and analyze the gas turbines and thermodynamic cycle related to it

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-		1	-
CO2	3	3	1	1	-	-	-	-	-	-	-	-		2	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-		1	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-		2	-
CO5	2	2	1	1	-	-	2	-	-	-	-	1		1	-
CO6	3	3	2	-	-	-	3	-	-	-	-	-		2	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	**3**	students will able to apply the knowledge to solve problems related to different thermodynamic cycles.
	PO2	**3**	students can analyze problems regarding different thermodynamic cycles and nozzles.
CO2	PO1	**3**	students will able to apply the knowledge to solve problems related to steam turbines.
	PO2	**3**	students can analyze problems regarding different steam turbines.
	PO3	**1**	May help to find solutions for problems related to steam turbines.
	PO4	**1**	knowledge in steam turbines may help to investigate problems in steam turbine plants.

CO3	PO1	**3**	Apply the knowledge of engineering specialization for solving problems related to IC engines.
	PO2	**3**	knowledge in fundamentals of IC engines helps to analyze problems related to IC engines.
	PO3	**2**	students may able to design solutions in IC engines that meet some specific needs by considering various factors.
	PO4	**1**	May able to investigate problems related IC engines.
	PO7	**2**	Students can develop fins in a sustainable manner by considering environmental/societal impact.
CO4	PO1	**3**	knowledge in IC engine fundamentals helps to solve problems related to performance of IC engines.
	PO2	**3**	can analyze the problems related to IC engine performance and combustion reaching substantiated conclusions.
	PO3	**2**	May able to design IC engine variables that meet specific requirements.
	PO4	**2**	Gained knowledge in various IC engine tests helps to investigate problem related to the performance of IC engines.
	PO7	**2**	Students can develop heat exchangers in a sustainable manner by considering environmental/societal impact.
CO5	PO1	**2**	Students may able to solve problems regarding the combustion and emission of IC engines.
	PO2	**2**	Can analyze problems on combustion and emission of IC engines reaching substantiated conclusions
	PO3	**1**	May able to design engine systems that meet the specified needs with appropriate environmental considerations.
	PO4	**1**	May able to investigate problems regarding combustion and emission of IC engines to provide valid conclusions.
	PO7	**2**	Understand the impact of the professional engineering solutions in societal and environmental contexts.
	PO12	**1**	Recognize the need for life-long learning in the broadest context of technological change in emission and control techniques.
C06	PO1	**3**	Knowledge helps to solve problems regarding gas turbines.
	PO2	**3**	can analyze problems on gas turbines reaching substantiated conclusions.

	PO3	**2**	may able to design solutions to problems regarding gas turbines.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	**1**	Graduates will be able to practice for solving real-time problems in Thermal Engineering sectors of Mechanical Engineering.
CO2	PSO1	**2**	Students able to learn to solve real time problems in steam turbine plants
CO3	PSO1	**1**	The acquired knowledge on various thermodynamic cycle will may helps the students to solve real time problems.
CO4	PSO1	**2**	Students able to learn to solve real time problems based on the performance of IC engines
CO5	PSO1	**1**	The acquired knowledge on emission and emission control techniques helps to solve problems related to emission in IC engines.
CO6	PSO1	**2**	Graduates will be able to practice for solving real-time problems in gas turbine sectors of Mechanical Engineering.

ME 206 FLUID MACHINERY

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Fluid Machinery**	Course code**: ME 206**
L-T-P**: 3-1-0**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Impact of jets: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat and curve),– Series of vanes - work done and efficiency Hydraulic Turbines : Impulse and Reaction Turbines – Degree of reaction – Pelton Wheel – Constructional features - Velocity triangles – Euler's equation – Speed ratio, jet ratio and work done , losses and efficiencies, design of Pelton wheel – Inward and outward flow reaction turbines- Francis Turbine – Constructional features – Velocity triangles, work done and efficiencies.	7	15
II	Axial flow turbine (Kaplan) Constructional features – Velocity triangles- work done and efficiencies – Characteristic curves of turbines – theory of draft tubes – surge tanks – Cavitation in turbines – Governing of turbines – Specific speed of turbine , Type Number– Characteristic curves, scale Laws – Unit speed – Unit discharge and unit power.	7	15
III	Rotary motion of liquids – free, forced and spiral vortex flows Rotodynamic pumps- centrifugal pump impeller types,-velocity triangles-manometric head- work, efficiency and losses, H-Q characteristic, typical flow system characteristics, operating point of a pump. Cavitation in centrifugal pumps- NPSH required and available- Type number-Pumps in series and parallel operations. Performance characteristics- Specific speed-Shape numbers – Impeller shapes based on shape numbers.	7	15
IV	Positive displacement pumps- reciprocating pump – Single acting and double acting- slip, negative slip and work required and efficiency- indicator diagram- acceleration head - effect of acceleration and friction on indicator diagram – speed calculation- Air vessels and their purposes, saving in work done to air vessels multi cylinder pumps. Multistage pumps-selection of pumps-pumping devices-hydraulic ram, Accumulator, Intensifier, Jet pumps, gear pumps, vane pump and lobe pump.	7	15
V	Compressors: classification of compressors, reciprocating compressor-single stage compressor, equation for work with and without clearance volume, efficiencies, multistage compressor, intercooler, free air delivered (FAD)	7	20
VI	Centrifugal compressor-working, velocity diagram, work	7	20

	done, power required, width of blades of impeller and diffuser, isentropic efficiency, slip factor and pressure coefficient, surging and chocking. Axial flow compressors:- working, velocity diagram, degree of reaction, performance. Roots blower, vane compressor, screw compressor.		

TEXT BOOKS:

1	Som, Introduction to Fluid Mechanics and Fluid Machines ,McGraw Hill Education India 2011
2	Bansal R. K., A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications,2005.

REFERENCES:

1	Cengel Y. A. and J. M. Cimbala, Fluid Mechanics, Tata McGraw Hill, 2013
2	Yahya S. M, Fans, Blower and Compressor, Tata McGraw Hill, 2005.
3	Shepherd D. G, Principles of Turbo Machinery, Macmillan, 1969.
4	Stepanoff A. J, Centrifugal and Axial Flow Pumps, John Wiley & Sons, 1991.
5	Rajput R. K, Fluid Mechanics and Hydraulic Machines, S. Chand & Co.,2006.
6	Subramanya, Fluid mechanics and hydraulic machines, 1e McGraw Hill Education India,2010

PREREQUISITE: ME203 Mechanics of Fluids

COURSE OBJECTIVES:

1	To acquire knowledge on hydraulic machines such as pumps and turbines
2	To understand the working of air compressors and do the analysis
3	To Introduce the concepts of design aspects of hydraulic machines like turbines and pumps and their applications.
4	Describe the operating characteristics of Fluid machinery (pumps, turbines and compressors), and the factors affecting their operation and specifications, as well as their operation in a system.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Students will be able to define the principles and working of Hydraulic Machines
2	Students will be able to estimate the hydrodynamic forces on various types of vanes and to calculate the performance of various hydraulic machines.
3	Students will be able to design an appropriate pump/turbine with reference to given application/situation. Carry out calculations involved in design of pump/turbine
4	Students will be able to understand the relation between various performance parameters and to interpret characteristic curves of a given pump/turbine/compressor.
5	Students will be able to define the principles of various type of compressors
6	Students will be able to discover the working of various type of compressors

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	1	1	1	-	-	1	2	-	-	-	-	-		2	-
CO2	3	3	1	-	-	2	2	-	-	-	-	-		1	-
CO3	3	3	3	-	-	-	1	-	-	-	-	-		1	2
CO4	1	3	3	3	-	-	-	-	-	-	-	-		1	2
CO5	1	1	1	-	-	-	-	-	-	-	-	-		2	-
CO6	1	1	1	-	-	-	-	-	-	-	-	-		-	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	1	As they could use their acquired knowledge to solve engineering problems
	PO2	1	Knowledge in principles of Hydraulic Machines helps the students to identify many problems related to power plants and power generation.
	PO3	1	Knowledge in principles of Hydraulic Machines is the basis for a new design.
	PO6	1	Students will be Aware of safety issues for specific machinery
	PO7	2	Students will able to assess environmental/ societal impact of a particular turbine or pump installation.
CO2	PO1	3	Analytical knowledge on the turbine performance helps the students to solve of the engineering problems related to fluid power plants.
	PO2	3	Analytical knowledge on the turbo machinery performance help the students to analyze engineering problems related to power producing and power consuming machineries (Turbine/ Pump).
	PO3	1	Ability to apply various energy equations to find the performance of turbo machinery is useful for designing efficient system components.
	PO6	2	Knowledge on the performance on the turbine will help the students to reduce energy wastage.
	PO7	2	Ability to apply energy equations in engineering systems helps the students to pursue higher education in the fields like science and turbo machinery.
CO3	PO1	3	Ability design, carry out complex calculation helps solve complex problems.
	PO2	3	Ability design, carry out complex calculation helps analyse complex

			problems.
	PO3	**3**	Ability design, carry out complex calculation helps in designing various system components.
	PO7	**1**	Ability to select best pump/ turbine with due the consideration towards sustainability
CO4	PO1	**1**	Knowledge about various performance parameters help to solve problems.
	PO2	**3**	An ability to interpret characteristic curve of various turbo machinery equip the students to review research literatures, and analyze complex engineering problems related to hydraulic machines reaching substantiated conclusions.
	PO3	**3**	Knowledge on process parameter helps in better designs.
	PO4	**3**	Ability to interpret characteristic curve help to analyse and interpret various results to reach better conclusions.
CO5	PO1	**1**	As they could use their acquired knowledge to solve engineering problems
	PO2	**1**	Knowledge in principles of compressors helps the students to identify many problems related to gas turbine power plants and power generation.
	PO3	**1**	Knowledge in principles of fluid Machines is the basis for a new design.
CO6	PO1	**1**	As they could use their acquired knowledge to solve engineering problems
	PO2	**1**	Knowledge in principles of compressors helps the students to identify many problems related to gas turbine power plants and power generation.
	PO3	**1**	Knowledge in principles of fluid Machines is the basis for a new design.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	**2**	Students can apply their knowledge in fluid science to solve engineering problems.
CO2	PSO1	**1**	Design knowledge in turbine/ pumps helps to implement various mechanical systems.
CO3	PSO1	**1**	Interpreting skill acquired help to analyse various systems
	PSO2	**2**	Become aware of the requirement for advanced knowledge by prolonged learning.
CO4	PSO1	**1**	Students can apply their knowledge in fluid science to solve engineering

			problems.
	PSO2	**2**	Interpreting skill acquired help to analyse various systems
CO5	PSO1	**2**	Students can apply their knowledge in fluid science to solve engineering problems.

ME 220 MANUFACTURING TECHNOLOGY

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Manufacturing Technology**	Course code**: ME 220**
L-T-P**: 3-0-0**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Sand Casting – Sand Molds-Types of Molding Sands and Testing.Type of patterns - Pattern Materials - Cores –Types and applications –Sand Molding Machines - Gating System – Risering - Shell Mold Casting – Ceramic Mold Casting - Investment Casting – Vacuum Casting – Slush Casting - Pressure Casting – Die Casting – Centrifugal Casting - Design Considerations based on Various Shapes - Defects in Castings – simple problems in casting	8	15
II	Principles of Rolling –Types of rolling mills, Mechanics of Flat Rolling - Roll Force and Power Requirement - Neutral Point - Hot and Cold Rolling - Defects in Rolled Plates - Rolling Mills - Ring Rolling – Thread Rolling - Applications- Rolling of tubes, wheels, axles and I-beams	6	15
III	Classification of forging – Forging methods – Forging under sticking condition - Precision Forging – Coining – Heading – Piercing - Die Design:- Preshaping, Design Features, Draft Angles – Die Materials and Lubrication - Forging Machines – Forging Defects and tests - Extrusion Process - Hot Extrusion – Cold Extrusion - Impact Extrusion – Extrusion Defects – Drawing Process, wire drawing process	6	15
IV	Principles Location - Degrees of Freedom, 3-2-1 principle of locating - Locating from Planes - Locating from Circular Surfaces - Concentric Locating - Principles of Clamping - Types of Clamps - Strap Clamps Slide Clamps - Swing Clamps - Hinge Clamps - Vacuum Clamping - Magnetic Clamping	5	15
V	Sheet metal characteristics – Typical shearing - Bending Sheet and Plate – Spingback - Bending Force - Press Brake Forming - Tube Bending - Stretch Forming - Deep Drawing - Rubber forming - Spinning Shear Spinning - Tube Spinning - Definition of Welding - Weldability – Solidification of the Weld Metal - Heat Affected Zone – correlation of strength of welded joint with structure - Welding Defects	7	20
VI	Gas Welding: – Flame Characteristics - Equipment, fluxes and filler rods - Arc Welding – Applications and Equipment - Electrodes - Shielded Metal Arc Welding – Submerged Arc Welding - GTAW – Plasma Arc Welding - Ultrasonic Welding – Friction Welding - Resistance Spot Welding -	10	20

	Resistance Seam Welding – Stud Welding – Percussion Welding - simple problems in welding - Brazing:- Filler Metals, Methods - Soldering:- Techniques, Types of Solders and Fluxes		

TEXT BOOKS:

1	Amitabha Ghosh and Ashok Kumar Mallick, Manufacturing Science Affiliated East West Press Ltd, New Delhi, 2002
2	S.Kalpakjian and Steven R Schimid, Manufacturing Engineering and Technology, Pearson,2001

REFERENCES:

1	RAO, Manufacturing Technology-Vol 2 3e, McGraw Hill Education India, 2013
2	RAO, Manutacturing Technology-Vol 1 4e, McGraw Hill Education India, 2013
3	Cyril Donaldson and George H LeCain, Tool Design,TMH
4	Handbook of Fixture Design – ASTME
5	Campbell J. S., Principles of Manufacturing Materials and Processes, Tata McGraw Hill, 1999
6	P R Beeley, Foundry Technology, Elsevier, 2001
7	Richard W. Heine, Carl R. Loper, Philip C. Rosenthal, Principles of Metal Casting, Tata McGraw-Hill Education, 2001
8	Paul Degarma E and Ronald A. Kosher ,Materials and Processes in Manufacturing, Wiley,20111
9	P. N. Rao,Manufacturing Technology Foundry, Forming and Welding, Tata McGraw- Hill Education,2011
10	HMT Production Technology, 1e McGraw Hill,2001

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To give an exposure to different techniques of casting and molds required.
2	To provide an exposure to different rolling processes and different rolled products.
3	To familiarize with different forging methods, cautions to be adopted in die design.
4	To give an introduction to various work and tool holding devices used in manufacturing.
5	To introduce to the bending, shearing and drawing processes of sheet metal working and allied machines.
6	To give an understanding of welding metallurgy and weldability and to introduce various metal joining techniques.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Students will be able to acquire knowledge in various casting processes and technology related to them.

2	Students will be able to understand the rolling passes required for getting required shapes of rolled products.
3	Students will be able to discuss important aspects of forging techniques
4	Students will be able to discuss sheet metal working processes and their applications to produce various shapes and products
5	Students will be able to acquire knowledge in various types of welding processes.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	2	-	2	-	-	-	-	-	-	-	-	-		-	2
CO2	2	2	-	-	-	-	-	-	-	-	-	-		-	2
CO3	2	2	-	-	2	-	-	-	-	-	-	-		-	2
CO4	2	2	-	-	2	-	-	-	-	-	-	-		-	2
CO5	2	2	-	-	2	-	-	-	-	-	-	-		-	2

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	2	Acquire the knowledge of the science behind different manufacturing methods.
	PO3	2	Will be able to select the best economical manufacturing process for the given problem.
CO2	PO1	2	Students will be able to apply the engineering knowledge in selection of different manufacturing process depending upon the product design.
	PO2	2	For selecting a manufacturing process for a problem the student should analyse and identify the situation/requirement.
CO3	PO1	2	Students will get to know the different parameters and techniques of manufacturing process.
	PO2	2	Students will be able to analyse the requirement of a proper manufacturing method for a given component.
	PO5	2	Enable students to understand about importance of proper method for the execution of a manufacturing process.
CO4	PO1	2	Students will be able to understand the different techniques of manufacturing process to produce variety of components.
	PO2	2	Identification of the importance of different manufacturing method parameters for the various mechanical components

	PO5	**2**	Studets will be able to understand about different manufacturing methods and interpret the differences between different processess.
CO5	PO1	**2**	Students will get to know the different parameters, techniques and aspects of manufacturing process.
	PO2	**2**	Student will be able to analyse possible defects in each methods
	PO5	**2**	Studets will be able to understand about various manufacturing processess and interpret the state of final product when different methods are followed.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO2	**2**	Understanding of different manufacturing methods will enable students to apply different product development processess and they can choose the right method for the right product.
CO2	PSO2	**2**	Students could describe and analyse various manufacturing methods.
CO3	PSO2	**2**	Students could select a proper manufacturing method to apply on an engineering component.
CO4	PSO2	**2**	Students could analyse various manufacturing process parameters and thereby can apply to manufacture different products
CO5	PSO2	**2**	Students will be able to choose a appropriate manufacturing and joining process with vey less rejection rate.

HS200 BUSINESS ECONOMICS

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree :**B-Tech**
Course**: Business Economics**	Course code**: HS200**
L-T-P**:3-0-0**	Credit**:3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Nature of Economics Definitions of Economics and their limitations, Economic Problems (2 Hrs.), Economic Systems, meaning of Business or Managerial Economics (2 Hrs.)and its role and relevance in managerial decision making in an industrial setting (2 Hrs).	6	15
II	Demand and Supply Analysis Demand Curve, Demand function (2 Hrs.), Elasticity of demand and its estimation (2 Hrs.), Supply curve, equilibrium price and price mechanism (2 Hrs).	6	15
III	Production Economics Economies of Scale and Diseconomies of Scale (1 Hr.), Production and Cost Functions. Factors of Production (2 Hrs.), Law of Diminishing marginal Productivity. Construction and analysis of Break Even Charts (3 Hrs.)	6	15
IV	Market Structure and Price-Output Decisions Price and output determination under Perfect Competition, Monopoly and Monopolistic Competition (3 Hrs.). Collusion and Cartel, Nash Equilibrium (3 Hrs.)	6	15
V	Money, National Income and Taxation Money, Emerging Bit Coin concept, Quantity Theory of Money, Interest Rate Management (2 Hrs), Open Market Operations by RBI, Selective Credit Controls, SLR, CRR (2 Hrs), Definition & Measurement of National Income, methods, sectors of economy (3 Hrs), inflation, deflation, trade cycles- ValueAdded Tax (2 Hrs).	9	20
VI	Investment Decisions and Balance Sheet Analysis Capital Budgeting, Investment Analysis – NPV, IRR, Profitability Index, ARR, Payback Period (3 Hrs), Depreciation, Time value of money. Business Forecasting– Elementary techniques (2 Hrs). Balance sheet preparation principles and interpretation (4 Hrs)	9	20

TEXT BOOKS:

1	Yogesh, Maheswari, Management Economics , PHI learning, NewDelhi, 2012

REFERENCES:

1	Dornbusch, Fischer and Startz, Macroeconomics, McGraw Hill, 11th edition, 2010
2	Khan M Y, Indian Financial System, Tata McGraw Hill, 7th edition, 2011
3	Samuelson, Managerial Economics, 6th edition, Wiley
4	Snyder C and Nicholson W, Fundamentals of Microeconomics, Cengage Learning (India), 2010.
5	Truett, Managerial Economics: Analysis, Problems, Cases, 8th Edition, Wiley Welch, Economics: Theory and Practice 7th Edition, Wiley

PREREQUISITE:NIL

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	To familiarize the elementary perspectives of economics
2	To acquaint the students about the concepts of demand, supply and general production theory related to economics
3	To apply business analysis to the firm under different market conditions
4	To apply economic models to examine current economic scenario and to solve the economic issues
5	To apply various economic tools for analyzing the projects and decision making process
6	To analyze the various economic tools like balance sheet, tax, forecasting, and international concepts like FDI, FPI, and FII

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1											3					
CO2	2										2	3				
CO3	2										2					
CO4								3				2				
CO5	3										2					
CO6	2										3					

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO11	**3**	To know about the elementary principles in business economics helps them to understand the management as well as the business practices in economics
CO2	PO2	**2**	Simple kind of mathematical equations are used to identify the degree of elasticities related to demand and supply and production function
	PO11	**2**	With help of management and business practices students can analyze the changing patterns of demand, supply and production function
	PO12	**3**	The demand and supply functions are lifelong learning concepts
CO3	PO2	**2**	To analyze the market conditions of a firm, break even concepts is used. It is a mathematical concept.
	PO11	**2**	The marketing functions are highly correlated with the business practices and principles in economics
CO4	PO8	**3**	To analyze the current economic scenario it necessary to take into consider the social and legal procedures and programmed related to them
	PO12	**2**	Corrective action related to economic scenario helps the students to analyze the various economic conditions faced throughout their life
CO5	PO1	**3**	The decision making and evaluation of projects are based on different economic tools which are used mathematical and statistical equations.
	PO11	**2**	Some kind of decision making functions are based on the principles that is used in economics like risk, uncertainty etc
CO6	PO1	**2**	Mathematical tools are used to analyze the various economic tools. Eg, trend projection method, balance sheet
	PO12	**3**	These are helpful to students to identify the various opportunities in their life within outside the nation

ME 230 FLUID MECHANICS AND MACHINES LABORATORY

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Fluid Mechanics and Machines Lab**	Course code**: ME 230**
L-T-P**: 0-0-3**	Credit**: 1**

SYLLABUS

Study:

1. Study of flow measuring equipments - water meters, venturi meter, orifice meter, current meter, rotameter
2. Study of gauges - pressure gauge, vacuum gauge, manometers.
3. Study of valves - stop valve, gate valve and foot valve.
4. Study of pumps – Centrifugal, Reciprocating, Rotary, Jet.
5. Study of Turbines - Impulse and reaction types.
6. Study of Hydraulic ram, accumulator etc.

List of Experiments:

1. Determination of coefficient of discharge and calibration of Notches
2. Determination of coefficient of discharge and calibration of Orifice meter
3. Determination of coefficient of discharge and calibration of Venturimeter.
4. Determination of Chezy's constant and Darcy's coefficient on pipe friction apparatus
5. Determination of hydraulic coefficients of orifices
6. Determination of metacentric height and radius of gyration of floating bodies.
7. Experiments on hydraulic ram
8. Reynolds experiment
9. Bernoulli's experiment
10. Experiment on Torque converter
11. Performance test on positive displacement pumps
12. Performance test on centrifugal pumps, determination of operating point and efficiency
13. Performance test on gear pump
14. Performance test on Impulse turbines
15. Performance test on reaction turbines (Francis and Kaplan Turbines)
16. Speed variation test on Impulse turbine

17. Determination of best guide vane opening for Reaction turbine

18. Impact of jet

PREREQUISITE: ME203 Mechanics of fluids

COURSE OBJECTIVES:

1	To provide experience on various Hydraulic machines.
2	To acquaint the students with the measurement of various parameters.
3	To familiarize the theory and their applications in the field of fluid mechanics.
4	To gain practical experience in handling various hydraulic machines.
5	Calibration of discharge measuring equipments and nature of calibration curves in both closed & open channel flow.
6	Stability of floating bodies and the significance of metacentric height & radius of gyration.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Students will be able to select an appropriate pump/turbine with reference to given application/situation.
2	Students will be able to estimate the optimum efficiency of a given pump/turbine under different load and (or) speed conditions
3	Students will be able to apply the fundamental principles of fluid mechanics in calculations involving basic flow measuring devices in both closed and open channel flows
4	Analyse the trends depicted by characteristic curves obtained from the experiments
5	Students will be able to predict the stability of a floating vessel following the principles of metacentric height and radius of gyration

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	-	-	3	-	-	3	3	-	-	-	-	-			
CO2	3	-	-	2	-	-	-	-	-	-	-	-			
CO3	-	3	3	-	-	-	2	-	-	-	-	-			
CO4	-	3	-	-	-	-	-	-	-	-	-	3			
CO5	-	-	-	3	-	-	-	-	-	-	-	-			

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO3	**3**	Students can select best pump or turbine for a design/requirement
	PO6	**3**	Students will be aware of safety issues for specific machinery
	PO7	**3**	Students will able to assess environmental/ societal impact of a particular turbine or pump installation.
CO2	PO1	**3**	Analytical knowledge on the pump/turbine performance helps the students to solve some of the engineering problems.
	PO4	**2**	With the knowledge gained they can interpret the data and can provide valid conclusions.
CO3	PO2	**3**	They can identify, formulate and analyse complex engineering problems related to basic flow metering devices and open channel flows.
	PO3	**3**	Can design solutions for complex engineering problems considering health, safety and environment considerations.
	PO7	**2**	Will be able to assess the impact on society and environment.
CO4	PO2	**3**	An ability to interpret characteristic curve of various turbo machinery equip the students to review research literatures, and analyse complex engineering problems related to hydraulic machines reaching substantiated conclusions
	PO12	**3**	Ability to interpret characteristic curves act as a foundation for higher studies.
CO5	PO4	**3**	With the knowledge gained they can analyse and interpret data regarding the stability and arrive at valid conclusions.

ME 232 THERMAL ENGINEERING LABORATORY

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Thermal Engineering Laboratory**	Course code**: ME 232**
L-T-P**: 0-0-3**	Credit**: 1**

SYLLABUS

List of experiments:

1. Study of I.C engines :-

    a) Diesel engines - all systems and parts

    b) Petrol engines - all systems and parts

Experiments

1. Determination of flash and fire points of petroleum products -flash and fire point apparatus
2. Determination of viscosity of lubricating oil- viscometer
3. Determination of calorific value of solid and liquid fuels- calorimeter
4. Determination of calorific value of and gaseous fuels - calorimeter
5. Performance test on petrol engines with various types of loading systems
6. Performance test on Diesel engines with various types of loading systems
7. Heat Balance test on petrol/Diesel engines 8. Cooling curve of IC engines
8. Valve timing diagram of IC engines 10. Economic speed test on IC engines
9. Retardation test on IC engines
10. Determination volumetric efficiency and Air-fuel ratio of IC engines
11. Morse test on petrol engine
12. Performance test on reciprocating compressor
13. Performance test on rotary compressor/blower
14. Draw velocity profile in a pipe flow using Prandtl -Pitot tube
15. Analysis of automobile exhaust gas and flue gas using exhaust gas analyser

PREREQUISITE: ME204 Thermal Engineering

COURSE OBJECTIVES:

1	To study the various types IC engines and their parts
2	To conduct the performance test on IC engines, compressors and blowers
3	To familiarize equipment used for measuring viscosity, flash and fire point and Calorific value of petroleum products.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Understand and determine the properties of lubricating oils and fuels
2	Understand, prepare, analyse and evaluate valve timing diagram of four stroke engines
3	Understand various tests and performance parameters of IC engines, reciprocating compressor and blower
4	Conduct appropriate tests and determine the perforamnce parameters of IC engines, reciprocating compressor and blower.
5	Prepare heat balance sheet of IC engines.
6	Analyse the effect of cooling water flow on the performance of IC engine

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	1	-	-	3	-	-	-	2	-	3	-	-		1	1
CO2	2	3	-	2	-	-	-	2	-	3	-	-		1	2
CO3	1	-	-	2	-	-	-	-	-	-	-	-		1	1
CO4	3	3	-	3	-	-	-	2	-	3	-	-		2	3
CO5	2	3	-	3	-	-	-	2	-	3	-	-		1	2
CO6	2	3	-	3	-	-	-	2	-	3	-	-		1	2

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	**1**	The fundamental knowledge about the properties of fuel and oil may help to solve engineering related problems.
	PO4	**3**	Students will be able to analyze fuels and lubricating oils and interpretation of data helps to provide valid conclusions.
	PO8	**2**	Students will maintain professional ethics and norms of engineering practice while conducting the experiment and recording datas.
	PO10	**3**	Students will communicate effectively by writing effective reports and

			inferences.
CO2	PO1	**2**	Knowledge in valve timing diagram of IC engines may help in solving problems related to valve timig of engines.
	PO2	**3**	Students will be able to identify and analyze problems on valve timing of IC engines reaching substantiated conclusions.
	PO4	**2**	Students may be able to provide valid conclusions by analysing and interpreting datas from valve timing diagram.
	PO8	**2**	Students will maintain professional ethics and norms of engineering practice while conducting the experiment and recording datas.
	PO10	**3**	Students will communicate effectively by writing effective reports and inferences.
CO3	PO1	**1**	The fundamental knowledge about the performance parameters may help to solve engineering problems.
	PO4	**2**	Students may able to provide valid conclusions by analysing various performance parameters of IC engines, compressor and blowers.
CO4	PO1	**3**	Evaluation of performance paramenters helps to finding out the solution of complex engineering problems.
	PO2	**3**	Analysis of various performance paramenters helps reaching in substantiated conclusions.
	PO4	**3**	Analysis and interpretation of various performance parameters helps to provide valid conclusions.
	PO8	**2**	Students will maintain professional ethics and norms of engineering practice while conducting the experiment and recording datas.
	PO10	**3**	Students will communicate effectively by writing effective reports and inferences.
CO5	PO1	**2**	Fundamental knowledge about heat balance sheet may help to solve engineering problems related to IC engines.
	PO2	**3**	Analysis of datas from heat balance sheet helps to reach at substantiated conclusions.
	PO4	**3**	Analysis and interpretation of data from heat balance sheet helps to provide valid conclusions.
	PO8	**2**	Students will maintain professional ethics and norms of engineering practice while conducting the experiment and recording datas.

