CURRICULUM

(2022 Admitted students)

B Tech in Mechanical Engineering: Revised Teaching Scheme

DEPARTMENT OF MECHANICAL ENGINEERING

Dr B R AMBEDKAR NATIONAL INSTITUTE OF TECHNOLOGY, JALANDHAR

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CODING SCHEME FOR BTECH COURSES

The following scheme is the revised B Tech Teaching scheme and curriculum applicable from 2018 admission onwards.

It has been proposed to have a 07 letters alpha numeric code for each course – XXYY-ABB. Wherein the first four letters are alphabets and next 03 are numerals.

XX, Code for Department which is offering course
YY Code regarding the type of course
A-Code representing the year in which the course is offered
BB- Code representing the course

Departmental Codes

S. No.	Department	Code
1	Bio Technology	BT
2	Civil Engineering	CE
3	Chemical Engineering	CH
4	Computer Science & Engineering	CS
5	Electrical Engineering	EE
6	Electronics & Communication Engineering	EC
7	Information Technology	IT
8	Instrumentation & Control Engineering	IC
9	Industrial & Production Engineering	IP
10	Mechanical Engineering	ME
11	Textile Engineering	TT
12	Chemistry	CY
13	Humanities & Management	HM
14	Mathematics	MA
15	Physics	PH
16	Student Welfare	SW

Course Codes

S. No.	Type of Courses	Code
1	Common Institute requirement	CI
2	Programme Core	PC
3	Programme Elective	PE
4	Open Elective	OE
5	Minor Elective	MI

SCHEME OF INSTRUCTION

B Tech in Mechanical Engineering Course Structure (2022 Admission)

B. Tech. 1st Year Semester I

S. No.	Course Code	Course Title	L	T	P	C
1	PHCI-101	Applied Physics-A	3	1	0	4
2	MECI-101	Elements of Mechanical Engineering	3	1	0	4
3	CSCI-101	Computer Programming	3	0	0	3
4	MACI-101	Applied Mathematics-I	3	1	0	4
5	HMCI-101	Management, Principles & Practices	3	0	0	3
6	MECI-102	Engineering Graphics and CADD	1	0	4	3
7	PHCI-102	Applied Physics-A Lab	0	0	2	1
8	CSCI-102	Computer Programming Lab	0	0	2	1
		Total Credits	**16**	**3**	**8**	**23**

B. Tech. 1st Year Semester II

S. No.	Course Code	Course Title	L	T	P	C
1	CYCI-101	Applied Chemistry-A	3	1	0	4
2	MACI-102	Applied Mathematics-II	3	1	0	4
3	ICCI-101	Basic Electrical Science	3	1	0	4
4	HMCI-102	English Communication& Report Writing	3	0	0	3
5	IPCI-101	Manufacturing Processes	2	0	0	2
6	IPCI-102	Product Realization through Manufacturing Laboratory	0	0	4	2
7	HMCI-103	English Communication Lab	0	0	2	1
8	CYCI-103	Applied Chemistry-A Lab	0	0	2	1
9	CYCI-104	Environmental Studies	3	0	0	3
		Total Credits	**17**	**3**	**8**	**24**

Basic Engineering Courses Selected

1. MECI-101 Elements of Mechanical Engineering
2. ICCI-101 Basic Electrical Science

B. Tech. 2nd Year Semester III

S. No.	Course Code	Course Title	L	T	P	C
1	MEPC-201	Strength of Materials	3	1	0	4
2	MEPC-203	Theory of Machines	3	1	0	4
3	MEPC-205	Machine Drawing	1	0	6	4
4	MEPC-207	Applied Thermodynamics-I	3	1	0	4
5	MEPC-209	Material Science and Metallurgy	3	0	0	3
6	MEPC-211	Fluid Mechanics-I	3	1	0	4
7	MEPC-213	Strength of Material and Material Characterization Lab	0	0	2	1
		Total Credits	**16**	**4**	**8**	**24**

B. Tech. 2nd Year Semester - IV

S. No.	Course Code	Course Title	L	T	P	C
1	MEPC-202	Applied Thermodynamics-II	3	1	0	4
2	MEPC-204	Dynamics of Machines	3	1	0	4
3	MEPC-206	Mechanics of Deformable Bodies	3	1	0	4
4	MEPC-208	Production Processes	3	0	0	3
5	MEPC-210	Fluid Mechanics-II	3	1	0	4
6	MACI-201	Mathematics-III	3	1	0	4
7	MEPC-214	Production Processes Lab	0	0	2	1
		Total Credits	**18**	**5**	**2**	**24**

B Tech 3rd Year Semester V

S. No.	Course Code	Course Title	L	T	P	C
1	MEPC-301	Design of Machine Elements-I	3	0	0	3
2	MEPC-303	Heat Transfer	3	0	0	3
3	MEPC-305	Internal Combustion Engines and Emission Control	3	0	0	3
4	MEPC-309	Mechatronics	3	0	0	3
5	MEPC-319	Computer Aided Design (CAD)	3	0	0	3$
6	HMCI-202	Entrepreneurship Development and Management	3	0	0	3
7	MEPC-323	Applied Thermal and e-Mobility Engineering Laboratory	0	0	2	1#
8	MEPC-313	Design of Machine Elements-I Lab	0	0	2	1
9	MEPC-315	Heat Transfer Lab	0	0	2	1
10	MEPC-321	Computer Aided Design (CAD) Lab	0	0	2	1$
11	MECI-300	Minor Project, Phase-I	0	0	2	0*
		Total Credits	**18**	**0**	**10**	**22**

* Minor Project, to be allotted in beginning of 5th Semester, evaluation at the end of 6th Semester
# Course code, course name & syllabus has been modified in 14th Board of Studies held on May 26, 2023
$ Theory course & laboratory shifted in V semester from VIII semester in 13th Board of Studies held on July 19, 2022

B Tech 3rdYear Semester VI

S. No.	Course Code	Course Title	L	T	P	C
1	MEPC-302	Fluid Machinery	3	0	0	3
2	MEPC-304	Industrial Automation	3	0	0	3
3	XXOE-XXX	Open Elective-I	3	0	0	3
4	MEPE-3XX	Programme Elective-I	3	0	0	3
5	MEPC-306	Design of Machine Elements-II	3	0	0	3
6	MEPC-307	Mechanical Measurement & Metrology	3	0	0	3*
7	MEPC-310	Fluid Mechanics and Fluid Machinery Lab	0	0	2	1
8	MEPC-312	Industrial Automation & Mechatronics Lab	0	0	2	1#
9	MEPC-314	Design of Machine Elements-II Lab	0	0	2	1
10	MEPC-317	Mechanical Measurement & Metrology Lab	0	0	2	1*
11	MECI-300	Minor Project, Phase-II	0	0	2	2
		Total Credits	**18**	**0**	**10**	**24**

$ Theory course & laboratory shifted in VI semester from V semester in 14th Board of Studies held on May 26, 2023
# Syllabus has been modified in 14th Board of Studies held on May 26, 2023

