

INSTITUTE OF ENGINEERING & TECHNOLOGY
DR. RAMMANOHAR LOHIA AVADH UNIVERSITY AYODHYA



EVALUATION SCHEME & SYLLABUS

for

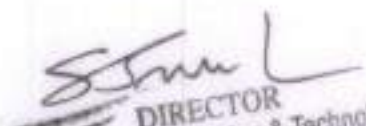
B.TECH. 2nd YEAR

MECHANICAL ENGINEERING DEPARTMENT

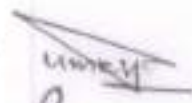
AS PER

AICTE MODEL CURRICULUM

[Effective from the Session: 2025-26]


DIRECTOR
Institute of Engineering & Technology
Dr. R.M.L. Avadh University
Ayodhya U.P. - 224001




Sep 16, 2025



Proposed Syllabus for B.Tech. III & IV Semester for (2024-2025) Session Admitted Student

B.Tech (Mechanical Engineering)

Semester III

SEMESTER III																
Sr. No	Subject Code	Subject	Periods					Evaluation Scheme				End Semester			Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE					
1	APH301	Technical Communication	2	0	2	30	20	50		100		150		3		
2	MET301	Engineering Mechanics	3	0	0	30	20	50		100		150		3		
3	MET302	Thermodynamics	3	0	0	30	20	50		100		150		3		
4	MET303	Material Science	3	1	0	30	20	50		100		150		4		
5	MET304	Fluid Mechanics	3	1	0	30	20	50		100		150		4		
6	MEL351	Machine Drawing Lab	0	0	2				25		25	50		2		
7	MEL352	Thermodynamics Lab	0	0	2				25		25	50		1		
8	MEL353	Material Testing Lab	0	0	2				25		25	50		1		
9	MEL354	Fluid Mechanics Lab	0	0	2				25		25	50		1		
10	MAB301 /MAB302	Environmental Science/Cyber Security	2	0	0	15	10	25		50		NC+		NC+		
11		MOOCs (Essential for Hons. Degree)														
		Total	16	2	10							950		22		

CT:- Class Test

TA:- Teacher Assessment

L/T/P:- Lecture/Tutorial/Practical

NC+ :- Non Credit

*Practical Experiment to be included as per Virtual lab Platform

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B.Tech (Mechanical Engineering)

Semester IV

Sr. No	Subject Code	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	APS401	Math-IV	3	1	0	30	20	50		100		150	4
2	MET401	Applied Thermodynamics	3	1	0	30	20	50		100		150	4
3	MET402	Strength of Materials	3	0	0	30	20	50		100		150	3
4	MET403	Manufacturing Technology I	3	1	0	30	20	50		100		150	4
5	MET404	Fluid Machinery	3	1	0	30	20	50		100		150	4
6	MEL453	Manufacturing Technology I Lab	0	0	2				25		25	50	1
7	MEL454	Fluid Machinery Lab	0	0	2				25		25	50	1
8	MEL455	Computer Aided Machine Drawing Lab	0	0	2				25		25	50	1
9	MAB402 / MAB401	Cyber Security/ Environmental Science	2	0	0	15	10	25		50		NC+	NC+
10		MOOCs (Essential for Hons. Degree)											
		Total	17	3	6							900	22

CT:- Class Test

TA:- Teacher Assessment

L/T/P:- Lecture/Tutorial/Practical

NC+ :- Non Credit

* Practical Experiment to be included as per Virtual lab Platform.

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Engineering Mechanics

L-T-P
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MEB301

Course Objectives:

To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering

Module I:

Two-dimensional force systems: Basic concepts, Laws of motion, Principle of transmissibility of forces, transfer of a force to parallel position, resultant of a force system, simplest resultant of two dimensional concurrent and non-concurrent force systems, Distribution of force systems, free body diagrams, equilibrium and equations of equilibrium, Varignon's Theorem and moment. 8L

Module II:

Beam: Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams.