	PO10	**3**	Students will communicate effectively by writing effective reports and inferences.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	**1**	Students may be able to solve real-time problems in Fluid allied Engineering sectors of Mechanical Engineering
CO2	PSO1	**1**	Students may be able to solve real-time problems in IC engine related sectors of Mechanical Engineering
CO3	PSO1	**1**	Students may be able to solve real-time problems in IC engine related sectors of Mechanical Engineering
CO4	PSO1	**2**	Students will be able to solve real-time problems in IC engine related sectors of Mechanical Engineering
CO5	PSO1	**1**	Students will be able to solve real-time problems in IC engine related sectors of Mechanical Engineering
CO6	PSO1	**1**	Students will be able to solve real-time problems in IC engine related sectors of Mechanical Engineering

SREEPATHY INSTITUTE OF MANAGEMENT AND TECHNOLOGY

COURSE HANDBOOK

DEPARTMENT OF MECHANICAL ENGINEERING

SEMESTER V

SREEPATHY INSTITUTE OF MANAGEMENT AND TECHNOLOGY

VISION

"Strive for excellence in generation and dissemination of knowledge."

MISSION

➢ To mould engineers of tomorrow, who are capable of addressing the problems of the nation and the world, by imparting technical education at par with international standards.

➢ To instil a desire in students for research, innovation, invention and entrepreneurship.

➢ To strive for creative partnership between the industry and the Institute.

➢ To impart the values of environment awareness, professional ethics, societal commitment, life skills and a desire for lifelong learning.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To act as quality knowledge center for creating technologically competent Mechanical Engineering professionals who will cater to the needs of emerging and interdisciplinary industry and research fields.

MISSION

1. To provide theoretical and conceptual knowledge in Mechanical engineering stream and enhance lifelong learning.
2. To work in close association with stakeholders in industry by enhancing industry-institute interaction, to take up need based research and industry specific programs.
3. To infuse professional, social and economic responsibilities along with ethical values to graduates.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

The graduates from Mechanical Engineering program are expected to achieve the following Program Educational Objective within a few years of graduation

PEO1: Have an overall knowledge in Mechanical Engineering and also in the fields of Mathematics, Science, Communication and Computing skills.

PEO2: Design machines, analyze thermo-fluid problems and optimize the quality of products and services.

PEO3: Implement ideas of Mechanical Engineering for the challenging task in the interdisciplinary areas like Electrical, Electronics, Computer Science, Civil, Bio-Technology and allied branches.

PROGRAM OUTCOMES (POS)

POs are generic to engineering education and applies to all branches of Engineering.

- **PO1** **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.
- **PO2** **Problem Analysis:** Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.
- **PO3** **Design/development of solutions**: Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations
- **PO4** **Conduct investigations of complex Problems**: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO5** **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO6** **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO7** **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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

PO9 **Individual and team work**: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

PO10 **Communication:** Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions

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

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

PROGRAM SPECIFIC OUTCOMES (PSO)

Mechanical Engineering Graduates will be able to

PSO1: Solve real-time problems in Design, Fluids, Thermal, Manufacturing and allied Engineering sectors of Mechanical Engineering.

PSO2: Recognize the importance of self-learning and engage in continuous independent learning to become experts in either as entrepreneurs or employees in the field.

BL BLOOM'S LEVEL

L1	Level -1	Remembering	Recalling from memory of previously learned material
L2	Level -2	Understanding	Explaining Ideas or Concepts
L3	Level -3	Applying	Using information in another familiar situation
L4	Level -4	Analyzing	Breaking information into part to explore understandings and relationships
L5	Level -5	Evaluating	Justify a decision or course of action
L6	Level -6	Creating	Generating new ideas, products or new ways of viewing

ME 301 MECHANICS OF MACHINERY

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Mechanics Of Machinery**	Course code**: ME 301**
L-T-P**: 3-1-0**	Credit**: 4**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction to kinematics and mechanisms - various mechanisms, kinematic diagrams, degree of freedom- Grashof's criterion, inversions, coupler curves straight line mechanisms exact, approximate – Ackerman Steering Mechanism - Hooke's joint - Geneva mechanism - mechanical advantage, transmission angle, Displacement, velocity and acceleration analysis - relative motion - relative velocity - instant centre - Kennedy's theorem	11	15
II	Relative acceleration - Coriolis acceleration - graphical and analytical methods – complex number methods – computer oriented methods, Cams - classification of cam and followers - displacement diagrams, velocity and acceleration analysis of SHM, uniform velocity, uniform acceleration, cycloidal motion	8	15
III	Graphical cam profile synthesis, pressure angle, Analysis of tangent cam with roller follower and circular cam with flat follower, Introduction to polynomial cams.	10	15
IV	Gears – terminology of spur gears – law of Gearing - involute spur gears involutometry - contact ratio - interference - backlash - gear standardization – interchangability, Non-standard gears, centre distance modification, long and short addendum system. - internal gears - theory and details of bevel, helical and worm gearing	8	15
V	Gear trains - simple and compound gear trains - planetary gear trains – differential -solution of planetary gear train problems - applications. Kinematic synthesis (planar mechanisms) - tasks of kinematic synthesis – type, number and dimensional synthesis – precision points	9	20
VI	Graphical synthesis for motion - path and prescribed timing - function generator. 2 position and 3 position synthesis – overlay Method. Analytical synthesis techniques, Freudenstein's equation – complex number methods - one case study in synthesis of mechanism.	10	20

TEXT BOOKS:

1	Ballaney P. L., Theory of Machines and Mechanisms, Khanna Publishers,2005
2	S. S. Rattan, Theory of Machines, Tata Mc Graw Hill,2009

REFERENCES:

1	C. E. Wilson, P. Sadler, Kinematics and Dynamics of Machinery, Pearson Education,2005
2	D. H. Myskza, Machines and Mechanisms Applied Kinematic Analysis, Pearson Education,2013
3	G. Erdman, G. N. Sandor, Mechanism Design: Analysis and synthesis Vol I & II, Prentice Hall of India,1984.
4	Ghosh, A. K. Malik, Theory of Mechanisms and Machines, Affiliated East West Press,1988
5	J. E. Shigley, J. J. Uicker, Theory of Machines and Mechanisms, McGraw Hill,2010

PREREQUISITE: Nil

COURSE OBJECTIVES:

1	To provide knowledge on kinematics of selected mechanisms, design of cams, theory and analysis of gears, gear trains and synthesis of mechanisms.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Knowledge in different types of mechanisms and their inversions, and to calculate their degrees of freedom.
2	Knowledge to conduct displacement, velocity and acceleration analysis of planar mechanisms
3	Knowledge to design and develop a cam for a specified follower motion
4	Knowledge in in gear terminologies and classify types of gears with applications
5	Knowledge about gear trains and to calculate velocity of gears in a gear train.
6	To conduct synthesis of mechanism, and to construct a mechanism for a specified output motion

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	3		2	3
CO2	3	3	3	-	-	-	-	-	-	-	-	3		2	3
CO3	3	3	3	-	-	-	-	-	-	-	-	3		2	3
CO4	3	3	3	-	-	-	-	-	-	-	-	3		2	3
CO5	3	3	3	-	-	-	-	-	-	-	-	3		2	3
CO6	3	3	-	-	-	-	-	-	-	-	-	-		-	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Students understand different mechanisms and apply their knowledge in mathematics and Engineering fundamentals to find their degrees of freedom
	PO2	3	Students can understand and analyze complex Engineering problems related to planar mechanisms and can reach substantiated conclusions using first principles of mathematics and Engineering.
	PO3	3	Students are capable of designing planar mechanisms that meet the specified needs with appropriate consideration for public safety and environmental considerations.
	PO12	3	Students recognize the need for life- long learning in the area of planar and spatial mechanisms
CO2	PO1	3	Students could apply their Engineering knowledge to conduct velocity and acceleration analysis of complex mechanism.
	PO2	3	Students can understand and analyze complex Engineering problems related to planar mechanisms and can reach substantiated conclusions using first principles of mathematics and Engineering.
	PO3	3	Students are capable of designing and analysing planar mechanisms that meet the specified needs with appropriate consideration for public safety and environmental considerations.
	PO12	3	Students recognize the need for life- long learning in the area of planar and spatial mechanisms

CO3	PO1	3	Students will be able to apply their knowledge in mathematics and Engineering fundamentals to synthesize a mechanism
	PO2	3	Students can understand, analyse and synthesize complex Engineering problems related to planar mechanisms and can reach substantiated conclusions using first principles of mathematics and Engineering.
	PO3	3	Students are capable of designing and analysing planar mechanisms that meet the specified needs with appropriate consideration for public safety and environmental considerations.
	PO12	3	Students recognize the need for life- long learning in the area of planar and spatial mechanisms
CO4	PO1	3	Students apply their knowledge in mathematics and Engineering fundamentals to design and do motion analysis of cam and follower mechanisms.
	PO2	3	Students can understand and analyze complex Engineering problems related to cam mechanism and can reach substantiated conclusions using first principles of mathematics and Engineering.
	PO3	3	Students are capable of designing and analysing cam mechanisms that meet the specified needs with appropriate consideration for public safety
	PO12	3	Students recognize the need for life- long learning in the area of cams and followers.
CO5	PO1	3	Students have knowledge in gear terminologies and apply their knowledge Engineering fundamentals for calculating velocity of gears in a gear train.
	PO2	3	Students can understand and analyze complex Engineering problems related to gear mechanisms and can reach substantiated conclusions using first principles of mathematics and Engineering.
	PO3	3	Students are capable of designing and analysing gear mechanisms that meet the specified needs with appropriate consideration for public safety
	PO12	3	Students recognize the need for life- long learning in the area of gear and gear train analysis

CO6	PO1	3	Students are capable of communicating effectively and write effective reports, make effective presentations, and give and receive clear instructions regarding kinematic analysis of gear and gear trains
	PO2	3	Students are capable of communicating effectively and write effective reports, make effective presentations, and give and receive clear instructions regarding analysis of cam mechanism

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PS01	2	Apply their knowledge in the domain of engineering mechanics to find degrees of freedom of different planar mechanism
	PS02	3	Students can successfully apply the kinematic principles of design and analysis for generating mechanisms of desired output motion.
CO2	PS01	2	Apply their knowledge in the domain of engineering mechanics to conduct kinematic analysis of different planar mechanism
	PS02	3	Students can successfully apply the kinematic principles of design and analysis for generating mechanisms of desired output motion.
CO3	PS01	2	Apply their knowledge in the domain of engineering mechanics to conduct synthesis of different planar mechanism
	PS02	3	Students can successfully apply the kinematic principles of design and analysis for generating mechanisms of desired output motion.
CO4	PS01	2	Apply their knowledge in the domain of engineering mechanics to conduct analysis of motion of cam and follower mechanism.
	PS02	3	Students could apply their acquired knowledge to design and analyze the motion of cam and follower mechanism.
CO5	PS01	2	Apply their knowledge in the domain of engineering mechanics to conduct analysis of motion of gear and gear train mechanism
	PS02	3	Students can successfully apply the kinematic principles of design and analysis for generating gear and gear train mechanisms.

ME 303 MACHINE TOOLS & DIGITAL MANUFACTURING

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Machine Tools & Digital Manufacturing**	Course code**: ME 303**
L-T-P**: 3-0-0**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction to metal cutting: Tool nomenclature – Attributes of each tool nomenclature – Attributes of feed and tool nomenclature on surface roughness obtainable, Orthogonal and oblique cutting - Mechanism of metal removal – Primary and secondary deformation shear zones. Mechanism of chip formation – Types of chips, need and types of chip breakers – Merchant's theory. Analysis of cutting forces in orthogonal cutting– Work done, power required (simple problems). Friction forces in metal cutting – development of cutting tool materials. Thermal aspects of machining -Tool wear and wear mechanisms. Factors affecting tool life– Economics of machining (simple problems) Cutting fluids	8	15
II	General purpose machine tools – Principle and operation of lathe – Types of lathes and size specification. Work holding parts of lathes and their functions – Main operations. Taper turning and thread cutting – Attachments. Feeding mechanisms, Apron mechanisms. Drilling Machines – Types – Work holding devices. Tool holding devices – Drill machine operations. Drilling machine tools – Twist drill nomenclature- cutting forces in drilling.	7	15
III	Reciprocating machines: Shaping machines – Types – Size – Principal parts – Mechanism. Work holding devices – Operations performed – Tools, Cutting speed, feed and depth of cut – Machining time Slotting machines – Types – Size – Principal parts – Mechanism – Work holding devices Operations performed – Tools – Cutting speed, feed and depth of cut Planing machines – Types – Size – Principal parts – Mechanism – Work holding devices Operations performed – Tools – Cutting speed, feed and depth of cut – Machining time- Surface roughness obtainable.	7	15

IV	Milling machines – Types – Principal parts – Milling mechanism. Work holding devices – Milling machine attachments, Types of milling cutters – Elements of plain milling cutters. Nomenclature - Cutting forces in milling – Milling cutter materials, Up milling, down milling and face milling operations. Calculation of machining time. Indexing – Simple indexing – Differential indexing	7	15
V	Grinding machines – Classification – Operations – Surface, cylindrical and Centre less grinding Grinding mechanisms – Grinding wheels: Specification – types of abrasives, grain size Types of bond, grade, structure – Marking system of grinding wheels, Selection of grinding wheels Glazing and loading of wheels – Dressing and Truing of grinding wheels, surface roughness obtainable Superfinishing operations: Lapping operation– Types of hand lapping, Lapping machines – Types of honing –Methods of honing. Types of honing stones – Honing conditions – Cutting fluids – Types of broaches – Force required for broaching – Surface roughness obtainable in lapping, honing and broaching operations. Semi-automatic machine tools – Turret and capstan lathes. Automatic machine tools – Single and multi-spindle machines	7	20
VI	Definition of digital manufacturing – Features and development of digital manufacturing. Theory system of digital manufacturing science: Operation Mode and Architecture of Digital Manufacturing System Operation reference mode of digital manufacturing system – Architecture of digital manufacturing system Modeling theory and method of digital manufacturing science Critical modeling theories and technologies of digital manufacturing science (Theory system of digital manufacturing science – Basicsonly)	7	20

TEXT BOOKS:

1	Chapman W. A. J., Workshop Technology, Viva books (P) Ltd,1988
2	HMT, Production Technology, Tata McGraw-Hill,2001
3	Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited,2012

REFERENCES:

1	Acharkan. N., Machine Tool Design Vol. 1 to 4, MIR Publication,2000
2	Chernov, Machine Tools, MIR Publication,1984
3	Ghosh A. And Malic A. K., Manufacturing Science, East West Press, 2010
4	Hajra Choudary, Elements of workshop technology, Vol I & II, Media Publishers, 2010
5	Lihui Wang and Andrew Yeh Ching Nee, Collaborative Design and Planning for Digital Manufacturing, Springer-Verlag London Limited, 2009
6	Malkin Stephen, Grinding Technology: Theory and Applications of Machining with Abrasives, Industrial press, 2008
7	Poul De Garmo, J.T.Black, R.A.Kosher, Materials and Processes in Manufacturing, Prentice Hall of India Pvt. Ltd.,1997.

PREREQUISITE: Nil

COURSE OBJECTIVES:

1	To introduce students to the scientific principles underlying material behavior during manufacturing processes so as to enable them to undertake calculations of forces, tool stresses and material removal rates.
2	To understand various machine tools such as lathe, drilling machine, reciprocating machines etc. and their operations..
3	To impart knowledge of appropriate parameters to be used for various machining operations.
4	To develop knowledge on the importance of milling grinding and super finishing in metal cutting process.
5	To introduce the fundamentals of digital manufacturing.

COURSE OUTCOMES:

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

CO's	
1	**Explain** the tool nomenclature, mechanism of metal removal and chip formation and can perform the **analysis** of cutting forces in orthogonal cutting
2	**Explain** the types, parts, mechanisms and main operations of lathe and drilling machine.
3	**Understand** various reciprocating machines used in the metal cutting Processes
4	**Explain** the types, parts, mechanism of milling machine and can **analyze** the cutting forces

	developed in metal cutting process
5	**Select** the best suited super finishing operations for meeting the industry requirements.
6	**Understand** and **apply** the principles of digital manufacturing.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	2	-	-		2	-
CO2	2	-	-	-	2	2	-	-	-	-	-	-		-	2
CO3	2	-	-	-	2	2	-	-	-	-	-	-		-	2
CO4	2	-	-	-	2	2	-	-	-	-	-	-		-	2
CO5	3	-	-	-	2	-	-	-	-	2	-	-		2	-
CO6	3	-	-	-	-	-	-	-	-	-	-	3		2	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	**3**	Acquired knowledge in tool nomenclature, material removal mechanism and cutting forces generated during machining will help the students to effectively machine different materials for the industrial purpose
	PO2	**2**	Work piece damages and tool breakages occurring during machining process can be rectified by analyzing the cutting force and understanding the material removal mechanism
	PO10	**2**	Can effectively communicate the effects of cutting forces on work piece surface quality
CO2	PO1	**2**	Operations which have to be carried out using lathe and drilling machine need the knowledge of production engineering fundamentals
	PO5	**2**	Able to select different techniques, work holding devices and tools to perform machining operation in lathe and drilling machine
	PO6	**2**	Knowledge of parts, mechanism, tools used and operations performed in lathe and drilling machines help us to introduce safety measures in workshop
CO3	PO1	**2**	Operations which have to be carried out using reciprocating machine tools need the knowledge of production engineering fundamentals

	PO5	**2**	Knowledge different types of cutting tools used in reciprocating machining process.
	PO6	**2**	Knowledge of parts, mechanism, tools used and operations performed in reciprocating machines help us to introduce safety measures in workshop
CO4	PO1	**2**	Gear cutting and plain surface machining can be carried out using milling machine by understanding the mechanisms
	PO5	**2**	Able to select different techniques, work holding devices and tools to perform gear cutting and plain machining operation in milling machine
	PO6	**2**	Improve the safe working atmosphere by better understanding of machine and its parts
CO5	PO1	**3**	For improving the surface quality and reliability of products suitable super finishing operations can be recommended
	PO5	**2**	Able to suggest the finishing techniques & tools for the required applications in manufacturing industry
	PO10	**2**	Able to provide clear instruction regarding the super finishing operation suited for the particular industrial application.
CO6	PO1	**3**	Design and development of solutions in manufacturing industry using digital manufacturing principles
	PO12	**3**	Learn deep into the different principles of digital manufacturing for improving the productivity and quality of products

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	**2**	Students will acquire basic knowledge on mechanism of metal removal and cutting forces during machining and will be able to apply this knowledge to solve manufacturing problems in industry.
CO2 CO3 CO4	PSO2	**2**	Knowledge in structure of machine tools, their mechanism, work and tool holding devices and the different cutting forces developed will help the students to take up careers in manufacturing industries or to become an entrepreneur in that field

CO5	PSO1	**2**	Improves the reliability and surface quality of products by recommending the most suited finishing operations
CO6	PSO1	**3**	Learn deep into the different principles of digital manufacturing for becoming an expert in that field

ME305 COMPUTER PROGRAMMING & NUMERICAL METHODS

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Computer Programming & Numerical Methods**	Course code**: ME 305**
L-T-P**: 2-0-1**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction to Computer programming concept –internal representation of data - Algorithm and flow chart, Basics of procedure oriented and object oriented programming. Introduction to C++: Structure of C++ program; Keywords; Identifiers; Data types – integer, real, character, string, boolean, enumeration, Constant and Variables; Operators – assignment, arithmetic, relational, logical, increment, decrement and conditional operators; Statements – simple & compound, declaration statements. Input and output streams.	5	15
II	Control statements: if, if-else, switch, for, while, do-while, break and continue statements, Arrays – one dimensional & two dimensional; Functions: inline functions, function over loading, Functions with default arguments, recursion.	7	15
III	Basics of Pointers. Function call by value, call by reference. Preparation of programs for evaluation of Factorial of a number, infinite series, Sorting, Searching and Matrix multiplication	8	15
IV	Introduction to Class and Object- definition, data members, member function. private & public member functions, member access, friend declaration, class	7	15

	objects, predefined classes, initialization. Inheritance-base class and derived class. Simple programs using the above features. (No programming questions for University examination and internals)		
V	Errors and approximations, sources of errors. Solution of linear system of equations: Gauss elimination, Gauss-Jordan and Gauss–Seidel methods. Interpolation: Lagrange and Aitken techniques	7	20
VI	Curve fitting: method of least squares, non-linear relationships, Linear correlation, measures of correlation. Solution of Partial differential equations: classification, Laplace equation, Finite difference method. Numerical problems and preparation of computer programs for the above methods	8	20

TEXT BOOKS:

1	Balagurusamy, Computer Programming 1e McGraw Hill Education , 2013
2	Balagurusamy, Numerical Methods 1e McGraw Hill Education, 1999
3	Jose S., Computer Programming and Numerical Methods, Pentagon, 2015.
4	Ravichandran D., Programming with C++, Tata McGraw Hill, 2007

REFERENCES:

1	Balaguruswamy E., Object Oriented Programming with C++, Tata McGraw Hill, 1992.
2	Barkakati N., Object Oriented Programming in C++, SAMS, 1991.
3	Gerald C. F. and P. O. Wheatley, Applied Numerical Analysis, Pearson,2004.
4	Kamthane A. M., Object Oriented Programming with ANSI & Turbo C++,
5	Lippman S. B. and J. Lajoie, C++ Primer, Pearson Education, 2005. Pearson Education, 2009.

PREREQUISITE: Nil

COURSE OBJECTIVES:

1	To equip students with fundamentals of computer programming
2	To provide fundamental idea about the use of computer programming and numerical methods for analyzing the basic engineering problems

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Understand the fundamentals of algorithms and flowcharts and computer programming concept.
2	Design programs involving control statements, loops, functions and pointers.
3	Understand the concept of object oriented programming
4	Understand and apply numerical methods and design programs in C++ to solve basic engineering problems.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	-	-	-	-	3	0	-	-	-	-	-	-		2	-
CO2	-	-	-	-	3	0	-	-	-	-	-	-		2	-
CO3	-	-	-	-	3	0	-	-	-	-	-	-		2	-
CO4	-	2	-	-	3	0	-	-	-	-	-	-		2	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
C01	PO5	3	Students will have a fundamental idea about programming concept, algorithm and flowchart.
C02	PO5	3	Students could apply their acquired knowledge to develop programs using loops, functions and pointers.
C03	PO5	3	Students will be able to develop idea of object oriented programming.
CO4	PO2	2	Students will have a fundamental idea to carry out solution of linear system of equations, interpolation, curve fitting, solution of partial differential equations.
	PO5	3	Students could apply their knowledge in programming to develop programs for different numerical methods

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	**2**	Students could apply their knowledge to develop algoritm and flow chart to solve different engineering problems.
CO2	PSO1	**2**	Students could apply their acquired knowledge to create programs to solve different engineering problems.
CO3	PSO1	**2**	Students could apply their acquired knowledge to create programs to solve different engineering problems.
CO4	PSO1	**2**	Students will be capable of applying numerical methods to solve problems different engineering problems.

EE 311 ELECTRICAL DRIVES & CONTROL FOR AUTOMATION

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree :**B-Tech**
Course**: Electrical Drives & Control for Automation**	Course code**: EE 311**
L-T-P**: 3-0-0**	Credit**:3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	DC Machines-principle of operation-emf equation-types of excitations. Separately excited, shunt and series excited DC generators, compound generators. General idea of armature reaction, OCC and load characteristics - simple numerical problems.	6	15%
II	Principles of DC motors-torque and speed equations-torque speed characteristics- variations of speed, torque and power with motor current. Applications of dc shunt series and compound motors. Principles of starting, losses and efficiency – load test- simple numerical problems.	6	15%

III	Transformers – principles of operations – emf equation- vector diagrams- losses and efficiency – OC and SC tests. Equivalent circuits-efficiency calculations- maximum efficiency – all day efficiency – simple numerical problems. Auto transformers constant voltage transformer- instrument transformers	7	15%
IV	Three phase induction motors- slip ring and squirrel cage types principles of operation – rotating magnetic field- torque slip characteristics- no load and blocked rotor tests. Circle diagrams methods of starting – direct online – auto transformer starting	7	15%
V	Single phase motors- principle of operation of single phase induction motor – split phase motor – capacitor start motor- stepper motor-universal motor Synchronous machines types – emf equation of alternator – regulation of alternator by emf method. Principles of operation of synchronous motors- methods of starting- V curves synchronous condenser	8	20%
VI	Stepper motors: Principle of operation, multistack variable reluctance motors, single-stack variable reluctance motors, Hybrid stepper motors, Linear stepper motor, comparison, Torque-speed characteristics, control of stepper motors Controllers for automation, servo control, Digital controllers, Advanced control systems, Digital signal processors, motor controllers, Axis controllers, Machine tool controllers, Programmable Logic Controllers	8	20%

TEXT BOOKS:

1	Kothari D. P. and I. J. Nagrath, Electrical Machines, Tata McGraw Hill, 2004.
2	Nagrath .I.J. & Kothari .D.P, Electrical Machines, Tata McGraw-Hill, 1998
3	Richard Crowder, Electrical Drives and Electromechanical systems, Elsevier, 2013
4	Mehta V. K. and R. Mehta, Principles of Electrical and Electronics, S. Chand & Company Ltd., 1996.
5	Theraja B. L. and A. K. Theraja, A Text Book of Electrical Technology, S. Chand & Company Ltd., 2008.
6	Vedam Subrahmaniam, Electric Drives (concepts and applications), Tata McGraw- Hill, 2001

REFERENCES:

1	H.Partab, Art and Science and Utilisation of electrical energy, Dhanpat Rai and Sons, 1994
2	M. D.Singh, K. B. Khanchandani, Power Electronics, Tata McGraw-Hill, 1998
3	Pillai.S,K A first course on Electric drives, Wiley Eastern Limited, 1998

PREREQUISITE: NIL

COURSE OBJECTIVES:

1	To understand the basic concepts of different types of electrical machines and their \ performance
2	To know the different methods of starting D.C motors and induction motors.
3	To introduce the controllers for automation

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Students will be able to **Explain** the Principle of DC Machines and their application
2	Students will be able to **Apply** the principle of electrical drives and understand the dynamics of Electrical drive system.
3	Students will be able to **Select** a drive for a particular application based on power rating.
4	Students will be able to **Select** a drive based on mechanical characteristics for a particular drive application
5	Students will be able to **Design** speed control of induction motor drives in an energy efficient manner using power electronics & be able to learn the control system for synchronous motor drives
6	Students will be able to **Discuss** the Controllers for Automation.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2	PSO3
CO1	**3**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**		**2**	**-**	**-**
CO2	**-**	**3**	**-**	**-**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**		**2**	**-**	**-**
CO3	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**		**2**	**-**	**-**
CO4	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**		**1**	**-**	**-**
CO5	**-**	**-**	**3**	**-**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**		**1**	**-**	**-**
CO6	**3**	**3**	**-**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**		**1**	**-**	**-**

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	**PO1**	3	Students will be able to use the Knowledge of Mathematics & Electrical machines to find solutions for Engineering problems
	PO5	2	Students will be able to utilize the knowledge of Electrical machines & IT tools to solve complex Engineering activities with an understanding of the limitations.
CO2	**PO2**	3	Students will be applying the knowledge in the area of Electrical drives to analyze engineering problems and arrive at substantiated Conclusions.
	PO5	2	Students will be able to utilize the knowledge of Electric drives and understand the dynamics of Electric drive system to solve complex Engineering activities with an understanding of the limitations
	PO7	2	Students will be able to Understand the impact of the electric drives in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments
CO3	**PO2**	3	Students will be able to select a drive for a particular application
	PO5	3	Select the drive and use the modern programming tools to model complex engineering problems
CO4	**PO2**	3	Students will be able to select a drive for a particular application depending the Mechanical characteristics, Analyze and arrive at substantiated Conclusions.