B. Tech. 4thYear Semester VII

S. No.	Course Code	Course Title	L	T	P	C
1	MEPC-401	Refrigeration and Air Conditioning	3	0	0	3
2	MEPC-403	Vibrations and Control	3	0	0	3
3	MEPE-4XX	Programme Elective-II	3	0	0	3
4	MEPE-4XX	Programme Elective-III	3	0	0	3
5	XXOE-XXX	Open Elective-II	3	0	0	3
6	MECI-411	Industrial Lecture*	1	0	0	1
7	MECI-400	Major Project (Phase –I)	0	0	4	0**
8	MEPC-405	Refrigeration and Air Conditioning Lab	0	0	2	1
9	MEPC-407	Vibrations and Control Lab	0	0	2	1$
10	MECI-413	Industrial Practical Training	0	0	0	2#
		Total Credits	**16**	**0**	**8**	**20**

***** Minimum 04 Industrial lectures to be organized by department in final year of study. Grades to be awarded based upon Quiz test on the same day of lecture

** Major Project, to be allotted in beginning of 7th Semester, evaluation at the end of 8th Semester

#Industrial Practical Training will be held during summer vacation after sixth semester

$Syllabus has been modified in 14th Board of Studies held on May 26, 2023

B. Tech. 4thYear Semester VIII*

S. No.	Course Code	Course Title	L	T	P	C
1	MEPEX-4XX	Programme Elective-IV	3	0	0	3
2	MEPE-4XX	Programme Elective-V	3	0	0	3
3	MEPE-4XX	Programme Elective-VI	3	0	0	3
4	MEPE-4XX	Programme Elective-VII	3	0	0	3
5	XXOE-XXX	Open Elective-III	3	0	0	3
6	MECI-400	Major Project (Phase –II)	0	0	8	4
		Total Credits	**15**	**0**	**8**	**19**

Industrial training in 8th semester will carry 12 credit equivalent to 4 elective subjects

*Teaching Scheme for Eight semester has been modified in 13th Board of Studies held on July 19, 2022

Note: Industrial training in 8th semester will carry 12 credit equivalent to 4 elective subjects

DETAILED CURRICULUM for 2nd year courses

B Tech 2nd Year **Semester-III**

Course Title	**:**	**Strength of Materials**			
Course Code	**:**	**MEPC-201**	**Course Type**	**:**	**Core**
Contact Hours	**:**	**L- 3 T- 1 P- 0**	**Credit**	**:**	**4**
Program/Semester	**:**	**B. Tech.**			
Evaluation Scheme	**:**	**Mid Sem Exam (30%), End Sem Exam (50%), Quizzes & Assignments (20%)**			

Pre-requisites: Elements of Mechanical Engineering
Course Assessment Method: Both continuous and semester end examination.
Topics to be covered: All.

Course Outcomes: At the end of the course the student will be able to

CO 1	Understand the theoretical concepts of mechanics of solids.
CO 2	Apply the systematic methods for solving engineering problems such as calculations of stresses, strains, shear forces, bending moments etc.
CO 3	Evaluate the tensile/compressive/bending/shear stresses and combination of these in beams, shafts, composite-sections, columns etc including calculations of slope and deflection.
CO 4	Assess the combined loading for the design of Industrial components and machine elements.

Course Details:

Simple stresses and strains: Concept of stress and strain: St. Venant's principle, Stress and strain diagram, Hooke's law, Young's modulus, Poisson ratio, stress at a point, stresses and strains in bars subjected to axial loading, Modulus of elasticity, stress produced in compound bars subjected to axial loading, Temperature stresses and strain calculations due to applications of axial loads and variation of temperature in single and compound walls.

Compound stresses and strains: Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stress, ellipse of stress and their applications, Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain, Relationship between elastic constants.

Bending moment and shear force diagrams: Bending moment and shear force diagrams, SF and BM definitions. BM and SF diagrams for cantilevers, simply supported and fixed beams with or without overhangs and calculation of maximum BM and SF and the point of contraflexure under Concentrated loads, Uniformity distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

Theory of bending stresses: Assumptions in the simple bending theory, derivation of formula: its application to beams of rectangular, circular and channel sections, composite/fletched beams, bending and shear stresses in composite beams. Unsymmetrical Bending, Combined bending and torsion, bending and axial loads etc.

Slope and deflection: Relationship between moment, slope and deflection, Moment area method, Macaulay's method, Use of all these methods to calculate slope and deflection for the determinant beams.

Torsion: Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion.

Columns and struts: Columns under uni-axial load, Buckling of Columns, Slenderness ratio and conditions. Derivations of Euler's formula for elastic buckling load, equivalent length, Rankine Gordon's empirical formula.

List of Extended Activities:

1. Solving problems for axial assemblies, beams, shafts, column members etc. via MDSolids software.

2. Solving problems for Mohr's circle analysis via MDSolids software.

Suggested Textbooks:

1. Gere J and Goodno B J, "Mechanics of Materials", 7th Edition, Cengage Learning, Toronto, Canada (2009).
2. Beer P F and Johnston (Jr) E R, *"Mechanics of Materials"*, SI Version, Tata McGraw Hill, India (2001).
3. Hearn E.J., "Mechanics of Materials 1", 3rd Edition, Butterworth Heinemann, Linacre House, Jordan Hill, Oxford, Woburn, UK.
4. Jindal U C, *"Introduction to Strength of Materials"*, 3rd Edition, Galgotia Publishing Private Limited New Delhi (2001).
5. Popov E P, *"Engineering Mechanics of Solids"*, SI Version 2nd Edition, Prentice Hall of India, New Delhi (2003).
6. Timoshenko S P and Young D H, *"Elements of Strength of Materials"*, 5th Edition, East West Press, New Delhi (1984).
7. Pytel A H and Singer F L, *"Strength of Materials"*, 4th Edition, Harper Collins, New Delhi (1987).

Online Resources:

1. https://nptel.ac.in/courses/105105108
2. https://www.youtube.com/playlist?list=PLtpJfjyaifnkon5gE5-XErIWYoYC-fGAJ
3. https://web.mst.edu/mdsolids/

Course Title	**:**	**Machine Drawing**			
Course Code	**:**	**MEPC-205**	**Course Type**	**:**	**Core**
Contact Hours	**:**	**L- 1 T- 0 P- 6**	**Credit**	**:**	**4**
Program/Semester	**:**	**B. Tech.**			
Evaluation Scheme (Suggested)	**:**	40% Assignments in the form of drafting (**software based**) exercises 30% Mid Term Evaluation 30% End Term Evaluation			

Pre-requisites: Engineering Graphics & CADD (MECI-102) (1 0 4 3)
Course Assessment Method: Both continuous and semester end examination.
Topics to be covered: All.
Course Outcomes: At the end of the course the student will be able to:

CO 1	Interpret the conventions/ Standardized representation used in development of part and assembly drawings.
CO 2	Create part/assembly drawings of standard Mechanical components using drafting/design software.
CO 3	Create and Analyse three dimensional models of Mechanical Assemblies/components using drafting/design software.
CO 4	Apply tolerance, machining, processing and surface finish symbols in relation to few Industrial components.

Course Details:

Review of Principle of Orthographic Projections, Sectioning, dimensioning, Standardized representation of screw threads, screw fasteners, welds, bearings, springs and related components. Introduction to limits, fits and tolerances, dimensional and geometric tolerances, surface finish symbols.
Generation of part and assembly drawings including sectioning and bill of materials. Detailing of components involving shafts, couplings, bearing, pulleys, gears, machine tool parts and miscellaneous components.
Note: First angle projection to be used. BIS codes for various applications in Machine Drawing. Drawings should contain bill of materials and illustrate the use of its tolerances and surface finish requirements.
The syllabus given above indicates the broad outlines and the scope of the subject to be covered.

