DETAILED SYLLABI

FOR

B. TECH DEGREE PROGRAMME
IN
MECHANICAL ENGINEERING

(SEMESTERS III & IV)

2023 SCHEME

(AUTONOMOUS)

MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY
(Approved by AICTE, Autonomous Institution Affiliated to APJ Abdul Kalam Technological University)
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S3 SYLLABUS

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23MAL20A	PARTIAL DIFFERENTIAL EQUATIONS AND COMPLEX ANALYSIS	BSC	3	1	0	0	4	2023

i) COURSE OVERVIEW

This course introduces basic ideas of partial differential equations which are widely used in the modelling and analysis of a wide range of physical phenomena and has got application across all branches of engineering. The basic theory of functions of a complex variable, residue integration and conformal transformation are discussed.

ii) COURSE OUTCOMES

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

CO1	Solve partial differential equations.	Apply
CO2	Use appropriate methods to solve one dimensional wave equation and heat equation.	Apply
CO3	Solve problems using analyticity of complex functions	Apply
CO4	Find the image of regions under conformal mapping	Apply
CO5	Find complex integrals using Cauchy's formulas to compute several kinds	Apply

iii) SYLLABUS

Partial differential equations: Formation of partial differential equations, Solutions of a partial differential equations, Linear equations of the first order, Method of separation of variables.

One dimensional wave equation-derivation and solution -One dimensional heat equation, derivation and solution

Complex Differentiation: Analytic functions, Cauchy-Riemann equations, harmonic functions, Conformal mappings- standard mappings, Linear fractional transformation.

Complex integration: Line integrals in the complex plane, Contour integrals, Cauchy integral theorem, Cauchy Integral formula

Taylor's series and Laurent's series, zeros of analytic functions, singularities, Residues, Cauchy Residue theorem, Evaluation of definite integral using residue theorem

iv) a) TEXTBOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons,2016

b) REFERENCES

1. J. Stewart, Essential Calculus, Cengage, 2nd Edition, 2017
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
3. Peter V. O'Neil, Advanced Engineering Mathematics, Cengage, 7th Edition 2012

v) COURSE PLAN

Module	Contents	No. of hours
I	Partial differential equations, Formation of partial differential equations –elimination of arbitrary constants-elimination of arbitrary functions, Solutions of a partial differential equations, Equations solvable by direct integration, Linear equations of the first order- Lagrange's linear equation, Non-linear equations of the first order - Charpit's method Boundary value problems, Method of separation of variables.	12
II	One dimensional wave equation- vibrations of a stretched string, Derivation. Solution of wave equation using method of separation of variables, Fourier series solution of boundary value problems involving wave equation, D'Alembert's solution of the wave equation One dimensional heat equation, derivation. Solution of the heat equation using method of separation of variables, Fourier series solutions of boundary value problems involving heat equation- Laplace's equations - Derivation and solution by method of separation of variables.	13
III	Complex function, limit, continuity, derivative, analytic functions, Cauchy-Riemann equations-harmonic functions, finding harmonic conjugate-Conformal mappings- mappings of w=z^2, w=e^z,w=1/z , $w = sinz$	12
IV	Complex integration, Line integrals in the complex plane, Basic properties, first evaluation method, second evaluation method, use of representation of a path-Contour integrals, Cauchy integral theorem (without proof) on simply connected domain, on multiply connected domain (without proof). Cauchy Integral formula (without proof), Cauchy Integral formula for derivatives of an analytic function Taylor's series and Maclaurin series.	11
V	Laurent's series (without proof)-zeros of analytic functions, singularities, poles, removable-singularities, essential singularities, Residues,Cauchy Residue theorem (without proof), Evaluation of definite integral using residue theorem-Residue integration of real integrals –integrals of rational functions of $cos\theta$ and $sin\theta$, integrals of improper integrals of the form ∫_(-∞)^∞▒f(x)dx with no poles on the real axis. (∫_A^B▒f(x)dx whose integrand become infinite at a point in the interval of integration is excluded from the syllabus)	12
	Total	**60**

vi) ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii) CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii) END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23MEL20A	MECHANICS OF SOLIDS	PCC	3	1	0	0	4	2023

i) COURSE OVERVIEW:

The aim of the course is to convey the concept of stresses and strains developed in deformable bodies under various loading conditions. The course also covers deflection in beams due to bending, torsion in circular section, strain energy and different theories of failure.

ii) COURSE OUTCOMES

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

CO 1	Apply the fundamental principles to estimate the deformation and stress of linear elastic solids under axial loading.	Apply
CO 2	Solve for principal stresses and identify principal planes	Apply
CO 3	Construct shear force and bending moment diagrams.	Apply
CO 4	Solve for slope, deflection in beams and stresses developed in beams/shafts.	Apply
CO5	Solve for strength of thin cylinder, thick cylinder and column.	Apply
CO6	Apply failure theories in engineering design.	Apply

iii) SYLLABUS

Simple stress and strain- Stress, Strain, Hook's Law, Poisson's ratio, Stress - Strain Diagram for structural steel, Principles of superposition, Composite sections, Volumetric strain, Elastic constants, Relationship among elastic constants, Thermal stresses in compound bars. Strain Energy & Impact loading.

Compound stresses- Stress components on inclined planes, Principal planes and stresses and Mohr's circle of stresses

Bending moment of beams and Torsional deformation of circular shafts- Shear force and bending moment Diagrams Differential equations between load, shear force and bending moment. Flexural formula. Shear stress formula for beams.

Deflection of beams- using Macaulay's method and Moment Area method

Fundamentals of bucking and stability- critical load, equilibrium diagram for buckling of an idealized structure.

Thin and thick cylinder- Short and long columns, Buckling load, Euler's theory on columns, Effective length, Slenderness ratio, Limitations of Euler's theory, Rankine's formula

Theories of Failure- Rankine's theory for maximum normal stress, Guest's theory for maximum shear stress, Saint-Venant's theory for maximum normal strain, Hencky-von Mises theory for maximum distortion energy, Haigh's theory for maximum strain energy.

iv) (a) TEXT BOOKS

1. R. C. Hibbeler, Mechanics of Materials,PearsonEducation,2008.
2. L. S. Srinath, Advanced Mechanics of Solids, McGraw HillEducation,2017.
3. V. B Bhandari, Design of Machine Elements, McGraw HillIndia,2016.
4. Rattan, Strength of Materials, McGraw Hill EducationIndia,2011.

(b) REFERENCES

1. S. H. Crandal, N. C. Dhal, T. J. Lardner, An introduction to the Mechanics of Solids, McGrawHill,1999.
2. I.H. Shames, J. H. Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India,2006.
3. James M.Gere, Stephen Timoshenko, Mechanics of Materials, CBS Publishers & Distributors, NewDelhi,2012.
4. E. P. Popov, T. A. Balan, Engineering Mechanics of Solids, PearsonEducation,2012.

v) COURSE PLAN

Module	Contents	No. of Hours
I	Simple Stress and Strain: Introduction, Properties of materials, Stress, Strain, Hook's Law, Poisson's ratio, Stress - Strain Diagram for structural steel, S-N curve, stress concentration. Principles of superposition, Total elongation of tapering bars of circular and rectangular cross sections. Elongation due to self weight, Composite sections, Volumetric strain, Elastic constants, Relationship among elastic constants, Thermal stresses in compound bars. Strain Energy & Impact loading.	**12**
II	Compound Stresses: Introduction, Stress components on inclined planes, General two-dimensional stress system, Principal planes and stresses and Mohr's circle of stresses. Bending Moment and Shear Force in Beams: Introduction, Types of beams, loadings and supports, Shear force in beam, Bending moment in beam, Sign convention, Relationship between loading, shear force and bending moment, Shear force and bending moment equations, SFD and BMD with salient values for Cantilever beams, Simply supported beams and Overhanging beams considering Point loads, UDL, UVL and Couple.	**12**
III	Bending and shear stresses in beams. Deflection of beams: Intoduction, Definition of Slope, Deflection, Elastic curve, Deflection using Macaulay's method, Moment Area methos for prismatic beams subjected to transverse point loads, UDL and Couple.	**12**