Trusses: Introduction, simple truss and solution of simple truss, methods of F-joint and methods of sections. 8L

Module III:

Centroid and moment of inertia: Centroid of plane, curve, area, composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem. Mass moment of inertia of circular ring, disc, cylinder, sphere, and cone about their axis of symmetry. 8L

Module IV:

Simple stress and strain: Introduction, normal and shear stresses, stress-strain diagrams for ductile and brittle material, elastic constants, one-dimensional loading of members of varying cross sections, strain energy. 8L

Module V:

Kinematics of rigid bodies, Equations of Motion, circular motion, basic analysis of instantaneous center, Kinetics of rigid bodies for linear and circular motion, D'Alembert Principle, motions and analysis of the connecting bodies. 8L

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Dr. Deepak Aggarwal
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Course Outcomes:

CO Number	Course Outcome (Please include all COs of your Course here)
CO1	Define the basic parameters related to mechanics in static and dynamic conditions and draw corresponding diagrams.
CO2	Describe and explain general governing equations for various types of elements related to basic physical shape and geometry.
CO3	Calculate and analyze parameters by the help of conditions of equilibrium, basic governing equations related to moment of inertia, dynamic equilibrium, moment and momentum principles etc.
CO4	Design and compare various stresses, elastic properties etc. on machine elements like shaft, beams etc.
CO5	Evaluate values of shear force, bending moment & stresses and sketch corresponding diagrams.

Text Books:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

References Books:

1. Engineering Mechanics: Statics J.L Meriam , Wiley
2. Engineering Mechanics: Dynamics J.L Meriam , Wiley
3. Engineering Mechanics: F L Singer
4. Engineering Mechanics: Statics and Dynamics R. C. Hibbler, Pearson
5. Engineering Mechanics: Timoshenko&Young , 4ed, Tata McGraw Hill
6. Engineering Mechanics: Statics and Dynamics A. Nelason, McGraw-Hill
7. Engineering Mechanics: Statics and Dynamics Shames and Rao, Pearson
8. Engineering Mechanics: Statics and Dynamics S. Rajasekaran and G. Sankarasubramanian, Vikas

E-Portals:

- 1 <https://nptel.ac.in/courses/112103109/>
- 2 <https://nptel.ac.in/courses/112103108/>



Thermodynamics

L-T-P

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MET301

COURSE OBJECTIVES:

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

Module I

Review of Fundamental Concepts and Definitions: Introduction- Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle Reversibility Quasi - static Process, Irreversible Process, Causes of Irreversibility Energy and its forms, Work and heat (sign convention), Gas laws, Ideal gas, Real gas, Law of corresponding states, Property of mixture of gases and shaft work.

Zeroth law of thermodynamics: Concept of Temperature and its measurement, Temperature scales. 8(L)

Module II

First law of thermodynamics: First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume. Limitations of first law of thermodynamics, PMM-I. Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. 8(L)

Module III

Second law of thermodynamics: Thermal reservoirs, Energy conversion, Heat engines, Efficiency, Reversed heat engine, Heat pump, Refrigerator, Coefficient of Performance, Kelvin

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Planck and Clausius statement of second law of thermodynamics, Equivalence of the two statements. Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and its corollaries, Thermodynamic Temperature Scale, PMM-II.

Entropy: Clausius inequality, Concept of Entropy, Entropy change of pure substance indifferent thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics. 8(L)

Module IV

Availability and Irreversibility: Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz & Gibb's function.

Thermodynamic relations: Conditions for exact differentials. Maxwell relations, Clapeyron equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic and Isothermal compressibility. 8(L)

Module V

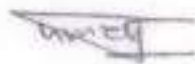
Pure substance, Property of Pure Substance (steam), Triple point, Critical point, Saturation states, Subcooled liquid state, Superheated vapour state, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T, P-V and P-h diagrams, T-S and H-S diagrams, use of property diagram, Dryness factor and it's measurement, processes involving steam in closed and opensystems. 8(L)

Course Outcomes:

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

Books and References:

1. Basic and Applied Thermodynamics by PK Nag, MCGRAW HILL INDIA.
2. Thermodynamics for Engineers by Kroos & Potter, Cengage Learning.
3. Thermodynamics by Shavit and Gutfinger, CRC Press.
4. Thermodynamics- An Engineering Approach by Cengel, MCGRAW HILL INDIA.
5. Basic Engineering Thermodynamics, Joel, Pearson.
6. Fundamentals of Engineering Thermodynamics by Rathakrishnan, PHI.
7. Engineering Thermodynamics by Dhar, Elsevier.
8. Engineering Thermodynamics by Onkar Singh, New Age International.