List of Extended Activities:

- Solid modelling of Screw jack, drill press vice, connecting rod, eccentric.
- Solid modelling of Lathe tail stock, tool post.
- Solid modelling of incorporating assembly constraints for animation of motion of machine components such as shafts, couplings, bearings, pulleys, gears assemblies.

Suggested Textbooks:

1. French T E, Vierck C J, and Foster R, "Engineering Drawing and Graphic Technology", 14th Ed., McGraw-Hill, 2003.
2. SP 46: 1988, "Engineering Drawing Practice for Schools and Colleges", Bureau of Indian standards.
3. Bhatt N D, "*Machine Drawing*", 26th Edition, Charotar Publishing House, Anand (1991).
4. Gill P S, "*Machine Drawing*", 17th Edition, S K Kataria and Sons, New Delhi (2002).
5. Goetsch David L, Chalk W, Nelson John A, "*Technical Drawing (Drafting and Design)*" Delmar Publishers, 2000.
6. Lakshminarayanan, V., and Mathur, M.L., "Text Book of Machine Drawing (with Computer Graphics)", 12th Ed., Jain Brothers, 2007.
7. Online Resources
8. Sidheshwar N, Kannaiah P and Sastry V V S, "*Machine Drawing*", 27th Reprint, TataMcGraw Hill, New Delhi (2003).

Online resources:

1. https://www.autodesk.in/campaigns/autocad-tutorials
2. https://my.solidworks.com/training

B Tech 2nd Year **Semester-III**

Course Title	**:**	**Applied Thermodynamics-I**			
Course Code	**:**	**MEPC-207**	**Course Type**	**:**	**Core**
Contact Hours	**:**	**L- 3 T- 1 P- 0**	**Credit**	**:**	**4**
Program/Semester	**:**	**B. Tech.**			
Evaluation Scheme (Suggested)	**:**	**Mid Sem Exam (30%), End Sem Exam (50%), Quizzes (at least two) (15%), and Assignment/Project (5%)**			

Pre-requisites: None

Course Assessment Method: Both continuous and semester end examination.

Topics to be covered: All.

Course Outcomes: At the end of the course the student will be able to:

CO 1	Use the properties of the steam to solve Rankine cycle, reheating, regeneration and Binary vapour cycle
CO 2	Solve for Boiler performance and boiler draught applicable to Thermal Power Plants.
CO 3	Analyse the flow of steam through different types of nozzles, steam injector and calculate Nozzle efficiency.
CO 4	Apply the principles of thermodynamics and evaluate the performance of various types of steam turbines.
CO 5	Evaluate the cooling load in a different type of steam condensers .
CO6	Solve and analyse the isothermal efficiency and performance of reciprocating air compressors.

Course Details:

Fundamentals: Pure substances, Thermodynamic property relations, Properties of mixtures, Fuel and Combustion.

Steam Generators: Review of steam generation process. Classification, Fire and water tube boilers, Description of Cochran, Locomotive, Lancashire Babcock and Wilcox boilers and Sterling Boiler, mountings and accessories: Economizer, super heater etc. Modern high pressure boilers, Characteristics of high pressure boilers, Advantages of forced circulation, steam accumulators, boiler performance, equivalent evaporation, boiler efficiency, Boiler Trial.

Working Cycles: Simple Rankine cycle, methods of improving efficiency: Feed water heating (Bleeding), reheat cycle, combined reheat and regenerative cycle, Ideal working fluid – Binary vapour cycle, combined power and heating cycles. Introduction to Steam Engine with brief discussion.

Nozzle: Types of nozzles and their utility, Flow of steam through nozzles, Critical pressure and discharge, Area of throat and exit for maximum discharge, Effect of friction on Nozzle efficiency, Supersaturated flow.

Steam Turbines: Classification; Impulse & Reaction Steam turbines, description of

components, Pressure and velocity compounding, Velocity diagram and work done, Effect of blade friction on velocity diagram, Stage efficiency and overall efficiency, Reheat factor and condition curve. Degree of reaction, blade efficiency and its derivation; calculation of blade height, backpressure and extraction turbines and cogeneration; Economic assessment. Method of attachment of blades to turbine rotor, losses in steam turbines, governing of steam turbines, Labyrinth packing.

Condensers: Function, Elements of condensing plant, types of condensers, Dalto's law of partial pressure applied to condenser problems, condenser and vacuum efficiencies. Cooling water calculations. Effect of air leakage, Methods to check and prevent air infiltration. Description of air pump and calculation of its capacity.

Reciprocating Air Compressors: Use of compressed air in industry. Classification of air compressors, Operation of single stage reciprocating compressors, Work input and the best value of index of compression. Isothermal and polytropic efficiency. Effect of clearance and volumetric efficiency, Multistage compression and its advantages. Optimal multistaging, work input in multistage compression, Reciprocating air motors.

List of Extended Activities:

1. Study of various boilers with the help of models.
2. Visit to some Thermal Power Generation Plant to understand the actual steam generation by boiler and power generation by steam turbine.

Suggested Textbooks:

1. Yunus A Cengel, Michael A Boles, "Thermodynamics: An Engineering Approach", Tata McGraw Hill, New Delhi.
2. P.K. Nag, "Engineering Thermodynamics", McGraw Hill
3. R. Yadav, "Applied Thermodynamics", Central Publishing House

Online Resources:

https://archive.nptel.ac.in/courses/112/105/112105123/

Course Title	**:**	**Materials Science and Metallurgy**			
Course Code	**:**	**MEPC-209**	**Course Type**	**:**	**Core**
Contact Hours	**:**	**L- 3 T- 0 P- 0**	**Credit**	**:**	**3**
Program/Semester	**:**	**B. Tech.**			
Evaluation Scheme	**:**	**Mid Sem Exam (30%), End Semester Exam (50%), Quizzes (Minimum 2)- 15%, Assignments (5%)**			

Course Assessment Method: Both continuous and semester end examination.
Course Outcomes: At the end of the course the student will be able to-

CO 1	Relate between "Structure-Process-Property- Performance" of materials.
CO 2	Interpretation of Phase Diagrams, various strengthening mechanisms in metals and alloys and utilize these for improvement in mechanical properties.
CO 3	Interpret the effect of cooling rate using TTT and CCT diagrams on the microstructure and properties of materials.
CO 4	Understand the origin of various properties of materials and apply various heat treatment processes for development of desirable properties in materials.
CO 5	Design alloys, heat treatment processes for improvement in properties of metals and alloys.

Course Details:

Structure of Crystalline Solids: Crystal structure and crystal systems, closed packing, some prominent crystal structures, Miller indices of Directions and planes, determination of crystal structure using X-Ray diffraction.

Imperfections in Solids: Point, line and surface defects, Berger's vector, Slip and plastic deformation, Importance of defects and their effect on properties of materials, Strengthening Mechanisms, Grain Boundaries and deformation, effect of grain size on properties, determination of grain size.

Phase Diagrams- Phases & Phase Diagram, Solubility & Solid Solutions, Unlimited & Limited Solid Solubility, Solid Solution Strengthening, Binary Isomorphous Phase Diagrams, Equilibrium and non-equilibrium Solidification of solid solutions, Eutectic Phase Diagrams, Principle of Dispersion Strengthening

Iron Carbon Diagram: Allotropic forms of carbon, Eutectic & Eutectoid Reactions, types of steels, types of cast irons, microstructures at various carbon percentages, properties as a function of microstructure.