IV	Torsion of Circular Shafts: Introduction pure torsion, Torsion equation of circular shafts, Torsional rigidity and polar modulus, Power transmitted by shaft of solid and hollow circular sections. Elastic Stability of Columns: Introduction, Short and long columns, Buckling load, Euler's theory on columns, Derivation, Effective length, Slenderness ratio, Radius of gyration, Limitations of Euler's theory, Rankine's formula, Problems	**12**
V	Thick and Thin Cylinders: Analysis of thin cylindrical shells, Analysis of Thick cylindrical shells using Lame's equation. Theories of Failure: Rankine's theory for maximum normal stress, Guest's theory for maximum shear stress, Saint-Venant's theory for maximum normal strain, Henky-von Mises theory for maximum distortion energy, Haigh's theory for maximum strain energy.	**12**
		Total Hours: 60

vi) ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vi) CONTINUOUS ASSESSMENT TEST

- No.of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

vii) END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23MEL20B	Engineering Thermodynamics	PCC	2	1	0	0	3	2023

i) COURSE OVERVIEW

The course deals with the science of energy transfer, mainly in the format of heat and work. It deals with the concepts of entropy, available energy etc. associated with energy transfer and mixing of gas mixtures. The subject focuses on phase transformation process of pure substances as well. After this course, students will be able to recognize similar problems in real-world situations and respond accordingly.

ii) COURSE OUTCOMES

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

CO 1	Explain the thermodynamic concepts applied to different systems.	Understand
CO 2	Apply the energy conservation principles in open and closed systems.	Apply
CO 3	Apply the principles of entropy, reversibility and irreversibility in various processes.	Apply
CO 4	Solve practical problems by applying the knowledge of pure substances and their behaviour.	Apply
CO5	Make use of thermodynamic relations to identify the properties of ideal gas mixtures.	Apply

iii) SYLLABUS

Fundamental Concepts & Definitions, Basic thermodynamic terms, different approaches, continuum concept, types of system, heat and work, types of work. Zeroth law of thermodynamics, Temperature scales and measurement of temperature.

Free expansion, Joule's Experiment, First law of Thermodynamics applied to closed and open system, Steady flow energy equation and its applications, Transient flow.

Second law of thermodynamics, Reversibility and entropy: Carnot's theorem and its corollaries. Clausius Inequality. Entropy, its effects and entropy changes in various thermodynamic processes. Availability and irreversibility.

Properties of pure substances, property diagrams, phase transformations, property changes during phase change, practical applications, Mollier chart. Carnot vapour power cycle, Simple Rankine cycle.

Ideal Gases and its deviation, properties of gas mixtures. Thermodynamic Relations – Maxwell's Relations, Clapeyron Equation, throttling process and inversion curve.

iv) a) TEXTBOOKS

1. Nag P. K., Engineering Thermodynamics, Tata McGraw Hill, 5th Edition, 2011.

2. D. S. Kumar., Applied Thermodynamics, S.K. Kataria, 2010.

3. Yunus A Cengel and Boles M.A., Thermodynamics, 7th Edition, Tata McGraw Hill, 2009.

b) REFERENCES

1. Holman J.P, Thermodynamics, McGraw Hill, 2004.
2. Moran, M.J., and Shapiro, H.N., Fundamentals of Engineering Thermodynamics, 6th ed., John Wiley & Sons, 2008.

v) COURSE PLAN

Module	Contents	No. of hours
I	Review of fundamentals of thermodynamics - Basic Concepts of Macroscopic and Microscopic viewpoints, Concept of Continuum. Thermodynamic System, Processes and Equilibrium. Energy transfer – Work and Heat. Zeroth Law of Thermodynamics, Measurement of Temperature, reference points, Temperature Scales. Work – Pdv work, free expansion work, heat capacity. Joule's Experiment- First law of Thermodynamics. First law applied to non-flow and flow process - Enthalpy, specific heats. Mass and Energy balance in simple steady flow process. Applications of SFEE, PMM1. Transient Flow Process, limitations of the First Law.	10
II	Second Law of Thermodynamics, Thermal Reservoir, Heat Engine, Heat pump – Kelvin-Planck and Clausius Statements, Equivalence of two statements. Reversibility, Causes of Irreversibility, PMM2, Carnot's theorem and its corollaries, Absolute Thermodynamic Temperature scale, Clausius Inequality.	8
III	Entropy- Entropy changes in various thermodynamic processes, principle of increase of entropy and its applications, Entropy generation, isentropic process, Available Energy, Availability and Irreversibility- Second law efficiency, Third law of thermodynamics.	8
IV	Pure Substances, Phase Transformations, Triple point, critical point, property diagrams - properties during phase change, saturation pressure and temperature, dryness fraction, enthalpy of change of phase. Mollier Charts and steam tables, property calculations. Carnot vapour power cycle, drawbacks as a reference cycle. Simple Rankine cycle; description, calculation of work done and heat transfer.	10
V	The ideal gas equation, characteristic and universal gas constants, deviations from ideal gas model. Vander Waals Equation of State. Introduction to real gas mixtures. Mixtures of ideal gases – Dalton's Law of partial pressure, Amagat's Laws	9

	of additive volumes, Gibbs-Dalton's law, Properties of gas mixtures. General Thermodynamic Relations – Combined First and Second law equations – Helmholtz and Gibb's functions - Maxwell's Relations, Tds Equations. The Clapeyron Equation. Throttling process, Joule Thomson Coefficient, inversion curve.	
	Total	**45**

vi) ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii) CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii) END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23MEL20C	METALLURGY AND MATERIALS SCIENCE	PCC	3	1	0	0	4	2023

i) COURSE OVERVIEW

The aim of the course is to build awareness regarding the behaviour of materials in engineering applications and select the materials for various engineering applications. This course also aims to develop an awareness to apply knowledge of material behaviour in material selection

ii) COURSE OUTCOMES

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

CO1	Apply the fundamentals of crystallography and the associated mechanisms of crystallization to determine crystal structure and grain size of different materials.	Apply
CO2	Explain the different modes of imperfections and defects in engineering materials along with the various methods to determine the microstructure of a material.	Understand
CO3	Interpret on various binary phase diagrams including Iron Carbon equilibrium diagram and the different types of heat treatment processes.	Understand
CO4	Explain the different types of surface hardening methods and various aspects of fatigue.	Understand
CO5	Explain the mechanisms behind ductile fracture, brittle fracture, creep and the relevance of super plasticity.	Understand
CO6	Identify suitable modern engineering materials for given applications.	Apply

iii) SYLLABUS

Crystallography: SC, BCC, FCC, HCP structures, APF, Miller Indices. Modes of plastic deformation. Crystallization.

Crystal imperfections: Classification of crystal imperfections. Polishing and etching. X – ray diffraction, SEM and TEM, Diffusion in solids, Fick's laws.

Phase Diagrams: equilibrium diagram of common types of binary systems, Detailed discussion on Iron-Carbon equilibrium diagram with microstructure and properties. Heat treatment: TTT, CCT diagram, applications. Tempering. Hardenability, Surface hardening methods.

Strengthening mechanisms and alloys: cold and hot working. Alloy steels: how alloying elements affecting properties of steel, nickel steels, chromium steels, high speed steels, cast iron, principal non-ferrous alloys.