	PO5	3	Select the drive and use the modern programming tools to model complex engineering problems
CO5	**PO3**	3	Students will be able to design speed control of induction motor drives in an energy efficient manner using Power electronics.
	PO5	2	Students will be able to apply the knowledge in the area of speed control drives to solve complex Engineering activities.
	PO7	2	Students will be able to Understand the impact of Speed control of induction motors in an efficient manner and demonstrate the knowledge of, and the need for sustainable developments
CO6	**POI**	3	Students will be able to use the Knowledge of Different control circuits and Electrical machines to find solutions for Engineering problems
	PO2	3	Students will be able to Identify the Controllers for different engineering problems

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	**PSO1**	2	Graduates will be able to gain the knowledge of DC machines to solve the real time problems in Mechanical engineering
CO2	**PSO1**	2	Graduates will be able to gain the knowledge of Electrical drive system to solve the real time problems in Mechanical engineering
CO3	**PSO1**	2	Graduates will able to gain the knowledge of Electrical drive system to select for the particular application
CO4	**PSO1**	1	Graduates will able to gain the knowledge of mechanical characteristics of Electrical drive system to select for the particular application
CO5	**PSO1**	1	Graduates will able to gain the knowledge to design speed control of induction motor drives in an efficient manner.
CO6	**PSO1**	1	Graduates will able to gain the knowledge of controllers which will be suitable for mechanical engineering application

HS300 PRINCIPLES OF MANAGEMENT

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Principles Of Management**	Course code**: HS 300**
L-T-P**: 3-0-0**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction to Management: definitions, managerial roles and functions; Science or Art perspectives- External environment global, innovative and entrepreneurial perspectives of Management – Managing people and organizations in the context of New Era- Managing for competitive advantage - the Challenges of Management	6	15
II	Early Contributions and Ethics in Management: Scientific Management- contributions of Taylor, Gilbreths, Human Relations approach-contributions of Mayo, McGregor's Theory, Ouchi's Theory Z , Systems Approach, the Contingency Approach, the Mckinsey 7-S Framework Corporate Social responsibility- Managerial Ethics.	6	15
III	Planning: Nature and importance of planning, -types of plans Steps in planning, Levels of planning - The Planning Process. – MBO	6	15
IV	Organizing for decision making: Nature of organizing, organization levels and span of control in management Organizational design and structure –departmentation, line and staff concepts , Limitations of decision making Evaluation and selecting from alternatives programmed and non-programmed decisions - decision under certainty, uncertainty and risk-creative process and innovation	6	15
V	Staffing and related HRD Functions: definition, Empowerment, staff – delegation, decentralization and recentralization of authority – Effective Organizing and culture-responsive organizations –Global and entrepreneurial organizing Manager inventory chart-matching person with the job-system approach to selection Job design skills and personal characteristics	9	20

	needed in managers selection process, techniques and instruments (DBTT) in steels and structural changes during DBTT, applications.		
VI	Leading and Controlling: Leading Vs Managing – Trait approach and Contingency approaches to leadership - Dimensions of Leadership) - Leadership Behavior and styles – Transactional and Transformational Leadership Basic control process- control as a feedback system – Feed Forward Control – Requirements for effective control – control techniques – Overall controls and preventive controls – Global controlling	9	20

TEXT BOOKS:

1	Harold Koontz and Heinz Weihrich, Essentials of Management, McGraw Hill Companies, 10th Edition

REFERENCES:

1	Daft, New era Management, 11th Edition, Cengage Learning
2	Griffin, Management Principles and Applications, 10th Edition, Cengage Learning
3	Heinz Weirich, Mark V Cannice and Harold Koontz, Management: a Global, Innovative and Entrepreneurial Perspective, McGraw Hill Education, 14th Edition
4	Peter F Drucker, The Practice of Management, McGraw Hill, New York
5	Robbins and Coulter, Management, 13th Edition, 2016, Pearson Education

PREREQUISITE: Nil

COURSE OBJECTIVES:

1	To develop ability to critically analyse and evaluate a variety of management practices in the contemporary context
2	To understand and apply a variety of management and organizational theories in practice;.
3	To be able to mirror existing practices or to generate their own innovative management competencies required for today's complex and global workplace.
4	To be able to critically reflect on ethical theories and social responsibility ideologies to create sustainable organizations

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	To know about management and basics management functions and problems
2	To evaluate about the early contributions and ethics related to management and its applications.
3	To develop planning skills, procedures and levels of planning in day to day life activities..
4	Analyzing of organizational models, levels, structure and make the ability to decision making power on students
5	To familiarize the staffing procedures and related functions
6	To analyze the aspects related to leader and its functions, controlling and its applications and need in an organization and daily life.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	-	-	-	-	-	-	-	3	3	-	-	-		-	-
CO2	-	-	-	-	-	-	-	-	3	-	2	-		-	-
CO3	-	-	-	-	-	-	-	-	-	-	2	3		-	-
CO4	-	-	-	-	-	2	-	-	-	-	2	-		-	-
CO5	-	-	-	-	-	-	3	-	2	-	-	-		-	-
CO6	-	-	-	-	-	3	2	-	2	-	-	-		-	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO8	3	To analyzing the managerial functions and roles it should concerned the related social and cultural issues
	PO9	3	The functions of management are highly correlated with the ethics related to management
CO2	PO9	3	To apply the managerial theories it is necessary to analyze the professional ethics and responsibilities
	PO11	2	The application of management theory is related to demonstration knowledge and understanding of theories
CO3	PO11	2	Planning procedures are depends upon the different kinds of managerial practices and roles

	PO12	3	Planning is a lifelong learning process which is changed according to programs, and levels of organizations
CO4	PO6	2	The decision making is an important tool which is connected to entire work forces
	PO11	2	The organizational pattern, structure and levels determination is depend on the business practices followed by them
CO5	PO7	3	The proper communication skills is essential for each staff with co workers
	PO9	2	It is necessary to understand the ethics and responsibilities related to an organization when a staff was appointed
CO6	PO6	3	Leader must have the ability to concerned about the group he posses
	PO7	2	Maintaining of effective communication among members is essential
	PO9	2	Understanding of ethics and responsibilities is crucial when a team is formed.

ME 365 ADVANCED METAL CASTING

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Advanced Metal Casting**	Course code**: ME 365**
L-T-P**: 3-0-0**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Design of molds Functional requirements of molding materials, type of sands Properties of molding sand, sand testing techniques Effect of molding on sand properties, Bonding material , Mould surface coating, Sand design and control, Thermal aspect of molding sand, mould wall movement	6	15
II	Pouring and feeding Gating - type of gating- gating design, Factor involved in gating design-illustrative problems in determination of filling time and discharge rate, Aspiration effect- effects of friction and velocity distribution, Risers – primary function of a riser Theoretical consideration Riser design and placement Determination of dimensions of rise- blind risers, Internal risers-use of chills Use of insulators and exothermic compounds	6	15

III	Solidification Freezing of pure metal Skin effects- nucleation and growth Shrinkage- freezing of alloys Effect of mould materials and alloy composition on casting Fluidity- factor affecting fluidity- fluidity measurement and application of fluidity Gases in metals- degassing Grain refinement Illustrative problems related to determination of solidification time	7	15
IV	Heat transfer during solidification Methods of manipulating heat transfer Experimental methods for the study of heat transfer during solidification Crystal growth methods Heat flow in solidification Heat transfer with in the solid/liquid metal system Heat transfer at the metal-mould interface Heat flow in one dimensional solidification geometries Freezing at mould wall Rapid freezing in contact with a cold substrate with initial melt super cooling	8	15
V	Ferrous and non ferrous castings Steel Casting – The family of cast iron Melting of steels and cast irons–Grey iron Foundry practice – ductile iron – Malleable Iron casting design Aluminum and its alloys: Different Aluminum alloy systems Advantage and limitation of Aluminum alloy castings Molding for aluminum castings - melting of Aluminum degassing- grain refinement Modification- effect of various melt treatment on the mechanical properties of Aluminum castings. Magnesium and its alloys: different alloy systems advantage and limitation of Magnesium alloy castings Molding for magnesium casting- melting of Magnesium flux and flux less melting Type and functions of fluxes used- degassing and grain refinement- pouring technique Copper alloys: advantage of Copper alloys- melting drossing-oxygen and hydrogen in Copper melting-control of gases- de oxidation	8	20
VI	Casting defects and testing Functional design-metallurgical design simplification of foundry practice-economic considerations design of junction- specification of castings inspection of castings- analysis of casting defects nondestructive testing of casting- dye penetrant testing magnetic flaw detection, radiography, ultrasonic testing, etc. quality control and quality assurance	7	20

TEXT BOOKS/REFERENCES:

1	A.K.Chakrabarti, Casting Technology and Cast Alloys, Prentice –Hall Of India Ltd, 2005
2	Beely, Foundry Technology, Newnes-Butterworths, 1979
3	Gruzleski, The Treatment of Liquid Aluminum-Silicon Alloys, the American Foundrymen's Society Inc, USA, 1992
4	Heine, Loper and Rosenthal, Principle of Metal Casting, 2nd Edition, Tata Mc-Graw-Hill Publishing Company Limited, New Delhi, 1978
5	John Cambell, Casting, Butterworth-Heineman Ltd, Jordon Hill, Oxford, 1991
6	T.V.Rama Rao, Metal casting Principles and Practice, New Age International,2010
7	Gruzleski, The Treatment of Liquid Aluminum-Silicon Alloys, the American Foundrymen's Society Inc, USA, 1992.

PREREQUISITE: Nil

COURSE OBJECTIVES:

1	To gain theoretical and practical knowledge in material casting processes
2	To develops an understanding of the dependent and independent variables which control materials casting in a production processes.
3	To impart knowledge on design of gating system for castings.
4	To know foundry practice of ferrous and non ferrous alloys

COURSE OUTCOMES:

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

CO's	
1	**Explain** the requirements and properties of molding sand, bonding materials and surface coatings used in molding process
2	Perform the Gating and riser **Design** for a given product
3	**Compare** the solidification pattern in pure metal and alloys
4	**Explain** the heat transfer during solidification and the different methods of crystal growth.
5	**Compare** the molding,melting, degassing and grain refinement methods followed in ferrous and non- ferrous castings
6	**Identify** the different defects in casting and **recognize** the best suited inspection technique for a particular material and defect

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	-		3	-
CO2	3	3	2	-	-	-	-	2	-	-	-	-		3	-
CO3	1	-	-	-	-	-	-	-	-	2	-	1		-	2
CO4	2	-	-	-	-	-	-	-	-	-	-	-		1	2
CO5	-	-	3	-	-	-	-	2	-	2	-	-		2	-
CO6	3	2	3	-	-	-	-	2	-	2	-	-		3	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Knowledge in the requirements and properties of molding materials simplify the complications in sand casting operations
	PO2	2	By analysing the casting failure research literatures students can properly select/change the molding materials to rectify the problems
	PO3	2	Components can be designed to meet the specific needs like soundness, surface quality by selecting the proper molding sand and casting parameters
CO2	PO1	3	Properly pour and feed the molten metal into the mold cavity by the design of gating and riser systems
	PO2	3	The problems encountered in casting process like aspiration effect and shrinkage cavities can be eliminated by using proper gating design and by providing adequate risering
	PO3	2	Quality components can be designed with prior priority to safety is possible with proper gating and riser systems
	PO8	2	Strict norms of the engineering practices to be followed in the design of gating and risers for improving the quality as well as safety
CO3	PO1	1	Knowledge in solidification pattern of pure metals and alloys are useful in casting new mechanical components
	PO10	2	Students will be able to communicate effectively regarding the solidification pattern in metals and alloys with engineering community/leaners and can give instructions on the effect of alloy composition on casting.

	PO12	1	With the base knowledge in solidification pattern, students can analyse how the variation in alloy composition affect solidification pattern
CO4	PO1	2	Knowledge in heat transfer during solidification will be helpful in manipulating the grain structure and crystal growth methods
CO5	PO3	3	Alloy products of aluminum, copper and magnesium can be made with great accuracy and quality considering public health and safety
	PO8	2	Strict casting practices and norms to be followed in alloy casting for improving quality and safety of products
	PO10	2	Will be able to give instructions regarding melting, degassing and grain refining in alloys and there by achieving quality control in production.
CO6	PO1	3	Knowledge of the causes of various casting defects helps in casting quality products.
	PO2	2	Analysing the characteristic of defects, the type and causes of the defects can be easily identified.
	PO3	3	Design new product/process with several quality control measures to meet the specified requirements like quality ,dimensional accuracy, surface finish etc.
	PO8	2	Will be able to follow proper norms while inspecting casting using various methods
	PO10	2	Able to give clear instructions on what are the procedures to be followed for improving the quality of products

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
C01	PSO1	3	Students will acquire basic knowledge on sand mold design and will be able to apply this knowledge to solve manufacturing problems in industry.
C02	PSO1	3	Knowledge in the design of gating and risering will help the students to take up careers in casting industries
C03	PSO2	2	Helps to analyze the effect of different alloy composition on solidification pattern of products
C04	PSO1	1	Will be helpful in manipulating heat transfer in molds for improving/ changing the crystal growth in products
	PSO2	2	Research on heat transfer during solidification and crystal growth methods

			will make them an expert in casting industry
CO5	PSO1	2	Make them an experts in field of non-ferrous alloy casting
C06	PSO1	3	Will be able to detect the type and causes of defects in products

ME 367 NON-DESTRUCTIVE TESTING

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Non-Destructive Testing**	Course code**: ME 367**
L-T-P**: 3-0-0**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction to NDT, Comparison between destructive and NDT, Importance of NDT, Scope of NDT, difficulties of NDT, future progress in NDT, economics aspects of NDT. Visual Inspection - tools, applications and limitations - Fundamentals of visual testing: vision, lighting, material attributes, environmental factors. Visual perception, direct and indirect methods mirrors, magnifiers, boroscopes, fibroscopes, closed circuit television, light sources. Special lighting, a systems, computer enhanced system	7	15
II	Liquid Penetrant Inspection: principles, properties required for a good penetrants and developers - Types of penetrants and developers. And advantages and limitations of various methods of LPI - LPI technique/ test procedure. Interpretation and evaluation of penetrant test indications, false indication and safety precaution required in LPI, applications, advantages and limitations	7	15
III	Magnetic Particle Inspection (MPI): Principles of MPI, basic physics of magnetism, permeability, flux density, cohesive force, magnetizing force, retentivity, residual magnetism. Methods of magnetization, magnetization techniques such as head shot technique, cold shot technique, central conductor testing, magnetization using	7	15

	products using yokes. Direct and indirect method of magnetization, continuous testing of MPI, residual technique of MPI, system sensitivity, checking devices in MPI. Interpretation of MPI, indications, advantage and limitation of MPI.		
IV	Ultrasonic Testing (UT): principle, types of waves, frequency, velocity, wavelength, reflection, divergence, attenuation, mode conversion in ultrasonic UT testing methods. Contact testing and immersion testing, normal beam and straight beam testing, angle beam testing, dual crystal probe, ultrasonic testing techniques. Resonance testing, through transmission technique, pulse echo testing technique, instruments used UT, accessories such as transducers, types, frequencies, and sizes commonly used. Reference blocks with artificially created defects, calibration of equipment, Applications, advantages, limitations, A, B and C scan - Time of Flight Diffraction (TOFD).	7	15
V	Radiography Testing (RT): Principle, electromagnetic radiation sources: X-ray source, production of X-rays, high energy X-ray source, gamma ray source - Properties of X-rays and gamma rays. Inspection techniques like SWSI, DWSI, DWDI, panoramic exposure, real time radiography, films used in industrial radiography, types of film, speed of films, qualities of film screens used in radiography, quality of a good radiograph, film processing, interpretation, evaluation of test results, safety aspects required in radiography applications, advantages and limitations of RT.	7	20
VI	Eddy Current Testing (ECT): Principle, physics aspects of ECT like conductivity, permeability, resistivity, inductance, inductive reactance, impedance.Field factor and lift of effect, edge effect, end effect, impedance plane diagram in brief, depth of penetration of ECT, relation between frequency and depth of penetration in ECT. Equipments and accessories, various application of ECT such as conductivity measurement, hardness measurement, defect detection, coating thickness measurement, advantages and limitations of eddy current testing.	7	20

TEXT BOOKS:

1	Baldev Raj, Practical Non – Destructive Testing, Narosa Publishing House ,1997.

REFERENCES:

1	Hull B. and V.John, Non-Destructive Testing, Macmillan,1988.
2	Krautkramer, Josef and Hebert Krautkramer, Ultrasonic Testing of Materials, Springer-Verlag, 1990.

PREREQUISITE: Nil

COURSE OBJECTIVES:

1	To introduce the basic principles, techniques, equipment, applications and limitations of NDT methods such as Visual, Penetrant Testing, Magnetic Particle Testing, Ultrasonic Testing, Radiography, Eddy Current.
2	To enable selection of appropriate NDT methods.
3	To identify advantages and limitations of nondestructive testing methods
4	To make aware the developments and future trends in NDT.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	To impart knowledge on basic concepts of different types of Non – Destructive Testing and different types of visual inspection tools used for NDT.
2	To understand Liquid Penetration Inspection and its application
3	To understand Magnetic Particle Inspection and its application.
4	To understand the working principle of Ultrasonic Testing and analyse components
5	Gain knowledge about Radiography Testing and spread the idea of Films used in industrial radiography application.
6	To impart the knowledge about working of Eddy Current Testing and to get an idea about principle of Thermography.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	-	-	-	-	2	-	-	-	3	-	1		3	-
CO2	3	-	-	-	-	2	-	-	-	3	-	1		3	-
CO3	3	-	-	-	-	2	-	-	-	3	-	1		3	-
CO4	3	-	-	-	-	2	-	-	-	3	-	1		3	-
CO5	3	-	-	-	-	2	-	-	-	3	-	1		3	-
CO6	3	-	-	-	-	2	-	-	-	3	-	1		3	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Students use the knowledge to build upon the existing fundamental concepts
	PO6	2	Helps students to assess safety issues and the consequent responsibilities related to Engineering practices
	PO10	3	Helps students to effectively communicate on safety issues related to Non-Destructive Testing res
	PO12	1	Students recognize the need for self-study and importance of earning skills in Non-Destructive Testing through lifelong learning
CO2	PO1	3	Students use the knowledge to build upon the existing fundamental concepts
	PO6	2	Helps students to assess safety issues and the consequent responsibilities related to Engineering practices
	PO10	3	Helps students to effectively communicate on safety issues related to Non-Destructive Testing results
	PO12	1	Students recognise the need for self-study and importance of earning skills in Non-Destructive Testing through lifelong learning
CO3	PO1	3	Students use the knowledge to build upon the existing fundamental concepts
	PO6	2	Helps students to assess safety issues and the consequent responsibilities related to Engineering practices
	PO10	3	Helps students to effectively communicate on safety issues related to Non-Destructive Testing results
	PO12	1	Students recognise the need for self-study and importance of earning skills in Non-Destructive Testing through lifelong learning
CO4	PO1	3	Students use the knowledge to build upon the existing fundamental concepts

	PO6	2	Helps students to assess safety issues and the consequent responsibilities related to Engineering practices
	PO10	3	Helps students to effectively communicate on safety issues related to Non-Destructive Testing results
	PO12	1	Students recognize the need for self-study and importance of earning skills in Non-Destructive Testing through lifelong learning
CO5	PO1	3	Students use the knowledge to build upon the existing fundamental concepts
	PO6	2	Helps students to assess safety issues and the consequent responsibilities related to Engineering practices
	PO10	3	Helps students to effectively communicate on safety issues related to Non-Destructive Testing results
	PO12	1	Students recognise the need for self-study and importance of earning skills in Non-Destructive Testing through lifelong learning
CO6	PO1	3	Students use the knowledge to build upon the existing fundamental concepts
	PO6	2	Helps students to assess safety issues and the consequent responsibilities related to Engineering practices
	PO10	3	Helps students to effectively communicate on safety issues related to Non-Destructive Testing results
	PO12	1	Students recognise the need for self-study and importance of earning skills in Non-Destructive Testing through lifelong learning

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	**3**	Apply the knowledge of advanced technology in engineering
CO2	PSO1	**3**	Apply the knowledge of advanced technology in engineering
CO3	PSO1	**3**	Apply the knowledge of advanced technology in engineering
CO4	PSO1	**3**	Apply the knowledge of advanced technology in engineering
CO5	PSO1	**3**	Apply the knowledge of advanced technology in engineering
CO6	PSO1	**3**	Apply the knowledge of advanced technology in engineering

ME 341 DESIGN PROJECT

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Design Project**	Course code**: ME 341**
L-T-P**: 0-1-2**	Credit**: 2**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	**Study** : Take minimum three simple products, processes or techniques in the area of specialisation, study, analyse and present them. The analysis shall be focused on functionality, strength, material, manufacture/construction, quality, reliability, aesthetics, ergonomics, safety, maintenance, handling, sustainability, cost etc. whichever are applicable. Each student in the group has to present individually; choosing different products, processes or techniques. **Design:** The project team shall identify an innovative product, process or technology and proceed with detailed design. At the end, the team has to document it properly and present and defend it. The design is expected to concentrate on functionality, design for strength is not expected. Note : The one hour/week allotted for tutorial shall be used for discussions and presentations. The project team (not exceeding four) can be students from different branches, if the design problem is multidisciplinary	30	100

REFERENCES:

1	Michael Luchs, Scott Swan, Abbie Griffin, 2015. Design Thinking. 405 pages, John Wiley & Sons, Inc

PREREQUISITE: Nil

COURSE OBJECTIVES:

1	To understand the engineering aspects of design with reference to simple products
2	To foster innovation in design of products, processes or systems
3	To develop design that add value to products and solve technical problems

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Think innovatively on the development of components, products, processes or technologies in the engineering field
2	Analyse the problem requirements and arrive workable design solutions
3	The students will be able to understand the engineering aspects of design with reference to simple products to assess its impact on the society, health, environment and safety
4	The students will be able to develop design that add value to products and solve technical problems

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	-	1	3	1	-	3	3	-	3	3	-	2		3	3
CO2	3	3	3	2	3	3	3	-	3	3	-	2		3	3
CO3	3	3	-	2	-	3	3	-	3	3	2	2		3	3
CO4	3	3	3	2	3	3	3	-	3	3	2	2		3	3

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO2	1	Review research literature helps in the analysis of problems identified but needs creative thinking for innovative products
	PO3	3	Tutorials and suggestions helps in the designing of the solution for the problem identified
	PO4	1	An innovative thinking need not require thorough literature survey
	PO6	3	Projects are identified on the aspects of engineer and society
	PO7	3	Design project aims to promote the subject based on environment and sustainability
	PO9	3	Individual presentation of the project aims to promote the team work
	PO10	3	Presentation and group discussions promote the communication skills of the student

	PO12	2	The programme helps to explore new technologies and techniques to continue the learning process beyond curriculum
CO2	PO1	3	Engineering knowledge improves by applying of engineering fundamentals
	PO2	3	A thorough literature review is essential
	PO4	2	Detailed literature survey helps in the development of knowledge base
	PO3	3	Tutorials and suggestions helps in the designing of the solution for the problem identified
	PO5	3	Students will be able to use CAD and other simulations tools for their project
	PO6	3	Projects are identified on the aspects of engineer and society
	PO7	3	Design project aims to promote the subject based on environment and sustainability
	PO9	3	Individual presentation of the project aims to promote the team work
	PO10	3	Presentation and group discussions promote the communication skills of the student
	PO12	2	The programme helps to explore new technologies and techniques to continue the learning process beyond curriculum
CO3	PO1	3	Engineering knowledge improves by applying of engineering fundamentals
	PO2	3	A thorough literature review is essential
	PO4	2	Detailed literature survey helps in the development of knowledge base
	PO6	3	Projects are identified on the aspects of engineer and society
	PO7	3	Design project aims to promote the subject based on environment and sustainability
	PO9	3	Individual presentation of the project aims to promote the team work
	P10	3	Presentation and group discussions promote the communication skills of the student
	PO11	2	The programme doesn’t primarily aim to develop project management skills for the student
	PO12	2	The programme helps to explore new technologies and techniques to continue the learning process beyond curriculum

CO4	PO1	3	Engineering knowledge improves by applying of engineering fundamentals
	PO2	3	A thorough literature review is essential
	PO3	3	Tutorials and suggestions helps in the designing of the solution for the problem identified
	PO4	2	Detailed literature survey helps in the development of knowledge base
	PO5	3	Students will be able to use CAD and other simulations tools for their project
	PO6	3	Projects are identified on the aspects of engineer and society
	PO7	3	Design project aims to promote the subject based on environment and sustainability
	PO9	3	Individual presentation of the project aims to promote the team work
	PO10	3	Presentation and group discussions promote the communication skills of the student
	PO11	2	The programme doesn't primarily aim to develop project management skills for the student
	PO12	2	The programme helps to explore new technologies and techniques to continue the learning process beyond curriculum

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	**3**	Engineering knowledge improves by applying mechanical engineering fundamentals
CO2		**3**	
CO3		**3**	
CO4		**3**	
CO1	PSO2	**3**	Students will be able to use CAD and other simulations tools for their project
CO2		**3**	
CO3		**3**	
CO4		**3**	

EE 335 ELECTRICAL & ELECTRONICS LAB

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Electrical & Electronics Lab**	Course code**: EE 335**
L-T-P**:0-0-3**	Credit**: 1**

SYLLABUS:

List of Experiments	CONTENT
1.	OCC on a dc shunt generator, determination of critical resistance, critical speed, additional resistance required in the field circuit
2.	Load characteristics of DC Shunt generator
3.	Load characteristics of DC Compound generator
4.	Load test on DC Series motor
5.	Load test on DC Shunt motor
6.	Load test on single phase transformer
7.	Starting of three phase squirrel cage induction motor by star delta switch, load test on three phase squirrel cage induction motor
8	Load test on three phase slip ring induction motor
9.	Load test on single phase induction motor
10.	OC and SC test on single phase transforme
11.	V-I Characteristics of diodes and Zener diodes
12.	Input and output characteristics of CE configuration of BJT S. Determination of β, input resistance and output resistance
13.	Half wave and full wave rectifiers with and without filters- Observe the waveforms on CRO.

PREREQUISITE: Nil

COURSE OBJECTIVES:

1	To give a practical knowledge on the working of electrical machines including dc machines, induction motors and synchronous motors
2	To impart the basics about design and implementation of small electronic circuits.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Perform load test on DC shunt, series motors, single phase transformers,3/1 phase induction motors and analyse its performance characteristics
2	Perform the load test on shunt generator and predetermine the performance of DC machine when working as motor or generator.
3	Determine the efficiency and voltage regulation of a single phase transformer performing OC/SC test.
4	Determine the open circuit characteristics of self excited shunt generator.
5	Get awareness in applying rectifier circuits and CE configuration of BJT.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	2	3	1	-	-	-	-	-	2	2	2	-		-	-
CO2	2	3	1	-	-	-	-	-	2	2	2	-		-	-
CO3	2	3	2	-	-	-	-	-	3	3	2	-		-	-
CO4	2	3	2	-	-	-	-	-	3	2	2	-		-	-
CO5	2	3	2	-	-	-	-	-	2	2	2	-		-	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	**PO1**	**2**	Students will be able to apply the knowledge of mathematics, science, Engineering fundamentals while conducting load test on different electrical machines.
	PO2	**3**	Students will be able to analyze complex engineering problems using engineering science
	PO3	**1**	Students will be able to acquire knowledge on the design solutions for complex engineering problems.
	PO9	**2**	Students will be able to function effectively as an individual and as a member or leader of a team and in interdisciplinary settings.
	PO10	**2**	Students will able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

CO2	**PO11**	**2**	Students will able to demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
	PO1	**2**	Students will be able to apply the knowledge of mathematics, science, Engineering fundamentals while conducting load test on different types of DC generators.
	PO2	**3**	Students will be able to analyze complex engineering problems using first principles of mathematics and Engineering sciences.
	PO3	**1**	Students will acquire knowledge on the design solutions of DC generators that meet the specified needs with appropriate consideration for the safety.
	PO9	**2**	Students will able to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
CO3	**PO10**	**2**	Students will able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
	PO11	**2**	Students will able to demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
	PO1	**2**	Students will be able to apply the knowledge of mathematics, science, Engineering fundamentals while conducting load test on different electrical machines.
	PO2	**3**	Students will be able to analyze complex engineering problems using engineering science
	PO3	**2**	Students will acquire knowledge on the design solutions of DC generators that meet the specified needs with appropriate consideration for the safety
CO4	**PO9**	**3**	Students will able to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
	PO10	**3**	Students will able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
	PO11	**2**	Students will able to demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work,

			as a member and leader in a team, to manage projects and in multi-disciplinary environments.
	PO1	**2**	Students will be able to apply the knowledge of mathematics, science, Engineering fundamentals while conducting load test on different types of DC generators.
	PO2	**3**	Students will be able to analyze complex engineering problems using engineering science
CO5	**PO3**	**2**	Students will acquire knowledge on the design solutions of DC generators that meet the specified needs with appropriate consideration for the safety
	PO9	**3**	Students will able to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
	PO10	**2**	Students will able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
	PO11	**2**	Students will able to demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
	PO1	**2**	Students will be able to apply the knowledge of mathematics, science, Engineering fundamentals while conducting load test on different types of DC generators.

ME 331 MANUFACTURING TECHNOLOGY LABORATORY – I

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Manufacturing Technology Laboratory – I**	Course code**: ME 331**
L-T-P**: 0-0-3**	Credit**: 1**

SYLLABUS:

List of Exercises	CONTENT
	Centre Lathe Study of lathe tools: - tool materials - selection of tool for different operations - tool nomenclature and attributes of each tool angles on cutting processes – effect of nose radius, side cutting edge angle, end cutting edge angle and feed on surface roughness obtainable – tool grinding. • Study the different methods used to observe how the work-piece is precisely fixed on lathe. • Study the optimum aspect ratio of work-piece to avoid vibration and wobbling during turning. • Machine tool alignment of test on the lathe. • Re-sharpening of turning tool to specific geometry
1.	Exercises on centre lathe:- Facing, plain turning, step turning and parting – groove cutting, knurling and chamfering - form turning and taper turning – eccentric turning, multi-start thread, square thread and internal thread etc..
2.	Exercises on lathe: - Measurement of cutting forces in turning process and correlation of the surface roughness obtainable by varying feed, speed and feed.
3.	Measurement of cutting temperature and tool life in turning and machine tool alignment test on lathe machine.
4.	Exercises on Drilling machine- drilling, boring, reaming, tapping and counter sinking etc.
5.	Exercises on drilling machine: - Measurement of cutting forces in drilling process and correlate with varying input parameters.
6.	Exercises on Shaping machine Exercises on shaping machine: - flat surfaces, grooves and key ways
7.	Exercises on Slotting machine Exercises on slotting machine: - flat surfaces, grooves and key ways.
8	Exercises on Milling machine Exercises on milling machine: - face milling, end milling – spur and helical gear cutting – milling of keyways etc
9.	Exercises on milling machine: - Measurement of cutting forces in milling process and correlate the surface roughness obtainable by varying input parameters.
10.	Machine tool alignment test on milling machine

11.	Planing and Broaching machine. Study and demonstration of broaching machine
12.	Exercises on planing machine
13.	Exercises on Welding Exercises on arc and gas welding: - butt welding and lap welding of M.S. sheets.
14	Exercises on Grinding machine Exercise on surface grinding, cylindrical grinding and tool grinding etc.
15	Measurement of cutting forces and roughness in grinding process and correlate with varying input parameters.
16.	Metallurgy Specimen preparation, etching & microscopic study of Steel, Cast iron and Brass and Grain size measurement.
17.	Heat treatment study:–Effect on mechanical properties and microstructure of Steel, Cast Iron and Brass
18.	Studies of various quenching mediums, Carryout heat treatments on steel based on ASM handbook vol.4 and observe the hardness obtained.
	A minimum of 12 experiments are mandatory out of total 18 experiments but all the experiments mentioned in metallurgy are mandatory. Besides to the skill development in performing the work, oral examination should be conducted during end semester examination. The student's assessment, continuous evaluation, awarding of sessional marks, oral examination etc. should be carried out by the assistant professor or above.