Material Science

L-T-P

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MET302

COURSE OBJECTIVES:

Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.

Module I

Introduction: Importance of materials, historical perspective, Future aspects of engineering materials.

Crystal Structure: brief on BCC, FCC and HCP Structures, coordination number and atomic packing factors. Bravais lattices, Miller indices, crystal imperfections-point line and surface imperfections. Atomic Diffusion: Phenomenon, Ficks laws of diffusion, factors affecting diffusion.

Ferrous and non-ferrous materials: Properties, Composition and uses of Grey cast iron, malleable iron, SG iron and steel, copper alloys-brasses and bronzes, Aluminum alloys. 8(L)

Module II

Mechanical Behavior: Stress-strain diagram showing ductile and brittle behavior of materials, mechanical properties in plastic range, yield strength off set yield strength, ductility, ultimate tensile strength, toughness, Hardness Tests.

Fracture Creep Fatigue: Fracture: Type I, Type II and Type III. Creep: Description of the phenomenon with examples. Three stages of creep, creep properties, stress relaxation. Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and S-N diagram. 8(L)

Module III

Solidification: Mechanism of solidification, Homogenous and Heterogeneous nucleation, crystal growth, cast metal structures. Phase Diagram I: Solid solutions Hume Rothary rule, substitutional and interstitial solid solutions, intermediate phases, Gibbs phase rule.

Phase Diagram: Construction of equilibrium diagrams involving complete and partial solubility. Iron carbon equilibrium diagram description of phases, solidification of steels and cast irons. 8(L)

Module IV

Heat Treating of Metals: TTT curves, annealing and its types, Normalizing, hardening, tempering, Martempering, Austempering, Hardenability, surface hardens methods like carburizing, cyaniding, nitriding, flame hardening and induction hardening, age hardening. 8(L)

Module V

Composite materials: Definition, classification, types of matrix materials & reinforcements. **Ceramics:** Structure types and properties and applications of ceramics. Mechanical/ Electrical behavior and processing of Ceramics.

Plastics: Various types of polymers/ plastics and its applications. Mechanical behavior and processing of plastics, Future of plastics. Introduction to Smart materials & Nano-materials and their potential applications. 8(L)

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SD Deepak Aggarwal

Course Outcomes: After taking this course students should be able to:

- | | |
|-----|---|
| CO1 | Identify crystal structures for various materials and understand the defects in such structures |
| CO2 | Know the various properties like mechanical and electrical of various materials. |
| CO3 | Know the various types of materials used in engineering. |
| CO4 | Know how to increase the strength of materials. |
| CO5 | Select materials for design and construction. |

Reference Books

1. Introduction to Material Science for Engineers" by J F Shackelford
2. Materials Science and Engineering: An Introduction" by William D Callister
3. Fundamentals of Materials Science and Engineering: An Integrated Approach" by William D Callister
4. A Textbook of Material Science" by R K Rajput
5. Material Science and Metallurgy" by A V K Suryanarayana
6. Material Science by K M Gupta

Dr. Deepak Aggarwal

Dr. Anurag

Dr. Anurag

Course Objective

1. To give fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
2. To develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.
3. To learn about basic laws and equations used for analysis of static and dynamic fluids.
4. To understand the concept of fluid flow measurement and its applications, types of flows and dimensional analysis.
5. To determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies.