Fatigue and composites: Fatigue, creep, DBTT, super plasticity - need, properties. applications of composites, super alloy, intermetallics, maraging steel, Titanium, Ceramics: structures, applications

iv) a) TEXTBOOKS

1. William D Callister, Material Science and Engineering, John Wiley,2014
2. Raghavan V, Material Science and Engineering, Prentice Hall, 2015
3. Higgins R.A. - Engineering Metallurgy part - I –ELBS,1998

b) REFERENCES

1. Anderson J.C., Material Science for Engineers, Chapman and Hall,1990
2. Clark and Varney, Physical metallurgy for Engineers, Van Nostrand,1964
3. Reed Hill E. Robert, Physical metallurgy principles, 4th Edn. Cengage Learning, 2009

v) COURSE PLAN

Module	Contents	No. of hours
I	Crystallography:- Crystal, space lattice, unit cell- SC, BCC, FCC, atomic packing factor and HCP structures. Coordination number and radius ratio; theoretical density; simple problems - Polymorphism and allotropy. Miller Indices: -crystal plane and direction - Attributes of miller indices for slip system, 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. 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	**12**
II	Classification of crystal imperfections: - types of point and dislocations. 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. Significance high and low angle grain boundaries on dislocation –driving force for grain growth and applications during heat treatment. Polishing and etching to determine the microstructure and grain size-Fundamentals and crystal structure determination by X – ray diffraction,SEM and TEM. Diffusion in solids, fick's laws, mechanisms, applications of diffusion in mechanical engineering**.**	**12**

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. 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-austempering, martempering and ausforming - Comparative study on ductility and strength with structure of pearlite, bainite, spherodite, martensite, tempered martensite and ausforming.	**12**
IV	Cold working: Detailed discussion on strain hardening; recovery; recrystallization, effect of stored energy; re- crystallization temperature - hot working, Bauschinger effect and attributes in metal forming. 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. Fatigue: - Stress cycles – Primary and secondary stress raisers - Characteristics of fatigue failure, fatigue tests. Factors affecting fatigue strength	**12**
V	Fracture: – Brittle and ductile fracture – Griffith theory of brittle fracture Effect of plastic deformation on crack propagation - transgranular, intergranular fracture - Mechanism of fatigue failure, Structural features of fatigue: - crack initiation, growth, propagation -Fracture toughness (definition only), applications - Ductile to brittle transition temperature (DBTT) in steels and structural changes during DBTT, applications. Creep: - Creep curves – creep tests-Mechanism of creep deformation - threshold for creep, prevention against creep - Super plasticity: need and applications. Alloy steels:- Effects of alloying elements on steel, Nickel steels, Chromium steels etc. – change of steel properties by adding alloying elements - High speed steels - Cast irons: Classifications; grey, white, malleable and spheroidal graphite cast iron etc, composition, microstructure, properties and applications - Principal Non ferrous Alloys: - Aluminum, Copper, Magnesium, Nickel, study of composition, properties, applications.	**12**

	Composites: - Need of development of composites; fiber phase; matrix phase; only need and characteristics of PMC, MMC, and CMC. Modern engineering materials: - properties and applications of, intermetallics, maraging steel, super alloys, Titanium, Ceramics	
	Total	**60**

vi) ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii) CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii) END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23MEL20D	Mechanics of Fluids	PCC	2	1	0	0	3	2023

i) COURSE OVERVIEW

This course provides an introduction to the properties and behaviour of fluids. It enables to apply the concepts in engineering, pipe networks. It introduces the concepts of boundary layer, dimensional analysis and model testing.

ii) COURSE OUTCOMES

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

	Course Outcomes	Learning Level
CO 1	Explain the fundamental principles and basic concepts of fluid mechanics	Understand
CO 2	Solve static equilibrium cases of fluids	Apply
CO 3	Apply the concepts of kinematics related to flowing fluids	Apply
CO 4	Apply concepts of fluid dynamics to fluid flow problems	Apply
CO 5	Solve problems related to flow through pipes	Apply
CO 6	Utilise dimensional analysis for model study	Apply

iii) SYLLABUS

Introduction: –Fluids and continuum, Physical properties of fluids, Newton's law of viscosity, fluid Statics, measurement of pressure , hydrostatic pressure on plane and curved surfaces, Stability of immersed and floating bodies.

Kinematics of fluid flow: Eulerian and Lagrangian approaches, classification of fluid flow, flow patterns, velocity and acceleration in fluid, circulation and vorticity, stream function and potential function, Laplace equation, equi-potential lines, flow nets.

Control volume analysis of mass, momentum and energy, Equations of fluid dynamics, Energies in flowing fluid, heads, and flow measuring devices.

Pipe Flow: Viscous flow, Reynolds experiment ,significance of Reynolds number, shear stress and velocity distribution in a pipe, Hagen Poiseuille equation , Major and minor loss, Turbulent flow ,pipe connections , siphon, transmission of power through pipes and efficiency, Water hammer, Cavitation.

Boundary Layer: Growth of boundary layer over a flat plate and definitions. Definition of boundary layer thickness.

Dimensional Analysis: Buckingham's theorem, important non dimensional numbers and

their significance. Applications and limitations of model testing - simple problems only.

iv) a) TEXTBOOKS

1. John. M. Cimbala and Yunus A. Cengel, Fluid Mechanics: Fundamentals and Applications, McGraw Hill, (4th edition, SIE), 2019.
2. Rathakrishnan, E., Fluid Mechanics: An Introduction, Prentice Hall India, 3rd Edition, 2012.

b) REFERENCES

1. White, F. M., Fluid Mechanics, McGraw Hill Education India Private Limited, 8th Edition, 2017.
2. Robert W. Fox, Alan T. McDonald, Philip J. Pritchard and John W. Mitchell, Fluid Mechanics, Wiley India, 2018.

v) COURSE PLAN

Module	Contents	Hours
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. Introduction to Fluid Statics: pressure at a point, pressure-density-height relationship, manometers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to uniform accelerations.	**8**
II	Kinematics of fluid flow: Eulerian and Lagrangian approaches, velocity and acceleration fields, streamlines, path lines, streak lines, stream tubes. Classification of fluid flows: 1D, 2D, 3D, steady, unsteady, uniform, non-uniform, laminar, and turbulent. Types of motion and deformation of fluid elements, rotational, irrotational flows, circulation and vorticity. Integral Relations: Reynolds Transport Theorem for a fixed non-deforming control volume, formulation of mass, momentum and energy equations.	**10**
III	Differential analysis of fluid flow: formulation of equations of mass, energy and momentum (Euler's equation), Navier-Stokes equations (without proof) in Cartesian co-ordinates. Stream function and potential function, Laplace equation, equi-potential lines, flow net and its uses. Dynamics of Fluid flow: Bernoulli's equation, Energies in flowing fluid, head, pressure, dynamic, static and total head, Venturi and Orifice meters. Velocity measurements: Pitot tube and Pitot-static tube.	**10**
IV	Pipe 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,	**9**

	efficiency of transmission, Water hammer, cavitation.	
V	Introduction to the concept of Boundary Layer: Growth of boundary layer over a flat plate and definition of boundary layer thickness, displacement, momentum and energy thickness. Dimensional Analysis: Buckingham's theorem, important non dimensional numbers and their significance, geometric, Kinematic and dynamic similarity, model studies. Froude, Reynolds, Weber, Cauchy and Mach laws-Applications and limitations of model testing (simple problems).	**8**
	Total	**45**

vi) ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii) CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 40
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii) END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23MEB20E	Computer Aided Machine Drawing	PCC	1	0	2	0	2	2023

i) COURSE OVERVIEW

The objective of the course is to make students familiarize with different types of riveted and welded joints, surface roughness symbols; limits, fits and tolerances, convey the principles and requirements of machine and production drawings. They will also be introduced to the preparation of 2D assembly drawings and 3D assembly models using design software.

ii) COURSE OUTCOMES

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

CO 1	Apply the knowledge to prepare standard dimensioned drawings of machine parts and other engineering components.	Apply
CO 2	Develop standard assembly drawings of machine components and valves using part drawings and bill of materials.	Apply
CO 3	Interpret the limits and tolerances of components and appropriate fits of given assemblies	Understand
CO 4	Interpret the symbols of welded joints and surface roughness of the components.	Understand
CO 5	Construct 3D assembly models of machine elements.	Apply

iii) SYLLABUS

1. Introduction to machine drawing, drawing standards, fits, tolerances, surface roughness

2. Introduction to assembly and part drawings of simple assemblies and sub-assemblies of machine parts viz., couplings, clutches, bearings, I.C. engine components, valves, machine tools, etc.