TEXT BOOKS:

1	Acharkan. N., Machine Tool Design Vol. 1 to 4, MIR Publication, 2000
2	HMT, Production Technology, Tata McGraw Hill, 2001
3	W. A. J. Chapman, Workshop Technology Part I, ELBS & Edward Arnold Publishers, 1956

PREREQUISITE: ME220 Manufacturing Technology

COURSE OBJECTIVES:

1	To practice on machine tools and identify, manipulate and control various process parameters during machining processes in manufacturing industry
2	To practice arc and gas welding technologies.
3	To gain knowledge on the structure, properties, treatment, testing and applications of Steel, Cast Iron and Brass.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
CO1	Explain the mechanism and operation carried out in lathe and apply this information to create new model
CO2	Examine the effect of various process parameters like depth of cut, feed rate on cutting force using lathe tool dynamometers
CO3	Explain the parts and mechanism of shaper, slotter, milling machine and construct working models on these machines based on requirements
CO4	Execute metal joining operations using arc welding
CO5	Discuss about the specimen preparation process for studying grain structure
CO6	Discuss about the effect of heat treatment on mechanical properties and microstructure of steel and cast iron

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	-	-	-	-	-	-	3	-	-	-	-		2	-
CO2	-	2	3	-	2	-	-	-	-	-	-	-		2	-
CO3	-	-	2	-	-	-	-	2	-	-	-	-		2	-
CO4	-	-	2	-	-	-	-	2	-	-	-	-		2	-
CO5	-	-	-	-	2	-	-	-	-	2	-	-		-	2
CO6	2	-	2	-	-	-	-	-	-	3	-	-		2	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Proper Understanding of the mechanism and working of lathe helps to construct work pieces of different shape and dimension.
	PO8	3	Safety and quality during machining can be attained by following of strict Engineering Norms
CO2	PO2	2	Quality of products being machined can be improved by knowing the effect of depth of cut and feed rate on cutting force
	PO3	3	Safe machining is possible by the selection of proper depth of cut and feed rate for different materials

	PO5	2	Techniques and tools are available for monitoring the cutting forces generated during machining
CO3	PO3	2	Can develop parts using different machine tools like shaper , slotter and milling machine with consideration for public issues and safety
	PO8	2	Able to communicate with team members and able to give instructions regarding the sequence of operations to be performed on machining the given part
	PO12	2	Ability to find out the technological changes in the development of various machine tools and to deal with the changes in production engineering aspects
CO4	PO3	2	Complicated shape of products can be easily made by using arc welding process
	PO8	2	Strict engineering norms can be followed for performing the joining process using welding
CO5	PO5	2	Techniques and tools are used for studying grain structure
	PO10	2	Can present the specimen preparation process for studying grain structure
CO6	PO1	2	Understanding how to choose the heat treatment process based on metallurgy principles of different materials selected.
	PO3	2	Ability to identify the various processes required for the completion of the heat treatment processes
	PO10	3	Able to communicate with industrial expert the effect of heat treatment on mechanical properties and microstructure of steel and cast iron

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	**2**	Will get the ability to Implement various mechanical processes required for machining using lathe
CO2	PSO1	**2**	Ability to apply the knowledge into situations where different feeds and speeds required for machine tools.
CO3	PSO1	**2**	Can apply the knowledge to implement different machine tools processes for developing a product.
CO4	PSO1	**2**	Can apply the knowledge of arc welding for joining process in industry
CO5	PSO2	**2**	Engage in self-study to understand the grain structure of components
CO6	PSO1	**2**	Can be able to get the knowledge out from the metallurgy principles to select heat treatment processes for different engineering materials

SREEPATHY INSTITUTE OF MANAGEMENT AND TECHNOLOGY

COURSE HANDBOOK

DEPARTMENT OF MECHANICAL ENGINEERING

SEMESTER III

SREEPATHY INSTITUTE OF MANAGEMENT AND TECHNOLOGY

VISION

"Strive for excellence in generation and dissemination of knowledge."

MISSION

- To mould engineers of tomorrow, who are capable of addressing the problems of the nation and the world, by imparting technical education at par with international standards.
- To instil a desire in students for research, innovation, invention and entrepreneurship.
- To strive for creative partnership between the industry and the Institute.
- To impart the values of environment awareness, professional ethics, societal commitment, life skills and a desire for lifelong learning.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To act as quality knowledge center for creating technologically competent Mechanical Engineering professionals who will cater to the needs of emerging and interdisciplinary industry and research fields.

MISSION

- To provide theoretical and conceptual knowledge in Mechanical engineering stream and enhance lifelong learning.
- To work in close association with stakeholders in industry by enhancing industry-institute interaction, to take up need-based research and industry specific programs.
- To infuse professional, social and economic responsibilities along with ethical values to graduates.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

The graduates from Mechanical Engineering program are expected to achieve the following Program Educational Objective within a few years of graduation

PEO1: Have an overall knowledge in Mechanical Engineering and also in the fields of Mathematics, Science, Communication and Computing skills.

PEO2: Design machines, analyze thermo-fluid problems and optimize the quality of products and services.

PEO3: Implement ideas of Mechanical Engineering for the challenging task in the interdisciplinary areas like Electrical, Electronics, Computer Science, Civil, Bio-Technology and allied branches.

PROGRAM OUTCOMES (PO):

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

2. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.

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

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

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

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

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

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

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

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

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

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

PROGRAM SPECIFIC OBJECTIVES (PSO)

The **Mechanical Engineering** program graduates will be able to:

PSO1: Solve real-time problems in Design, Fluids, Thermal, Manufacturing and allied Engineering sectors of Mechanical Engineering.

PSO2: Recognize the importance of self-learning and engage in continuous independent learning to become experts in either as entrepreneurs or employees in the field.

BL	**BLOOM'SLEVEL**		
L1	Level -1	Remembering	Recalling from memory of previously learned material
L2	Level -2	Understanding	Explaining Ideas or Concepts
L3	Level -3	Applying	Using information in another familiar situation
L4	Level -4	Analyzing	Breaking information into part to explore understandings and relationships
L5	Level -5	Evaluating	Justify a decision or course of action
L6	Level -6	Creating	Generating new ideas, products or new ways of viewing

MA201 LINEAR ALGEBRA AND COMPLEX ANALYSIS

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Linear Algebra and Complex Analysis**	Course code**: MA 201**
L-T-P**: 3-0-1**	Credit**: 4**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Complex differentiation Limit, continuity and derivative of complex functions Analytic Functions Cauchy-Riemann Equation (Proof of sufficient condition of analyticity & C R Equations in polar form not required)-Laplace's Equation Harmonic functions, Harmonic Conjugate	9	15
II	Geometry of Analytic functions, conformal mapping, Mapping $w=z^2$, conformality of $w=e^z$ The mapping $w=z+1/z$ Properties of $w=1/z$ Circles and straight lines, extended complex plane, fixed points Special linear fractional transformation, cross ratio, cross ratio property-mapping of disks and half planes Conformal mapping by w=sin z, w=cos z	9	15
III	Complex Integration Definition of Complex Line integrals, first evaluation method, second evaluation method, Cauchy's integral theorem, Independence of path, Cauchy's integral theorem for multi connected domains, Cauchy's integral formula-Derivatives of analytic functions, application of Derivatives of analytic functions, Taylor and Maclaurin series, Power series as Taylor series, Laurent's series.	10	15
IV	Residue theorem Singularities, Zeros, Poles, Essential singularity, Zeros of an analytic functions, Residue integration method, formulas, several singularities inside the contour residue theorem, Evaluation of real integral	10	15
V	Linear system of equations Linear system of equations, Coefficient matrix, Augmented matrix, Gauss Elimination and back substitution, Elementary row operations, Row equivalent systems, Gauss elimination –three possible cases, Row echelon form and information from it, Linear independence –rank of a matrix, vector Space Dimension-basis, Vector space R3, Solution of linear systems, Fundamental theorem of non-homogeneous linear systems, homogeneous linear systems	9	20
VI	Matrix Eigen value Problem Determination of Eigen values and Eigen vectors, Eigenspace, Symmetric, skew-symmetric and Orthogonal Matrices-Simple properties, Basis of Eigen vectors, Similar matrices, Diagonalization of a matrix, Principal axis theorem Quadratic forms	9	20

TEXT BOOKS:

1	Erin Kreyszig: Advanced Engineering Mathematics, 10th edition, Wiley

REFERENCES:

1	Dennis G Zill & Patric D Shanahan, A first course in complex analysis with applications-Jones & Bartlet publishers
2	B.S Grewal-Higher Engineering Mathematics, Khanna Publishers, New Delhi
3	Lipschutz, Linear Algebra, 3e (Schaums Series), McGraww Hill Education India 2005
4	Complex variables introduction and applications- Second edition- Mark.J.Owitz-Cambridge publication.

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To equip the students with methods of solving a general system of linear equations
2	To familiarize them with the concept of Eigen values and diagonalization of a matrix which have many applications in Engineering
3	To understand the basic theory of functions of a complex variable and conformal Transformations

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Solve any given system of linear equations
2	Find the Eigen values of a matrix and how to diagonalise a matrix
3	Identify analytic functions and harmonic functions.
4	Evaluate real definite Integrals as application of Cauchy integral theorem.
5	Evaluate real definite Integrals as application of Residue Theorem.
6	Identify conformal mappings and find regions that are mapped under certain Transformations

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-		-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-		-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-		-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-		-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-		-	-
CO6	3	3	-	-	-	-	-	-	-	-	-	-		-	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Apply the knowledge of mathematics, science and engineering fundamentals and engineering specialization to the complex engineering problems
	PO2	3	Identify, formulate and analyze engineering problems using first principle of mathematics and engineering sciences
CO2	PO1	3	Apply the knowledge of mathematics, science and engineering fundamentals and engineering specialization to the complex engineering problems
	PO2	3	Identify, formulate and analyze engineering problems using first principle of mathematics and engineering sciences
CO3	PO1	3	Apply the knowledge of mathematics, science and engineering fundamentals and engineering specialization to the complex engineering problems
	PO2	3	Identify, formulate and analyze engineering problems using first principle of mathematics and engineering sciences
CO4	PO1	3	Apply the knowledge of mathematics, science and engineering fundamentals and engineering specialization to the complex engineering problems
	PO2	3	Identify, formulate and analyze engineering problems using first principle of mathematics and engineering sciences
CO5	PO1	3	Apply the knowledge of mathematics, science and engineering fundamentals and engineering specialization to the complex engineering problems
	PO2	3	Identify, formulate and analyze engineering problems using first principle of mathematics and engineering sciences
CO6	PO1	3	Apply the knowledge of mathematics, science and engineering fundamentals and engineering specialization to the complex engineering problems
	PO2	3	Identify, formulate and analyze engineering problems using first principle of mathematics and engineering sciences

ME 201 MECHANICS OF SOLIDS

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Mechanics of Solids**	Course code**: ME 201**
L-T-P**: 3-1-0**	Credit**: 4**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction to analysis of deformable bodies – internal forces – method of sections – assumptions and limitations. Stress – stresses due to normal, shear and bearing loads – strength design of simple members. Definition of linear and shear strains. Material behavior – uniaxial tension test – stress-strain diagrams concepts of orthotropy, anisotropy and inelastic behavior – Hooke's law for linearly elastic isotropic material under axial and shear deformation. Deformation in axially loaded bars – thermal effects – statically indeterminate problems – principle of superposition - elastic strain energy for uniaxial stress.	10	15
II	Definition of stress and strain at a point (introduction to stress and strain tensors and its components only) – Poisson's ratio – biaxial and triaxial deformations – Bulk modulus - Relations between elastic. Torsion: Shafts - torsion theory of elastic circular bars – assumptions and 15% limitations – polar modulus - torsional rigidity – economic cross-sections – statically indeterminate problems – shaft design for torsional load.	8	15
III	Beams- classification - diagrammatic conventions for supports and loading - axial force, shear force and bending moment in a beam. Shear force and bending moment diagrams by direct approach. Differential equations between load, shear force and bending moment. Shear force and bending moment diagrams by summation approach – elastic curve – point of inflection.	10	15
IV	Stresses in beams: Pure bending – flexure formula for beams assumptions and limitations – section modulus - flexural rigidity - economic sections – beam of uniform strength. Shearing stress formula for beams – assumptions and limitations – design for flexure and shear.	8	15
V	Deflection of beams: Moment-curvature relation – assumptions and limitations - double integration method – Macaulay's method - superposition techniques – moment area method and conjugate beam ideas for simple cases. Transformation of stress and strains: Plane state of stress - equations of transformation - principal planes and stresses.	10	20

VI	Mohr's circles of stress – plane state of strain – analogy between stress and strain transformation – strain rosettes. Compound stresses: Combined axial, flexural and shear loads – eccentric loading under tension/compression - combined bending and twisting loads. loading under tension/compression - combined bending and twisting loads.	7	20

TEXT BOOKS:

1	Rattan, Strength of Materials, 2e McGraw Hill Education India, 2011
2	S.Jose, Sudhi Mary Kurian, Mechanics of Solids, Pentagon, 2015

REFERENCES:

1	S. H. Crandal, N. C. Dhal, T. J. Lardner, An introduction to the Mechanics of Solids, McGraw Hill, 1999
2	R. C. Hibbeler, Mechanics of Materials, Pearson Education,2008
3	I.H. Shames, J. H. Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India, 2006
4	James M.Gere, Stephen Timoshenko, Mechanics of Materials, CBS Publishers & Distributors, New Delhi,2012
5	F. Beer, E. R. Johnston, J. T. DeWolf, Mechanics of Materials, Tata McGraw Hill, 2011
6	A. Pytel, F. L. Singer, Strength of Materials, Harper & Row Publishers, New York,1998
7	E. P. Popov, T. A. Balan, Engineering Mechanics of Solids, Pearson Education, 2012
8	R. K. Bansal, Mechanics of solids, Laxmi Publications, 2004
9	P. N. Singh, P. K. Jha, Elementary Mechanics of Solids, Wiley Eastern Limited, 2012

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To acquaint with the basic concepts of stress and deformation in solids.
2	To practice the methodologies to analyse stresses and strains in simple structural members, and to apply the results in simple design problems.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Understand the basic concepts of stress and strain and apply this knowledge for the analysis of axially loaded, thermal stress and statically indeterminate structure problems.
2	Apply elastic constant relationship and the torsion theory for shaft size selection.
3	Analyse the shear force and bending moment that develops in a beam for various loads.

4	Determine the bending stress and shear stress in beams and analyse the changes.
5	Develop the governing differential equation for the elastic curve and Apply different techniques for finding out the deflection at required points. Apply stress transformation equation for analysing stress planes.
6	Apply Mohr's circle for finding principal stresses and Calculate the buckling load for columns with different end conditions.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	1	3	2	-	-	-	-	-	-	-	-	-		3	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-		3	-
CO3	3	3	1	-	-	-	-	-	-	-	-	-		3	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-		3	-
CO5	3	3	1	-	-	-	-	-	-	-	-	-		3	-
CO6	3	3	1	-	-	-	-	-	-	-	-	-		3	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	1	Basic concepts and relations of stress and strain enable the students to apply the equations for solving problems in solid mechanics.
	PO2	3	Equations of deformation enable the students to identify, formulate and analyze problems in the Design of components
	PO3	2	Fundamental of stress and strain enable the students to do safe and sound design of structures.
CO2	PO1	3	Knowledge of elastic constants relation will enable the students to apply these equations for solving problems.
	PO2	3	Torsion formula enable the students to analyze complex problems in shaft design
	PO3	3	Torsion theory Enable the students to do safe and sound design of structures.
CO3	PO1	3	Knowledge of shear force bending moment in beams will enable the students to solve complex problems in beam bending.
	PO2	3	Understanding of shear force and bending moment diagram enable the students to identify, formulate and analyze engineering problems.
	PO3	1	Shear force and bending moment study will enable the students to design safe and sound design of structures.
CO4	PO1	3	Knowledge to bending formula will enable the students to solve problems in the design of structures.
	PO2	3	Understanding of nature of stresses developed enable the students to analyze problems in the structural and component design.
	PO3	3	Bending and shear stress analysis enable the students to do safe and sound design of components and structures.
CO5	PO1	3	Knowledge to compute the deflection in beams will enable the students to apply these equations for solve problems in Structural design of beams.
	PO2	3	Clear understanding of stress transformation and principal stresses enable the

			students to analyze the stresses in different planes of a component
	PO3	3	Enable the students to design safe and sound design of components and structures
CO6	PO1	3	Knowledge to use mohr circle will enable the students to apply the method to find out graphical solution to stresses in structures.
	PO2	3	Understanding of Column and compound stress theory will enable the students to identify, formulate and analyze problems in structural mechanics.
	PO3	1	Application of mohr's circle and column deflection formula for solving structural problems enables the students to design safe and sound design of structural members.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	3	Student's knowledge in solid Mechanics will be enhanced by studying fundamental equations of elasticity.
CO2	PSO1	3	Knowledge in elastic constants and torsion theory will enhance Student's capability to solve engineering problems.
CO3	PSO1	3	Knowledge of shear force and bending moment helps in solving basic problems in beams, machine components and structures.
CO4	PSO1	3	Clear understanding of bending stresses and shear stresses developed in beam will enhance student's capability to solve engineering problems.
CO5	PSO1	3	Application of deflection and stress transformation equations will enhance the student's capability to analyze and design mechanical components and structures.
CO6	PSO1	3	Application of mohr's circle and column theory enable student to solve real time problems in structures, beams and mechanical components.

ME 203 MECHANICS OF FLUIDS

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Mechanics of Fluids**	Course code**: ME 203**
L-T-P**: 3-1-0**	Credit**: 4**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction: Fluids and continuum, Physical properties of fluids, density, specific weight, vapour pressure, Newton's law of viscosity. Ideal and real fluids, Newtonian and non-Newtonian fluids. Fluid Statics- Pressure-density-height relationship, manometers, pressure on plane and curved surfaces, center of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to uniform accelerations, measurement of pressure.	8	15
II	Kinematics of fluid flow: Eulerian and Lagrangian approaches, classification of fluid flow, 1-D, 2-D and 3-D flow, steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational, irrotational flows, stream lines, path lines, streak lines, stream tubes, velocity and acceleration in fluid, circulation and vorticity, stream function and potential function, Laplace equation, equipotential lines flow nets, uses and limitations.	8	15
III	Dynamics of Fluid flow: Fluid Dynamics: Energies in flowing fluid, head, pressure, dynamic, static and total head, Control volume analysis of mass, momentum and energy, Equations of fluid dynamics: Differential equations of mass, energy and momentum (Euler's equation), Navier-Stokes equations (without proof) in rectangular and cylindrical co-ordinates, Bernoulli's equation and its applications: Venturi and Orifice meters, Notches and Weirs (description only for notches and weirs). Hydraulic coefficients, Velocity measurements: Pitot tube and Pitot-static tube.	10	15
IV	Pipe Flow: Viscous flow: Reynolds experiment to classify laminar and turbulent flows, significance of Reynolds number, critical Reynolds number, shear stress and velocity distribution in a pipe, law of fluid friction, head loss due to friction, Hagen Poiseuille equation. Turbulent flow: Darcy- Weisbach equation, Chezy's equation Moody's chart, Major and minor energy losses, hydraulic gradient and total energy line, flow through long pipes, pipes in series, pipes in parallel, equivalent pipe, siphon, transmission of power through pipes, efficiency of transmission, Water hammer, Cavitation.	12	15
V	Concept of Boundary Layer: Growth of boundary layer over a flat plate and definition of boundary layer thickness, displacement thickness, momentum thickness and energy thickness, laminar and turbulent boundary layers, laminar sub	10	20

	layer, velocity profile, Von- Karman momentum integral equations for the boundary layers, calculation of drag, separation of boundary and methods of control.		
VI	Dimensional Analysis and Hydraulic similitude: Dimensional analysis, Buckingham's theorem, important dimensional numbers and their significance, geometric, Kinematic and dynamic similarity, model studies. Froude, Reynold, Weber, Cauchy and Mach laws- Applications and limitations of model testing, simple problems only.	8	20

TEXT BOOKS:

1	Balachandran.P, Engineering Fluid Mechanics, PHI,2012
2	A S Saleem, Fluid Mechanics, Fathima Books,2016

REFERENCES:

1	Cengel, Fluid Mechanics, McGraw Hill Education India 2014
2	Bansal R. K., A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications, 2005
3	Modi P. N. and S. M. Seth, Hydraulics & Fluid Mechanics, S.B.H Publishers, New Delhi, 2002
4	Streeter V. L., E. B. Wylie and K. W. Bedford, Fluid Mechanics, Tata McGraw Hill, Delhi, 2010.
5	Joseph Karz, Introductory Fluid Mechanics, Cambridge University press,2010
6	Fox R. W. and A. T. McDonald, Introduction to Fluid dynamics, 5/e, John Wiley and Sons, 2009.
7	Shames I. H, Mechanics of Fluids, McGraw Hill, 1992.
8	White F.M., Fluid Mechanics, 6/e, Tata McGraw Hill, 2008

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To study the mechanics of fluid motion.
2	To establish fundamental knowledge of basic fluid mechanics and address specific topics relevant to simple applications involving fluids.
3	To familiarize students with the relevance of fluid dynamics to many engineering systems.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Calculate pressure variations in accelerating fluids using Euler's and Bernoulli's equations.
2	Become conversant with the concepts of flow measurements and flow through pipes.
3	Apply the momentum and energy equations to fluid flow problems.
4	Evaluate head loss in pipes and conduits.
5	Explain the concept of Boundary layer; analyze flow by boundary layer theory.

6	Use dimensional analysis to design physical or numerical experiments and to apply dynamic similarity.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	1		3	-
CO2	3	3	3	2	-	-	-	-	-	-	-	1		3	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-		3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-		3	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-		3	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Students will be able to solve complex engineering problems related to fluid mechanics, based on acquired knowledge
	PO2	3	Problem analysis based on first principles of mathematics and research based relevant data is essential to analyze the pressure variations in accelerating fluids.
	PO12	1	The student may recognize the need for lifelong learning in the context of technological changes pertaining to fluid mechanics
CO2	PO1	3	Students will be able to solve complex engineering problems related to flow measuring devices and pipe flow, based on acquired knowledge
	PO2	3	Problem analysis based on first principles of mathematics and research based relevant data is essential to analyze the pipe flow problems.
	PO3	3	In the design/development of solutions for complex pipeflow problems and to design fluid transmission systems that ensures public safety on ground, the knowledge of flow characteristics is essential.
	PO4	2	While conducting investigations of complex problems on pipe system, the student has to use research-based knowledge including analysis and interpretation of data to provide valid conclusions.
	PO12	1	The student may recognize the need for lifelong learning in the context of technological changes pertaining to various applications of fluid mechanics.
CO3	PO1	3	Strong knowledge in mathematics, science and engineering fundamentals helps to apply momentum and energy equations in complex fluid flow problems
	PO2	3	Problem analysis based on first principles of mathematics and research based relevant data is essential to analyze fluid flow problems.
	PO3	2	In designing solutions for complex flow problems and system components, momentum and energy equations need to be applied.
	PO4	2	To conduct investigations of complex problems on experimental analysis of lifting surfaces/aerodynamic bodies in wind tunnels and to generate relevant experimental data, the fundamental background on momentum and energy equations is essential
CO4	PO1	3	Application of basic knowledge in mathematics and engineering fundamentals is essential to evaluate heat losses in pipes and conduits

	PO2	3	Problem analysis in the area of complex system of pipes and conduits requires research-based literature and formulation of engineering problems using principles of mathematics and engineering.
CO5	PO1	3	Students must apply the knowledge of mathematics and engineering fundamentals in the analysis of flow by boundary layer theory for solving complex flow problems in engineering industries.
	PO2	3	Problem analysis using principles of mathematics and engineering is essential to solve boundary layer flow problems.
CO6	PO1	3	Student will be able to apply basic/fundamental knowledge in (engineering) for dimensional analysis, wind tunnel application, design and development of prototypes for solving complex problems fluid machinery.
	PO2	3	Problem analysis based on first principles of mathematics (Rayleigh method, pi theorem etc.) is essential to analyze, evaluate, and recommend appropriate non-dimensional terms for a fluid flow experiment.
	PO3	3	In the design/development of solutions for complex external flow problems in wind tunnel/water tunnel etc. and to design fluid dynamic systems that ensures civilian safety on ground, the knowledge of devising a test model based on dimensional analysis before building a prototype is a must.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	3	The Students will be able to solve real time flow problems and flow measurement problems and design problems in Fluid Mechanics after the successful completion of the course.
CO2	PSO1	3	The Students will be able to solve real time flow problems and flow measurement problems and design problems in Fluid Mechanics after the successful completion of the course.
CO3	PSO1	3	The Students will be able to solve real time flow problems and flow measurement problems and design problems in Fluid Mechanics after the successful completion of the course.
CO4	PSO1	3	The Students will be able to solve real time flow problems and flow measurement problems and design problems in Fluid Mechanics after the successful completion of the course.
CO5	PSO1	3	The Students will be able to solve real time flow problems and flow measurement problems and design problems in Fluid Mechanics after the successful completion of the course.
CO6	PSO1	3	The Students will be able to solve real time flow problems and flow measurement problems and design problems in Fluid Mechanics after the successful completion of the course.

ME 205 THERMODYNAMICS

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Thermodynamics**	Course code**: ME 205**
L-T-P**: 3-1-0**	Credit**: 4**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Role of Thermodynamics in Engineering and Science -- Applications of Thermodynamics Basic Concepts - Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic System and Control Volume, Surrounding, Boundaries, Types of Systems, Universe, Thermodynamic properties, Process, Cycle, Thermodynamic Equilibrium, Quasi – static Process, State, Point and Path function. (Review only- self study) Zeroth Law of Thermodynamics, Measurement of Temperature- Thermometry, reference Points, Temperature Scales, Ideal gas temperature scale, Comparison of thermometers-Gas Thermometers, Thermocouple, Resistance thermometer Energy - Work - Pdv work and other types of work transfer, free expansion work, heat and heat capacity.	7	15
II	Joule's Experiment- First law of Thermodynamics - First law applied to Non flow Process- Enthalpy- specific heats- PMM1, First law applied to Flow Process, Mass and Energy balance in simple steady flow process. Applications of SFEE, Transient flow –Filling and Emptying Process. (Problems), Limitations of the First Law.	8	15
III	Second Law of Thermodynamics, Thermal Reservoir, Heat Engine, Heat pump - Performance factors, Kelvin-Planck and Clausius Statements, Equivalence of two statements, Reversibility, Irreversible Process, Causes of Irreversibility, Corollaries of second law, PMM2, Carnot's theorem and its corollaries, Absolute Thermodynamic Temperature scale. Clausius Inequality, Entropy- Causes of Entropy Change, Entropy changes in various thermodynamic processes, principle of increase of entropy and its applications, Entropy generation in open and closed system, Entropy and Disorder, Reversible adiabatic process- isentropic process.	10	15
IV	Available Energy, Availability and Irreversibility- Useful work, Dead state, Availability function, Availability and irreversibility in open and closed systems - Gouy-Stodola theorem, Third law of thermodynamics. Pure Substances, Phase Transformations, Triple point, properties during change of phase, T-v, p-v and p-T diagram of pure substance, p-v-T surface, Saturation pressure and Temperature, T-h and T-s diagrams, h-s diagrams or Mollier Charts, Dryness Fraction, steam tables. Property	10	15

	calculations using steam tables.		
V	The ideal Gas Equation, Characteristic and Universal Gas constants, Deviations from ideal Gas Model: Equation of state of real substances- Vander Waals Equation of State, Berthelot, Dieterici, and Redlich-Kwong equations of state , Virial Expansion, Compressibility factor, Law of corresponding state, Compressibility charts Mixtures of ideal Gases – Mole Fraction, Mass fraction, Gravimetric and volumetric Analysis, Dalton's Law of partial pressure, Amagat's Laws of additive volumes, Gibbs-Dalton's law - Equivalent Gas constant and Molecular Weight, Properties of gas mixtures: Internal Energy, Enthalpy, specific heats and Entropy, Introduction to real gas mixtures- Kay's rule. *Introduction to ideal binary solutions, Definition of solution, ideal binary solutions and their characteristics, Deviation from ideality, Raoult's Law, Phase diagram, Lever rule (*in this section numerical problems not)	11	20
VI	General Thermodynamic Relations – Combined First and Second law equations – Helmholtz and Gibb's functions - Maxwell's Relations, Tds Equations. The Clapeyron Equation, equations for internal energy, enthalpy and entropy, specific heats, Throttling process, Joule Thomson Coefficient, inversion curve. Introduction to thermodynamics of chemically reacting systems, Combustion, Thermochemistry – Theoretical and Actual combustion processes- Definition and significance of equivalence ratio, enthalpy of formation, enthalpy of combustion and heating value (#in this section numerical problems not included)	10	20

TEXT BOOKS:

1	P.K.Nag, Engineering Thermodynamics, McGraw Hill,2013
2	E.Rathakrishnan Fundamentals of Engineering Thermodynamics, PHI,2005

REFERENCES:

1	Y. A. Cengel and M. A.Boles,Thermodynamics an Engineering Approach,McGraw Hill, 2011
2	G.VanWylen, R.Sonntag and C.Borgnakke, Fundamentals of Classical Thermodynamics, John Wiley & Sons,2012
3	Holman J.P, Thermodynamics, McGraw Hill, 2004
4	M.Achuthan, Engineering Thermodynamics, PHI,2004

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To understand basic thermodynamic principles and laws
2	To develop the skills to analyze and design thermodynamic systems

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Understand the basic concepts of thermodynamics, temperature measurement and techniques used.
2	Understand and apply the first Law of Thermodynamics on closed and control volume systems and to analyze preliminary problems.
3	Understand and apply Second Law of Thermodynamics, reversibility and irreversibility and entropy concepts in analyzing preliminary problems.
4	Understand and apply the concept of availability and irreversibility of a thermodynamic system and also will be able to analyze the properties of pure substances from property diagrams and tables.
5	Understand the concept of real and ideal substances and also will be able understand and analyze the properties of ideal gas mixtures.
6	Understand the general thermodynamic relations used for analyzing properties and also the basic concepts of throttling and combustion process.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	1	1	1	-	-	-	-	-	-	-	-	-		1	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-		3	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-		2	-
CO4	2	3	-	2	-	-	-	-	-	-	-	-		2	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-		2	-
CO6	1	1	-	-	-	-	-	-	-	-	-	-		1	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	1	May able to solve problems regarding temperature measurement from the fundamentals Zeroth law.
	PO2	1	Students will be able to analyze problems using the knowledge in Zeroth law.
	PO3	1	Students will be able to design temperature measuring devices using the knowledge in Zeroth law.
CO2	PO1	3	Students will be able to solve problems regarding compressors, nozzles and turbines etc. with the knowledge of Steady Flow Energy Equation.