Phase Transformations & Heat Treatment Processes: Kinetics of Phase Transformations, Isothermal Transformation Diagrams, Continuous Cooling Transformations, mechanism of various transformations, and significance of TTT diagram in heat treatments. Designation & Classification of steels, Isothermal heat Treatments, Quench & Temper Heat Treatments, meaning of hardenability, tests of hardenability, factors affecting hardenability, Effect of Alloying Elements on strength and hardness, effect on hardenability, effect on transformation temperature, Introduction to chemical heat treatment, mechanism and methods of carburizing, nitriding, cyaniding, introduction to flame hardening.

Origin of Properties & their manipulation- Origins of Density, Young's Modulus, strength, ductility, toughness and their manipulation through various routes, microstructure sensitive and insensitive properties.

High performance alloys- Aluminium Alloys, Magnesium & Beryllium Alloys, Copper Alloys, Nickel & Cobalt Alloys, Titanium Alloys, Age Hardening and its uses

Extended Activities:

1. Determination of crystal structure using X-Ray Diffractometer.
2. Determination of grain orientation using EBSD.
3. Use ANSYS- GRANTA Edupack software to explore Heat Treatment Process – Mechanical Property correlation.

Suggested Textbooks:

1. Askeland R D, Phule P P, "The Science and Engineering of Materials", 5th Edition, Indian Reprint, Thomson Learning, Canada, (2007).
2. Callister D W, "Callister's Materials Science and Engineering", Indian Adaptation, Wiley India P Ltd, New Delhi, (2011).
3. Avner H S, "Introduction to Physical Metallurgy", 2nd Edition, Tata McGraw Hill , New Delhi .
4. Asvhby M, Shercliff H and Cebon D, "Materials: Engineering, science, processing and design",

3rd Edition, Butterworth-Heinemann, Oxford, UK (2014).

Online resources:

1. https://www.youtube.com/playlist?list=PLEhtSI8r-9H6lWZvDn2pl-ZeI8_6K0jWm
2.NPTEL- Introduction to materials science and engineering, https://archive.nptel.ac.in/courses/113/102/113102080/
3.Teaching Materials- HKDH Bhadhesia, Cambridge University, https://www.phase-trans.msm.cam.ac.uk/teaching.html#MP6

Course Title	**:**	**Fluid Mechanics-I**			
Course Code	**:**	**MEPC-210**	**Course Type**	**:**	**Core**
Contact Hours	**:**	**L- 3 T- 1 P- 0**	**Credit**	**:**	**4**
Program/Semester	**:**	**B. Tech.**			
Evaluation Scheme (Suggested)	**:**	**Mid Sem Exam (30%), End Sem Exam (50%), Quizzes (at least two) (15%), and Assignment/Project (5%)**			

Pre-requisites: Elements of Mechanical Engineering (MEPC-101).
Course Assessment Method: Both continuous and semester end examination.
Course Outcomes: At the end of the course the student will be able to:

CO 1	Understand the physical properties of a fluid, calculating the pressure distribution for incompressible fluids in static condition and the formulation of the problems on static fluid and solve them.
CO 2	Describe the principles of motion for fluids, describe the velocity and acceleration. Derivation and application of the equation of the conservation of energy.
CO 3	Derive of general governing equations of fluid mechanics, application the equation of the conservation of mass, apply the equation of the conservation of momentum in constrained flow
CO 4	Understand the use of the dimensional analysis and derivation of the dimensionless numbers, apply the similitude concept and set up the relation between a model and a prototype.
CO5	Understand the mechanics of flow about immersed boundaries, profile drag, drag coefficients and the determination of drag forces.

Course Details:

Fluid and their properties: Concept of fluid, difference between solids, liquids and gases; ideal and real fluids; properties of fluid, Newtonian and non-Newtonian fluids.
Fluid Statics: Pressure and its measurement, Pascal's law and its engineering applications, Hydrostatic force on a plane and curved submerged surfaces, resultant force and center of pressure, Buoyancy and flotation, stability of floating and submerged bodies, metacentric height and its determination, pressure distribution in a liquid subjected to constant horizontal/ vertical acceleration, rotation of liquid in a cylindrical container.
Fluid Kinematics: Classification of fluid flows, velocity and acceleration of fluid particle, local and convective acceleration, normal and tangential acceleration, streamline, path line and streak line, continuity equation; Rotational flows, rotation velocity and circulation, stream and velocity potential functions, flow net.
Fluid Dynamics: Euler's equation, Bernoulli's equation and steady flow energy equation; applications of Bernoulli's equation, impulse momentum equation, flow along a curved streamline, free and forced vortex motions.
Flow measurements: Pitot tube, Siphon, Venturimeter, Orificemeter, Mouthpiece, Weirs and notches
Viscous Flow: Navier-Stokes equation of motion, relationship between shear stress and pressure gradient, two-dimensional laminar flow between two fixed parallel planes and pipe flow, plain Couette flow, Minor Losses in Pipe Systems, Multiple-Pipe Systems, Experimental Duct Flows: Diffuser Performance, Fluid Meters.
Dimensional Analysis and Similitude: Fundamental and derived units and dimensions, dimensional

homogeneity; Rayleigh's and Buckingham's Pi method for dimensional analysis; Dimensionless numbers and their significance; model studies.

Flow Around Immersed Bodies: Concept of friction, pressure, wave and induced drag- lift and drag coefficients; variation of drag coefficient with Reynolds number for two dimensional bodies (flat plate, circular cylinder); Vortex shedding from cylindrical bodies, effect of streamlining; drag coefficient versus Reynolds number for flow past axisymmetric bodies (sphere); Terminal velocity, lift of an airfoil, airfoil of finite length-effect on drag and lift, downwash and induced drag

List of Extended Activities:

1. Determination of Floating condition of body
2. Verification of Bernoulli's Theorem
3. Use of ANSYS-FLUENT for fluid Mechanics Problem

Suggested Textbooks:

5. Çengel, Y.A. and J.M. Cimbala, Fluid Mechanics, McGraw-Hill, Boston, MA.
6. Munson, B.R., D.F. Young, and T.H. Okiishi, Fundamentals of Fluid Mechanics, 4th Ed., Wiley, New York, NY, 2002.
7. White, F. M., Fluid Mechanics, Fifth Edition, McGraw Hill 2003.
8. Fluid Mechanics – V L Streeter and E B Wylie, McGraw Hill
9. Currie, I.G., Fundamental Mechanics of Fluids, 2nd Edition, McGraw Hill 1993.
10. Fluid Mechanics and Hydraulic Machines – R K Rajput, S chand& Co. Ltd.
11. Mechanics of Fluids – I H Shames, McGraw Hill .
12. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons
13. Kundu, P. K., and Ira M. Cohen, Fluid Mechanics, 4th ed., Academic Press, 2007/Elsevier, 2008. ISBN-10: 0123737354, ISBN-13: 978-0123737359.
14. White, F. M., Viscous Fluid Flow, 2nd Edition, McGraw Hill 1991.
15. Panton, R.L., Incompressible Flow, 2nd Ed., John Wiley & Sons, 1996.
16. Chevray, R. and J. Mathieu, Topics in Fluid Mechanics, Cambridge University Press, 1993.