Module I

Properties of Fluids, Fluid Statics, Submerged Bodies and Buoyancy Introduction, Properties of Fluids, Viscosity, Thermodynamic Properties, Compressibility and Bulk Modulus, Surface Tension and Capillarity, Vapour Pressure and Cavitation. Pressure-density-height relationship, manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, buoyancy, Meta-centre, stability of immersed and floating bodies, Introduction to CFD. 8(L)

Module II

Fluid Kinematics and Dynamics Types of fluid flows: Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows, one, two and three dimensional flows, streamlines, continuity equation for 3D and 1D flows, circulation, stream function and velocity potential. 8(L)

Module III

Fluid Flow Measurements and Flow through Pipes Potential Flow: source, sink, doublet and half-body. Equation of motion along a streamline and its integration, Bernoulli's equation and its applications- Pitot tube, orifice meter, venturimeter and bend meter, notches and weirs, momentum equation and its application to pipe bends, resistance to flow, Minor losses in pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and pipe networks. 8(L)

Module IV

Laminar Flow, Turbulent Flow and Boundary Layer Flow Equation of motion for laminar flow through pipes, Stokes' law, transition from laminar to turbulent flow, turbulent flow, types of turbulent flow, isotropic, homogenous turbulence, eddy viscosity, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces, Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub-layer, separation and its control. 8(L)

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Module V

Forces on Submerged Bodies and Compressible Flow Drag and lift, drag on a sphere, a two dimensional cylinder, and an aerofoil, Magnus effect. Similarity Laws: geometric, kinematics and dynamic similarity, undistorted and distorted model studies, Dimensional analysis, Buckingham's Pi theorem, important dimensionless numbers and their significance. 8(L)

Course Outcomes:

After taking this course students should be able to:

1. Identify and obtain the values of fluid properties and relationship between them.
2. Understand stress-strain relationship in fluids, classify their behavior and also establish force balance in static systems.
3. Understand the principles of continuity, momentum, and energy as applied to fluid motions.
4. Ability to analyze fluid flow problems with the application of the momentum and energy equations.
5. Apply dimensional analysis to predict physical parameters that influence the flow in fluid mechanics.

TEXT BOOKS

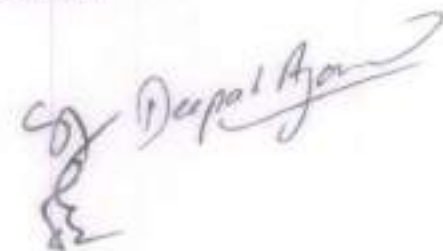
1. A Textbook of Fluid Mechanics and Hydraulic Machines (SI Units), Dr. R.K. Bansal, Laxmi Publications (P) Limited, 10th Edition, 2018.
2. A Textbook of Fluid Mechanics and Hydraulic Machines (SI Units), Er. R.K. Rajput, S. Chand Publications & company Ltd., Revised 5th Edition, 2013.

REFERENCES BOOKS

1. Fluid Mechanics: Fundamentals and Applications (SI Units), Yunus A. Cengel, John M. Cimbala, McGraw-Hill Publications (SIE), 3rd Edition, 2014.
2. Fluid Mechanics, Frank M. White, McGraw-Hill Publications (SIE), 7th Edition, 2011.

e-LEARNING RESOURCES

1. <http://www.nptelvideos.in/2012/11/fluid-mechanics.html>
2. <https://nptel.ac.in/courses/112105171/>
3. https://nptel.ac.in/keyword_search_result.php?word=fluid+mechanics

Material Testing Lab

COURSE OBJECTIVES:

L-T-P
0-0-2
MEL353

To understand the principles and performance characteristics different materials.

To know about material properties.

Experiments on Material Testing

1. Strength test (Tensile/Flexural /Compression) of a given mild steel specimen on UTM with full details and stress versus strain plot on the machine.
2. Impact test of a given mild steel specimen on impact testing machine like Charpy, Izod or both.
3. Hardness test of a given mild steel specimen on using Rockwell and Vickers/Brinell testing machines.
4. Fatigue test of a given mild steel specimen on fatigue testing machine.
5. Creep test of a given mild steel specimen on creep testing machine.
6. Study of NDT (non-destructive testing) methods like magnetic flaw detector, ultrasonic flaw detector, eddy current testing machine, dye penetration tests.
7. Torsion test of a rod using torsion testing machine.
8. Spring index test on spring testing machine.
9. Experiment on deflection of beam, comparison of actual measurement of deflection with dial gauge to the calculated one, and or evaluation of young's modulus of beam.