	PO2	3	Helps to identify and analyze complex problems on nozzles, compressors, turbines etc. reaching substantiated conclusions using principles of Steady Flow.
	PO3	2	Helps the students to design steady flow components like nozzle, compressor etc. that satisfy specific needs.
CO3	PO1	2	Students will be able to solve problems regarding heat engines and refrigeration system from the fundamentals of Second Law of Thermodynamics.
	PO2	2	Students will be able to analyze problems regarding heat engines and refrigeration system reaching substantiated conclusions using from the fundamentals of Second Law of Thermodynamics.
CO4	PO1	2	Students will be able to solve problems regarding steam properties with help of property diagrams and tables.
	PO2	3	Students will be able to analyze problems regarding steam properties reaching substantiated conclusions with help of property diagrams and tables.
	PO4	2	Interpretation of properties with the help of property diagram and tables helps the students to provide valid conclusions.
CO5	PO1	2	Students will be able to find out the change in properties of gas mixtures from the fundamentals of Thermodynamics.
	PO2	2	Students will be able to analyze the effect mixing of pure gases reaching substantiated conclusions.
CO6	PO1	1	Students may able to solve problems regarding combustion of fuels.
	PO2	1	May able to analyze throttling process reaching substantiated conclusions

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	1	Students may able to solve real-time problems temperature measurement from the knowledge gained Zeroth law.
CO2	PSO1	3	Students will be able to solve problems on steady flow components like nozzles, compressor etc. in thermal and fluid sectors.
CO3	PSO1	2	Students may able to solve problems regarding heat engine and refrigeration sector from the knowledge of Second Law of thermodynamics.
CO4	PSO1	2	Students may be able to analyze the steam properties in steam powerplant sector.
CO5	PSO1	2	Helps the students to analyze the change in properties due to mixing of gases in thermal & steam power plants.
CO6	PSO1	1	Students may able to solve problems in refrigeration system by analyzing the throttling process from the fundamentals of Joule-Thompson effects.

ME 210 METALLURGY AND MATERIALS ENGINEERING

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Metallurgy and Materials Engineering**	Course code**: ME 210**
L-T-P**: 3-0-0**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Earlier and present development of atomic structure; attributes of ionization energy and conductivity, electronegativity and alloying; correlation of atomic radius to strength; electron configurations; electronic repulsion Primary bonds: - characteristics of covalent, ionic and metallic bond: attributes of bond energy, cohesive force, density, directional and non-directional and ductility. properties based on atomic bonding:- attributes of deeper energy well and shallow energy well to melting temperature, coefficient of thermal expansion - attributes of modulus of elasticity in metal cutting process -Secondary bonds:- classification- hydrogen bond and anomalous behavior of ice float on water, application- atomic mass unit and specific heat, application. *(brief review only, no University questions and internal assessment from these portions).* Crystallography:- Crystal, space lattice, unit cell- BCC, FCC, HCP structures - short and long range order – effects of crystalline and amorphous structure on mechanical properties. Coordination number and radius ratio; theoretical density; simple problems - Polymorphism and allotropy. Miller Indices: - crystal plane and direction *(brief review)*. Attributes of miller indices for slip system, brittleness of BCC, HCP and ductility of FCC - Modes of plastic deformation: - Slip and twinning. Schmid's law, equation, critical resolved shear stress, correlation of slip system with plastic deformation in metals and applications.	6	15
II	Mechanism of crystallization: Homogeneous and heterogeneous nuclei formation, under cooling, dendritic growth, grain boundary irregularity. Effects of grain size, grain size distribution, grain shape, grain orientation on dislocation/strength and creep resistance - Hall – Petch theory, simple problems. Classification of crystal imperfections: - types of dislocation – effect of point defects on mechanical properties - forest of dislocation, role of surface defects on crack initiation. Burgers vector dislocation source, significance of Frank Read source in metals deformation - Correlation of dislocation density with strength and nano concept, applications. Significance high and low angle grain boundaries on dislocation – driving force for grain growth and applications during heat treatment. Polishing and etching to	8	15

	determine the microstructure and grain size. Fundamentals and crystal structure determination by X – ray diffraction, simple problems –SEM and TEM. Diffusion in solids, Fick's laws, mechanisms, applications of diffusion in mechanical engineering, simple problems.		
III	Phase diagrams: - Limitations of pure metals and need of alloying - classification of alloys, solid solutions, Hume Rothery`s rule - equilibrium diagram of common types of binary systems: five types. Coring - lever rule and Gibb`s phase rule - Reactions: - monotectic, eutectic, eutectoid, peritectic, peritectoid. Detailed discussion on Iron-Carbon equilibrium diagram with microstructure and properties changes in austenite, ledeburite, ferrite, cementite, special features of martensite transformation, bainite, spheroidite etc. Heat treatment: - Definition and necessity – TTT for a eutectoid iron–carbon alloy, CCT diagram, applications - annealing, normalizing, hardening, spheroidizing. Tempering:- austermpering, martempering and ausforming - Comparative study on ductility and strength with structure of pearlite, bainite, spherodite, martensite, tempered martensite and ausforming. Hardenability, Jominy end quench test, applications- Surface hardening methods:- no change in surface composition methods :- Flame, induction, laser and electron beam hardening processes- change in surface composition methods :carburizing and Nitriding; applications.	8	15
IV	Types of Strengthening mechanisms: - work hardening, equation - precipitation strengthening and over ageing dispersion hardening. Cold working: Detailed discussion on strain hardening; recovery; re-crystallization, effect of stored energy; recrystallization temperature - hot working Bauschinger effect and attributes in metal forming. Alloy steels:- Effects of alloying elements on steel: dislocation movement, polymorphic transformation temperature, alpha and beta stabilizers, formation and stability of carbides, grain growth, displacement of the eutectoid point, retardation of the transformation rates, improvement in corrosion resistance, mechanical properties Nickel steels, Chromium steels etc. - Enhancement of steel properties by adding alloying elements: - Molybdenum, Nickel, Chromium, Vanadium, Tungsten, Cobalt, Silicon, Copper and Lead. High speed steels:- Mo and W types, effect of different alloying elements in HSS Cast irons: Classifications; grey, white, malleable and spheroidal graphite cast iron etc, composition, microstructure, properties and applications. Principal Nonferrous Alloys: - Aluminum, Copper, Magnesium, Nickel, study of composition, properties, applications, reference shall be made to the phase diagrams whenever necessary.	7	15
V	Fatigue: - Stress cycles – Primary and secondary stress raisers - Characteristics of fatigue failure, fatigue tests, S-N curve. Factors affecting fatigue strength: stress concentration, size effect, surface roughness, change in surface properties, surface residual stress. Ways to improve fatigue life – effect of temperature on fatigue, thermal fatigue and its applications in	6	20

	metal cutting Fracture: – Brittle and ductile fracture – Griffith theory of brittle fracture – Stress concentration, stress raiser – Effect of plastic deformation on crack propagation. trans granular, intergranular fracture - Effect of impact loading on ductile material and its application in forging, applications - Mechanism of fatigue failure. Structural features of fatigue: - crack initiation, growth, propagation - Fracture toughness (definition only) – Ductile to brittle transition temperature (DBTT) in steels and structural changes during DBTT, applications.		
VI	Creep: - Creep curves – creep tests - Structural change:- deformation by slip, sub-grain formation, grain boundary sliding Mechanism of creep deformation - threshold for creep, prevention against creep - Super plasticity: need and applications Composites:- Need of development of composites - geometrical and spatial Characteristics of particles – classification - fiber phase: - characteristics, classifications - matrix phase:- functions – only need and characteristics of PMC, MMC, and CMC – applications of composites: aircraft applications, aerospace equipment and instrument structure, industrial applications of composites, marine applications, composites in the sporting goods industry, composite biomaterials. Modern engineering materials: - only fundamentals, need, properties and applications of, intermetallics, maraging steel, super alloys, Titanium – introduction to nuclear materials, smart materials and bio materials. Ceramics:-coordination number and radius ratios- AX, A_mX_p, $A_mB_mX_p$ type structures – applications.	7	20

TEXT BOOKS:

1	Raghavan V, Material Science and Engineering, Prentice Hall,2004
2	Jose S and Mathew E V, Metallurgy and Materials Science, Pentagon, 2011

REFERENCES:

1	Anderson J.C. *et.al*., Material Science for Engineers,Chapman and Hall,1990
2	Clark and Varney, Physical metallurgy for Engineers, Van Nostrand,1964Wiley & Sons,2012
3	Reed Hill E. Robert, Physical metallurgy principles, 4th Edn. Cengage Learning,2009
4	Avner H Sidney, Introduction to Physical Metallurgy, Tata McGraw Hill,2009
5	Callister William. D., Material Science and Engineering, John Wiley,2014
6	Dieter George E, Mechanical Metallurgy,Tata McGraw Hill,1976
7	Higgins R.A. - Engineering Metallurgy part - I – ELBS,1998
8	Myers Marc and Krishna Kumar Chawla, Mechanical behavior of materials, Cambridge University press,2008
9	Van Vlack -Elements of Material Science - Addison Wesley,1989

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To provide fundamental science relevant to materials
2	To provide physical concepts of atomic radius, atomic structure, chemical bonds, crystalline and non-crystalline materials and defects of crystal structures, grain size, strengthening mechanisms, heat treatment of metals with mechanical properties and changes in structure.
3	To enable students to be more aware of the behavior of materials in engineering applications and select the materials for various engineering applications.
4	To understand the causes behind metal failure and deformation.
5	To determine properties of unknown materials and develop an awareness to apply this knowledge in material design.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Identify the crystal structures of metallic materials.
2	Analyze the binary phase diagrams of alloys.
3	Analyze the microstructure with properties, processing and performance of metals.
4	Analyze the failure of metals with structural change.
5	Recommend materials for design and construction.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	3	-	-		-	-
CO2	-	3	3	2	-	-	-	-	-	-	-	-		-	-
CO3	-	3	3	-	-	2	-	2	-	-	-	-		-	-
CO4	-	3	3	-	-	2	-	2	-	-	-	-		-	-
CO5	-	3	3	-	-	-	-	-	-	-	-	-		3	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	As they could apply their knowledge of engineering fundamentals to the solution of complex engineering problems.
	PO10	3	Students will be able to communicate to the engineering community regarding the structure of materials.
CO2	PO2	3	As they could analyze phase diagrams to arrive at substantiated conclusions.
	PO3	3	As they could design solutions with the help of phase diagrams to meet the specifications with consideration for the public health and safety.
	PO4	2	As they could interpret data and synthesis of the information to provide valid conclusions.
CO3	PO2	3	As they could analyze phase diagrams to arrive at substantiated conclusions.

	PO3	**3**	As they could design solutions with the help of phase diagrams to meet the specifications with consideration for the public health and safety.
CO4	PO2	**3**	As they could analyze failure of engineering materials and arrive at substantiated conclusions.
	PO3	**3**	With the knowledge gained they could develop solutions by considering the societal and environmental impacts.
CO5	PO2	**2**	Students will be able to identify and arrive at conclusions regarding the type of material to be used for a particular application.
	PO3	**2**	With the knowledge gained they can design components by considering the public health and safety.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO5	PSO1	**3**	Students will be able to select materials depending upon the application for designing components.

HS210 LIFE SKILLS

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Life Skills**	Course code**: HS 210**
L-T-P**: 2-0-2**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS L-P
I	Need for Effective Communication, Levels of communication; Flow of communication; Use of language in communication; Communication networks; Significance of technical communication, Types of barriers; Miscommunication; Noise; Overcoming measures, Listening as an active skill: Types of Listeners; Listening for general content; Listening to fill up information; Intensive Listening; Listening for specific information; Developing effective listening skills; Barriers to effective listening skills. Technical Writing: Differences between technical and literary style, Elements of style; Common Errors, Letter Writing: Formal, informal and demi-official letters; business letters, Job Application: Cover letter, Differences between bio-data, CV and Resume, Report Writing: Basics of Report Writing; Structure of a report; Types of reports. Non-verbal Communication and Body Language: Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language Interview Skills: Types of Interviews; Ensuring success in job interviews; Appropriate use of non-verbal communication, Group Discussion: Differences between group discussion and debate; Ensuring success in group discussions, Presentation Skills: Oral presentation and public speaking skills; business presentations, Technology-based Communication: Netiquettes: effective e-mail messages; power-point presentation; enhancing editing skills using computer software.	5-10
II	Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence. Steps in problem solving, Problem Solving Techniques, Problem Solving through Six Thinking Hats, Mind Mapping, Forced Connections. Problem Solving strategies, Analytical Thinking and quantitative reasoning expressed in written form, Numeric, symbolic, and graphic reasoning, Solving application problems.	4-4
III	Introduction to Groups and Teams, Team Composition, Managing Team Performance, Importance of Group, Stages of Group, Group Cycle, Group thinking, getting acquainted, Clarifying expectations. Group Problem Solving, Achieving Group Consensus. Group Dynamics techniques, Group vs Team, Team Dynamics, Teams for enhancing productivity, Building & Managing Successful Virtual Teams. Managing Team Performance & Managing Conflict in Teams. Working Together in Teams, Team Decision-Making, Team Culture & Power, Team Leader Development.	6-4

IV	Morals, Values and Ethics, Integrity, Work Ethic, Service Learning, Civic Virtue, Respect for Others, Living Peacefully. Caring, Sharing, Honesty, Courage, Valuing Time, Cooperation, Commitment, Empathy, Self-Confidence, Character Spirituality, Senses of 'Engineering Ethics', variety of moral issued, Types of inquiry, moral dilemmas, moral autonomy, Kohlberg's theory, Gilligan's theory, Consensus and controversy, Models of Professional Roles, Theories about right action, Self-interest, customs and religion, application of ethical theories. Engineering as experimentation, engineers as responsible experimenters, Codes of ethics, Balanced outlook on. The challenger case study, Multinational corporations, Environmental ethics, computer ethics, Weapons development, engineers as managers, consulting engineers, engineers as expert witnesses and advisors, moral leadership, sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers(India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers(IETE), India, etc.	12-4
V	Introduction, a framework for considering leadership, entrepreneurial and moral leadership, vision, people selection and development, cultural dimensions of leadership, style, followers, crises. Growing as a leader, turnaround leadership, gaining control, trust, managing diverse stakeholders, crisis management. Implications of national culture and multicultural leadership Types of Leadership, Leadership Traits. Leadership Styles, VUCA Leadership, DART Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders, making of a Leader, Formulate Leadership	6-4

TEXT BOOKS:

1	Life Skills for Engineers, Complied by ICT Academy of Kerala, McGraw Hill Education (India) Private Ltd., 2016

REFERENCES:

1	Barun K. Mitra; (2011), "Personality Development & Soft Skills", First Edition; Oxford Publishers.
2	Kalyana; (2015) "Soft Skill for Managers"; First Edition; Wiley Publishing Ltd.
3	Larry James (2016); "The First Book of Life Skills"; First Edition; Embassy Books.
4	Shalini Verma (2014); "Development of Life Skills and Professional Practice"; First Edition; Sultan Chand (G/L) & Company

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To develop communication competence in prospective engineers.
2	To enable them to convey thoughts and ideas with clarity and focus.
3	To develop report writing skills.
4	To equip them to face interview & Group Discussion.

5	To inculcate critical thinking process.
6	To prepare them on problem solving skills.
7	To provide symbolic, verbal, and graphical interpretations of statements in a problem description.
8	To understand team dynamics & effectiveness.
9	To create an awareness on Engineering Ethics and Human Values.
10	To instill Moral and Social Values, Loyalty and also to learn to appreciate the rights of others.
11	To learn leadership qualities and practice them.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Students will be able to realize the important factors involved in verbal/non-verbal communication in a professional context.
2	Students will be able to apply creative and critical thinking while approaching different types of problems.
3	Students should be able to become an adaptable team member as well as a leader who could successfully manage any team/group.
4	Students in future would become a professional who has inculcated integrity, values, ethics and realize his/her commitment to the society.
5	Students will realize the factors involved in the growth of an effective leader and become one in the future.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	-	-	-	-	-	-	3	-	-	-	-	-		-	-
CO2	-	1	-	-	-	-	-	-	-	-	-	-		-	-
CO3	-	-	-	-	-	3	-	-	-	-	-	-		-	-
CO4	-	-	-	-	-	-	-	3	3	1	1	-		-	-
CO5	-	-	-	-	-	3	-	-	-	-	-	-		-	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO7	3	Apply the knowledge of mathematics, science and engineering fundamentals and engineering specialization to the complex engineering problems.
CO2	PO2	1	Students should be able to apply their creative and critical thought process to solve complex problems.
CO3	PO6	3	Students are familiarized with the stages of group formation, types of groups and teams, their differences, team performance management and group problem solving methods.

CO4	PO8	3	Students are familiarized with many case studies which effectively conveys the role of an engineer in a society and the paramount importance of public. health and safety an engineer should be concerned with.
	PO9	3	Students should not ignore the importance of ethics and morality as professionals.
	PO10	1	Environmental ethics, computer ethics professional ethics professed by certain professional associations are to be familiarized by students.
	PO11	1	Students must understand the theory of moral development as well as the responsibilities of an engineer as a manager, expert witness and consulting engineer.
CO5	PO6	3	Different leadership styles based on different contexts and the growing stages of a leader must be familiarized by the students.

ME 231 COMPUTER AIDED MACHINE DRAWING LAB

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Computer Aided Machine Drawing Lab**	Course code**: ME 231**
L-T-P**: 0-0-3**	Credit**: 1**

SYLLABUS:

MODULE	CONTENT	HOURS
0	Introduction, Principles of drawing, free hand sketching, manual drawing, CAD drawing etc.	1
I	Drawing standards**:** 2 exercises Code of practice for Engineering Drawing, BIS specifications – lines, types of lines, dimensioning, sectional views, Welding symbols, riveted joints, keys, fasteners –bolts, nuts, screws, keys etc.	5
II	Fits, Tolerances and Surface Roughness**:** 2 exercises Limits, Fits – Tolerances of individual dimensions – Specification of Fits – basic principles of geometric & dimensional tolerances. Preparation of production drawings and reading of part and assembly drawings, surface roughness, indication of surface roughness, etc.	6
III	Introduction to drafting package: Introduction, input, output devices, introduction to drafting software like Auto CAD, basic commands and development of simple 2D and 3D drawings. Drawing, Editing, Dimensioning, Plotting Commands, Layering Concepts, Matching, Detailing, Detailed drawings.	6
IV	Assembly drawings(2D)**:** 10 exercises Preparation of assembled views. (Manually): Shaft couplings – Connecting rod - Machine Vice – Stuffing box – Plummer block. (Using software package, 2D Drawing) :– Universal joint - Screw jack – Lathe Tailstock – Rams Bottom Safety Valve – Steam stop valve. Preparation of Bill of materials and tolerance data sheet.	24

TEXT BOOKS:

1	N. D. Bhatt and V.M. Panchal, Machine Drawing, Charotar Publishing House,2014
2	K C John, Machine Drawing, PHI,2009
3	P I Vargheese and K C John, Machine Drawing, VIP Publishers ,2011
4	K.L.Narayana, P.Kannaiah & K. Venkata Reddy,Machine Drawing, New Age Publishers,2009
5	Ajeet Singh, Machine Drawing Includes AutoCAD, Tata McGraw-hill,2012
6	P S Gill, Machine Drawing, Kataria & Sons,2009

PREREQUISITE: BE 110 ENGINEERING GRAPHICS

COURSE OBJECTIVES:

1	To introduce students to the basics and standards of engineering drawing related to machines and components.
2	To teach students technical skills regarding assembly, production and part drawings.
3	To familiarize students with various limits, fits and tolerances.
4	To help students gain knowledge about standard CAD packages on modeling and drafting.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Explain about the various standards and specifications about standard machine component.
2	Explain about geometric and dimensional tolerances, surface roughness and preparation of production drawings.
3	Apply drawing standards while sketching the assembled views of a mechanical component
4	Construct drawings of mechanical components using CAD package.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	2	-	-	-	-	-	2	-	-	-	-		2	-
CO2	2	3	-	-	2	-	-	-	-	3	-	-		2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-		2	-
CO4	2	-	2	-	3	-	-	-	-	2	-	2		-	2

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Standard way of representing parts is possible while designing and sketching Engineering drawings.
	PO2	2	Use of specified standards in size, material and geometry while designing helps in improving the quality and safety of products.
	PO8	2	Students develop their skill to understand information from standard manual drawings of components.
CO2	PO1	2	Basic knowledge in engineering is helpful in providing the tolerances and surface roughness while preparing the production drawings.
	PO2	3	Knowledge in geometric and dimensional tolerance is necessary for proper design and assembly of mechanical components.
	PO5	2	Will be capable of using appropriate techniques for representing Fits and tolerances in Engineering Drawing.
	PO10	3	Capable of explaining symbols used in apart drawing effectively to others.
CO3	PO1	3	Selection and assembly of mechanical components requires fundamental knowledge in machine components.

	PO2	2	Skill to assembly components and to create assembled views is necessary for designing mechanical systems.
CO4	PO1	2	Modelling of machine components using CAD software require fundamental knowledge in Engineering drawings.
	PO3	2	Use of 2D modelling tools easy and accurate solution for design problems in the industry.
	PO5	3	Capable of using 2D software packages for drafting complex machine components and its assembly.
	PO10	2	Designs of mechanical parts can be easily prepared and communicated effectively with others using CAD packages.
	PO12	2	Lifelong learning is required for becoming an expert in the usage of CAD tools for designing machine component.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	2	Use of standards in design and manufacturing improves the quality of products.
CO2	PSO1	2	Use of fits, tolerances and surface roughness in part modelling helps in standardizing the manufacturing industry.
CO3	PSO1	2	Assembly Drawing of mechanical parts can be prepared by following the drawing standards.
CO4	PSO2	2	Continuous independent learning helps in becoming an expert in the usage of CAD tools for designing machine component.

CE232 MATERIAL TESTING LAB

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Material Testing Lab**	Course code**: CE 232**
L-T-P**:0-0-13**	Credit**: 1**

SYLLABUS:

CONTENT
List of experiments: 1. Tension test on mild steel/ tor-steel/ high strength steel and cast iron using Universal Testing Machine and extensometers. 2. Tests on springs (Open and closed coiled). 3. Torsion pendulum (mild steel, aluminium and brass wires). 4. Hardness test (Brinell, Vickers and Rockwell). 5. Impact test (Izod and Charpy). 6. Torsion test on mild steel rods. 7. Shear test on mild steel rods. 8. Fatigue test – Study of testing machine. 9. Bending test on wooden beams. 10. Strut test (Column buckling experiment). 11. Verification of Clerk Maxwell's law of reciprocal deflection and determination of Young's modulus of steel. 12. Photo elastic methods for stress measurements. 13. Jominy hardenability test. 14. Measurement using strain gauges. 15. Determination of moment of inertia of rotating bodies. Note: A minimum of 10 experiments are mandatory.

REFERENCES:

1	G E Dieter. Mechanical Metallurgy, McGraw Hill,2013
2	Dally J W, Railey W P, Experimental Stress analysis , McGarw Hill,1991
3	Baldev Raj, Jayakumar T, Thavasimuthu M., Practical Non destructive testing, Narosa Book Distributors,2015

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To provide knowledge on mechanical behaviour of materials.
2	To acquaint with the experimental methods to determine the mechanical properties of materials.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Measure tensile and compressive strength of a specimen for applying in a practical design-based project work.
2	Determine hardness, impact strength, fatigue strength to analyze the application of a specific material for a given design requirements for different loading conditions of structures.
3	Judge the capacity of a material to withstand torsional stresses for a safe and sustainable design of machine elements.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	-	-	3	-	-	-	-	-	-	-	-		-	-
CO2	3	-	-	3	-	-	-	-	-	-	-	-		-	-
CO3	3	-	-	3	-	-	-	-	-	-	-	-		-	-

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Apply the knowledge of engineering fundamentals to find the desired material property.
	PO4	3	Conduct investigation on engineering materials.
CO2	PO1	3	Apply the knowledge of engineering fundamentals to find the desired material property.
	PO4	3	Conduct investigation on engineering materials.
CO3	PO1	3	Apply the knowledge of engineering fundamentals to find the desired material property.
	PO4	3	Conduct investigation on engineering materials.

SREEPATHY INSTITUTE OF MANAGEMENT AND TECHNOLOGY

COURSE HANDBOOK

DEPARTMENT OF MECHANICAL ENGINEERING

SEMESTER 7

SREEPATHY INSTITUTE OF MANAGEMENT AND TECHNOLOGY

VISION

"Strive for excellence in generation and dissemination of knowledge."

MISSION

- To mould engineers of tomorrow, who are capable of addressing the problems of the nation and the world, by imparting technical education at par with international standards.
- To instil a desire in students for research, innovation, invention and entrepreneurship.
- To strive for creative partnership between the industry and the Institute.
- To impart the values of environment awareness, professional ethics, societal commitment, life skills and a desire for lifelong learning.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To act as quality knowledge center for creating technologically competent Mechanical Engineering professionals who will cater to the needs of emerging and interdisciplinary industry and research fields.

MISSION

- To provide theoretical and conceptual knowledge in Mechanical engineering stream and enhance lifelong learning.
- To work in close association with stakeholders in industry by enhancing industry-institute interaction, to take up need-based research and industry specific programs.
- To infuse professional, social and economic responsibilities along with ethical values to graduates.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

The graduates from Mechanical Engineering program are expected to achieve the following Program Educational Objective within a few years of graduation

PEO1: Have an overall knowledge in Mechanical Engineering and also in the fields of Mathematics, Science, Communication and Computing skills.

PEO2: Design machines, analyze thermo-fluid problems and optimize the quality of products and services.

PEO3: Implement ideas of Mechanical Engineering for the challenging task in the interdisciplinary areas like Electrical, Electronics, Computer Science, Civil, Bio-Technology and allied branches.

PROGRAM OUTCOMES (PO):

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

2. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.

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

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

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

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

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

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

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

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

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

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

PROGRAM SPECIFIC OBJECTIVES (PSO)

The **Mechanical Engineering** program graduates will be able to:

PSO1: Solve real-time problems in Design, Fluids, Thermal, Manufacturing and allied Engineering sectors of Mechanical Engineering.

PSO2: Recognize the importance of self-learning and engage in continuous independent learning to become experts in either as entrepreneurs or employees in the field**.**

BL	BLOOM'SLEVEL		
L1	Level -1	Remembering	Recalling from memory of previously learned material
L2	Level -2	Understanding	Explaining Ideas or Concepts
L3	Level -3	Applying	Using information in another familiar situation
L4	Level -4	Analyzing	Breaking information into part to explore understandings and relationships
L5	Level -5	Evaluating	Justify a decision or course of action
L6	Level -6	Creating	Generating new ideas, products or new ways of viewing

ME 401 DESIGN OF MACHINE ELEMENTS - I

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: DESIGN OF MACHINE ELEMENTS - I**	Course code**: ME 401**
L-T-P**: 3-1-0-4**	Credit**: 4**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Design- Definition, steps in design process, preferred numbers, standards and codes in design Materials and their properties- Elastic and plastic behaviour of metals ductile and brittle behaviour, shear, bending and torsional stresses, Combined stresses, stress concentration factor.	9	15
II	Theories of Failure- Guest's Theory, Rankine's Theory, St. Venant's Theory, Haigh's Theory, and Von Mises and Hencky Theory. Shock and impact loads, fatigue loading, endurance limit stress, factors affecting endurance limit, factor of safety	11	15
III	Threaded Joints- Terminology, thread standards, types of threads, stresses in screw threads. Bolted joints- effect of initial tension, eccentric loading, design of bolts for static and fatigue loading, gasketed joints, power screws	7	15
IV	Design of riveted joints- Material for rivets, modes of failure, efficiency of joint, design of boiler and tank joints, structural joints Cotter and Knuckle joints- Gib and Cotter Joint, analysis of knuckle joint. Design of welded joints- welding symbols, stresses in fillet and butt welds, Butt joint in tension, fillet weld in tension, fillet joint under torsion, fillet wed under bending, eccentrically loaded welds.	12	15
V	Springs- classification, spring materials, stresses and deflection of helical springs, axial loading, curvature effect, resilience, static and fatigue loading, surging, critical frequency, concentric springs, end construction. Leaf springs- Flat springs, semi elliptical laminated leaf springs, design of leaf springs, nipping	9	20
VI	Shafting- material, design considerations, causes of failure in shafts, design based on strength, rigidity and critical speed, design for static and fatigue loads, repeated loading, reversed bending Design of Coupling- selection, classification, rigid and flexible coupling, design of keys and pins	8	20

TEXT BOOKS:

1	Jalaludeen , Machine Design, Anuradha Publications, Chennai,2014
2	R. L. Norton, Machine Design – An Integrated Approach, Pearson Education, 2001
3	V.B.Bhandari, Design of Machine elements, McGraw Hill, 2010

DATA BOOKS PERMITTED FOR REFERENCE IN THE FINAL EXAMINATION:

1	K. Mahadevan, K.Balaveera Reddy, Design Data Hand Book, CBS Publishers & Distributors, 2013
2	NarayanaIyengar B.R & Lingaiah K, Machine Design Data Handbook, Tata McGraw Hill/Suma Publications, 1984
3	PSG Design Data, DPV Printers, Coimbatore, 2012

REFERENCES:

1	J. E. Shigley, Mechanical Engineering Design, McGraw Hill,2003
2	Juvinall R.C & Marshek K.M., Fundamentals of Machine Component Design, John Wiley,2003
3	M. F. Spotts, T. E. Shoup, Design of Machine Elements, Pearson Education, 2006
4	Rajendra Karwa, Machine Design, Laxmi Publications,2006

PREREQUISITE: ME201 MECHANICS OF SOLIDS

COURSE OBJECTIVES:

1	To review concepts of statics and strength of materials.
2	To introduce fundamental approaches to failure prevention of components.
3	To provide knowledge in the design of common machine elements such as fasteners, shafts, springs cotter joints and couplings

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	**Understand** the procedure to be followed during different phases of design process, **understand** the basic material properties and stress concentration and **analyze** systems subjected to combined stresses.
2	**Understand** different failure theories and fatigue loading and **analyze** failure of shafts due to combined stresses and fatigue loading.
3	**Understand** the basics of threaded and bolted joints. They will be able to **evaluate** the

	permissible stress on a material and with the optimum constrains and to **design** threaded joints and bolts.
4	**Understand** the basics and applications of riveted, cotter, knuckle, gib and welded joints. They will be able to **calculate** and **analyze** the load on the joints and **design** the system to satisfy the requirements.
5	**Calculate** the load and **analyze** the deformation of the spring according to the application. The student can **design** the spring to the required system.
6	**Calculate** the forces acting on the system and **design** shafts suitable for the system. They will be able to **design** couplings for the specified requirement.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	0	0	0	0	0	0	0	0	0	3	0
CO2	3	2	0	0	0	0	0	0	0	0	0	0	3	0
CO3	3	3	3	0	0	0	0	0	0	0	0	0	3	0
CO4	3	3	3	0	0	0	0	0	0	0	0	0	3	0
CO5	3	3	3	0	0	0	0	0	0	0	0	0	3	0
CO6	3	3	3	0	0	0	0	0	0	0	0	0	3	0

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Students can gain the basic knowledge of material properties, stress concentration and steps involved in design process
	PO2	2	Students will be able to analyze stress members subjected to combined stresses and effect of stress concentration among various members.
CO2	PO1	3	Students will understand different failure theories and fatigue loading.
	PO2	2	Students will be able to apply various theories of failure and analyze problems involving fatigue loading
CO3	PO1	3	Student will understand the basic concepts of threaded and bolted joints.
	PO2	3	Students will be able to analyse different forces acting on threaded and bolted joints
	PO3	3	Students will be able to design threaded and bolted joints with the help of design data book according to the specifications
CO4	PO1	3	Student will understand basic concepts of riveted, cotter, knuckle, gib and welded joints.
	PO2	3	Students will be able to analyse different forces acting on riveted, cotter, knuckle, gib and welded joints.
	PO3	3	Students will be able to design riveted, cotter, knuckle, gib and welded joints with the help of design data book according to the specifications
CO5	PO1	3	Student will understand basic concepts of springs, classification of springs and application of different types of springs
	PO2	3	Students will be able to analyse different forces acting on springs.
	PO3	3	Students will be able to design springs with the help of design data book according to the specifications

CO6	PO1	**3**	Student will understand the basic concepts of shafts and couplings
	PO2	**3**	Students will be able to analyse different forces acting on shafts and couplings.
	PO3	**3**	Students will be able to design shafts and couplings with the help of design data book according to the specifications

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	**2**	Students will be able to understand the basic procedure of design.
CO2	PSO1	**2**	Students will be able to analyze systems under fatigue loading and apply different theories of failure
CO3	PSO1	**2**	Students will be able to design threaded and bolted joints.
CO4	PSO1	**2**	Students will be able to design riveted, cotter, knuckle, gib and welded joints.
CO5	PSO1	**2**	Students will be able to design springs
CO6	PSO1	**2**	Students will be able to design shafts and couplings.