Online Resources:

Course Title	**:**	**Strength of Materials and Material Characterization Lab**			
Course Code	**:**	**MEPC-213**	**Course Type**	**:**	**Core**
Contact Hours	**:**	**L- 0 T- 0 P- 2**	**Credit**	**:**	**1**
Program/Semester	**:**	**B. Tech.**			
Evaluation Scheme (Suggested)	**:**	Internal Examination (50%), End Sem Examination & Viva (50%)			

Pre-requisites: None.

Course Assessment Method: Both continuous and semester end examination.

Topics to be covered: All.

Course Outcomes: At the end of the course the student will be able to:

CO 1	Get exposure of testing and characterization facilities for finding various mechanical properties such as tensile, compressive, impact, hardness etc.
CO 2	Compare the theoretical topics via experimental practices such as shear force, bending moment, torsion, deflection, fatigue etc.
CO 3	Examine the nature, microstructure of different materials and their interpretation by using metallurgical microscope.

CO 4	Analyze & plan their project work by utilizing these testing facilities.

List of Experiments:

Experiment 1: To determine the Young's modulus, Yield strength, Ultimate tensile strength, percentage elongation and percentage reduction in area for mild steel specimen on Universal Testing Machine (UTM). Also plot the stress-strain curve for these tested specimens.

Experiment 2: To determine the compressive strength for the cast iron specimen on Universal Testing Machine (UTM).

Experiment 3: Impact Test

a) To determine the Impact strength of the given specimen using Charpy impact testing machine.
b) To determine the Impact strength of the given specimen using Izod impact testing machine.

Experiment 4: Shear Force Apparatus

a) To determine the variation of shear force with an increasing point load.
b) To examine how shear force varies at the cut position of beam for various loading conditions.

Experiment 5: Bending Moment Apparatus

a) To study the variation of bending moment at a point with an increasing point load.
b) To study how bending moment varies at the cut position of beam for various loading conditions.

Experiment 6: Hardness Test

a) To determine the hardness of the given specimen using Rockwell hardness tester.
b) To determine the hardness of the given specimen using Brinell hardness tester.
c) To determine the hardness of the given specimen using Vickers hardness tester.

Experiment 7: To perform the bending test on a mild steel specimen using Universal testing machine and determination of deflection and verification of beam formula in bending.

Experiment 8: To determine modulus of rigidity and angle of twist of given specimen using torsional testing machine.

Experiment 9: To analyse the microstructure of steel and cast iron using metallurgical microscope.

Experiment 10: Research Based Experiment

To study and plot mechanical hysteresis curve of metal and polymer composite materials using the MTS servo-hydraulic universal testing machine.

B Tech 2nd Year **Semester-IV**

Course Title	**:**	**Applied Thermodynamics-II**			
Course Code	**:**	**MEPC-202**	**Course Type**	**:**	Core
Contact Hours	**:**	**L- 3 T- 1 P- 0**	**Credit**	**:**	**4**
Program/Semester	**:**	**B Tech**			
Evaluation Scheme (Suggested)	**:**	**Mid Sem Exam (30%), End Sem Exam (50%), Quizzes or practical problems Assignment with project (at least two) (15%), and Assignments (5%)**			

Pre-requisites: Applied Thermodynamics-I (MEPC-207)

Course Assessment Method: Both continuous and semester end examination.

Topics to be covered: All.

Course Outcomes: At the end of the course the student will be able to:

CO 1: Apply mass, momentum, energy and entropy balances to compressible flow and use compressible flow tables and relations to solve problems involving compressible flow in a nozzle and diffuser.

CO 2: Apply the principles of thermodynamics to evaluate the performance of Rotary, Centrifugal and Axial Air compressors,

CO 3: Design the bladeing, study the velocity triangles and estimate the performance of centrifugal and axial flow compressors.

CO4: Understand the ideal and real thermodynamic cycles of air-breathing engines and Industrial gas turbines Gas Turbines incorporating intercooling, reheat, regeneration, afterburning, etc.

Course Details:

Introduction: Stagnation properties, sonic velocity and Mach number, Mach waves, Flow through Nozzles and diffusers, Metastable state and super saturated flow, thrust function. Flow through variable area, isentropic flow, adiabatic flow with friction; Flow through constant area with friction (Fanno Flow), Frictionless Flow through a constant area duct with heat transfer (Rayleigh Flow), Isothermal flow through a constant area duct, normal shock waves, Rankine Hugoniot equation, Strength of shock waves, application of gamma function to specific flow process.

Rotary Compressors: Classification of rotary compressors, comparison with reciprocating compressors, working of rotary compressors like Roots blower, Lysholm Compressor and Vanetype Blower. Determination of total work done for compressors, energy loss in internal friction.Isentropic, polytropic and isothermal efficiencies of compressor.

Centrifugal Compressors: Thermodynamic analysis of centrifugal compressor: Stage, polytropic, isentropic and isothermal efficiencies, velocity vector diagrams for centrifugal compressors, power calculation, pre-guided vanes, pre-whirl, Slip factor, power input factor. Modes of energy transfer in impeller and diffuser. Degree of reaction and its derivation, energy transfer in backward, forward and radial vanes, Derivation of Non-dimensional parameters for plotting compressor characteristics, surging and choking in centrifugal compressors. Various losses occurring in centrifugal compressors and application of centrifugal compressors.

Axial Flow Compressor: Components of axial flow compressor, aerofoil blading, angle of attack, coefficients of lift and drag, turbine versus compressor blades, velocity vector diagrams,

thermodynamic analysis and power calculations. Modes of energy transfer in rotor and stator blade flow passages. Work done factor, Degree of reaction and Blade efficiency, isentropic polytropic and Isothermal Efficiencies. Surging, choking and stalling in axial flow compressors, characteristic curves for axial flow compressor, flow parameters of axial flow compressor pressure coefficient, flow coefficient, work coefficient and temperature rise coefficient, specific speed etc. Comparison of axial flow compressor with centrifugal compressor and reaction turbine.Application of axial flow compressors.

Gas Turbines: Classification, Open and closed cycle and their comparison. Application of gas turbine. Position of gas turbine in power industry. Thermodynamic analysis-Brayton cycle, calculation of net output, work ratio, and thermal efficiency, Operating variables and their effects on thermal efficiency and work ratio. Gas turbine cycle with regeneration, intercooling, multistage compression and expansion. Closed and semi closed gas turbine cycle, requirements of a gas turbine combustion chamber, types of combustion chambers, Pressure losses in heat exchangers and combustion chambers. Gas turbine fuels.

Jet Propulsion: Principle of jet propulsion, Performance characteristics of different propulsion systems, Application of various propulsion systems.

Extended Activity:
Application of Matlab to analyse the performance of Axial Flow Compressor, Centrifugal Compressor, Gas Turbine, Compressible Flow and Jet Propulsion

Suggested Textbooks:

1. Shepherd D G, "An Introduction to Gas Turbine", Von Nastrand, New York (1949).
2. Stodola A, "Steam and Gas Turbines", McGraw Hill Book Company, (1970).
3. Shapiro A M, "Dynamics and Thermodynamics of Compressible Fluids", Ronald"s Press, New York (1953).
4. Benson R W, "Advanced Engineering Thermodynamics", Pergamon Press, London (1975).
5. Cohen H, Rogers G F C and Saravanamuttoo H I H, "Gas Turbine Theory", Orient Longman Limited, New Delhi (1996).