iv) a) TEXTBOOKS

1. N. D. Bhatt and V.M. Panchal, Machine Drawing,Charotar Publishing House, 2011.
2. Kalpakjian S. And Steven S. Schmid, Manufacturing Engineering and Technology, 4th Edition, Pearson Education India Edition, 2002.
3. P S Gill, Machine Drawing, Kataria & Sons,2013

v) COURSE PLAN

Sl No.	Lab Work	No. of Hours
1	Fasteners: Sketching of conventional representation of welded joints, Bolts and Nuts or Keys and Foundation Bolts.	3
2	Fits and Tolerances: Limits, Fits – Tolerances of individual dimensions – Specification of Fits – basic principles of geometric & dimensional tolerances.	3
3	Surface Roughness: Preparation of production drawings and reading of part and assembly drawings, surface roughness, indication of surface roughness, etc.	3
4	Assembly drawings (2D) with Bill of materials: Lathe Tailstock and Universal joint	3
5	Assembly drawings (2D) with Bill of materials: Connecting rod and Plummer block	3
6	Assembly drawings (2D) with Bill of materials: Rams Bottom Safety Valve	3
7	Creating assembly models of Plummer block(3D)	3
8	Creating assembly models of Screw jack(3D)	3
9	Creating assembly models of Pipe joints(3D)	3
10	Creating assembly models of Tail stock(3D)	3
	Total	**30**

vi) ASSESSMENT PATTERN

Continuous Assessment – 100 marks

Continuous Assessment		
Attendance	:	5 marks
Assignment	:	10 marks
Regular Classwork	:	20 marks
Mid Semester Exam	:	25 marks
Final Exam	:	40 marks
Total Continuous Assessment	:	**100 marks**

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23HSL2NA	PROFESSIONAL ETHICS	HSC	2	0	0	0	1	2023

i) COURSE OVERVIEW

The objective of this course is to create an awareness on engineering ethics and human values. The course also aims to instill moral and social values, loyalty and also to learn to appreciate the rights of others

ii) COURSE OUTCOMES

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

CO1	Identify different skills required in personal life.	Understand
CO2	Apply well-defined techniques to cope with emotion and stress.	Apply
CO3	Solve moral and ethical problems in professional life.	Apply
CO4	Explain the core values that shape the ethical behaviour of a professional.	Understand
CO5	Solve moral and ethical problems through explorations and assessment by established experiments.	Apply
CO6	Apply the knowledge of human values and social values to contemporary ethical values and global issues	Apply

iii) SYLLABUS

Meaning and significance of life skills. Life skills identified by WHO: Self- awareness, Empathy, Decision making, problem solving, interpersonal relationship, coping with stress, coping with emotion. Self-awareness: Definition, need for self-awareness; Human Values, tools and techniques of SA: questionnaires, journaling, reflective questions, meditation, mindfulness, psychometric tests, feedback Stress Management: Stress, reasons and effects, stress diaries, the four A's of stress management, techniques, approaches: action-oriented, emotion-oriented, acceptance-oriented, resilience, Gratitude training

Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method and relaxation techniques

Life skills for Professionals: positive thinking, right attitude, attention to detail, having the big picture, learning skills, research skills, perseverance, setting goals and achieving them, motivation, personality development, IQ, EQ and SQ Responsibilities and Rights.– Collegiality and loyalty- Managing conflict-Respect for authority- Collective bargaining-Confidentiality-Role of confidentiality in moral integrity- conflicts of interest-occupational crime-professional rights-employee right-IPR discrimination

Engineering Ethics & Professionalism- Senses of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy – Kohlberg’s theory- Gilligan's theory- Consensus and Controversy-Profession and Professionalism- Models of professional roles-Theories about right action- Self-Interest-Customs and Religion-uses of ethical theories

Engineering as social Experimentation- Engineering as Experimentation-Engineers as responsible Experimenters- Codes of Ethics- Plagiarism-A balanced outlook on law-Challenger case study-Bhopal gas tragedy

Global Ethical Issues- Multinational Corporations- Environmental Ethics-Business Ethics-Computer Ethics- Role in Technological Development-Engineers as Managers-Consulting Engineers- Engineers as Expert witnesses and Advisors-Moral leadership

iv) a) TEXTBOOKS

1. Remesh S., Vishnu R.G., "Life Skills for Engineers", Ridhima Publications, 1st Edition, 2016.
2. Life Skills for Engineers, Complied by ICT Academy of Kerala, McGraw Hill Education (India) Private Ltd., 2016
3. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012
4. R S Naagarazan, A textbook on professional ethics and human values, New age international (P) limited, New Delhi,2006.

b) REFERENCES

1. Barun K.Mitra, Personality Development & Soft Skills, Oxford Publishers, 3rd impression, 2017.
2. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi,2014.
3. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
4. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics-
5. Concepts and cases, Wadsworth Thompson Learning, United states,2005.

v) COURSE PLAN

Module	Contents	No. of hours
I	Overview of Life Skills: Meaning and significance of life skills Life skills identified by WHO: Self- awareness, Empathy, Decision making, problem solving, interpersonal relationship, coping with stress, coping with emotion. Self-awareness: Definition, need for self-awareness; Human Values, tools and techniques of SA: questionnaires, journaling, reflective questions, meditation, mindfulness, psychometric tests, feedback. Stress Management: Stress, reasons and effects, stress diaries, the four A's of stress management, techniques, Approaches: action-oriented, emotion- oriented, acceptance- oriented, resilience, Gratitude Training, Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method and relaxation techniques	5

II	Life skills for Professionals: positive thinking, right attitude, attention to detail, having the big picture, learning skills, research skills, perseverance, setting goals and achieving them, motivation, personality development, IQ, EQ, and SQ Collegiality and loyalty, Managing conflict, Respect for authority Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest-Occupational crime, Professional rights, Employee right, IPR, Discrimination	**5**
III	Senses of Engineering Ethics, Variety of moral issues, Types of Inquiry-Professionalism, Models of professional roles, Theories about right action-Self-Interest-Customs and Religion, Uses of Ethical Theories	**6**
IV	Engineering as Experimentation, Engineers as responsible Experimenters-Codes of Ethics, Plagiarism, A balanced outlook on law-Case study)	**8**
V	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics-Role in Technological Development, Moral leadership-Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors	**6**
	Total	**30**

vi) ASSESSMENT PATTERN

Continuous Assessment : Group Project – 50 : 50

Continuous Assessment		
Attendance	:	5 marks
Case Study	:	30 marks
CAT	:	15 marks
(Test to be conducted for 30 marks and need to be converted to 15 Marks)		
Total Continuous Assessment	:	**50 marks**
Group Project with Presentation and Report	:	**50 marks**
TOTAL	:	**100 marks**

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23MEP20A	MATERIAL TESTING LAB	PCC	0	0	2	0	1	2023

i) COURSE OVERVIEW

Goal of this course is to impart practical knowledge to students about the behavior of different materials when subjected to various types of loading. The course details the different mechanical properties of engineering materials.

ii) COURSE OUTCOMES

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

CO 1	Identify the behaviour of engineering materials under various forms and stages of loading	Analyse
CO 2	Examine the moment of inertia of rotating bodies	Apply
CO 3	Analyse the toughness, strength and stiffness properties of engineering materials under various loading conditions	Analyse
CO 4	Examine the displacement and strains of materials under various types of loading	Apply

iii) SYLLABUS

Study on stress-strain characteristics of mild steel rod and HYSD bars, Estimation of modulus of rigidity of Steel wire, Estimation of modulus of rigidity of mild steel circular bars and Tor steel, Study on flexural behaviour of wooden beam, Estimation of compressive strength of wooden specimen, Estimation of toughness of steel, Estimation of modulus of rigidity of open coiled and closed coiled springs, Estimation of hardness properties of engineering materials, Determination of shear capacity of mild steel specimen, Determination of moment of inertia of fly wheel, Bend and rebend test on mild steel specimen, Verification of Clerk Maxwell's Reciprocal Theorem, Estimation of modulus of elasticity of Tor steel using strain gauge, study and demonstration of load cells and strain gauges.

iv) REFERENCES

1. T. Davis and Hawk, Testing of Engineering Materials, International Student Edition, McGraw Hill Book Co. New Delhi, 4th Edition, 2005
2. M. L. Gambhir and Neha Jamwal, Building and construction materials-Testing and quality control, McGraw Hill education(India)Pvt. Ltd., 2014

3. K. A. Holes, Experimental Strength of Materials, English Universities Press Ltd. London, 2019
4. A.K. Suryanarayana, Testing of Metallic Materials, Prentice Hall of India Pvt. Ltd.New Delhi, 2007
5. C. B. Kukreja,K. Kishore, and R.Chawla, Material Testing Laboratory Manual,Standard Publishers & Distributors, 2006.
6. J. W. Dally and W.P. Railey, Experimental Stress analysis, McGraw Hill, 2012.