ME 403 ADVANCED ENERGY ENGINEERING

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: ADVANCED ENERGY ENGINEERING**	Course code**: ME 403**
L-T-P**: 3-0-0-3**	Credit**: 4**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction to the course. Global and Indian energy resources. Energy Demand and supply. Components, layout and working principles of steam, hydro, nuclear, gas turbine and diesel power plants.	7	15
II	Solar Energy- passive and active solar thermal energy, solar collectors, solar thermal electric systems, solar photovoltaic systems. Economics of solar power. Sustainability attributes.	7	15
III	Wind Energy-Principle of wind energy conversion system, wind data and energy estimation, wind turbines, aerodynamics of wind turbines, wind power economics. Introduction to solar-wind hybrid energy systems.	7	15
IV	Biomass Energy – Biomass as a fuel, thermo-chemical,	6	15

	bio-chemical and agro-chemical conversion of biomass-pyrolysis, gasification, combustion and fermentation, trans esterification, economics of biomass power generation, future prospects,		
V	Other Renewable Energy sources – Brief account of Geothermal, Tidal, Wave, MHD power generation, Small, mini and micro hydro power plants. Fuel cells – general description, types, applications. Hydrogen energy conversion systems, hybrid systems- Economics and technical feasibility	8	20
VI	Environmental impact of energy conversion – ozone layer depletion, global warming, greenhouse effect, loss of biodiversity, eutrophication, acid rain, air and water pollution, land degradation, thermal pollution, Sustainable energy, promising technologies, development pathways.	7	20

TEXT BOOKS:

1	Jefferson W Tester et.al., Sustainable Energy: Choosing Among Options, PHI, 2006
2	P K Nag, Power Plant Engineering, TMH, 2002
3	Tiwari G N, Ghosal M K, Fundamentals of renewable energy sources, Alpha Science International Ltd., 2007

REFERENCES:

1	David Merick, Richard Marshall, Energy, Present and Future Options, Vol.I & II, John Wiley & Sons, 2001
2	Godfrey Boyle, Renewable Energy : Power for a Sustainable Future, Oxford University Press, 2012
3	Roland Wengenmayr, Thomas Buhrke, 'Renewable Energy: Sustainable energy concepts for the future, Wiley – VCH, 2012
4	Twidell J W and Weir A D, Renewable Energy Resources, UK, E&F.N. Spon Ltd., 2006.

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To give an idea about global energy scenario and conventional energy sources
2	To understand solar, wind and Biomass energy
3	To know concepts of other renewable energy sources
4	To create awareness on the impacts of energy conversion and importance of sustainable energy

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Identify global and Indian energy sources & Explain the working of Power Plants
2	Explain capture, conversion and application of solar energy
3	Explain capture, conversion and application of wind energy
4	Explain conversion of biomass to energy
5	Explain capture of energy from oceans, fuel cells, geothermal and MHD power generation.
6	Understand the environmental impacts of energy conversion

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	0	0	0	0	2	3	0	0	0	0	0	0	0
CO2	1	0	2	0	0	2	3	0	0	0	0	0	1	0
CO3	1	0	1	0	0	2	3	0	0	0	0	0	1	0
CO4	3	1	3	0	0	2	3	0	0	0	0	1	1	0
CO5	3	1	3	0	0	2	3	0	0	0	0	1	1	0
CO6	0	0	3	0	0	2	3	0	0	0	0	1	0	0

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	1	Identification of various energy resources, their potentials and explanation of working of power plants needs basic knowledge in engineering & mathematics.
	PO6	2	Comparison of energy sources and identifying the impacts of power plants involves assessing social, health, safety issues related to power generation
	PO7	3	The environmental impact and sustainability attributes are taken in to consideration while developing each energy conversion techniques.
CO2	PO1	1	To understand the capture and conversion of solar energy, basic engineering knowledge is needed
	PO3	2	Public health, safety and environmental factors are taken in to consideration for developing solutions for solar energy conversion.
	PO6	2	Solar energy conversion technologies and their sustainability attributes involves assessing social, health, safety issues related to power generation
	PO7	3	The environmental impact and sustainability attributes are taken in to consideration while developing each energy conversion techniques.
	PO12	1	Sustainable energy conversion technologies requires life long learning in the broadest context of technological change
CO3	PO1	3	To explain the capture and conversion of wind energy, application of engineering fundamentals is required.
	PO2	1	Designing of wind energy conversion systems involves problem analysis using principles of aerodynamics, mathematics and engineering sciences.
	PO3	1	Public health, safety and environmental factors are taken in to consideration for developing solutions on wind energy conversion systems.

	PO6	**1**	Wind energy conversion technologies and their sustainability attributes involves assessing social, health, safety issues related to power generation
	PO7	**2**	The environmental impact and sustainability attributes are taken in to consideration while developing each energy conversion techniques.
	PO12	**1**	Sustainable energy conversion technologies requires life long learing in the broadest context of technological change
CO4	PO1	**3**	To explain the capture and conversion of biomass energy, application of engineering fundamentals is required.
	PO2	**1**	Designing of biomass conversion systems involves problem analysis using principles of mathematics and engineering sciences.
	PO3	**3**	Public health, safety and environmental factors are taken in to consideration for developing solutions on energy conversion systems.
	PO6	**2**	Biomass energy conversion technologies and their sustainability attributes involves assessing social, health, safety issues related to power generation
	PO7	**3**	The environmental impact and sustainability attributes are taken in to consideration during conversion and application of biomass energy.
	PO12	**1**	Sustainable energy conversion technologies requires life long learing in the broadest context of technological change
CO5	PO1	**3**	To explain the capture and conversion of ocean energy, Geothermal energy, MHD and fuel cell application of engineering fundamentals is required.
	PO2	**1**	Designing of ocean, geothermal and MHD conversion systems involves problem analysis using principles of mathematics and engineering sciences.
	PO3	**3**	Public health, safety and environmental factors are taken in to consideration for developing solutions on energy conversion systems.
	PO6	**2**	Ocean and geothermal energy conversion technologies and their sustainability attributes involves assessing social, health, safety issues related to power generation
	PO7	**3**	The environmental impact and sustainability attributes are taken in to consideration during conversion and application of biomass energy.
	PO12	**1**	Sustainable energy conversion technologies requires life long learing in the broadest context of technological change
CO6	PO3	**3**	Reducing the environmental impact of energy conversion requires design solutions for systems and processes with appropriate considerations for public health, safety and enviromnemtal factors.
	PO6	**2**	Understanding the environmental impacts of energy conversion involves assessing the social, health and safety issues relavant to the energy conversion techniques.
	PO7	**3**	The environmental impact and sustainability attributes are taken in to consideration while developing each energy conversion techniques.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO2	PSO1	**1**	Graduates will gain knowledge helpful in designing and developing solar

			energy conversion systems.
CO3	PSO1	**1**	Graduates will gain knowledge helpful in designing and developing wind energy conversion systems.
CO4	PSO1	**1**	Knowledge gained in biomass sources and conversion to alternate fuel and energy forms will help to solve complex engineering problems related to sustainable energy production and waster management.
CO5	PSO1	**1**	Knowledge gained in Ocean and geothermal energy sources, MHD Technology and fuel cells will help to solve real time engineering problems related to power generation.

ME 405 REFRIGERATION AND AIR CONDITIONING

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: REFRIGERATION AND AIR CONDITIONING**	Course code**: ME 405**
L-T-P**: 2-1-0-3**	Credit**: 4**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction – Brief history and applications of refrigeration. Thermodynamics of refrigeration- reversed Carnot cycle- heat pump and refrigeration machines, Limitations of reversed Carnot cycle. Unit of refrigeration- Air refrigeration systems- Reversed Joule cycle, Air craft refrigeration systems, simple bootstrap- Regenerative and reduced ambient system	6	15
II	Vortex tube refrigeration-Very low temperature refrigeration systems (concept only). Adiabatic demagnetization of paramagnetic salts Vapour compression systems-simple cycle - representation on T- s and P- h Diagrams. COP- Effect of operating parameters on COP –methods of improving COP of simple cycle- super- heating , under cooling, Liquid suction heat exchanger, actual cycle.	8	15
III	Multi pressure systems - multi compression and multi evaporator, systems. Inter cooling - flash inter cooling and flash gas removal- Different combinations of evaporator and compressor for different applications, Cascade system Refrigerants and their properties-Eco-friendly Refrigerants, mixed refrigerants, selection of refrigerants for different applications Vapour absorption systems - Ammonia – water system - simple system-	7	15

	drawbacks-Lithium Bromide water system- Electrolux-comparison with vapour compression system- steam jet refrigeration		
IV	Application of refrigeration- domestic refrigerators- water coolers- ice plants. Cold storages- food preservation methods- plate freezing, quick-freezing. Refrigeration system components- Compressors, condensers, expansion devices, evaporators. Cooling towers- Different types and their application fields- Refrigerant leakage and detection – charging of refrigerant – system controls.	6	15
V	Air conditioning – meaning and utility, comfort and industrial air conditioning. Psychometric properties- saturated and unsaturated air, dry, wet and dew point temperature – humidity, specific humidity, absolute humidity, relative humidity and degree of saturation- thermodynamic equations- enthalpy of moisture- adiabatic saturation process -psychrometers. Thermodynamic wet bulb temperature, psychometric chart- Psychometric processes- adiabatic mixing- sensible heating and cooling- humidifying and dehumidifying, air washer – bypass factor- sensible heat factor-RSHF and GSHF line- Design condition- Apparent dew point temperature – Choice of supply condition, state and mass rate of dehumidified air quantity – Fresh air supplied –air refrigeration. Comfort air conditioning- factors affecting human comfort. Effective temperature – comfort chart. Summer air Conditioning- factors affecting-cooling load estimation.	8	20
VI	Air conditioning systems- room air conditioner- split system- packaged system-all air system-chilled water system. Winter air conditioning – factors affecting heating system, humidifiers. Year round air conditioning AC system controls-thermostat and humidistat. Air distribution systems- duct system and design- Air conditioning of restaurants, hospitals, retail outlets, computer center, cinema theatre, and other place of amusement. Industrial applications of air Conditioning.	7	20

TEXT BOOKS:

1	Arora C. P, Refrigeration and Air-Conditioning, McGraw-Hill, 2008
2	Arora S. C. and Domkundwar, Refrigeration and Air-Conditioning, Dhanpat Rai, 2010
3	Ballaney P. L, Refrigeration and Air-Conditioning, Khanna Publishers, New Delhi, 2014
4	Manohar Prasad, Refrigeration and Air-Conditioning, New Age International, 2011

REFERENCES:

1	ASHRAE Handbook
2	Dossat. R. J, Principles of Refrigeration, Pearson Education India, 2002
3	Stoecker W.F, Refrigeration and Air-Conditioning, McGraw-Hill Publishing Company, 2009

PREREQUISITE: ME205 THERMODYNAMICS

COURSE OBJECTIVES:

1	To introduce vapour compression and vapour adsorption systems
2	To impart knowledge on refrigeration cycles and methods to improve performance
3	To familiarize the components of refrigeration systems
4	To introduce air conditioning systems
5	To know the applications of refrigeration and air conditioning systems

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Understand the principles of refrigeration. Apply refrigeration principles and analyse different type of air refrigerating systems.
2	Understanding different types of refrigeration systems, Analyse and Evaluate vapour compression refrigeration system.
3	Select the right refrigerant for a particular situation. Understand vapour absorption, multi compressor and multi evaporator systems.
4	Applying refrigeration principles for various purposes and understanding various components of refrigeration system.
5	Understanding air conditioning and Analyzing Psychometric processes
6	Design different type of air conditioning systems and duct systems for industrial applications

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	0	0	0	0	0	0	0	0	0	3	0
CO2	3	3	3	0	0	0	0	0	0	0	0	0	3	0
CO3	1	0	0	0	0	3	3	0	0	0	0	0	3	0
CO4	1	0	0	0	0	3	3	0	0	0	0	0	3	0
CO5	1	0	2	0	0	0	3	0	0	0	0	0	3	0
CO6	2	3	3	0	0	3	0	0	0	0	0	0	3	0

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Refrigeration fundamentals helps students to solve engineering problems in refrigeration
	PO2	3	Thermodynamic study enable students to analyse refrigeration and air conditioning problems
	PO3	3	Air refrigeration system study enable students to design aircraft refrigeration systems
CO2	PO1	3	Refrigeration systems knowledge helps in suggesting solution for various refrigeration problems
	PO2	3	Vapour compression refrigeration study enable analysis of real problems in refrigeration
	PO3	3	Refrigeration system analysis helps in design and development of more efficient systems
CO3	PO1	1	Refrigeration application knowledge helps in solving engineering problems
	PO6	3	Refrigerant leakage and detection study enable safe and healthy design of refrigeration systems
	PO7	3	Refrigerant device study helps in environment friendly and sustainable development
CO4	PO1	1	Refrigeration application knowledge helps in solving engineering problems
	PO3	3	Refrigerant leakage and detection study enable safe and healthy design of refrigeration systems
	PO7	3	Refrigerant device study helps in environment friendly and sustainabe development
CO5	PO1	1	Human Comfort condition knowledge helps in solving complex engineering problems
	PO3	2	Psychometric property study helps in developing healthy and safe designs.
	PO7	3	Air conditioning knowledge enable environment friendly development
CO6	PO1	2	Air condition systems knowledge helps in solving complex engineering problems
	PO2	3	Air conditioning design knowledge enable students to analyse various engineering problems
	PO3	3	Air distribution system study helps in design of ducts for various engineering problems
	PO6	3	Knowledge of various air-conditioning systems enable safe and healthy design

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	3	Student's knowledge in refrigeration will be enhanced by studying fundamentals of refrigeration
CO2	PSO1	3	Knowledge in refrigeration systems will enhance Student's capability to solve engineering problems
CO3	PSO1	3	Knowledge of refrigerants helps in selecting the right refrigerant for

			engineering problems
CO4	PSO1	**3**	Understanding of various components in refrigeration system will enhance student's capability to solve engineering problems.
CO5	PSO1	**3**	Understanding human comfort conditions helps to design and analyze the most suited components for real engineering problems
CO6	PSO1	**3**	Air conditioning and duct design knowledge enhance the capability to solve mechanical and design problems

ME 407 MECHATRONICS

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: MECHATRONICS**	Course code**: ME 407**
L-T-P**: 3-0-0-3**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction to Mechatronics: Structure of Mechatronics system. Sensors Characteristics -Temperature, flow, pressure sensors. Displacement, position and proximity sensing by magnetic, optical, ultrasonic, inductive, capacitive and eddy current methods. Encoders: incremental and absolute, gray coded encoder. Resolvers and synchros. Piezoelectric sensors. Acoustic Emission sensors. Principle and types of vibration sensors.	8	15
II	Actuators: Hydraulic and Pneumatic actuators Directional control valves, pressure control valves, process control valves. Rotary actuators. Development of simple hydraulic and pneumatic circuits using standard Symbols	7	15
III	Micro Electro Mechanical Systems (MEMS): Fabrication: Deposition, Lithography, Micromachining methods for MEMS, Deep Reactive Ion Etching (DRIE) and LIGA processes. Principle, fabrication and working of MEMS based pressure sensor, accelerometer and gyroscope	6	15
IV	Mechatronics in Computer Numerical Control (CNC) machines: Design of modern CNC machines - Mechatronics elements - Machine structure: guide ways, drives. Bearings: anti-friction bearings, hydrostatic bearing and hydrodynamic bearing. Re-circulating ball screws, pre-loading methods. Re-circulating roller screws. Typical elements of open and closed loop control	8	15

	systems. Adaptive controllers for machine tools. Programmable Logic Controllers (PLC) –Basic structure, input/ output processing. Programming: Timers, Internal Relays, Counters and Shift registers. Development of simple ladder programs for specific purposes.		
V	System modeling - Mathematical models and basic building blocks of general mechanical, electrical, fluid and thermal systems. Mechatronics in Robotics- Electrical drives: DC, AC, brushless, servo and stepper motors. Harmonic drive. Force and tactile sensors. Range finders: ultrasonic and light based range finders	6	20
VI	Robotic vision system - Image acquisition: Vidicon, charge coupled device (CCD) and charge injection device (CID) cameras. Image processing techniques: histogram processing: sliding, stretching, equalization and thresholding. Case studies of Mechatronics systems: Automatic cameras, bar code reader, pick and place robot, automatic car park barrier system, automobile engine management system.	7	20

TEXT BOOKS:

1	Bolton W., Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Person Education Limited, New Delhi, 2007
2	Ramachandran K. P., G. K. Vijayaraghavan, M. S. Balasundaram, Mechatronics: Integrated Mechanical Electronic Systems, Wiley India Pvt. Ltd., New Delhi, 2008
3	Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications, Person Education, Inc., New Delhi, 2006.

REFERENCES:

1	David G. Aldatore, Michael B. Histand, Introduction to Mechatronics and Measurement Systems, McGraw-Hill Inc., USA, 2003.
2	HMT, Mechatronics, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
3	Gordon M. Mair, Industrial Robotics, Prentice Hall International, UK, 1998.
4	Vijay K. Varadan, K. J. Vinoy, S. Gopalakrishnan, Smart Material Systems and MEMS: Design and Development Methodologies, John Wiley & Sons Ltd., England, 2006.

PREREQUISITE: nil

COURSE OBJECTIVES:

1	To introduce the features of various sensors used in CNC machines and robots
2	To study the fabrication and functioning of MEMS pressure and inertial sensors
3	To enable development of hydraulic/pneumatic circuit and PLC programs for simple applications

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Students will be able to explain the basic structure of Mechatronics system, sensors and encoders.
2	Students will gain enough knowledge about the various hydraulic and Pneumatic systems for developing simple hydraulic and pneumatic circuit's using standard symbols.
3	Students will develop a basic idea about Micro Electro Mechanical System, Deep Reactive Ion Etching (DRIE) and LIGA Process.
4	Students will be able to select various mechatronics elements in the Design of modern CNC machines
5	Students will gain fundamental knowledge in system modeling and Mechatronics in Robotics.
6	Students will be able to assess case studies of mechatronic systems.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	0	0	2	0	0	0	0	0	0	0	1	1
CO2	2	0	2	3	0	0	0	0	0	0	0	0	2	1
CO3	2	0	0	0	2	0	0	0	0	0	0	0	1	1
CO4	1	0	0	0	2	0	0	0	0	0	0	2	2	1
CO5	2	2	2	2	0	0	0	0	0	0	0	2	2	1
CO6	2	0	0	2	0	0	0	0	0	0	0	2	2	1

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	**1**	Students will be able to apply suitable sensors and encoders and other mechatronic elements based on acquired knowledge.
	PO2	**2**	Problem analysis and finding sustainable solutions based on principles and characteristics of sensors.
	PO5	**2**	Students will be able to select appropriate sensors for the modern engineering tools.
CO2	PO1	**2**	Students will be able to apply their knowledge in the hydraulic and pneumatic system on engineering problems.
	PO2	**2**	Formulation of required circuits in hydraulic and pneumatic applications.
	PO3	**3**	Design/development of solutions using actuators both hydraulic and

			pneumatic to analyze the various levels and need of automation and finally development of hydraulic and pneumatic circuit.
CO3	PO1	**2**	By gaining a broad overview but only at the level of basic/fundamental knowledge in MEMS and its principles will lead to knowledge on sensor fabrication.
	PO5	**2**	Modern tool usage using DRIE and LIGA process to micro machine sensors and other related components ,students will strongly recognize the need and development of MEMS.
CO4	PO1	**1**	Students will gain knowledge about the parts of CNC machine tools and will be able to work on it.
	PO5	**2**	Design and development of modern cnc machines and solution to growing needs of machine tool industry by studying various mechatronic element selection and controllers for machine tools.
CO5	PO1	**2**	Enhance knowledge in electrical drives and motors to apply robotic applications in mechatronics.
	PO2	**2**	Students can formulate mathematical models for mechanical and electrical engineering problems.
	PO3	**2**	Design solutions for mechatronics using the knowledge gained through studying about servo and stepper motors and system modelling.
	PO4	**2**	Students can use the knowledge in system modelling for solving real time complex problems
CO6	PO1	**2**	Apply the knowledge to robotic vision system.
	PO4	**2**	Conduct design of experiments, analysis using robotics for vivid mechatronic solutions

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	**1**	Students will be able to solve complex engineering simulations related to automations, based on acquired knowledge.
	PSO2	**1**	Students can enhance their self-learning capability and will be able to expertise themselves in the respective topics.
CO2	PSO1	**2**	Students will gain knowledge on the various fundamentals of hydraulics and pneumatic s for utilizing advanced technology.
	PSO2	**1**	Students can enhance their self-learning capability and will be able to expertise themselves in the respective topics.
CO3	PSO1	**1**	Apply the principles of design in Micro Electro Mechanical Systems manufacturing industries.
	PSO2	**1**	Students can enhance their self-learning capability and will be able to expertise themselves in the respective topics.
CO4	PSO1	**2**	Use CAD/CAM tools for best design development and manufacturing of CNC machines based on the knowledge acquired through mechatronic elements, PLC and ladder diagram for specific purpose.
	PSO2	**1**	Students can enhance their self-learning capability and will be able to expertise themselves in the respective topics.

CO5	PSO1	**2**	Apply the knowledge to use advanced technology mechatronics using robotics and to model mechanical, electrical and fluid systems.
	PSO2	**1**	Students can enhance their self-learning capability and will be able to expertise themselves in the respective topics.
CO6	PSO1	**2**	Develop and introduce new ideas on product design for mechatronic case studies using modern automation solutions.
	PSO2	**1**	Students can enhance their self-learning capability and will be able to expertise themselves in the respective topics.

ME409 COMPRESSIBLE FLUID FLOW

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: compressible fluid flow**	Course code**: ME 409**
L-T-P**: 2-1-0-3**	Credit**:**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction to Compressible Flow- Concept of continuum-system and control volume approach-conservation of mass, momentum and energy-stagnation state- compressibility-Entropy relations. Wave propagation- Acoustic velocity-Mach number-effect of Mach number on compressibility- Pressure coefficient-physical difference between incompressible, subsonic, sonic and supersonic flows- Mach cone-Sonic boom-Reference velocities- Impulse function-adiabatic energy equation-representation of various flow regimes on steady flow adiabatic ellipse.	8	15
II	One dimensional steady isentropic flow- Adiabatic and isentropic flow of a perfect gas- basic equations- Area-Velocity relation using 1D approximation-nozzle and diffuser-mass flow rate-chocking in isentropic flow-flow coefficients and efficiency of nozzle and diffuser-working tables-charts and tables for isentropic flow-operation of nozzle under varying pressure ratios –over expansion and under expansion in nozzles.	7	15
III	Irreversible discontinuity in supersonic flow- one dimensional shock wave- stationary normal shock-governing equations- Prandtl- Meyer relations- Shock	7	15

	strength- Rankine- Hugoniot Relation- Normal Shock on T-S diagram- working formula- curves and tables- Oblique shock waves - supersonic flow over compression and expansion corners (basic idea only).		
IV	Flow in a constant area duct with friction (Fanno Flow) –Governing Equations- Fanno line on h-s and P-v diagram- Fanno relation for a perfect gas- Chocking due to friction- working tables for Fanno flow- Isothermal flow(elementary treatment only)	6	15
V	Flow through constant area duct with heat transfer (Rayleigh Flow)- Governing equations- Rayleigh line on h-s and P-v diagram- Rayleigh relation for perfect gas- maximum possible heat addition- location of maximum enthalpy point- thermal chocking- workingtables for Rayleigh flow.	6	20
VI	Compressible flow field visualization and measurement- Shadowgraph-Schlieren technique- interferometer- subsonic compressible flow field -measurement (Pressure, Velocity and Temperature) – compressibility - correction factor- hot wire anemometer- supersonic flow measurement- Shock tube-Rayleigh Pitot tube- wedge probe- stagnation temperature probe- temperature recovery factor –Kiel probe - Wind tunnels – closed and open type-	8	20

DATA BOOK/GAS TABLES:

1	Yahya S. M., Gas Tables**,** New Age International, 2011
2	Balachandran P., Gas Tables, Prentice-Hall of India Pvt. Limited, 2011

TEXT BOOKS:

1	Balachandran P., Fundamentals of Compressible Fluid Dynamics, PHI Learning. 2006
2	Rathakrishnan E., Gas Dynamics, PHI Learning, 2014
3	Yahya S. M., Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion, New Age International Publishers, 2003

REFERENCES BOOKS:

1	Anderson**,** Modern compressible flow, 3e McGraw Hill Education, 2012
2	Shapiro, Dynamics and Thermodynamics of Compressible Flow – Vol 1., John Wiley & Sons,1953

PREREQUISITE: ME205 THERMODYNAMICS

COURSE OBJECTIVES:

1	To familiarize with behavior of compressible gas flow.
2	To understand the difference between subsonic and supersonic flow
3	To familiarize with high speed test facilities

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Understand and apply the fundamentals of compressible flow
2	Understand the fundamentals of isentropic flow of ideal gases and also will be able analyze the compressible flow through nozzles and diffusers.
3	understand and analyze the effect of shock in compressible flow
4	Understand and analyze the effect of friction in compressible flow through a constant area duct (Fanno flow)
5	Understand and analyze the effect of heat transfer in a compressible flow through a constant area duct (Rayleigh flow)
6	Explain the various compressible flow visualization and measurement techniques

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	2	2	0	0	0	0	0	0	0	0	0	0		2	0
CO2	3	3	3	0	0	0	0	0	0	0	0	0		3	0
CO3	3	3	0	0	0	0	0	0	0	0	0	0		3	0
CO4	3	3	2	0	0	0	0	0	0	0	0	0		3	0
CO5	3	3	2	0	0	0	0	0	0	0	0	0		3	0
CO6	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	2	Will be able to solve engineering problems since it deals with fundamentals of compressible flow.
	PO2	2	Students will be able to analyze problems using the knowledge in fundamentals of compressible flow.
CO2	PO1	3	Students will be able to solve problems regarding the flow through nozzles and diffusers.
	PO2	3	Helps to indentify and analyze complex problems on nozzle and diffusers.

	PO3	**3**	Helps the students to design nozzles and diffusers that satisfy specific needs.
CO3	PO1	**3**	Students will be able to solve problems regarding the presence of normal shocks in the nozzles and diffusers.
	PO2	**3**	Students will be able to analyze the effect of normal shocks in nozzles and diffusers.
CO4	PO1	**3**	Students will be able to solve problems regarding the flow through constant area duct with friction.
	PO2	**3**	Students will be able to analyze the effect friction in costant area duct reaching substantiated conclusions.
	PO3	**2**	Helps the students to design duct by considering the effect of friction that satisfy specific needs.
CO5	PO1	**3**	Students will be able to solve problems regarding the flow through constant area duct with heat transfer.
	PO2	**3**	Students will be able to analyze the effect heat transfer in costant area duct.
	PO3	**2**	Helps the students to design duct by considering the effect of heat transfer that satisfy specific needs.
CO6	PO3	**1**	Students may able to suggest proper flow measurement or visualisation technique that meet specified need.
	PO5	**1**	May able to apply appropriate techniques or tools to complex engineering activities with an understanding of the limitations.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	**2**	Students will be able to solve real-time problems in compressible flow from the knowledge gained from fundamentals.
CO2	PSO1	**3**	Students will be able to design nozzles and diffusers according to the conditions given.
CO3	PSO1	**3**	Students will be able to find the change in parameters in compressible due to the presence of shock.
CO4	PSO1	**3**	Students will be able to solve engineering problems in compressible flow in which flow parameters affected by friction.
CO5	PSO1	**3**	Students will be able to solve engineering problems in compressible flow in which flow parameters affected by heat transfer.