COURSE OUTCOME

The students who have undergone the course will be able to measure various properties of materials.

Perform the strength test of a given mild steel specimen on UTM

Perform the test on impact testing machine like Charpy, Izod or both.

Perform Hardness test of given specimen using Rockwell and Vickers/Brinell testing machines.

Perform Fatigue test on fatigue testing machine.

Perform Creep test on creep testing machine.



Dr. Anshu

Fluid Mechanics Lab

L-T-P

0-0-2

MEL354

Note: Ensure to conduct at least 07 experiments from the list:

1. To verify the momentum equation using the experimental set-up on impact of jet.
2. To determine the coefficient of discharge of an orifice of a given shape. Also to determine the coefficient of velocity and the coefficient of contraction of the orifice mouthpiece.
3. To calibrate an orifice meter and study the variation of the co-efficient of discharge with the Reynolds number.
4. To calibrate a Venturimeter and study the variation of the co-efficient of discharge with the Reynolds number.
5. To calibrate a bend meter and study the variation of the co-efficient of discharge with the Reynolds number.
6. To draw a flow-net using Electrical Analogy Method.
7. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
8. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
9. To study the variation of friction factor, 'f' for turbulent flow in commercial pipes.
10. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.
11. To determine Meta-centric height of a given ship model.
12. To determine the head loss for a sudden enlargement.
13. To determine the head loss for a sudden Contraction.

CSJ Dapah Azam

Yusuf

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Machine Drawing Lab

L-T-P
0-0-2
MEL351

Introduction (1 drawing sheet)

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Graphics Language, Classification of drawings, Principles of drawing, IS codes for machine drawing, scales, types of lines, section lines, Dimensioning

Orthographic Projections (1 drawing sheet)

Principle of first angle and third angle projection, drawing of machine elements in first angle projection, selection of views, sectional views

Screwed fasteners (2 drawing sheet)

Thread nomenclature, Forms of thread, Thread series, designation, Representation of threads, Bolted joints, Locking arrangement of nuts

Keys and Cotter and Pin joint (1 drawing sheet)

Types of keys, Cotter joint or Knuckle joint

Shaft Couplings (1 drawing sheet)

Introduction, Rigid coupling or Flexible coupling

Riveted joints (1 drawing sheet)

Introduction, rivets and riveting, Types of rivet heads, Types of riveted joints, Boiler joint

Assembly Drawing (1 drawing sheet)

Introduction, Engine parts-stuffing box, cross head

Free hand sketching*

Introduction, Need for free hand sketching, Free hand sketching of foundation bolts, studs, pulleys, couplings etc.

* students may be asked to submit the free hand sketching assignment at the end of the semester

SD Deepak Aggarwal
H.K. Verma
H.K. Verma

THERMODYNAMICS LAB

L-T-P

0-0-2

MEL352

Course Objectives: To understand the principles and performance of various boilers and engines.

List of Experiments: (At least 8 of the following)

1. Study of Fire Tube boiler.
2. Study of Water Tube boiler.
3. Study and working of Two stroke petrol Engine.
4. Study and working of Four stroke petrol Engine.
5. Study and working of two stroke Diesel Engine.
6. Study and working of four stroke Diesel Engine.
7. Determination of Indicated H.P. of I.C. Engine by Morse Test.
8. Prepare the heat balance sheet for Diesel Engine test rig.
9. Prepare the heat balance sheet for Petrol Engine test rig.
10. Study of Velocity compounded steam turbine.
11. Study of Pressure compounded steam turbine.
12. Study of Impulse & Reaction turbine.
13. Study of steam Engine model.
14. Study of Gas Turbine Model.

Course Outcomes: The students who have undergone the course will be able to identify various properties of system.

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ENVIRONMENTAL SCIENCE

L-T-P

2-0-0

MAB301/401

Course Learning Objectives:

1. Create the awareness about environmental problems.
2. Develop an attitude of concern for the environment.
3. Impart basic knowledge about the environment and its allied problems.
4. Acquire skills to help the concerned individuals in identifying and solving environmental problems.
5. Motivate learner to participate in environment protection and environment improvement.