v) COURSE PLAN

Experiment No.	List of exercises/ experiments	No. of hours
1	Tension test on Mild Steel Rod and TMT bars	2
2	Torsion test on Steel wire	2
3	Torsion test on Mild Steel Rod	2
4	Bending Test on wooden beams	2
5	Study on estimation of compression strength of timber specimen	2
6	Impact test a. Izod Impact Test b. Charpy Impact Test	2
7	Spring test a. Open Coiled Spring Test b. Closed Coiled Spring Test	2
8	Hardness Test a. Brinell hardness Test b. Rockwell Hardness Test	2
9	Double shear test	2
10	Moment of Inertia of Fly wheel	2

11	Bend and rebend test on mild steel specimen	2
12	Bending test on steel I Section	2
13	Verification of Clerk Maxwell's Theorem	2
14	Modulus of Elasticity of Tor Steel Using Strain Gauge	2
15	Study/Demonstration of strain gauges and load cells.	2
	Total hours	**30**

vi) CONTINUOUS INTERNAL EVALUATION PATTERN

Attendance	: 5 marks
Class work/ Assessment /Viva-voce	: 55 marks
Final Assessment	: 40 marks
Total	: **100 marks**

S4 SYLLABUS

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23MAL20D	PROBABILITY, STATISTICS AND NUMERICAL METHODS	BSC	3	1	0	0	4	2023

i) COURSE OVERVIEW

This course introduces students to the modern theory of probability and statistics, covering important models of random variables and techniques of parameter estimation and hypothesis testing. A brief course in numerical methods familiarizes students with some basic numerical techniques for finding roots of equations, evaluating definite integrals solving systems of linear equations, and solving ordinary differential equations which are especially useful when analytical solutions are hard to find

ii) COURSE OUTCOMES

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

CO1	Identify the different discrete random experiments and find the probabilities of their occurrence	Apply
CO2	Identify the different continuous random experiments and find the probabilities of their occurrence	Apply
CO3	Use statistical inference to draw conclusions concerning characteristics of a population based on attributes of samples drawn from the population	Apply
CO4	Find roots of equations, definite integrals and interpolating polynomial on given numerical data using standard numerical techniques	Apply
CO5	Apply standard numerical techniques for solving systems of equations, ordinary differential equations and for fitting curves on given numerical data	Apply

iii) SYLLABUS

Discrete random variables and their probability distributions, Binomial distribution, Poisson distribution, Discrete bivariate distributions, Expectation -multiple random variables.

Continuous random variables and their probability distributions -Uniform, exponential and normal distributions, Continuous bivariate distributions, Expectation-multiple random variables, i.i.d random variables and Central limit theorem.

Population and samples, Sampling distribution of the mean and proportion. Test of hypotheses Concerning mean and proportion. Confidence interval.

Roots of equations- Newton-Raphson, regula falsi methods. Interpolation-finite differences, Newton's forward and backward formula, Newton's divided difference method, Lagrange's method. Numerical integration.

Solution of linear Systems-Gauss-Siedal and Jacobi iteration methods. Curve fitting-method of least squares, Solution of ordinary differential equations -Euler and Classical Runge-Kutta method of second and fourth order, Adams- Moulton predictor-correction method

iv) a) TEXTBOOKS

1. Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 8th edition, Cengage, 2012
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10 th Edition, John Wiley & Sons, 2016.

b) REFERENCES

1. Hossein Pishro-Nik, Introduction to Probability, Statistics and Random Processes, Kappa Research, 2014 (Also available online at www.probabilitycourse.com)
2. Sheldon M. Ross, Introduction to probability and statistics for engineers and scientists, 4th edition, Elsevier, 2009.
3. T. Veera Rajan, Probability, Statistics and Random processes, Tata McGraw-Hill, 2008
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36 Edition, 2010.

v) COURSE PLAN

Module	Contents	No. of hours
I	Discrete random variables and probability distributions, expected value, mean and variance (discrete) Binomial distribution-mean, variance, Poisson distribution-mean, variance, Poisson approximation to binomial-Discrete bivariate distributions, marginal distributions, Independence of random variables (discrete), Expected values	12
II	Continuous random variables and probability distributions, expected value, mean and variance (continuous)-Uniform, exponential and normal distributions, mean and variance of these distributions Continuous bivariate distributions, marginal distributions, Independent random variables, Expected values, Central limit theorem.	12
III	Population and samples, Sampling distribution of single mean and single proportion (large samples) Confidence interval for single mean and single proportions (large samples) Hypothesis testing basics, large sample test for single mean and single proportion Large sample test for equality of means and equality of proportions of two populations-t-distribution and small sample t-test for single mean and pooled t-test for equality of means	12
IV	Errors in numerical computation-round-off, truncation and relative error, Solution of equations – Newton-Raphson method and Regula-Falsi method. Interpolation-finite differences, Numerical integration-	12

	Trapezoidal rule and Simpson's 1/3rd rule (Proof or derivation of the formulae not required for any of the methods in this module)	
V	Solution of linear systems-Gauss-Siedal method, Jacobi iteration method Curve-fitting-fitting straight lines and parabolas to pairs of data points using method of least squares -Solution of ODE-Euler and Classical Runge - Kutta methods of second and fourth order- Adams-Moulton predictor-corrector methods	**12**
	Total	**60**

vi) ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii) CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii) END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23MEL20F	Mechanics of Machinery	PCC	3	1	0	0	4	2023

i) COURSE OVERVIEW

This course aims to introduce the students to the fundamentals of mechanisms followed by its kinematic analysis, synthesis and force analysis. The course will also cover the kinematics of cam follower motion, gears and gear trains.

ii) COURSE OUTCOMES

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

CO1	Explain the fundamental concepts of kinematics and theory of machines.	Understand
CO2	Apply principles of kinematics to analyse and design various mechanisms.	Apply
CO3	Apply methods of static force analysis to solve problems involving mechanisms.	Apply
CO4	Solve problems of dynamic force analysis in mechanisms.	Apply
CO5	Solve problems related to layout of cam profile, gear mechanisms and gear trains.	Apply

iii) SYLLABUS

Introduction to kinematics and mechanisms- kinematic diagrams, mobility, kinematic inversion. Synthesis of mechanisms. Kinematic Analysis of Planar Mechanisms- velocity analysis, acceleration analysis of four bar and slider-crank mechanisms; acceleration analysis of crank and slotted lever mechanism.

Static force analysis- method of superposition. Analysis of four bar and slider crank mechanisms with sliding and pin friction. Dynamic force analysis- four bar mechanism- engine force analysis

Introduction to cams and followers- layout of cam profile: cam with knife edge follower, reciprocating roller follower.

Gear and Gear Trains- types of gears; law of gearing, involute spur gear, path of contact, contact ratio, interference. Introduction to helical gear, worm gear and bevel gear. Simple, compound and epicyclic gear trains.

iv) a) TEXTBOOKS

1. D.H. Myskza, Machines and Mechanisms Applied Kinematic Analysis, 4th edition, Pearson Education,2011.
2. J. E. Shigley, J. J. Uicker, Theory of Machines and Mechanisms, McGraw Hill,2010
3. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill,2017

4. S. S. Rattan, Theory of Machines, 5th Edition, Tata Mc Graw Hill,2019
5. Ballaney P. L., Theory of Machines and Mechanisms, Khanna Publishers, 2005.