Resources: NPTEL

Course Title	**:**	**Mechanics of Deformable Bodies**			
Course Code	**:**	**MEPC-206**	**Course Type**	**:**	**Core**
Contact Hours	**:**	**L- 3 T- 1 P- 0**	**Credit**	**:**	**4**
Program/Semester	**:**	**B. Tech.**			
Evaluation Scheme	**:**	**Mid Sem Exam (30%), End Semester Exam (50%), Quizzes (Minimum 2)- 15%, Assignments (5%)**			

Pre-requisites: Elements of Mechanical Engineering, Strength of Materials
Course Assessment Method: Both continuous and semester end examination.
Topics to be covered: All.
Course Outcomes: At the end of the course the student will be able to learn

CO 1	3-D stress analysis: Analytical and graphical methods (Mohr's circle) understanding and problem solving

CO 2	Basic concept of strain energy for 2-D and 3-D state of stress.
CO 3	Theories of Failure: Ability solve problem related to maximum stress, maximum strain, and strain energy theory of failure.
CO 4	Thin & Thick Cylinders: Basic concept of design of thin & thick cylinders and problem solving.
CO5	Bending of curved beams: Basic concepts and problem solving
CO6	Springs: Analysis of closed and open coiled helical, flat spiral, and leaf springs. Problem solving related to mentioned topics.
CO7	Indeterminate systems: Basic concept of indeterminate structures and problem solving
CO8	Distribution of shear stress in beams: Derivation of general formula and its application to rectangular, triangular, I, C, T, L, circular and hollow sections and problem solving.

Course Details:

Strain energy: Energy of dilation and distortion, resilience stress due to suddenly applied loads, Castigliano's theorem, Maxwell's theorem of reciprocal deflection.
Theories of Failure: Maximum principal stress theory, maximum shear stress theory, maximum strain energy theory, maximum shear strain energy theory, graphical representation and derivation of equation for each and their application to problems relating to two-dimensional stress systems only.
Distribution of Shear Stress in Beams: Derivation of general formula and its application to rectangular, triangular, I, C, T, L, circular and hollow sections.
Springs: Closed and open coiled helical springs: Derivation of formula and application for deflection and rotation of free end under the action of axial load and or axial couple; flat spiral springs – derivation of formula for strain energy, maximum stress and rotation. Leaf spring, deflection and bending stresses
Thin Cylinders and Sphere: Derivation of formulae and calculations of hoop stress longitudinal stress in a cylinder, and sphere subjected to internal pressures increase in diameter and volume.
Thick Cylinders: Derivation of Lame's equations, calculation of radial longitudinal and hoop stresses and strains due to internal pressure in thick cylinders, compound cylinders, hub shrunk on solid shafts.
Bending of curved beams: Calculation of stresses in crane or chain hooks, rings of circular section and trapezoidal section and chain links with straight sides, Deflection of curved bars and rings.
Statically Indeterminant Systems: Force Method, Displacement method, Method of superposition and Analysis by differential equation of the deflection curve.
Unsymmetrical bending: Shear center for angle, channel and Z sections.
Rotational stresses: Discs and rims, discs of uniform strength.
3 D stress analysis: Analytical and graphical methods (Mohr's circle).

List of Extended Activities:

Use of Matlab for solving problems related to:

1. 3D stresses (Mohr's circle)
2. Failure theories
3. Shear stresses in beams
4. Statically indeterminate systems
5. Thin and thick cylinders (Lame's line solution)

Suggested Textbooks:

17. Gere J and Goodno B J, "Mechanics of Materials", 7th Edition, Cengage Learning, Toronto, Canada (2009).
18. Beer P F and Johnston (Jr) E R, *"Mechanics of Materials"*, SI Version, Tata McGrawHill, India (2001).
19. Popov E P, *"Engineering Mechanics of Solids"*, SI Version 2nd Edition, Prentice Hallof

India, New Delhi (2003).
20. Timoshenko S P and Young D H, *"Elements of Strength of Materials"*, 5th Edition,East West Press, New Delhi (1984).
21. Pytel A H and Singer F L, *"Strength of Materials"*, 4th Edition, Harper Collins, New Delhi (1987).
22. Hearn E.J., "Mechanics of Materials 1", 3rd Edition, Butterworth-Heinemann, Elsevier, Oxford U.K., 1997.

Online Resources:

1. https://nptel.ac.in/courses/105105108 Prof. S.K. Bhattacharyya, IIT Kharagpur
2. https://nptel.ac.in/courses/112101095 Prof. S.K. Maiti, IIT Bombay
3. https://nptel.ac.in/courses/112106319 Prof. K. Ramesh, IIT Madras
4. https://nptel.ac.in/courses/112102284 Prof. Ajeet Kumar, IIT Delhi

Course Title	**:**	**Production Processes**			
Course Code	**:**	**MEPC-208**	**Course Type**	**:**	**Core**
Contact Hours	**:**	**L- 3 T- 0 P- 0**	**Credit**	**:**	**3**
Program/Semester	**:**	**B. Tech.**			
Evaluation Scheme (Suggested)	**:**	**Mid Sem Exam (30%), End Sem Exam (50%), Quizzes (at least two) (15%), and Assignment/Project (5%)**			

Pre-requisites: Manufacturing Process (IPCI-101).
Course Assessment Method: Both continuous and semester end examination.
Topics to be covered: All.
Course Outcomes: At the end of the course the student will be able to:

CO 1	To impart knowledge and skills in the field of manufacturing and production processes. It deals with different processes that are used in several industries.
CO 2	Suggesting the simplified manufacturing processes with the aim of cost reduction and material wastage.
CO 3	Ability to clear the fundamental concepts of machining, casting, molding, welding, powder metallurgy, forming and holding devices.
CO 4	Selecting the appropriate methods and tooling for typical applications in the industries to produce critical design components.

Course Details:

Attributes of Manufactured Products: Mechanical properties, physical properties, chemical properties, geometric attributes, material selection.
Machining and Machine Tools: Elements of machining, classification of machine tools, concept of orthogonal metal cutting.
Metal Casting: Casting alloys, solidification of metals, melting and pouring, casting processes, finishing processes, designs for casting.
Welding Processes: Survey of welding processes, Weldability of Steels, Cast irons, aluminium and Copper alloys, Joint Design and specifications, Inspection of welds.
Forming Processes: Rolling, Drawing, Extrusion, Forging, Press working and die design and High Velocity Rate Forming.
Powder metallurgy: Process details, component and die design considerations.
Processing of Plastics: Introduction and types of plastics, Properties of plastics, Materials required for processing plastics, Forming and Shaping of plastics, Comparison of plastic forming

processes.
Jigs and Fixtures: Introduction, Production Devices, Advantages of Jigs and Fixtures, Elements of Jigs and Fixtures, Principles of Location and Clamping.
Process Planning: Definitions of process planning, contents of process planning, process operations, steps of process planning.

Extended activities: Use Ansys-Fluent software and CFD codes to explore physics of: Welding, Casting and Forming processes.

Suggested Textbooks:

1. Groover, M. P., "*Fundamentals of modern manufacturing: materials, processes, and systems"*, John Wiley & Sons (2020).
2. Schey A J, "*Introduction to Manufacturing Processes*", McGraw Hill Book Company, New York (1987).
3. Sharma P C, "*Production Technology*", S Chand & Co. (2003).
4. Black, J. T., & Kohser, R. A, "*DeGarmo's materials and processes in manufacturing*", John Wiley & Sons (2017).
5. Khan, M. I, "*Welding science and technology"*, New Age International (2007).
6. Juneja B L, "*Fundamentals of Metal Cutting & Machine Tools*", New Age International (1998).