Module I

Multidisciplinary nature of Environmental Science: Definition, Scope, Importance and Need of Public Awareness. Structure of Environment. 5(L)

Module II

Ecosystem: Concept of ecosystem, structure and function of ecosystem, food chain food web and ecological pyramid. Different types of ecosystems (Forest, Grassland & Pond). 6(L)

Module III

Natural Resource and associated problems: Use and over exploitation of forest resource, deforestation. Mining and their effects. Use and Overutilization of surface and ground water, Effect of modern agriculture. 6(L)

Module IV

Environmental pollution and their effects: Water pollution, Air Pollution, Noise pollution, Soil pollution, Solid waste management. 5(L)

Module V

Environmental Protection: Environmental Laws, Role of individual and NOG's in environmental protection, Sustainable development. 6(L)

Course Outcome:

- CO1: The students can able to make environmentally friendly decision in practical applications.
CO2: The knowledge gained will lead to pollution free environment.
CO3: The current environmental issues can be handled in better way.
CO4: The knowledge of natural resources will lead to have balanced ecosystems.
CO5: Environmental education at different levels will lead to control and protect the ecosystem.

References:

1. Bharucha Erach, The biodiversity of India, Mapin Publishing Pvt. Ltd. Ahmedabad.

2. Cunningham, W. P., Cooper, T. H., Gorhani, E and Hepworth, M.T. 2001. Environmental encyclopedia, Jaico Publ. House, Mumbai.
3. Miller, T. G. Jr Environmental Science system and solution, Web enhanced edition.
4. Sharma, B. K. 2009. Environmental Chemistry, Goel Publ. House.
5. Trivedi, R. K. and P. K. Goel. Introduction to air pollution, Techno-Science Publication

SD Depot Agam

Agam

Agam

Applied Thermodynamics

L-T-P

3-1-0

MET401

Course Objectives:

- 1- To learn about of I law for reacting systems and heating value of fuels.
- 2- To learn about gas dynamics of air flow and steam through nozzles.
- 3- To learn the about gas turbine, isotropic efficiency.
- 4- To analyze the performance of steam turbines.

Module I

Introduction to solid, liquid and gaseous fuels- Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions. Introduction and Otto, Diesel and Dual cycles. 8(L)

Module II

Vapour Power cycles:

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Rankine cycle, effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Fuels and Combustion: Combustion analysis, heating values, air requirement, Air/Fuel ratio. 8(L)

Module III

Boilers: Classifications and working of boilers, boiler mountings and accessories, Draught and its calculations, air pre-heater, feed water heater, super heater. **Condenser:** Classification of condenser, air leakage, condenser performance parameters. 8(L)

Module IV

Steam and Gas Nozzles: Flow through Convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, choked flow, throat area, Nozzle efficiency, Off design operation of nozzle, Shock waves stationary normal shock waves, Effect of friction on nozzle, Supersaturated flow. 4(L)

Steam Turbines: Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Comparison with steam engine. 4(L)

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Module V

Gas Turbine: Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency, Deviation of actual cycles from ideal cycles. (6L)

Course Outcomes:

1. After completing this course, the students will get a good understanding of various practical power cycles and heat pump cycles.
2. They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.
3. They will be able to understand phenomena occurring in high speed compressible flows.

Books and References:

1. Basic and Applied Thermodynamics by P.K. Nag, mcgraw hill india.
2. Applied thermodynamics by Onkar Singh, New Age International.
3. Applied Thermodynamics for Engineering Technologists by Eastop, Pearson Education.
4. Applied Thermodynamics by Venkanna And Swati, PHI.
5. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
6. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
7. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
8. Theory of Stream Turbine by WJ Kerton.

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Strength of Material

L-T-P
3-0-0
MET402

Course objective

1. To provide the basic concepts and principles of strength of materials.
2. To give an ability to calculate stresses and deformations of objects under external loadings.
3. To give an ability to apply the knowledge of strength of materials on engineering applications and design problems.