b) REFERENCES

1. C. E. Wilson, P. Sadler, Kinematics and Dynamics of Machinery, Pearson Education,2005.
2. G. Erdman, G. N. Sandor, Mechanism Design: Analysis and synthesis Vol I & II, Prentice Hall of India,1984.
3. Ghosh, A. K. Malik, Theory of Mechanisms and Machines, Affiliated East West Press,2008

v) COURSE PLAN

Module	Contents	No. of hours
I	Introduction of mechanisms; links, joints, kinematic diagram, mobility of mechanism. Grashof's Criterion, kinematic inversion- inversions of 4R, and slider crank, Mechanical Advantage, Transmission Angle, Toggle positions. Kinematic synthesis (planar mechanisms) - type, number and dimensional synthesis. Computer aided synthesis of mechanisms- Precision points - function generation- Freudenstein's method. Path generation.	12
II	Velocity Analysis- using relative velocity, Instantaneous Centre- Kennedy's Theorem. Acceleration Analysis of four bar and slider-crank mechanisms. Coriolis component of acceleration- acceleration analysis of crank and slotted lever mechanism.	12
III	Static force analysis- Analysis of four bar linkages and slider crank mechanism- method of superposition, principle of virtual work. Analysis of four bar and slider crank mechanisms with sliding and pin friction.	12
IV	Dynamic force analysis- inertia force, inertia torque, D' Alembert's principle –four bar mechanism- engine force analysis. Dynamical equivalent system. Dynamic force analysis of slider crank mechanism considering mass of the connecting rod-analytical method.	12
V	Introduction to Cams and Followers- Classification. Follower motion in SHM, Uniform Acceleration and deceleration- Displacement Diagrams. Layout of cam profile: cam with knife edge follower, reciprocating roller follower. Gears – types of gears- terminology of spur gears – law of gearing -tooth profiles- involute spur gears- path of contact- contact ratio - interference. Gear trains - simple and compound gear trains - planetary gear trains.	12

	Total	**60**

vi) ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii) CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii) END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23MEL20G	FLUID MACHINERY	PCC	3	1	0	0	4	2023

i) COURSE OVERVIEW

The aim of the course is to provides an understanding of reciprocating and rotary fluid machinery. The course consists of hydraulic pumps, turbines, air compressors and gas turbines

ii) COURSE OUTCOMES

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

CO 1	Explain the basic working principles and applications of turbomachines.	Understand
CO 2	Apply the fundamental principles to practical problems related to hydraulic turbines.	Apply
CO3	Apply the fundamental principles to practical problems related to hydraulic pumps.	Apply
CO 4	Apply the fundamental principles to practical problems related to compressors.	Apply
CO 5	Apply the fundamental principles to practical problems related to gas turbines.	Apply

iii) SYLLABUS

Introduction: Impulse of Jet and Impulse Turbines: Classification of Fluid Machines & Devices, Application of momentum and moment of momentum equation to flow through hydraulic machinery, Euler's fundamental equation. Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat &curve). Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations

Reaction Turbines: Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitation in turbines, Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines.

Centrifugal Pumps and Reciprocating Pump: Centrifugal Pumps: Principle and classification, Multistage pumps, Pumps in series and parallel, Blade angle, Velocity triangle, Efficiency, Specific speed, Characteristic curves. Reciprocating Pump**:** Working principle, Slip, Work done, Effect of acceleration and frictional resistance, Air vessels.

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). Centrifugal compressor-working, velocity

diagram, work done, performance. Axial flow compressors: - working, velocity diagram, degree of reaction, performance.

Gas Turbines: Brayton cycle Components of a gas turbine plant open and closed types of gas turbine plants Optimum pressure ratio Improvements of the basic gas turbine cycle multi stage compression with inter-cooling multi stage expansion with reheating between stages exhaust gas heat exchanger.

iv) a) TEXTBOOKS

1. Subramanya, K., Hydraulic Machines, Tata McGraw Hill, 1st edition, 2017
2. Rathore, M., Thermal Engineering, Tata McGraw Hill, 1st edition, 2010
3. Ganesan, V., Gas Turbines, Tata McGraw Hill, 3rd edition, 2017.
4. Balachandran P Engineering Fluid Mechanics., Prentice Hall India Learning Private Limited 2010.

b) REFERENCES

1. Robert, W. Fox and Allan, T. McDonald. "Introduction to Fluid Mechanics", 4th Edn., John Willey & Sons, 1995.
2. Hydraulic and Compressible Flow Turbomachines, Sayers, A.T., CBLS, 2003.
3. Gas Turbine Theory, H.I.H Saravanamuttoo, G.F.C. Rogers and H. Cohen, 4th Ed., Pearson, 2003.
4. Applied Thermodynamics for Engineering Technologists, T. D. Eastop and A. McConkey, Pearson Publishers, 205.

v) COURSE PLAN

Module	Contents	No. of hours
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	10
II	Inward and outward flow reaction turbines- Francis Turbine – Constructional features –Velocity triangles, work done and efficiencies. 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.	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	15

	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. 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.	
IV	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). Centrifugal compressor-working, velocity diagram, work 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.	**10**
V	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.	**10**
	Total	**60**

vi) ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii) CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 40
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii) END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23MEL20H	MANUFACTURING PROCESSES	PCC	3	1	0	0	4	2023

i) COURSE OVERVIEW

The aim of the course is to give the students an exposure to various manufacturing processes like casting, forming and welding. They will also gain an understanding on various work holding techniques.

ii) COURSE OUTCOMES

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

CO1	Explain various casting, welding, rolling and forming techniques as per required applications.	Understand
CO2	Apply concepts of manufacturing processes to determine various process parameters.	Apply
CO3	Identify the most suitable manufacturing process for a given condition.	Apply
CO4	Explain about additive manufacturing and various material addition processes.	Understand

iii) SYLLABUS

Casting: Characteristics of sand, patterns, cores, chaplets, simple problems. Solidification of metals. Elements of gating system. Special casting process. Defects in castings. Superalloy production methods.

Welding: welding metallurgy, destructive and non-destructive tests of welded joints.

Resistance welding. Arc welding. Thermit welding. Friction welding. Oxyacetylene welding.Brazing, Soldering, Adhesive bonding.

Rolling: principles, types of rolls and rolling mills, mechanics of flat rolling, defects, miscellaneous rolling process. Plastic deformation of metals. Flow rules.

Forging: material characterization, classification, forging methods analysis, applications, deformation zone geometry, defects in forging. Metal extrusion: metal flow, mechanics of extrusion, defects. Wire, rod, and tube drawing: mechanics of rod and wire drawing, drawing defects. Deep drawing.

Additive manufacturing: Material addition processes, LIGA process

iv) a) TEXTBOOKS

- Serope Kalpakjian; Steven R. Schmid, Manufacturing Engineering and Technology, 7th Edition, Publisher: Prentice Hall, ISBN-10 0-13-608168-1,
- HajraChoudhury S.K., Elements of Manufacturing Technology, Vol. - I, Media Publications.2010
- Rao, P.N. Manufacturing Technology Foundry, Forming and Welding, 2nd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi;2017

b) REFERENCES

- Roy. A. Lindberg, Processes and Materials of Manufacture, PHI / Pearson education, 2006
- Paul Degarmo E, Black J.T and Ronald A. Kosher, Materials and Processes in Manufacturing, Eight Edition, Prentice -Hall of India,199

v) COURSE PLAN

Module	Contents	No. of hours
I	Casting:-Characteristics of sand -pattern and allowances -type of patterns-cores-core prints-chaplets-simple problems. Elements of gating system-gating system, pouring time, choke area - risering Caine's method-chills –simple problems. Special casting process: -shell moulding, precision investment, die casting, centrifugal casting, continues casting, squeeze casting surface roughness obtainable and application of each casting process. Defects in castings:- Shaping faults arising in pouring, Inclusions and sand defects, Gas defects, Shrinkage defects, Contraction defects, Dimensional errors, Compositional errors and segregation; significance of defects on Mechanical properties. Super alloy Production Methods: Vacuum Induction Melting; Electro slag Re-melting; Vacuum Arc Re-melting (ASM).	12
II	Welding:-welding metallurgy, diffusion, heat affected zone, driving forcefor grain growth, grain size and hardness- joint quality: porosity, slag inclusions, cracks, surface damage, residual stress lamellar tears, stressreliving, heat treatment of welded joints - weldability - destructive and non-destructive tests of welded joints Resistance welding: HAZ, process and correlation of process parameters with welded joints of spot, seam, projection, stud arc, percussion welding- applications of each welding process –simple problems. Arc welding: -HAZ, process and correlation of process parameters with welded joints of shielded metal arc, submerged, gas metal, flux cored, electrogas, electroslag, gas tungsten, plasma arc, electron beam, laserbeam –simple problems - Thermit welding, friction welding- applications of each welding process. Oxyacetylene welding: -chemistry, types of flame and its applications - brazing- soldering - adhesive bonding.	12
III	Rolling: - principles - types of rolls and rolling mills - mechanics of flat rolling, roll pressure distribution, neutral point, front and back tension, torque and power, roll forces in hot rolling, friction, deflection and Flattening, spreading -– simple problems. rolling defects-vibration and chatter - flat rolling -miscellaneous rolling process: shape, roll forging, ring, thread and gear, rotary tube piercing, tube rolling - applications – simple problems. Flow rules -power and energy deformations - Heat generation and heat transfer in metal forming process -temperature in forging.	12
IV	Forging: material characterization; grain flow and strength - Forging: - classification - open die forging, forces and work of deformation - Forging methods analysis: - slab method only, solid cylindrical, rectangular	12