ME463 AUTOMOBILE ENGINEERING

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: automobile engineering**	Course code**: ME 463**
L-T-P**: 3-0-0-3**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Piston: - material for piston, clearances, piston rings, types, need for two compression rings, oil control ring, piston pin. Piston for IC engine, piston rings, piston pin, connecting rod, crank shaft, crank pin, cam shaft, valves, fly wheel, fluctuation of energy and size of fly wheel, hub and arms, stress in a fly wheel rim, simple problems. Petrol fuel injection systems: - comparison petrol injection and carbureted fuel supply systems-comparison –multiport fuel injection (MPFI) and common rail direct injection (CRDI) systems Super charging systems: fundamentals, naturally aspirated engines and supercharged engines– Turbo charger, turbolag. Hybrid cars, safety overview -Formula-I engine technology: overview, electrical technology, brakes, transmission Technology.	7	15
II	Friction clutch:- fundamentals, driven plate inertia, driven plate transmitted torque, driven plate wear – angular driven plate cushioning and torsional damping, clutch friction materials, when clutch is worn out. Pull type diaphragm clutch, multiple diaphragm clutch, multi-plate hydraulically operated automatic transmission clutch, semi centrifugal clutch, fully automatic centrifugal clutch, and integral single plate diaphragm clutch Need of gear box, resistance to vehicle motion, power to weight ratio, speed operating range-five speed and reverse sliding mesh, constant mesh, and synchromesh gear boxes:- gear synchronization and engagement Over drives – hydrodynamic fluid couplings: - efficiency and torque capacity – fluid friction coupling- torque converters.	7	15
III	Steering:-basic principle of a steering system:- swinging beam system – Ackermann –over steer and under steer – slip angle, camber, caster etc. Swivel axis inclination: Centre point steering, camber, king pin inclination, negative offset, caster, toe-in and toe-out Steering gear box: - fundamentals screw and nut	7	15

	steering gear mechanism-worm and roller type steering gear box – Re-circulating ball nut and rocker lever, re-circulating ball rack and sector steering gear box– need of power assisted steering. External direct coupled and rack and pinion and integrated steering power cylinder, power assisted steering lock limitations		
IV	Suspension: - suspension geometry, terminology-Macpherson strut friction and spring offset - suspension roll centers:-roll centers, roll axis, roll centre height, short swing and long arm suspension, transverse double wishbone, parallel trailing double arm and vertical pill strut suspension, Macpherson strut suspension, semi-trailing arm rear suspension, telescopic suspension. High load beam axle leaf spring, sprung body roll stability. Rear axle beam suspension- body roll stability analysis:- body roll couple, body roll stiffness, body over turning couple Body weight transfer, body direct weight transfer couple, body roll couple distribution, body roll weight transfer,lateral force distribution Anti roll bars and roll stiffness:- anti roll bar function, operating principle, anti roll bar action caused by the body rolling, single wheel lift -rubber spring bumper:- bump stop function and characteristics, axis inclination Rear suspension: - live rigid axle suspension, non drive rear suspension- swing arm rear wheel drive independent suspension Low pivot split axle coil spring wheel drive independent suspension, trailing and semi trailing arm rear wheel drive independent suspension. Transverse double link arm rear wheel drive independent suspension, De Dion axle rear wheel suspension Hydrogen suspension, hydro-pneumatic automatic height correction suspension	8	15
V	Brakes: - mechanical and hydraulic brakes (review only) – properties of friction lining and pad materials, efficiency, stopping distance, theory of internal shoe brake, equations – effect of expanding mechanism of shoes on total braking torque, equations. 1 20% 1 Braking vehicles: - brakes applied on rear, front and all four wheels, equations –calculation of mean lining pressure and heat generation during braking operation, equations. – braking of vehicle moving on curved path, simple problems. 11 Anti L ock Braking system (ABS): - need and advantage s of ABS – hydro -mechanical ABS - hydro -electric ABS - air -electric ABS. 1 Brake servos: - operating principle, vacuum servo - direct acting suspended vacuum assisted brake servo unit operation - hydraulic servo assisted brake systems. 1 Pneumatic operated disc brakes – air operated brake	7	20

	systems: - air over hydraulic brake system - Three line brake system - – electronic -pneumatic brakes		
VI	Aerodynamic drag: pressure drag, air resistance, opposing motion of a vehicle, equations, after flow wake, drag coefficients, various body shapes, base drag, vortices, trailing vortex drag, attached transverse vortices. 1 20% 1 Aerodynamic lift: -lift coefficients, vehicle lift, underbody floor height versus aerodynamic lift and drag, aerofoil lift and drag, front end nose shape. 11 Car body drag reduction: -profile edge chamfering, bonnet slope and wind screen rake, roof and side panel chamfering, rear side panel taper, underbody rear end upward taper, rear end tail extension, underbody roughness. Aerodynamic lift control:- underbody dams, exposed wheel air flow pattern, partial enclosed wheel air flow pattern, rear end spoiler, negative lift aerofoil wings. 1 After body drag: - square back drag, fast back drag, hatch back drag, notch back drag.	7	20

TEXT BOOKS:

1	Gupta R.B. Auto design , Satya Prakash, New Delhi, 2015
2	Heinz Heisler, Advanced engine technology, Butterworth-Heinemann,1995
3	Heinz Heisler, Advanced vehicle technology, Society of Automotive Engineers Inc, 2002
4	Hillier and Peter Coobes, Fundamentals of motor vehicle technology, Nelson Thornes, 2004
5	Tom Denton, Automobile mechanical and electrical systems, Butterworth-Heinemann, 2011

PREREQUISITE: Nil

COURSE OBJECTIVES:

1	To know the anatomy of automobile in general
2	To understand the working of different automotive systems and subsystems
3	To update the latest developments in automobiles

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Understand various parts, systems and technologies in IC engines
2	Understand and classify different power transmission components used in automobiles.
3	Understand the principles of steering system and will be able to classify different steering gearboxes used in automobiles.
4	Understand the the principles of suspension system and also will be able to differentiate

	suspension systems used in automobiles
5	Understand and apply the the principles of braking system and also will be able to differentiate the braking systems used in automobiles
6	Understand the effect of different aerodynamic parameters on vehicle performance and also the control methods used

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	1	0	1	0	0	0	0	0	0	0	0	3		1	2
CO2	2	2	1	0	0	0	0	0	0	0	0	3		2	2
CO3	1	2	0	0	0	0	0	0	0	0	0	3		2	2
CO4	2	2	0	0	0	0	0	0	0	0	0	3		2	2
CO5	2	2	0	0	0	0	0	0	0	0	0	3		2	2
CO6	1	2	2	2	0	0	0	0	0	0	0	3		2	2

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	1	Students may able to solve problems regarding IC engines from the fundamental knowledge about the engine components and technologies.
	PO3	1	Students may able to design flywheel of an IC engine according to specific needs.
	PO12	3	Students will be able to recognize the need for life-long learning in the broadest context of technological change.
CO2	PO1	2	Students will be able to solve problems regarding clutch design with the knowledge about the power transmission system.
	PO2	2	Helps the students to Identify problems related to power transmission devices.
	PO3	1	Students may able to design clutch system that meet the specified needs.
	PO12	3	Students will be able to recognize the need for life-long learning in the broadest context of technological change.
CO3	PO1	1	Students may able to apply the knowledge of steering system fundamentals to the solution of steering system related problems.
	PO2	2	Helps students to identify problems related to steering geometry reaching substantiated conclusions.
	PO12	3	Students will be able to recognize the need for life-long learning in the broadest context of technological change.
CO4	PO1	2	Helps the students to apply the knowledge of mathematics and engineering fundamentals to the solve body roll stability problems.
	PO2	2	Helps the students to identify and analyze problems related to stability of a vehicle reaching substantiated conclusions.
	PO12	3	Students will be able to recognize the need for life-long learning in the broadest context of technological change.

CO5	PO1	**2**	Helps the students to apply the knowledge of mathematics and engineering fundamentals to the solve braking of a vehicle related problems.
	PO2	**2**	Helps the students to identify and analyze problems related to braking of a vehicle reaching substantiated conclusions.
	PO12	**3**	Students will be able to recognize the need for life-long learning in the broadest context of technological change.
CO6	PO1	**1**	Knowledge about the aerodynamic parameters like drag and lift may help the students to solve engineering problems related to aerodynamics of a vehicle
	PO2	**2**	Students will be able to identify and analyze engineering problems related to aerodynamics of a vehicle reaching substantiated conclusions.
	PO3	**2**	Students will be able to design solutions for the problems related to aerodynamics of a vehicle that meet the specified needs.
	PO4	**2**	With interpretation of data from experimental values, students will be able to provide valid conclusions.
	PO12	**3**	Students will be able to recognize the need for life-long learning in the broadest context of technological change.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	**1**	Students may able to solve real-time problems related to Automobile Engineering sectors.
	PSO2	**2**	Students will be able to recognize the importance of self and advanced learning for continuous improvement to become competend in the field.
CO2	PSO1	**2**	Students may able to solve real-time problems related to Automobile Engineering sectors.
	PSO2	**2**	Students will be able to recognize the importance of self and advanced learning for continuous improvement to become competend in the field.
CO3	PSO1	**2**	Students may able to solve real-time problems related to Automobile Engineering sectors.
	PSO2	**2**	Students will be able to recognize the importance of self and advanced learning for continuous improvement to become competend in the field.
CO4	PSO1	**2**	Students may able to solve real-time problems related to Automobile Engineering sectors.
	PSO2	**2**	Students will be able to recognize the importance of self and advanced learning for continuous improvement to become competend in the field.
CO5	PSO1	**2**	Students may able to solve real-time problems related to Automobile Engineering sectors.
	PSO2	**2**	Students will be able to recognize the importance of self and advanced learning for continuous improvement to become competend in the field.
CO6	PSO1	**2**	Students may able to solve real-time problems related to Automobile Engineering sectors.
	PSO2	**2**	Students will be able to recognize the importance of self and advanced

			learning for continuous improvement to become competend in the field.

ME465 INDUSTRIAL HYDRAULICS

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: industrial hydraulics**	Course code**: ME 465**
L-T-P**: 3-0-0-3**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction to fluid power – Hydraulics and Pneumatics systems– Fluid power systems – Fundamentals of fluid mechanics , Properties of fluids. Selection of fluids, additives, effect of temperature and pressure on hydraulic fluids , Measurement of physical parameters – Hydraulic symbols	7	15
II	Pumps: Types , classification , principle of working & constructional details of vane pump, gear pumps, radial and axial plunger pumps, Power and efficiency calculations, char, Curves, selection of pumps for hydraulic power transmission	7	15
III	Hydraulic cylinders and rams – Fluid power pumping systems and components. Pressure accumulators – Functions – Fluid reservoirs – Filter in hydraulic circuits. Loading and replacement of filter elements – Materials for filters.	7	15
IV	Hydraulic Actuators (i) Linear and Rotary. (ii) Hydraulic motors - Types- Vane, Gear, Piston types, radial piston. (iii) Methods of control of acceleration, deceleration. (iv) Types of cylinders and mountings. (v) Calculation of piston velocity, thrust under static and dynamic applications, considering friction, inertia loads. (vi) Design considerations for cylinders. Cushioning of cylinders.	7	15
V	Fluid temperature control – Fluid pressure control – control valves – Sequence -valve – Counterbalance valve-unloading valve – Friction control valve – Servo systems, Hoses & Pipes : Types , materials , pressure drop in hoses/pipes. Hydraulic piping connections	7	20
VI	Simple reciprocating, Regenerative, Speed control (Meter in, Meter out and bleed off), Sequencing, Synchronization, transverse and feed, circuit for riveting	7	20

	machine, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, circuit for hydraulic press, unloading circuit (Numerical treatment), motor breaking circuit		

TEXT BOOKS:

1	B. Lall, Oil Hydraulics, International Literature Association
2	D. A. Pease, Basic Fluid Power, Prentice Hall,1986
3	J. J. Pipenger, Tyler Gregory Hicks, Industrial Hydraulics, McGraw Hill,1979
4	Pinches, Industrial Fluid Power, Prentice Hall,1989
5	R.K. Bansal, Fluid Mechanics, Laxmi Publication (P) Ltd.,2017

REFERENCES BOOKS:

1	ISO-1219,fluids systems and components,graphic symbols.
2	Andrew A. Parr, Hydraulics and Pneumatics, Elsevier ,1999
3	Michael J. Prinches and Ashby J. G, Power Hydraulics, Prentice Hall,1988
4	Yeaple, Fluid Power Design Handbook, CRC Press,1995

PREREQUISITE:Nil

COURSE OBJECTIVES:

1	To introduce various fluid power systems
2	To get knowledge on fluid power circuits

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	To classify the various components used in fluid power systems
2	To recall and summarise the working of suitable system employed fluid power transmission
3	To identify the various components used in hydraulic systems
4	To organize the various components used in hydraulic systems
5	To select the various fluid control valves used in hydraulic systems
6	To categorize the various fluid circuits used in hydraulic systems

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	0	2	0	2	0	0	0	0	0	0	2	2	0
CO2	3	0	2	0	0	0	2	0	0	0	0	0	2	0
CO3	3	0	0	2	2	0	0	0	0	0	0	0	2	0
CO4	3	0	2	0	0	0	0	0	0	2	0	0	2	0
CO5	3	0	0	2	0	1	0	0	0	0	0	0	2	0
CO6	3	0	0	0	2	0	0	0	0	2	0	0	2	0

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	3	Will be able to solve engineering problems since it deals with fundamentals of hydraulic systems
	PO3	2	Students may able to suggest proper hydraulic system.
	PO5	2	May able to apply appropriate techniques or tools to complex engineering activities with an understanding of the limitations.
	PO12	2	Evaluate the existing system and find the new hopes
CO2	PO1	3	Students will be able to appreciate and to a considerable extent solve complex engineering problems related to hydraulic systems, based on acquired knowledge
	PO3	2	In the design/development of solutions for complex hydraulics engineering problems and to design hydraulic system
	PO7	2	engineering solutions in societal and environmental context
CO3	PO1	3	design and development of hydraulic system ,meet the demands of the current industry
	PO4	2	it will helps in further scopes of hydraulic systems
	PO5	2	design the modern complex systems with in the limits of the knowledge.
CO4	PO1	3	study of various component is very important.
	PO3	2	various components used in hydraulic system for safety measures.
	PO10	2	standardization is very important in all systems,due to this evaluation,study of documents will become easy.
CO5	PO1	3	Knowledge about different types of valves very needed one.
	PO4	2	still research's,experiments going on ,about control valves
	PO6	1	proper selection of hydraulic valves will ensure the safety of entire system.
CO6	PO1	3	Knowledge about different types of hydraulic components very needed one.
	PO5	2	Modern tools uses,will ensure the stability and reliability of the system.
	PO10	2	standardization is very important in all systems,due to this evaluation,study of documents will become easy.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	**2**	different kind of components used for solving existing problems.
CO2	PSO1	**2**	appropriate selection of components used in hydraulic system,will rectify many problems
CO3	PSO1	**2**	knowledge about components used in hydraulic system,will rectify solve many problems
CO4	PSO1	**2**	proper design and organization will simplify the complexity of the system
CO5	PSO1	**2**	different kind of hydraulic valves used for solving existing problems.
CO6	PSO1	**2**	knowledge about components used in hydraulic system,will rectify solve many problems

ME431 MECHANICAL ENGINEERING LAB

COURSE INFORMATION SHEET:

Program: **MECHANICAL ENGINEERING**	Degree :**B-Tech**
Course**: MECHANICAL ENGINEERING LAB.**	Course code**: ME 431**
L-T-P:**0-0-3-1**	Credit:**1**

Experiments:

1. Determination of LMTD and effectiveness of parallel flow, Counter flow and cross flow heat exchangers(double pipe heat exchanger)
2. Determination of heat transfer coefficients in free convection(free convection apparatus)
3. Determination of heat transfer coefficients in forced convection (forced convection apparatus)
4. Determination of thermal conductivity of solids(composite wall)
5. Determination of thermal conductivity of powder
6. Determination of Thermal conductivity of liquids
7. Determination of emissivity of a specimen (emissivity apparatus)
8. Determination of Stefan Boltzman constant (Stefan Boltzmann apparatus)
9. Study and performance test on refrigeration (Refrigeration Test rig)
10. Study and performance test air conditioning equipment(air conditioning test rig)
11. Performance study on heat pipe
12. Calibration of Thermocouples
13. Calibration of Pressure gauge

PREREQUISITES:
ME302 Heat and mass transfer, ME304 Dynamics of machinery

COURSE OBJECTIVES:

1	To conduct the various heat transfer experiments
2	To practice calibration of thermometer and pressure gauges
3	To do experiments on dynamics

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Ability to apply the principle of heat transfer for quantitative measurement and to compare the results with theoretical values
2	Understand the theory behind Refrigeration and to find the coefficent of performance.
3	To practice calibration of thermometer and pressure gauges
4	To conduct experiments for finding the effectiveness of different heat exchangers.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	0	0	2	0	0	0	2	2	2	0	0	2	0
CO2	3	0	0	2	0	0	0	2	2	2	0	0	2	0
CO3	3	0	0	0	0	0	0	2	0	2	0	0	2	0
CO4	3	0	0	2	0	0	0	2	2	2	0	0	2	0

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	JUSTIFICATION
	PO1	Knowledge in the principle of heat transfer and respective apparatus to solve engineering problems

CO1	PO4	Conducting experiments and interpretation of data using the knowledge in heat transfer to solve similar engineering problems
	PO8	Conducting experiments and analyzing provide professionalism, ethical attitude, communication skills.
	PO9	Working as a team member or leader, effectively in conducting experiments and analyzing.
	PO10	Experiments enable students to comprehend and prepare effective reports.
CO2	PO1	Knowledge in the principle of Refrigeration and respective apparatus to solve engineering problems
	PO4	Conducting experiments and interpretation of data using the knowledge in Refrigeration to solve similar engineering problems
	PO8	Conducting experiments and analyzing provide professionalism, ethical attitude, communication skills.
	PO9	Working as a team member or leader, effectively in conducting experiments and analysing.
	PO10	Experiments enable students to comprehend and prepare effective reports.
CO3	PO1	Knowledge in the principle of different temperature sensors and respective apparatus to solve engineering problems
	PO8	Conducting experiments and analysing provide professionalism, ethical attitude, communication skills.
	PO 10	Experiments enable students to comprehend and prepare effective reports.
CO4	PO1	Knowledge in the principle of heat exchanging devices and respective apparatus to solve engineering problems
	PO4	Conducting experiments and interpretation of data using the knowledge in heat transfer to solve similar engineering problems
	PO8	Conducting experiments and analysing provide professionalism, ethical attitude, communication skills.
	PO9	Working as a team member or leader, effectively in conducting experiments and analysing.
	PO10	Experiments enable students to comprehend and prepare effective reports.

CO- PSO MAPPING

CO's	PSO's	JUSTIFICATION
CO1	PSO1	Experiments in heat transfer apparatus will help to utilize knowledge in thermal science to solve engineering problems.
CO2	PSO1	Experiments in Refrigeration systems apparatus will help to utilize knowledge in thermal science to solve engineering problems.
CO3	PSO1	Experiments in Temperature sensing apparatus will help to utilize knowledge in Calibration of instruments.
CO4	PSO1	Experiments in Heat ex changers will help to utilize knowledge in thermal science to solve engineering problems.

ME451 SEMINAR & PROJECT PRELIMINARY

COURSE INFORMATION SHEET:

Program: **mechanical Engineering**	Degree :**B-Tech**
Course**: Seminar & Project Preliminary**	Course code**: ME451**
L-T-P**:0-1-0**	Credit**:2**

PREREQUISITE: NIL

COURSE OBJECTIVES:

1	To develop skills in doing literature survey, technical presentation and report preparation.
2	To enable project identification and execution of preliminary works on final semester project

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Analyze a current topic of professional interest and present it before an audience
2	Identify an engineering problem, analyze it and propose a work plan to solve it.

3	Mould research capability on the selected topic

CO-PO-PSO MAPPING:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	0	3	0	0	0	0	0	0	0	3	0	0	0	3	0
CO2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2
CO3	0	0	0	3	0	0	0	2	0	0	0	0	0	0	0

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	JUSTIFICATION
CO1	PO2	Students will be able to analyze a current topic of personal interest
	PO10	Students will be able to communicate the selected topic with engineering community and collect the response. Design documentation and effective presentation can be done
CO2	PO3	Students will be able to identify engineering problems and select a designed system for solution with the consideration of public as well as environment.
CO3	PO4	Students will be able to use research based knowledge and research methods to provide valid conclusions
	PO8	Students will be able to apply ethical principles and norms while the selection and presentation of a topic.

CO- PSO MAPPING

CO's	PSO's	JUSTIFICATION
CO1	PSO1	Students will be able to apply engineering knowledge to identify, analyze a problem in the field of mechanical engineering

CO2	**PSO2**	Students will be able to identify and explore the current technical problems and find professional methodologies for the solution
CO3	**PSO3**	Students will be able to do research and gain the sufficient competence for the topic in different advanced fields of engineering.

SREEPATHY INSTITUTE OF MANAGEMENT AND TECHNOLOGY

COURSE HANDBOOK

DEPARTMENT OF MECHANICAL ENGINEERING

SEMESTER VIII

SREEPATHY INSTITUTE OF MANAGEMENT AND TECHNOLOGY

VISION

"Strive for excellence in generation and dissemination of knowledge."

MISSION

- To mould engineers of tomorrow, who are capable of addressing the problems of the nation and the world, by imparting technical education at par with international standards.
- To instil a desire in students for research, innovation, invention and entrepreneurship.
- To instil a desire in students for research, innovation, invention and entrepreneurship.
- To impart the values of environment awareness, professional ethics, societal commitment, life skills and a desire for lifelong learning.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To act as quality knowledge center for creating technologically competent Mechanical Engineering professionals who will cater to the needs of emerging and interdisciplinary industry and research fields.

MISSION

- To provide theoretical and conceptual knowledge in Mechanical engineering stream and enhance lifelong learning.
- To work in close association with stakeholders in industry by enhancing industry-institute interaction, to take up need-based research and industry specific programs.
- To infuse professional, social and economic responsibilities along with ethical values to graduates.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

The graduates from Mechanical Engineering program are expected to achieve the following Program Educational Objective within a few years of graduation

PEO1: Have an overall knowledge in Mechanical Engineering and also in the fields of Mathematics, Science, Communication and Computing skills.

PEO2: Design machines, analyse thermo-fluid problems and optimize the quality of products and services.

PEO3: Implement ideas of Mechanical Engineering for the challenging task in the interdisciplinary areas like Electrical, Electronics, Computer Science, Civil, Bio-Technology and allied branches.

PROGRAM OUTCOMES (PO):

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

2. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.

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

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

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

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

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

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

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

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

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

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

PROGRAM SPECIFIC OBJECTIVES (PSO)

The **Mechanical Engineering** program graduates will be able to:

PSO1: Solve real-time problems in Design, Fluids, Thermal, Manufacturing and allied Engineering sectors of Mechanical Engineering.

PSO2: Recognize the importance of self-learning and engage in continuous independent learning to become experts in either as entrepreneurs or employees in the field.

BL	BLOOM'S LEVEL		
L1	Level -1	Remembering	Recalling from memory of previously learned material
L2	Level -2	Understanding	Explaining Ideas or Concepts
L3	Level -3	Applying	Using information in another familiar situation
L4	Level -4	Analysing	Breaking information into part to explore understandings and relationships
L5	Level -5	Evaluating	Justify a decision or course of action
L6	Level -6	Creating	Generating new ideas, products or new ways of viewing

ME 402: Design of Machine Elements II

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Design of Machine Elements II**	Course code**: ME 402**
L-T-P**: 3-0-0**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Clutches – friction clutches, design considerations, multiple disc clutches, cone clutch, centrifugal clutch	2	15
	Brakes- Block brake, band brake, band and block brake, internal expanding shoe brake	3	
II	Rolling contact bearing- Design of bearings, Types, Selection of a bearing type, bearing life, static and dynamic load capacity, axial and radial loads, selection of bearings, dynamic equivalent load	4	15
	Sliding contact bearing- lubrication, lubricants, viscosity, Journal bearings, hydrodynamic theory, Sommerfield number, design considerations, heat balance, bearing housing and mountings	4	
III	Gears- classification, Gear nomenclature, Tooth profiles, Materials of gears, Law of gearing (review only), virtual or formative number of teeth, gear tooth failures, Beam strength, Lewis equation, Buckingham's equation for dynamic load, wear load, endurance strength of tooth, surface durability, heat dissipation – lubrication of gears – Merits and demerits of each type of gears.	3	15
	Design of spur gear	3	
IV	Design of helical gear	2	15
	Design of bevel gear	2	
	Design of worm & worm wheel	3	
V	Design of flat belt- materials for belts, slip of the belts, creep, centrifugal tension	3	20
	Design of V-belt drives, Advantages and limitations of V-belt drive	3	
	Selection of roller chains, power rating of roller chains, galling of roller chains, polygonal action, silent chain.	3	
VI	Connecting rod – material, connecting rod shank, small end, big end, connecting rod bolts, inertia bending stress, piston	5	20
	Pressure vessels, thin cylinders, Thick cylinder equation, open and closed cylinders.	2	

TEXT BOOKS:

1	J. E. Shigley, Mechanical Engineering Design, McGraw Hill,2003
2	Jalaludeen , Machine Dsign, Anuradha Publications, 2016
3	V.B.Bhandari, Design of Machine elements, McGraw Hill, 2016

REFERENCES:

1	Juvinall R.C & Marshek K.M., Fundamentals of Machine Component Design, John Wiley, 2011
2	M. F. Spotts, T. E. Shoup, Design of Machine Elements, Pearson Education, 2006
3	Rajendra Karwa, Machine Design , Laxmi Publications (P) LTD, New Delhi, 2006
4	Siegel, Maleev& Hartman, Mechanical Design of Machines, International Book Company, 1983

Prerequisite: ME401 Design of Machine Elements-I

COURSE OBJECTIVES:

1	To provide basic design methods for clutches, brakes, belt drives, bearings, gears and connecting rod.
2	To introduce the design modifications to be considered for ease of manufacturing.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Design different types of clutches and brakes
2	Explain the types of bearing, load carrying capacity, lubrication system and design bearings based on the requirements.
3	Explain the types, gear tooth failures, materials used, beam strength, endurance and wear strength for different gears and to design spur and helical gears
4	Design bevel and worm gear.
5	Select and design the suitable flexible drive among flat belt, v belt and chains for the required purpose
6	Design Connecting rod and Pressure vessels.