Module I

Compound stress and strains: Introduction, normal stress and strain, shear stress and strain, stresses on inclined sections, state of plane stress,

Principal stress and strain, maximum shear stress, Mohr's stress circle, three dimensional states of stress & strain, equilibrium equations, generalized Hook's law, Thermal Stresses. 8(L)

Module II

Stresses in Beams: Pure Bending, normal stresses in beams, shear stresses in beams due to transverse and axial loads, composite beams

Torsion: Torsion combined bending & torsion of solid & hollow shafts, torsion of thin walled tubes. 8(L)

Module III

Deflection of Beams: Equation of elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, double integration method, Fixed and Continuous beam. 8(L)

Module IV

Helical and Leaf Springs: Deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs.

Columns and Struts: Buckling and stability, slenderness ratio, struts with different end conditions, Euler's theory for pin ended columns, effect of end conditions on column buckling, Rankine Gordon formulae. 8(L)

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Prof. Dr. P. S. Rao
Dr. P. S. Rao
Dr. P. S. Rao

Module V

Thin cylinders & spheres: Introduction, difference between thin walled and thick walled pressure vessels, thin walled spheres and cylinders, hoop and axial stresses and strain, volumetric strain.

Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, compound cylinders, stresses in rotating shaft and cylinders. **8(L)**

Course outcome:

1. Analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behavior of materials.
2. Utilize appropriate materials in design considering engineering properties, sustainability, cost and weight.
3. Perform engineering work in accordance with ethical and economic constraints related to the design of structures and machine parts.

Books and References:

1. Mechanics of Materials by Hibbeler, Pearson.
2. Mechanics of material by Gere, Cengage Learning
3. Mechanics of Materials by Beer, Jhonston, DEwolf and Mazurek, MCGRAW HILL INDIA
4. Strength of Materials by Pytel and Singer, HarperCollins
5. Strength of Materials by Ryder, Macmillan.

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Manufacturing Technology I

L-T-P
3-1-0
MET403

Course Objectives:

To impart basic knowledge and understanding about the primary manufacturing processes such as casting, joining, forming and powder metallurgy and their relevance in current manufacturing industry; To introduce processing methods of plastics

Module I

Introduction: Importance of manufacturing. Economic & technological considerations in manufacturing. Classification of manufacturing processes. Materials & manufacturing processes for common items. **Metal Forming Processes:** Elastic & plastic deformation, yield criteria (Mises' and Tresca's). Hot working versus cold working. Analysis (equilibrium equation method) of Forging process for load estimation with sliding friction, sticking friction and mixed condition for slab and disc. Work required for forging, Hand, Power, Drop Forging. 10(L)

Module II

Metal Forming Processes (continued): Analysis of Wire/strip drawing and maximum-reduction, Tube drawing, Extrusion and its application. Condition for Rolling force and power in rolling. Rolling mills & rolled-sections. Design, lubrication and defects in metal forming processes. 6(L)

Module III

Sheet Metal working: Presses and their classification, Die & punch assembly and press work methods and processes. Cutting/Punching mechanism, Blanking vs. Piercing. Compound vs. Progressive die. Flat-face vs Inclined-face punch and Load (capacity) needed. Analysis of forming process like cup/deep drawing. Bending & spring-back. 6(L)

Module IV

Casting (Foundry): Basic principle & survey of casting processes. Types of patterns and allowances. Types and properties of moulding sand, sand testing. Elements of mould and design considerations. Gating, Riser, Runnes, Core. Solidification of casting, Sand casting, defects & remedies and inspection. Cupola furnace. Die Casting, Centrifugal casting, Investment casting, Continuous casting, CO2 casting and Stir casting etc. 8(L)

Module V

Unconventional Metal forming processes: Unconventional metal forming or High EnergyRate Forming (HERF) processes such as explosive forming, electromagnetic, electro-hydraulic forming. **Powder Metallurgy:** Introduction to Powder metallurgy manufacturing process. Application and, advantages. **Jigs & Fixtures:** Locating & Clamping devices & principles. Jigs and Fixtures and its applications.