	work piece in plane strain, forging under sticking condition - simple problems -applications. Deformation zone geometry – die forging: - impression, close, coining, skew rolling etc. –simple problems– defects in forging. Metal extrusion: - metal flow - mechanics of extrusion: - deformation and friction, actual forces, die angle, forces in hot extrusion – miscellaneous process- defects -–simple problems- applications. Wire, Rod, and tube drawing: - mechanics of rod and wire drawing: Deformation, friction, die pressure and angle, temperature, reduction per pass, drawing flat strip and tubes- –simple problems- drawing defects- swaging-applications. Deep drawing- deep drawability, simple problems - different drawing practices	
V	**Introduction to Additive Manufacturing (AM):** Introduction, Evolution, Distinction between AM and CNC machining, Steps in AM, Classification, Advantages, Types of materials for AM. Material addition process:- stereo-lithography, selective laser sintering, 3D Printing, fused deposition modeling, laminated object manufacturing, laser engineered net-shaping, laser welding, LIGA process.	**12**
	Total	**60**

vi) ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment		
Attendance Assignments	:	5 marks
Assessment through	:	15 marks
Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii) CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

viii) END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23HSL2NB	UNIVERSAL HUMAN VALUES II	HSC	3	0	0	0	1	2023

i) COURSE OVERVIEW

The objectives of the course are:

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS'

2. To facilitate the development of a holistic perspective among students towards life and profession leading towards a value-based living

3. To help the students to have ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with nature

ii) COURSE OUTCOMES

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

CO1	Understand themselves and their surroundings (family, society, nature)	Understand
CO2	Show more commitment towards what they have learnt about Human values, Human relationship and Human society	Understand
CO3	Apply Sustainable Solutions to Real Life problems based on the learning gained through Universal Human Values	Apply

iii) SYLLABUS

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

Purpose and motivation for the course, recapitulation from Universal Human Values-I Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

(Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking)

Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'

Understanding the needs of Self ('I') and 'Body' - happiness and physical facility Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) Understanding thecharacteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.

(Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs. dealing with disease)

Understanding Harmony in the Family and Society- Harmony in Human Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

(Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives)

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence,

Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all pervasive space Holistic perception of harmony at all levels of existence.
(Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.)

Implications of the above Holistic Understanding of Harmony on Professional Ethics,
Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
Competence in professional ethics:

a. Ability to utilize the professional competence for augmenting universal human order

b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems,

c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

Case studies of typical holistic technologies, management models and production systems

Strategy for transition from the present state to Universal Human Order

a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers.

b. At the level of society: as mutually enriching institutions and organizations

Sum up.

(Include practice Exercise and Case studies will be taken up in Practice (tutorial) Sessions. Eg. To discuss the conduct as an engineer or scientist etc.)

iv) a) TEXTBOOKS

1. Gaur P.R, Asthana R, Bagaria G.P, Human Values and Professional Ethics (2ndrevised Edition) Excel Books, New Delhi, 2019
2. Tripathi A. N, Human Values, New Age Intl. Publishers, New Delhi, 2004.

b) REFERENCES

1. Gaur R.R, Sangal R, Bagaria G P 'A Foundation Course in Human Values and Professional Ethics (Teacher Manual), Excel Books, 1stEdition 2013.
2. Parichaya E K, Nagaraj A,Jeevan Vidya, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. Mohandas K Gandhi, 'The story of my Experiments with Truth' Fingerprint,2009
4. Cecile Andrews 'Slow is Beautiful',New Society Publishers,2006.
5. Kumarappa J C Economy of Permanence, Sarva Seva Sangh Prakashan, 2017.

v) COURSE PLAN

Module	Contents	No. of hours
I	Understanding Value Education Self-Exploration as the process for Value Education Sharing about oneself Understanding Happiness and Prosperity-the Basic Human Aspirations Right Understanding, Relationship, Physical Facility Exploring Human Consciousness Happiness and Prosperity- Current Scenario Method to Fulfil the Basic Human Aspirations Exploring Natural Acceptance	9
II	Understanding Human Being as the Co-existence of the Self and Body Distinguishing between the needs of the Self and the Body Exploring the difference of needs of the Self and the Body The Body as an Instrument of the Self Understanding Harmony in the Self Exploring Sources of Imagination in the Self Harmony of the Self with the Body Programme to ensure Self Regulation and Health Exploring Harmony of Self with the Body	9

III	Harmony in the Family-the Basic unit of Human Interaction Values in the Human-to-Human Relationship 'Trust' –the foundation Value in Relationship Exploring the feeling of Trust 'Respect'- as the Right Evaluation Exploring the feeling of Respect Understanding Harmony in the Society Vision for the Universal Human Order Exploring Systems to fulfil Human Goal	**9**
IV	Understanding Harmony in the Nature Interconnectedness, self regulation and Mutual Fulfilment among the four orders of Nature Exploring the four orders of Nature Realizing Existence as Co-Existence at all Levels The Holistic Perception of Harmony in Existence Exploring Co-Existence in Existence	**9**
V	Natural Acceptance of Human Values Definitiveness of (Ethical) Human Conduct Exploring Ethical Human Conduct A Basis for Humanistic Education,Humanistic Constitution and Universal Human Order Competence in Professional Ethics Exploring Humanistic Models in Education Holistic Technologies, Production Systems and Management-Models-Typical Case Studies Strategies for Transition towards Value –based Life and Profession Exploring Steps of Transition towards Universal Human Order	**9**
	Total	**45**

vi) ASSESSMENT PATTERN

Continuous Assessment Test (1 No) : 10 marks

Assignment/Project/Case study etc. : 20 marks

Self-Assessment : 5 Marks

Peer Assessment : 5 marks

Peer Assessment can be done on group-wise basis by dividing the class into suitable groups.

Total : 40 marks

Assessment Pattern can be modified (if needed), subject to the approval of the Committees Concerned

vii) END SEMESTER EXAMINATION

The End semester examination will be conducted by the faculty. The examination will be for three hours and 60 marks.

viii) MODE OF CONDUCT OF COURSE (L-T- P: 2 – 1 - 0)

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions. In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration. Scenarios may be used to initiate discussion. Depending on the nature of topics, worksheets, home assignment and/ or activity are included.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty. Teacher preparation with a minimum exposure to at least one 8-day FDP on Universal Human Values is deemed essential.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23ESL2NC	INDUSTRIAL SAFETY ENGINEERING	ESC	2	1	0	0	1	2023

i) COURSE OVERVIEW

Goal of this course is to expose the students to the concepts of safety engineering and identify possible safety requirements. It introduces students to the various safety equipment and precautions. After this course, students will be able to recognize similar safety problems in real-world situations and respond accordingly

ii) COURSE OUTCOMES

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

CO1	Explain the theories of accident causation and preventive measures of industrial accidents	Understand
CO2	Explain personal protective equipment, its selection, safety performance & indicators and importance of housekeeping.	Understand
CO3	Explain the various hazards and associated safety measures in construction industries.	Understand
CO4	Explain various hazards associated with different machines and mechanical.	Understand
CO5	Explain different hazard identification tools in different industries with the knowledge of different types of chemical hazards	Understand

iii) SYLLABUS

Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation. Safety organization- objectives, types, functions, Role of management.

Personal protection in the work environment, Types of PPEs, Personal protective equipment- respiratory and non-respiratory equipment. Performance: Frequency rate, severity rate, incidence rate, activity rate. Housekeeping: Responsibility of management and employees. Typical industrial models and methodology.