CO-PO-PSO MAPPING:

Course Outcomes	Program Outcomes												PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	0	0	0	0	0	2	2	0	0	0	2	0

CO2	3	2	3	0	0	0	0	1	0	0	0	0	2	0
CO3	3	3	3	0	0	0	0	3	0	0	0	0	2	0
CO4	3	3	3	0	0	0	0	3	0	0	0	0	2	0
CO5	3	3	3	0	0	0	0	3	0	0	0	0	2	0
CO6	2	0	3	0	0	0	0	2	0	0	0	0	2	0

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
C01	PO1	3	Students will able to select the suitable clutch or brake for the requirement and can design it properly based on the engineering knowledge
	PO2	3	Students can properly identify the causes of failure of clutches and brakes in industry and can suggests the remedials measures based on engineering knowledge to rectify them
	PO8	2	Able to follows the ethical principles and engineering norms in designing clutch and brake
	PO9	2	Work effectively as a team member and communicate properly with others, so as to maintain the quality and requirement of product
CO2	PO1	3	Able to properly select the journal or rolling contact bearing need for a particular industrial application and can design them
	PO2	2	identify the causes of failure of bearing and suggest high capacity bearing to rectify the problem based on engineering knowledge
	PO3	3	Select and design suitable roller and Journal bearing considering public and safety issues (less noise generation, high speed, more rigid)
	PO8	1	Able to follow the norms in engineering for selection and design of bearing for industrial application
C03	PO1	3	Will decide the best suited gear type for attaining the industrial requirement
	PO2	3	Identify the causes of gear failure and suggest the methods to improve the beam and wear strength based on engineering knowledge
	PO3	3	Design spur or helical gears for power transmission meeting the safety requirements
	PO8	3	Able to follow ethical principles and norms of engineering practices while designing and selecting materials for gears
C04	PO1	3	Able to select and design bevel and worm gears meeting the requirements for industry.
	PO2	3	Identify the causes of gear failure and suggest the methods to improve the beam and wear strength based on engineering knowledge
	PO3	3	Design bevel and worm gear drives for particular application meeting the safety requirements
	PO8	3	Able to follow ethical principles and norms of engineering practices while designing and selecting materials for gears

C05	PO1	3	Select and design flexible drive suitable for particular operation and environment
	PO2	3	Identify easily the causes of failure in belt and chain drives and can suggest methods to improve transmission efficiency
	PO3	3	Design suitable flexible transmission system considering safety and environmental considerations
	PO8	3	Able to follow engineering norms in designing belts and chain drives
C06	PO1	2	Able to design pressure vessels meeting the particular requirements
	PO3	3	Able to design connecting rods and pressure vessels for industrial applications meeting safety considering
	P08	2	Design the pressure vessels and connecting rods based on strict engineering norms

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	2	Students will be able to design clutches and brakes suitable to meet the requirements of manufacturing industry
CO2	PSO1	2	By studying various types of loads and by studying various types of bearings, one can recommend suitable bearings to be used under a particular loading system
CO3	PSO1	2	Able to select the suitable gear type and design them to meet industrial requirements with proper beam and wear strength
CO4	PSO1	2	
CO5	PSO1	2	By studying the various types of belts and its design, student will be able to select suitable belt drives for transmission and design the belt according to the requirements.
CO6	PSO1	2	Students will be able to design connecting rods and pressure vessels in accordance with the industrial need

ME 404 INDUSTRIAL ENGINEERING

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Industrial Engineering**	Course code**: ME 404**
L-T-P**: 3-0-0**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction to Industrial Engineering - Evolution of modern Concepts in Industrial Engineering - Functions of Industrial Engineering - Field of application of Industrial Engineering Product Development and research- Design function - Objectives of design, - Manufacturing vs purchase- Economic aspects- C-V-P analysis – simple problems-Development of designs- prototype, production and testing - Human factors in design- Value Engineering.	7	15
II	Plant layout and Material handling- principles of material handling, Types of material handling equipments, Selection and application. Preventive and break- down maintenance - Replacement policy--Methods of replacement analysis-Method of providing for depreciation- Determination of economic life - Simple problems.	7	15
III	Methods engineering: Analysis of work methods using different types of process chart and flow diagrams-Critical examination- Micro motion study and therbligs-Principles of motion economy – Work measurement-Performance rating.-Determination of allowances and standard time. - Job evaluation and merit rating - Objectives and principles of job evaluation--Wages and Incentives- Primary wage systems- Wage incentive plans.	7	15
IV	Industrial relations- Psychological attitudes to work and working conditions - fatigue- Methods of eliminating fatigue- Effect of Communication in Industry-Industrial safety-personal protective devices-, causes and effects of industrial disputes- Collective bargaining- Trade union - Workers participation in management.	7	15
V	Production planning and control- Importance of planning - job, batch and mass production-Introduction and need for a new product-product life cycle. - Functions of production control - Routing , Scheduling, dispatching and follow up- Gantt charts. Inventory Control, Inventory	7	20

	models -Determination of EOQ and reorder level-simple problems- Selective inventory control techniques.		
VI	Quality control and Inspection- Destructive and non-destructive testing methods- process capability- Statistical quality control –causes of variation in quality-control charts for X and R. Reliability-causes of failures-Bath tub curve.-System reliability- life testing-Introduction to concepts of, TQM, ISO, Six Sigma and Quality circles (Brief description only).	7	20

TEXT BOOKS:

1	B. Kumar, Industrial Engineering Khanna Publishers,2013
2	M Mahajan, Industrial Engineering & Production Management, Dhanpat Rai, 2005
3	Martand Telsang, Industrial Engineering & Production Management, S. Chand, 2006
4	O. P. Khanna, Industrial Engineering and Management, Dhanpat Rai, 2010

REFERENCES:

1	E. S. Buffa, Modern Production management, John Wiley, 1983
2	Grant and Ieven Worth, Statistical Quality Control, McGraw Hill, 2000
3	Introduction to work study – ILO, Oxford And IBH Publishing,2008
4	Ralph M Barnes, Motion and Time Study, Wiley, 1980

PREREQUISITE: Nil

COURSE OBJECTIVES:

1	To impart theoretical knowledge about various tools and techniques of Industrial Engineering.
2	To create awareness about various safety procedures to be followed in carrying out different types of projects.
3	To get acquainted with the Inventory management Principles and Techniques.
4	To equip with the theoretical knowledge on Quality control practices and testing methods.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Understand the various concepts and applications of industrial engineering.
2	Understand the Facility Planning, Material Handling methods and maintenance planning.
3	Relate and Summarize method study and work measurement using different techniques.
4	Explain psychological attitudes, effect of communication, safety in industry and effects of industrial disputes.
5	Relate production planning and production control and apply inventory control techniques in materials management.
6	Understand different quality control and inspection methods used in industry.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	1	1	1	0	0	0	1	2	0	0	0	0		2	0
CO2	2	2	2	0	0	0	2	2	0	0	0	0		2	0
CO3	2	2	2	1	0	0	1	0	0	0	0	0		1	0
CO4	0	0	0	0	0	3	2	2	0	1	0	0		0	0
CO5	2	1	1	0	1	0	2	0	0	0	0	0		2	0
CO6	1	0	1	0	0	0	1	0	0	0	0	2		0	1

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	1	May be used to solve engineering problems since it deals with fundamentals of industrial engineering.
	PO2	1	Students may able to analyze the break-even quantity from the fundamentals of industrial engineering.
	PO3	1	With the knowledge of fundamentals of Industrial engineering students will be able to provide solutions to specific problem regarding product design and development and can design a system/component based on need.
	PO7	1	With this fundamental's students will able to understand the impact of the professional engineering solutions in societal and environmental contexts.
	PO8	2	These fundamentals help the students to take responsibilities and decisions with professional ethics.
CO2	PO1	2	Students will able to provide solutions to the problem regarding facility planning, material handling and maintenance.
	PO2	2	Students will be able to identify problems in plant layout, material handling and maintenance in an industry by understanding the fundamentals of industrial engineering.
	PO3	2	Helps to design layouts and material handling systems that meet the specified needs with appropriate consideration for the public health and safety, and environmental considerations.
	PO7	2	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge for sustainable development.
	PO8	2	Helps the students to take decisions with professional ethics.
CO3	PO1	2	Students will be able to apply engineering fundamentals to solve complex engineering problems.
	PO2	2	Helps to indentify and analyse complex problems leading to a substatiated solutions
	PO3	2	Helps the students to design system components or processes that satisfy specific needs without compromising on health, safety and environment.

	PO4	1	Will be able to indentify problems by analysing data and design to provide a valid conclusions.
	PO7	1	Understand the impact of the professional engineering solutions in societal and environmental contexts
CO4	PO6	3	Will able to assess societal, health, safety, legal and cultural issues.
	PO7	2	Understand the impact of the professional engineering solutions in societal and environmental contexts.
	PO8	2	Helps the students to take decisions with professional ethics
	PO10	1	Helps the students to understand the importance of effective communication in an industry.
CO5	PO1	2	Students will able to find solutions for engineering problems.
	PO2	1	Will able to analyze complex engineering problems related to invente management reaching substantiated conclusions
	PO3	1	Helps the students to find solutions with specific needs.
	PO5	1	can apply appropriate techniques to engineering activities with an understanding of the limitations.
	PO7	2	knowledge in inventory control technique helps in environmental context and for sustainable development.
CO6	PO1	1	May be able to find solutions to quality related problems in industry
	PO3	1	May be able to design system components by considering public health, safety and environment.
	PO7	1	Understand the impact of the professional engineering solutions in societal and environmental contexts
	PO12	2	Recognize the need for life-long learning in the broadest context of technological change.

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	2	Students will be able to solve real-time problems in manufacturing sectors/industries.
CO2	PSO1	2	Students will be able to solve real-time problems in plant layouts and material handling.
CO3	PSO1	1	May be able to solve problems related to methods and time management in in an industry.
CO5	PSO1	2	Knowledge in inventory control and EOQ helps the students to solve problems in an industry
CO6	PSO3	1	Understand the importance of self-learning about the current technologies and trends in quality measures used in industries.

ME 474 MICRO AND NANO MANUFACTURING

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**: Micro and Nano Manufacturing**	Course code**: ME 474**
L-T-P**: 3-0-0**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Introduction to Precision engineering, macro milling a micro drilling, Micro-electromechanical systems – merits a applications, Micro phenomenon in Electro-photography applications	1	15
	Introduction to Bulk micromachining, Surface micromachining- steps, Micro instrumentation – applications, Micro Mechatronics, Nano finishing – finishing operations.	1	
	Laser technology in micro manufacturing- Practical Lasers, application of technology fundamentals	1	
	Introduction to Micro-energy and chemical system (MECS), Space Micro-propulsion, e-Beam Nanolithography – important techniques, Introduction to Nanotechnology	1	
	Carbon Nano-tubes – properties and structures, Molecular Logic Gates and Nano level Biosensors - applications	1	
II	Introduction to mechanical micromachining, Micro drilling – process, tools and applications	1	15
	Micro turning- process, tools and applications, Diamond Micro turning – process, tools and applications	1	
	Micro milling and Micro grinding – process, tools and applications.	1	
	Micro extrusion- process and applications	1	
	micro bending with Laser	1	
	Nano- Plastic forming and Roller Imprinting	1	
III	Introduction to Non - conventional micro - nano manufacturing	1	15
	Process, principle and applications – Abrasive Jet Micro Machining, WAJMM	1	
	Micro EDM, Micro WEDM, Micro EBM – Process principle, description and applications.	1	
	Micro ECM, Micro LBM - Process principle, description and applications.	1	
	Focused ion beams - Principle and applications	1	
IV	Introduction to Micro and Nano Finishing Processes	1	15
	Magnetorheological Finishing (MRF) processes, Magnetorheological abrasive flow finishing processes	1	

	(MRAFF) – process principle and applications		
	Force analysis of MRAFF process,	1	
	Magnetorheological Jet finishing processes	1	
	Working principle and polishing performance of MR Jet Machine	1	
	Elastic Emission Machining (EEM) – machine description, applications	1	
	Ion Beam Machining (IBM) – principle, mechanism of material removal, applications	1	
	Chemical Mechanical Polishing (CMP) – Schematic diagram, principle and applications	1	
V	Introduction to Micro Fabrication: basics, flowchart, basic chip making processes	1	20
	Introduction to Nanofabrication, Nanofabrication using soft lithography – principle, applications – Examples (Field Effect Transistor, Elastic Stamp)	1	
	Manipulative techniques – process principle, applications	1	
	Introduction to Carbon nano materials – CN Tubes	1	
	CN Tubes – properties and applications	1	
	CN Tube Transistors – Description only	1	
	Diamond - Properties and applications	1	
	CVD Diamond Technology	1	
	LIGA Process	1	
VI	Laser Micro welding – description and applications, Defects	1	20
	Electron Beam Micro-welding – description and applications	1	
	Introduction to micro and nano measurement, defining the scale, uncertainty	1	
	Scanning Electron Microscopy – description, principle	1	
	Scanning White-light Interferometry – Principle and application	1	
	Optical Microscopy – description, application	1	
	Scanning Probe Microscopy, scanning tunneling microscopy- description, application	1	
	Confocal Microscopy - description, application	1	
	Introduction to On-Machine Metrology	1	

REFERENCES:

1	Mark. J. Jackson, Micro and Nano-manufacturing, Springer, 2006.
2	Mark. J. Jackson, Micro-fabrication and Nano-manufacturing - Pulsed water drop micromachining CRC Press 2006.
3	Nitaigour Premchand Mahalik, Micro-manufacturing and Nanotechnology, 2006.
4	V.K.Jain, Micro-manufacturing Processes, CRC Press, 2012.

PREREQUISITE: Nil

COURSE OBJECTIVES:

1	To give awareness of different techniques used in micro and nano manufacturing
2	To give in-depth idea of the conventional techniques used in micro manufacturing
3	To introduce Non-conventional micro-nano manufacturing and finishing approaches
4	To introduce Micro and Nanofabrication Techniques and other processing routes in Micro and nano manufacturing
5	To know different techniques used in Micro Joining and the metrology tools in micro and nano manufacturing.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Get an awareness of different techniques used in micro and nano manufacturing
2	Get in depth idea of the conventional techniques used in micro manufacturing
3	Become aware about non-conventional micro nano manufacturing and finishing approaches
4	Get an awareness on micro and nano finishing process
5	Understand micro and nanofabrication techniques and other processing routes in micro and nano manufacturing.
6	Know about different techniques used in micro joining and the metrology tools in micro and nano manufacturing.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	**2**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**	**0**	**0**		**3**	**2**
CO2	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		**3**	**0**
CO3	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		**2**	**3**
CO4	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		**3**	**0**
CO5	**3**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**		**3**	**0**
CO6	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		**2**	**2**

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	2	Some mathematical relations are used to study the different machining process.
	PO5	2	Need some research level observation, for understand the subject.
	PO10	2	It will find many solutions for recent problems

CO2	PO1	2	Knowledge on the mathematical relations will help the students
CO3	PO1	3	Some mathematical relations are used to study the different machining process.
CO4	PO1	3	Knowledge on the mathematical relations will help the students
	PO2	3	It will improve the research level view of students
CO5	PO1	3	Knowledge on the mathematical relations will help the students, to ensure the differences between different operations.
	PO2	2	It will change the view from macro level to micro level
	PO12	3	It will help to predict the future trend of our society
CO6	PO1	2	Some mathematical relations are used to study the different machining process.
	PO2	2	It will improve the research level view of students

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	3	Students can apply their knowledge in manufacturing technology for practical mechanical design engineering problems.
	PSO2	2	Design knowledge in machining process, will help to solve the selection process
CO2	PSO1	3	Students can apply their knowledge in manufacturing technology for practical mechanical design engineering problems.
CO3	PSO1	2	Students can apply their knowledge in manufacturing technology for practical mechanical design engineering problems.
	PS02	3	Design knowledge in machining process, will help to solve the selection process
CO4	PSO1	3	Students can apply their knowledge in manufacturing technology for practical mechanical design engineering problems.
CO5	PSO1	3	Students can apply their knowledge in manufacturing technology for practical mechanical design engineering problems.
CO6	PSO1	2	Students can apply their knowledge in manufacturing technology for practical mechanical design engineering problems.
	PSO2	2	Design knowledge in machining process, will help to solve the selection process

ME 476 MATERIAL HANDLING & FACILITIES PLANNING

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree : **B-Tech**
Course**:** Material Handling & Facilities Planning	Course code**: ME 276**
L-T-P**: 3-0-0**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	Design of layout of factories, Office, Storage area etc. on consideration of facilities of working people, Storage facilities and general equipment for amenities of working people – Product, Process and combination layout – Systematic layout planning, Design of Assembly lines, Line balancing methods.	8	15
II	Computer applications in layout designs, Environmental aspects like lighting, Ventilation, dust control, humidity. Different type of Plant services like steam compressed air etc.	6	15
III	Plant safety, Elements off Industrial safety- Causes and prevention of accidents – Pollution and environmental consideration.	6	15
IV	Introduction, Material Handling systems, Material Handling principles, Classification of Material Handling Equipment, Relationship of material handling to plant layout.	8	15
V	Basic Material Handling systems: Selection, Material Handling method- path, Equipment, function-oriented systems.	7	20
VI	Methods to minimize cost of material handling- Maintenance of Material Handling Equipments, Safety in handling, Ergonomics of Material Handling equipment. Design, Miscellaneous equipment	7	20

TEXT BOOKS:

1	A W Peymberton, Plant layout and Material Handling, John Wiley
2	P B Mahapatra, Operations Management, PHI, 2010

REFERENCES:

1	James A Apple, Plant layout and Material Handlin, Krieger Pub Co,1998
2	John A Sehbin, Plant layout and Material Handling
3	K C Arora & Shinde, Aspects of Material handling, Lakshmi Publications.

PREREQUISITE: Nil

COURSE OBJECTIVES:

1	To understand the overall facilities planning process
2	To educate product, process and schedule design and their effects on the facility layout
3	To introduce concepts of material handling and safety in industries.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Identify the value of facility planning on the strategy of a firm
2	Develop a systematic plant layout
3	Analyze the safety and environmental aspects in facilities planning
4	Describe various material handling systems and classification of material handling equipment
5	Design the common material handling systems

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	1	1	0	0	0	2	2	2	2	0	2	0		2	1
CO2	0	0	2	0	0	0	2	0	0	0	0	0		2	1
CO3	0	0	0	0	0	2	2	0	0	0	0	0		2	1
CO4	1	2	0	0	0	0	0	0	0	0	2	0		2	1
CO5	2	2	3	2	3	0	0	0	0	2	2	0		2	1

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	1	Uses basic knowledge in mechanical engineering to identify the line balancing methods
	PO2	1	Identify the different layout types reach sustained conclusion on planning facility layout
	PO6	2	Considering the amenities and facilities of workers can apply to the reasoning capability in assessing the societal health and safety
	PO7	2	Assessing the value of facility planning on the strategy of a firm develop the need of sustainable developments
	PO8	2	Getting an insight on systematic layout planning on consideration of facilities of working people apply ethical principles to commit professional ethics
	PO9	2	Facilitating the general amenities for co-workers through plant layout make the individual as a good team player.

	PO11	2	Understanding the value of facility planning strategy of a firm leads to apply in one's own work to manage projects in multi-disciplinary environment
CO2	PO3	2	Computer applications in layout design leads to complex engineering layout solutions.
	PO7	2	Applying environmental aspects in layout design understand the impact of professional engineering solutions in societal and environmental context.
CO3	PO6	2	Pollution and environmental consideration make the engineer to analyse commitment of engineer to society.
	PO7	2	Safety and environmental aspects understand the need of sustainable developments in new and existing designs of layout facility.
CO4	PO1	1	Knowledge on various material handling systems guides to make better layout.
	PO2	2	Relationship of material handling knowledge make the student to solve real time problems in the system.
	PO11	2	Knowledge and understanding on Material handling principles can demonstrate engineering and management capability to work with multidisciplinary environment.
CO5	PO1	2	Students will be able to use their knowledge in the maintenance of common material handling equipments in finding technical solutions in the many industrial problems.
	PO2	2	Students will be able to identify and rectify problems in material handling technologies.
	PO3	3	Knowledge in the designing of common material handling equipments can be applied in many situations during their industrial exploration.
	PO4	2	Path function and equipment could be used to conduct complex investigations pertain to material handling systems
	PO5	3	Students will be able to alter or create new facilities in the existing material handling methods.
	PO10	2	Students can present strong recommendations and suggestions to the problems associated with material handling.
	PO11	2	Methods to minimise material handling cost can make one to work as a member as well as project lead in terms of management and finance

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	2	Applying the design principles in layout of factories students will identify the facility planning strategies of a firm.
	PSO2	1	Students can enhance their self-learning capability and will be able to expertise themselves in the respective topics.
CO2	PSO1	2	The computer applications in layout design leads to development of plant layout ensuring the best manufacturing practices.
	PSO2	1	Students can enhance their self-learning capability and will be able to expertise themselves in the respective topics.
CO3	PSO1	2	Analysing the safety and environmental aspects of facilities planning helps to successfully design a layout ensuring plant safety

	PSO2	1	Students can enhance their self-learning capability and will be able to expertise themselves in the respective topics.
CO4	PSO1	2	Classifying the material handling system and relationship between material handling and plant layout leads to asses facility in order to design or redesign an existing facility
	PSO2	1	Students can enhance their self-learning capability and will be able to expertise themselves in the respective topics.
CO5	PSO2	2	Right selection of material handling system design and Maintenance with safety and ergonomics aspects helps to make mechanical systems work and processes better
	PSO2	1	Students can enhance their self-learning capability and will be able to expertise themselves in the respective topics.

BT 362 SUSTAINABLE ENERGY PROCESSES

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Sustainable Energy Processes**	Course code**: BT 362**
L-T-P**: 3-0-0**	Credit**: 3**

SYLLABUS:

MODULE	CONTENT	HOURS	UNIVERSITY % MARKS
I	**General classification of energy**. Conventional and non-conventional. Renewable and non-renewable. Global and Indian energy sources. Global and Indian energy consumption. Problems of fossil fuels. Environmental aspects of energy utilization. Energy and sustainable development. Energy planning. Renewable energy sources, potentials, achievements and applications.	7	15
II	**Solar energy**. Solar radiation. Solar thermal systems. Flat plate and concentrating collectors. Solar desalination. Solar pond. Solar cookers. Solar dryers. Solar thermal electric power plant. Solar photovoltaic conversion. Semiconductor and thin film technology. Solar cells. Solar photovoltaic power generation. Hybrid systems. Merits and limitations of solar energy.	7	15
III	**Wind energy**. Availability of wind energy, Site characteristics, Wind turbine types-horizontal axis and vertical axis-design principles of wind turbine. Wind power plants, Wind energy storage. Safety and environmental aspects. Merits and limitations of wind energy.	7	15
IV	**Biomass energy**. Biomass resources, Biomass conversion technologies-direct combustion, pyrolysis, biomass gasification. Biogas production. Bio-methanation as an aid to environment improvement. Bioethanol, biodiesel and biobutanol production. Hydrogen as fuel. Biohydrogen	7	15

	production. Storage of hydrogen.		
V	**Energy from the oceans**. Ocean thermal electric conversion. Tidal energy conversion. Geothermal energy conversion. Hydro power-global and Indian scenario. Positive and negative attributes of hydropower. Electricity from hydropower. Small hydropower.	7	20
VI	**Fuel cells.** Alkaline fuel cells. Phosphoric acid fuel cell. Molten carbonate fuel cell. Solid oxide fuel cell, Solid polymer electrolyte fuel cell. Magneto-hydrodynamic systems. Electric vehicles. Energy storage routes like thermal, chemical, mechanical, electrical storage. Batteries.	7	20

REFERENCE BOOKS:

1	Bansal N K, Kleemann M, Michael Meliss, *Renewable Energy Sources & Conversion Technology*, Tata McGraw Hill publishing Company, New Delhi, 1990.
2	Boyle, Godfrey, *Renewable Energy*, 3/e, Oxford University Press, 2012.
3	S P Sukhatme, *Solar Energy - Principles of Thermal Collection and Storage*, 2/e, Tata McGraw-Hill Publishing company, New Delhi,1996.
4	Pramod Jain, *Wind Energy Engineering*, McGraw Hill, 2011.
5	Donald L Klass, *Biomass for Renewable Energy, Fuels and Chemicals*, Academic Press, 1998.

PREREQUISITE: Nil

COURSE OBJECTIVES:

1	To introduce the current and potential future energy systems, covering resources, extraction, conversion, and applications, with emphasis on meeting regional and global energy needs in a sustainable manner.

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Identify global and Indian energy sources
2	Understand the impacts of energy conversion and importance of sustainable energy
3	Understand the concepts of renewable energy sources.
4	Explain capture, conversion and application of solar and wind energy
5	Explain conversion of biomass to energy
6	Explain capture of energy from oceans
7	Explain fuel cells and energy storage routes

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	1	0	0	0	0	2	3	0	0	0	0	0		0	0

CO2	1	0	2	0	0	2	3	0	0	0	0	0	0	0
CO3	1	0	1	0	0	2	3	0	0	0	0	0	0	0
CO4	3	1	3	0	0	2	3	0	0	0	0	1	1	0
CO5	3	1	3	0	0	2	3	0	0	0	0	1	1	0
CO6	3	1	3	0	0	2	3	0	0	0	0	1	0	0
CO7	3	1	3	0	0	2	3	0	0	0	0	1	1	0

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO1	1	Identification of various energy resources and their potentials needs basic knowledge in engineering & mathematics.
	PO6	2	Comparison of energy sources involves assessing social, health, safety issues related to power generation
	PO7	3	The environmental impact and sustainability attributes are taken in to consideration while developing each energy conversion techniques.
CO2	PO1	1	To understand the impact of energy conversion, basic engineering knowledge is needed
	PO3	2	Public health, safety and environmental factors are taken in to consideration for developing solutions on sustainable energy
	PO6	2	Understanding the impacts of energy conversion and sustainability attributes involves assessing social, health, safety issues related to power generation
	PO7	3	The environmental impact and sustainability attributes are taken in to consideration while developing each energy conversion techniques.
CO3	PO1	3	Understanding the new concepts of renewable energy sources and their potentials needs basic knowledge in engineering & mathematics.
	PO3	1	Public health, safety and environmental factors are taken in to consideration for developing the concepts of renewable energy
	PO6	1	Renewable energy conversion technologies and sustainability attributes involves assessing social, health, safety issues related to power generation
	PO7	2	The environmental impact and sustainability attributes are taken in to consideration while developing each energy conversion techniques.
CO4	PO1	3	To explain the capture and conversion of solar and wind energy, application of engineering fundamentals is required.
	PO2	1	Designing of solar and wind conversion systems involves problem analysis using principles of mathematics and engineering sciences.
	PO3	3	Public health, safety and environmental factors are taken in to consideration for developing solutions on solar and wind energy conversion systems.

	PO6	2	Solar & wind energy conversion technologies and their sustainability attributes involves assessing social, health, safety issues related to power generation
	PO7	3	The environmental impact and sustainability attributes are taken in to consideration during conversion and application of solar and wind energy.
	PO12	1	Sustainable energy conversion technologies require lifelong learning in the broadest context of technological change
CO5	PO1	3	To explain the capture and conversion of biomass energy, application of engineering fundamentals is required.
	PO2	1	Designing of biomass conversion systems involves problem analysis using principles of mathematics and engineering sciences.
	PO3	3	Public health, safety and environmental factors are taken in to consideration for developing solutions on biomass energy conversion systems.
	PO6	2	Biomass energy conversion technologies and their sustainability attributes involves assessing social, health, safety issues related to power generation
	PO7	3	The environmental impact and sustainability attributes are taken in to consideration during conversion and application of biomass energy.
	PO12	1	Sustainable energy conversion technologies require lifelong learning in the broadest context of technological change
CO6	PO1	3	To explain the capture and conversion of energy from oceans, application of engineering fundamentals is required.
	PO2	1	Designing of ocean energy conversion systems involves problem analysis using principles of mathematics and engineering sciences.
	PO3	3	Specified needs with appropriate safety and environmental factors are taken in to consideration for developing solutions on ocean energy conversion systems.
	PO6	2	Ocean energy conversion technologies and their sustainability attributes involves assessing social, health, safety issues related to power generation
	PO7	3	The environmental impact and sustainability attributes are taken in to consideration while developing each energy conversion techniques.
	PO12	1	Sustainable energy conversion technologies require lifelong learning in the broadest context of technological change
CO7	PO1	3	To explain the fuel cells and energy storage routes, application of engineering fundamentals is required.
	PO2	1	Designing of fuel cells and energy storage systems involves problem analysis using principles of mathematics and engineering sciences.
	PO3	3	Specified needs with appropriate safety and environmental factors are taken in to consideration for developing solutions on fuel cell conversion systems.
	PO6	2	Fuel cell technologies and energy storage systems involves assessing social, health, safety issues related to power generation
	PO7	3	The environmental impact and sustainability attributes are taken in to consideration while developing each energy conversion techniques.
	PO12	1	Sustainable energy conversion technologies require lifelong learning in the broadest context of technological change

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO4	PSO1	1	Graduates will gain knowledge helpful in designing and developing solar and wind energy conversion systems.
CO5	PSO1	1	Graduates will gain knowledge helpful in designing and developing biomass energy conversion systems.
CO7	PSO1	1	Knowledge gained in Energy storage routes will help to solve complex engineering problems related to energy storage routes.

ME 492: PROJECT

COURSE INFORMATION SHEET:

Program: **Mechanical Engineering**	Degree: **B-Tech**
Course**: Project**	Course code**: ME 492**
L-T-P**:**	Credit**: 6**

COURSE PLAN
In depth study of the topic assigned in the light of the preliminary report prepared in the seventh semester Review and finalization of the approach to the problem relating to the assigned topic Preparing a detailed action plan for conducting the investigation, including team work Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed Final development of product/process, testing, results, conclusions and future directions Preparing a paper for Conference presentation/Publication in Journals, if possible Preparing a report in the standard format for being evaluated by the dept. assessment board Final project presentation and viva voce by the assessment board including external expert

PREREQUISITE: Nil

COURSE OBJECTIVES:

1	To develop skills in doing literature survey, technical presentation and report preparation.
2	To apply engineering knowledge in practical problem solving
3	To develop creative thinking in finding viable solutions to engineering problems
4	To foster innovation in design of products, processes or systems

COURSE OUTCOMES:

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

CO's	DESCRIPTION
1	Identify, define and formulate engineering problems through detailed literature survey
2	Communicate effectively with written, oral, and visual methods
3	Explore the recent technological advancements for the identified engineering problems
4	Develop professional ethics for project report making

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	0	3	3	3	2	2	2	0	0	0	0	0		3	0
CO2	0	0	0	0	2	0	0	3	3	3	1	0		0	3
CO3	3	0	0	0	3	0	0	0	0	2	0	0		1	2
CO4	0	0	0	0	0	0	0	3	3	3	2	0		3	3

CO-PO MAPPING JUSTIFICATION:

CO's	PO's	LEVEL	JUSTIFICATION
CO1	PO2	3	Literature survey helps in Identifying and formulating engineering problems
	PO3	3	Literature survey enhance the students to improve the existing design
	PO4	3	Data interpretation and analysis is possible by studying previous publications
	PO5	2	Modern tool usage can be adapted by having knowledge of tools used
	PO6	2	Address safety and health issues by identifying real engineering problems
	PO7	2	Sustainable design can be adopted by referring literature studies
CO2	PO5	2	Modern tools can be used for effective communication and presentation
	PO8	3	Professional ethics is applied in report writing and communication
	PO9	3	Coordination among team members is developed during presentation
	PO10	3	Able to comprehend and write supporting documents for project
	PO11	1	Able to manage project through proper communication among team members
CO3	PO1	3	Knowledge of technological improvement helps in proper project management
	PO5	3	Adopting new technology helps in better prediction and analysis
	PO10	2	Developing new technologies will enhance effective communication
CO4	PO8	3	Knowledge of professional ethics helps in following proper engineering norms
	PO9	3	Understanding Engineering ethics enhance team work among members
	PO10	3	Engineering norms study helps in following professional communication
	PO11	2	Ethical practices awareness supports better project management

CO-PSO MAPPING JUSTIFICATION:

CO's	PSO's	LEVEL	JUSTIFICATION
CO1	PSO1	3	Literature survey study helps in finding solution for real engineering problems
CO2	PSO2	3	Developing communication skills recognize the importance of self-learning
CO3	PSO1	1	Adapting new technological advancements helps in solving complex engineering problems
	PSO2	2	Knowledge of latest technologies enhance self-learning skills
CO4	PSO1	3	Ethics study helps in adapting sustainable solutions to engineering problems
	PSO2	3	Knowledge of professional ethics develop independent learning