Online resources

1. https://nptel.ac.in/courses/112104188
2. https://nptel.ac.in/courses/112104189
3. https://nptel.ac.in/courses/112107239
4. https://nptel.ac.in/courses/112107239

Course Title	**:**	**Fluid Mechanics-II**			
Course Code	**:**	**MEPC-201**	**Course Type**	**:**	**Core**
Contact Hours	**:**	**L- 3 T- 1 P- 0**	**Credit**	**:**	**4**
Program/Semester	**:**	**B. Tech.**			
Evaluation Scheme (Suggested)	**:**	**Mid Sem Exam (30%), End Sem Exam (50%), Quizzes (at least two) (15%), and Assignment/Project (5%)**			

Pre-requisites: Fluid Mechanics-I (MEPC-211).
Course Assessment Method: Both continuous and semester end examination.
Course Outcomes: At the end of the course the student will be able to:

CO 1	Understand the general phenomenon of inviscous flow (Potential flow) of fluid mechanics
CO 2	Derive the general equation of boundary layer problem and solve by analytical modeling techniques of fluid mechanics.
CO 3	Derive of general governing equations of turbulence, turbulent flow through pipe and its mathematical modeling and their solution of the turbulent problems.
CO 4	Describe the compressible flow, Mach number, Shock waves and the formulation of the general equations of compressible flow. Solution of the compressible flow problem.
CO5	Understand the basic of various other solution techniques of mathematical modeled equations using computational methods.

Course Details:

Potential Flows
Revisit of fluid kinematics, Stream and Velocity potential function, Circulation, Irrotational vortex, Basic

plane potential flows: Uniform stream; Source and Sink; Vortex flow, Doublet, Superposition of basic plane potential flows, Flow past a circular cylinder, Magnus effect; Kutta- Joukowski lift theorem; Concept of lift and drag.

Boundary Layer

Salient features of flow pattern in a boundary layer, Velocity and shear stress distribution along the boundary, similarity solutions, Von-Karman momentum integral equation, Approximate Methods, quantitative correlations for boundary layer thickness, local skin friction coefficient and drag coefficient in laminar, turbulent and laminar turbulent combined boundary layer flows on a flat plate without pressure gradient, flow over a curved surface boundary layer separation and its control.

Turbulent Flow

Introduction, Fluctuations and time-averaging, General equations of turbulent flow, Reynolds averaging, turbulent boundary layer equation, Flat plate turbulent boundary layer, turbulent pipe flow, Prandtl mixing hypothesis, turbulence modeling, Free turbulent flows.

Compressible Flows

Speed of sound and Mach number, Basic equations for one dimensional flows, Isentropic relations, Normal-shock wave, Rankine-Hugoniot relations, Fanno and Rayleigh curve, Mach waves, Oblique shock wave, Prandtl-Meyer expansion waves, Quasi-one dimensional flows.

Introduction to Computational Fluid Dynamics (CFD)

Boundary conditions, Basics of discretization – Introduction to Finite Difference Method, Finite Volume Method and Finite Element Method

List of Extended Activities:

1. Use of ANSYS-FLUENT for Fluid Mechanics Problem
2. Solving of basic problem of Turbulent on Ansys-Fluent

Suggested Textbooks:

1. Çengel, Y.A. and J.M. Cimbala, Fluid Mechanics, McGraw-Hill, Boston, MA. Web link.
2. S. K. Som and G. Biswas, Introduction to Fluid Mechanics and Machines, McGraw Hill.
3. White, F. M., Fluid Mechanics, Fifth Edition, McGraw Hill 2003.
4. W. P. Graebel, Advanced Fluid Mechanics, Academic Press, Elsevier.
5. Kundu, P. K., and Ira M. Cohen, Fluid Mechanics, 4th ed., Academic Press 2007.
6. Schlichting, H., Boundary Layer Theory, McGraw-Hill, 1968.
7. Stefan Popes, Turbulent Flows, McGraw-Hill, Boston, MA.
8. Yahya, S.M., Fundamentals of Compressible Flow, New Age International Publisher, 2005.
9. Anderson, J. D., Computational Fluid Dynamics, McGraw-Hill Higher Education; 6th edition (1 April 1995).
10. White, F. M., Viscous Fluid Flow, 2nd Edition, McGraw Hill 1991.
11. Bird, R.B., W.E. Stewart, and E.N. Lightfoot (1960), Transport Phenomena, Wiley, New York.
12. Panton, R.L., Incompressible Flow, 2nd Ed., John Wiley & Sons, 1996.
13. Chevray, R. and J. Mathieu, Topics in Fluid Mechanics, Cambridge University Press, 1993.
14. Fay, J. A., Introduction to Fluid Mechanics Cambridge, MA: MIT Press, 1994. ISBN: 026206165.

Online Resources:

Course Title	**:**	**Production Processes Lab**			
Course Code	**:**	**MEPC-214**	**Course Type**	**:**	**Core**
Contact Hours	**:**	**L- 0 T- 0 P- 2**	**Credit**	**:**	**1**
Program/Semester	**:**	**B. Tech.**			
Evaluation Scheme (Suggested)	**:**	**Lab Work (50%), End Sem Exam/Viva (50%)**			

Pre-requisites: None.
Course Assessment Method: Both continuous and semester end examination.
Topics to be covered: All.
Course Outcomes: At the end of the course the student will be able to:

CO 1 To enable the students to make 3D part drawing, assembly and animation of the engineering components using appropriate CAD tools.

CO 2 To enable the students to understand the production processes.

CO 3 To enable the students to apply theoretical knowledge of production processes in the production of a job.

CO 4 To enable the students to analyze different production processes through product development.

Course Details:

A small project covering the various aspects of Engineering from Design to Fabrication comprising of the following:

Part A:- Product development on CAD software

1. Hand on training on CAD software like Solidworks/Pro-e for 3D parts, assembly and animation.
2. Assignments in term of 3D part drawings that must include assembly and animation to be completed on CAD software.
3. Use CAD software for design and analyses of a 3D part drawing as a laboratory project.

Part B:- Execution of laboratory project on conventional production machines

1. Use of Lathe machine: external and internal threading (Vee, Square or Acme threads), taper turning, grooving, knurling, drilling operations on lathe.
2. Use of Milling machine: Spur gear.
3. Use of welding machines in the completion of laboratory project through welding operations like, LAP, BUTT, Edge, Outside Corner and T joints.

Part C: - Execution of laboratory project on conventional production machines

1. CNC programming for Milling jobs.
2. Product development on 3D printer, designed on CAD software during continuous training and learning in laboratory.

Weightage for evaluation in the laboratory:

(i) Preparation of Engineering Drawings on any CAD software – Weightage 30%.
(ii) Laboratory Assignments and Tests - Weightage 20%.
(iv) Completion of Project- Weightage 50%.

NOTE: Group size of minimum of 2 students and maximum of 4 students shall be used.