Introduction to construction industry and safety issues in construction Safety in various construction operations – Excavation and filling – Under-water works – Under-pinning & Shoring – Ladders & Scaffolds – Tunneling – Blasting – Demolition – Confined space –

Temporary Structures. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative Trauma Disorders.

Machinery safeguard-Point-of-Operation, Principle of machine guarding -types of guards and devices. Safety in turning, and grinding. Welding and Cutting-Safety Precautions of Gas welding and Arc Welding, Material Handling equipment-operation & maintenance. . Hearing Conservation Program in Production industries.

Hazard and risk, Types of hazards –Classification of Fire, Types of Fire extinguishers. Identification of hazards: Inventory analysis, Fire and explosion hazard rating of process plants - Hazard and Operability study (HAZOP)) –Hazardous properties of chemicals, Material Safety Data Sheets

iv) a) TEXTBOOKS

1. **R.K Jain,** Industrial Safety, Health and Environment management systems, Khanna Publications, 2000.
2. **Paul S V,** Safety management System and Documentation training Programme handbook, CBS Publication, 2000.
3. **Krishnan, N.V.** Safety management in Industry. Jaico Publishing House, New Delhi, 1997.

b) REFERENCES

1. Guidelines for Process Hazards Analysis (PHA, HAZOP), Hazards Identification, and Risk Analysis, CRC Press 2018.
2. Safety Management System And Documentation Training Programme Handbook, CBS Publishers & Distributors, 2019
3. Hazards and Safety in Process Industries - Case Studies, CRC Press, 2021

v) COURSE PLAN

Module	Contents	No. of hours
I	Need for safety- Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation - Safety, organization- objectives, types, functions, Role of management - supervisors, workers, unions, government and voluntary agencies in safety. Safety policy- Safety Officer-responsibilities, authority. Safety committee-need, types, advantages.	9

II	Personal protection in the work environment -Types of PPEs, Personal protective equipment-respiratory and non-respiratory equipment. Standards related to PPEs. Monitoring Safety Performance - Frequency rate, severity rate, incidence rate, activity rate. Housekeeping- Responsibility of management and employees. Advantages of good housekeeping. 5 s of housekeeping. Work permit system- objectives, hot work and cold work permits.	**9**
III	Introduction to construction - industry and safety issues in construction. Safety in various construction operations – Excavation and filling – Under-water works – Under-pinning & Shoring – Ladders & Scaffolds. Tunneling – Blasting , Demolition – Confined space –Temporary Structures. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety. Relevance of ergonomics in construction safety. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative Trauma Disorders.	**9**
IV	Machinery safeguard-Point-of-Operation, Principle of machine guarding -types of guards and devices. Safety in turning, and grinding. Welding and Cutting-Safety Precautions of Gas welding and Arc Welding. Material Handling-Classification-safety consideration- manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking. Material Handling equipment-operation & maintenance. Maintenance of common elements- wire rope, chains slings, hooks, clamps. Hearing Conservation Program in Production industries.	**9**
V	Hazard and risk, Types of hazards –Classification of Fire, Types of Fire extinguishers, fire explosion and toxic gas release, Structure of hazard identification and risk assessment. Identification of hazards: Inventory analysis, Fire and explosion hazard rating of process plants - The Dow Fire and Explosion Hazard Index, Preliminary hazard analysis. Hazard and Operability study (HAZOP)) – methodology, criticality analysis, corrective action and follow-up. Control of Chemical Hazards- Hazardous properties of chemicals, Material Safety Data Sheets	**9**
	Total	**45**

vi) ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 100: 0

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
Final Examination (Summative)	:	**60 marks**
TOTAL	:	**100 marks**

vii) CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1½ hours
- Topics: 2 ½ modules

viii) NO END SEMESTER EXAMINATION

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23MEP20B	Hydraulic Machines Lab	PCC	0	0	3	0	2	2023

i) COURSE OVERVIEW

The objective of this course is to develop a platform where the students can enhance their engineering knowledge in the fluid mechanics domain by applying the theoretical knowledge acquired.

ii) COURSE OUTCOMES

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

CO 1	Apply the knowledge of fluid mechanics to calibrate the flow measuring devices by determining the hydraulic coefficients.	Apply
CO 2	Apply the knowledge of fluid mechanics to determine the stability of floating bodies.	Apply
CO 3	Apply the knowledge of fluid mechanics to determine pipe friction coefficients.	Apply
CO 4	Apply the knowledge of fluid mechanics to evaluate the performance of hydraulic machines .	Apply
CO 1	Apply the knowledge of fluid mechanics to calibrate the flow measuring devices by determining the hydraulic coefficients.	Apply

iii) LIST OF EXPERIMENTS

1. Study of taps, valves, pipe fittings, gauges, pitot tube, water meter.
2. Determination of coefficient of discharge and calibration of notches.
3. Determination of coefficient of discharge and calibration of orifice meter.
4. Determination of coefficient of discharge and calibration of venturimeter.
5. Determination of hydraulic coefficients of orifice.
6. Determination of Chezy's Constant and Darcy's coefficient on pipe friction apparatus.
7. Determination of metacentric height and radius of gyration of floating bodies.
8. Performance test on reciprocating pumps.
9. Performance test on centrifugal pumps.
10. Performance test on gear pump.
11. Performance test on impulse turbine.
12. Performance test on Francis turbine.
13. Performance test on Kaplan turbine.

Minimum 10 experiments to be completed.

iv) a) TEXTBOOKS

1. Modi P.N and Seth S.M, Hydraulics and Fluid Mechanics Including Hydraulic Machines, Standard Book House, New Delhi, 22ndEdition,2019

2. Yunus A. Cenegel, John M. Cimbala; Fluid Mechanics- Fundamentals and Applications, 4thedition, McGraw Hill, 2019

b) REFERENCES

1. Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, John W. Mitchell Fluid Mechanics, John Wiley and sons, 9thEdition,2016

v) ASSESSMENT PATTERN

Continuous Assessment : – 100 marks

Continuous Assessment		
Attendance	:	5 marks
Class work/ Viva-voce		55 marks
Final Exam	:	40 marks
TOTAL	:	100 marks

vi) FINAL EXAM

- Maximum Marks: 40
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23MEP20C	MACHINE TOOLS LAB	PCC	0	0	2	0	1	2023

i) COURSE OVERVIEW

The main objective of this lab is to practice on machine tools and identify, manipulate and control various process parameters during machining processes in manufacturing industry.

ii) COURSE OUTCOMES

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

CO1	Infer various process parameters and their influence on surface properties of various materials.	Understand
CO2	Make use of various machine tools for manufacturing components according to given production drawings.	Apply

iii) LIST OF EXPERIMENTS

1. **Exercises on Centre lathe**:- Facing, plain turning, step turning and parting –groove cutting, knurling and chamfering - form turning and taper turning –multi-start thread, square thread and internal thread etc.
2. **Exercises on drilling machine**- drilling, boring
3. **Exercises on shaping machine**: - flat surfaces, angular surfaces
4. **Exercises on milling machine**: - face milling, end milling – spur gear cutting –milling of keyways.
5. Study on Slotting machine, planning machine.
   (Minimum 10 experiments to be completed)

iv) a) TEXTBOOKS

1. Acharkan. N., Machine Tool Design Vol. 1 to 4, MIR Publication,2000
2. HMT, Production Technology, Tata McGraw Hill,2001

b) REFERENCES

1. W. A. J. Chapman, Workshop Technology Part I, ELBS & Edward Arnold Publishers,1956
2. G. S. Sawhney, Mechanical Experiments and Workshop Practice, Dream tech Press, 2019

v) ASSESSMENT PATTERN

Continuous Assessment : – 100 marks

Continuous Assessment		
Attendance	**:**	**5 marks**
Model Evaluation	:	25 marks
Lab Record	:	10 marks
Viva Voce	:	20 marks
Total Continuous Assessment	:	**55 marks**
Final Exam	:	**40 marks**
TOTAL	:	**100 marks**

vi) FINAL EXAM

- Maximum Marks: 40
- Exam Duration: 3 hours