Course Title	**:**	**Theory of Machines**			
Course Code	**:**	**MEPC-203**	**Course Type**	**:**	**Core**
Contact Hours	**:**	**L- 3 T- 1 P- 0**	**Credit**	**:**	**4**
Program/Semester	**:**	**B. Tech.**			
Evaluation Scheme	**:**	**Mid Sem Exam (30%), End Sem Exam (50%), Quizzes (at least two) (15%), and Assignment/Project (5%)**			

Course Assessment Method: Both continuous and semester end examination.
Course Outcomes: At the end of the course the student will be able to-

CO 1	Understand the concepts of machines, mechanisms and related terminologies.
CO 2	Analyze planar mechanism for displacement, velocity and acceleration graphically.
CO 3	Analyze various motion transmission elements like gears, gear trains, cams, belt drives and rope drives.
CO 4	Utilize analytical, mathematical and graphical aspects of kinematics of machines for effective design.
CO 5	Perform the kinematic analysis of a given mechanism.

Course Details:

Basic Concepts: Kinematics of machine, Kinematic link and their different types, types of kinematic pair, kinematic chain, mechanism and inversions of four bar chain and slider crank mechanism. Degree of freedom, synthesis of linkages – number synthesis, Grashof's criterion and introduction to dimensional synthesis.

Velocity Analysis: Motion of a link, velocity of a point on a link by relative velocity method, velocities of slider crank mechanisms, rubbing velocity at a pin joint, velocity of a point on a link by instantaneous center method, properties and types of I-Center, Kennedy theorem and methods of locating I-centres in a mechanism.

Acceleration Analysis: Acceleration of a point on a link, acceleration in slider crank mechanism, Coriolis component of acceleration, Quick-return mechanism.

Cams and Follower: Types of cams and followers, cam terminology, types of motion of the follower, analysis of motion of the follower, analysis of motion of the follower for cams with specified contours.

Gears: Classification of gears, terminology used in gears, law of gearing, velocity of sliding, forms of teeth, construction and properties of an involute, construction and properties of cycloidal teeth, effect of variation of center distance on the velocity ratio of involute profile tooth gears, length of path of contact, arc of contact, number of pairs of teeth in contact, interference, minimum number of teeth, interference between rack and pinion, undercutting, terminology of helical and worm gears.

Gear Trains: Definition of simple, compound, reverted and epicyclic gear trains, velocity ratio of epicyclic gear trains.

Belt, Rope and Chain Drive: Types of belt drives, velocity ratio, law of belting, length of belt, ratio of friction tensions, power transmitted, effect of centrifugal tension on power transmission, condition for maximum power transmission, concept of slip and creep. Chain drive, chain length and angular speed ratio.

Governors: Different types of centrifugal and inertia governors: hunting, isochronism, stability, effort and power of governor, controlling force.

List of Extended Activities:

1. Kinematic analysis of planar 4-bar mechanism using MATLAB.
2. Kinematic analysis of slider-crank mechanism using MATLAB.
3. Kinematic analysis of Watt mechanism using MATLAB.
4. Kinematic analysis of Stephenson mechanism using MATLAB.
5. Design of cam and follower using MATLAB.
6. Design and kinematic analysis of gears using MATLAB.
7. Velocity and acceleration diagrams using MATLAB.

Suggested Textbooks:

1. Ratan S S, *"Theory of Machines"*, 4th Edition, Tata McGraw Hill, New Delhi (2017).
2. Bevan T, "*The Theory of Machines"*, 3rd Edition CBS Publishers and Distributors (2002).
3. Shigley J E and Vickar J J, *"Theory of Machines and Mechanism"*, 2nd Edition, McGrawHill, New Delhi (1995).
4. Wilson C and Sadler J, *"Kinematics and Dynamics of Machine"*, 3rd Edition, Prentice Hall(2002).
5. Russell K, Shen Q and Sodhi R S, *"Kinematics and Dynamics of Mechanical Systems"*, 2nd Edition, CRC Press, (2019).

Online Resources:

1. https://archive.nptel.ac.in/courses/112/106/112106270/
2.https://archive.nptel.ac.in/courses/112/104/112104121/
3. https://www.digimat.in/nptel/courses/video/112105268/L01.html

Course Title	**:**	**Dynamics of Machines**			
Course Code	**:**	**MEPC-204**	**Course Type**	**:**	**Core**
Contact Hours	**:**	**L- 3 T- 1 P- 0**	**Credit**	**:**	**4**
Program/Semester	**:**	**B. Tech.**			
Evaluation Scheme	**:**	**Mid Sem Exam (30%), End Sem Exam (50%), Quizzes (at least two) (15%), and Assignment/Project (5%)**			

Course Assessment Method: Both continuous and semester end examination.
Course Outcomes: At the end of the course the student will be able to-

CO 1	Able to do static and dynamic force analysis on different mechanism.
CO 2	Able to demonstrate the torque analysis on any kind of fly wheel i.e., either on engine fly wheel or machine fly wheel.
CO 3	Understand and avoid/suppress certain common dynamical problems a machinery may undergo.
CO 4	Understand the fundamentals of mechanical vibrations.
CO 5	Understand the fundamentals of machine design for desired kinematic or dynamic performance.

Course Details:

Static Force Analysis: Static equilibrium, equilibrium of two-force and three-force members,

members with two forces and a torque, free body diagram, principle of virtual work, friction in mechanisms.

Dynamic Force Analysis: D‟ Alembert Principle, dynamic analysis of four-link mechanisms and slider-crank mechanisms, analytical and graphical method, velocity and acceleration of piston, angular velocity and angular acceleration of connecting rod, piston and crank effort, inertia of connecting rod, inertia force in reciprocating parts.

Balancing: Static and dynamic balancing, balancing of several masses in different planes, Balancing of reciprocating masses, balancing of locomotive, partial balancing, direct and reverse crank method, balancing of inline engines and V-Engines, balancing machines.

Flywheels: Turning moment diagram for steam engine and four-stroke internal combustion engine and for multicylinder engines, fluctuation of energy and speed in flywheels, size of flywheel and flywheel for punching press.

Lower Pairs: Pantograph, straight line mechanisms, engine indicators, automobile steering gears, Hooke's joint and Double Hooke's joint.

Gyroscope: Effect of gyroscopic couple on supporting and holding structures of machines. Gyroscopic effect on naval and air ships and automobiles.

Brakes and Dynamometers: Types of brakes, principle and function of various types of brakes, problems to determine braking capacity, different types of dynamometers.

List of Extended Activities:

1. Static force analysis of planar 4-bar mechanism using MATLAB.
2. Static force analysis of Watt mechanism using MATLAB.
3. Dynamic force analysis of planar 4-bar mechanism using MATLAB.
4. Dynamic force analysis of Watt mechanism using MATLAB.
5. Solve balancing problems using MATLAB.

Suggested Textbooks:

1. Ratan S S, *"Theory of Machines"*, 4th Edition, Tata McGraw Hill, New Delhi (2017).
2. Bevan T, *"The Theory of Machines"*, 3rd Edition CBS Publishers and Distributors (2002).
3. Shigley J E and Vickar J J, *"Theory of Machines and Mechanism"*, 2nd Edition, McGrawHill, New Delhi (1995).
4. Wilson C and Sadler J, *"Kinematics and Dynamics of Machine"*, 3rd Edition, Prentice Hall(2002).
5. Russell K, Shen Q and Sodhi R S, *"Kinematics and Dynamics of Mechanical Systems"*, 2nd Edition, CRC Press, (2019).

Online Resources:

1. https://archive.nptel.ac.in/courses/112/106/112106270/
2.https://archive.nptel.ac.in/courses/112/104/112104121/
3. https://www.digimat.in/nptel/courses/video/112105268/L01.html