Manufacturing of Plastic components: Review of plastics, and its past, present & future uses. Injection moulding. Extrusion of plastic section. Welding of plastics. Future of plastic & its applications. Resins & Adhesives. 10(L)

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Course Outcomes:

1. To impart knowledge on bulk forming processes
2. To provide understanding of various sheet metal forming and processing of plastics.
3. To provide insight into sand casting and introduce other casting processes
4. To make the students understand fundamental of casting
5. Upon Completion of this course, students will be able to illustrate the concept and application of powder metallurgy process

Text Books:

1. Manufacturing Technology Part I and Part II, - PN. Rao, McGraw-Hill
2. Manufacturing Science – A. Ghosh and AK. Mallik, Affiliated East-West Press
3. Manufacturing Processes for Engineering Materials, - S. Kalpakjian, and Steven R Schmid, Pearson Publication, 5th Edition
4. Fundamental of Modern Manufacturing, MP. Groover, Wiley Publication, 3rd Edition

References Books:

1. Principles of Foundry Technology, Jain, McGraw-Hill
2. Production Technology - R.K. Jain Khanna Publishers.
3. Manufacturing Processes- JP Kaushish , PHI Publication
4. Manufacturing Processes- HS Shan, Pearson Publication
5. Production Technology - PC. Sharma, S. Chand Publication
6. Process & Materials of Manufacturing – R.A. Lindburg, Pearson Education

Web Portal:

<https://nptel.ac.in/courses/112107145/>

<https://nptel.ac.in/courses/112104195/>

<https://nptel.ac.in/courses/112107144/>

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Dr. Deepak Aggarwal

Fluid Machinery

L-T-P
3-1-1
MET404

Course Objectives:

1. To give fundamental knowledge of impact of jet.
2. To impart the knowledge on pumps and turbines.
3. To introduce the concepts of the working and design aspects of hydraulic machines like turbines and pumps and their applications.

Module I

Introduction:

Classification of Fluid Machines & Devices, Application of momentum and moment of momentum equation to flow through hydraulic machinery, Euler's fundamental equation.

Impact of Jet:

Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat & curve).

Hydraulic Turbines:

Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel. 8(L)

Module II

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. 8(L)

Module III

Centrifugal Pumps:

Classifications of centrifugal pumps, Vector diagram, Work done by impeller, Efficiencies of centrifugal pumps, Specific speed, Cavitation & separation, Performance characteristics. 8(L)

Module IV

Positive Displacement and other Pumps:

Reciprocating pump theory, Slip and coefficient of discharge, Indicator diagram, Effect of acceleration, air vessels, Comparison of centrifugal and reciprocating pumps, Positive rotary pumps, Gear and Vane Pumps, Performance characteristics. 8(L)

Module V

Other Machines:

Hydraulic accumulator, Special duty pumps, Hydraulic intensifier, Hydraulic Press, hydraulic crane, hydraulic lift, Theory of hydraulic coupling and torque converters, Performance

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characteristics.

Water Lifting Devices: Hydraulic Ram, hydraulic coupling, hydraulic torque converter, air lift pump, jet pump. 8(L)

Course Outcomes:

After taking this course students should be able to:

1. Analyze the forces exerted by a jet of fluid on vanes of different shapes, either stationary or moving.
2. Study and analyze the construction features and working principles of different classes of hydraulic turbines
3. Analyze the performance characteristic curves of hydraulic turbines.
4. Distinguish between different classes of pumps, their construction features and further analyze their performance
5. Understand the working principles of various hydraulic systems, hydraulic control systems and fluidics.

TEXT BOOKS

1. **A Textbook of Fluid Mechanics and Hydraulic Machines (SI Units)**, Dr. R.K. Bansal, Laxmi Publications (P) Limited, 10th Edition, 2018
2. **A Textbook of Fluid Mechanics and Hydraulic Machines (SI Units)**, Er. R.K. Rajput, S. Chand Publications & company Ltd., Revised 5th Edition, 2013.

REFERENCES BOOKS

1. **Hydraulic Machines** by K Subramanya, Tata McGraw-Hill
2. **Fluid Mechanics and Machinery** by C.S.P. Ojha, R. Berndtsson, P.N. Chandramouli, Oxford University Press

e-LEARNING RESOURCES

1. Spoken Tutorial MOOC, 'Course on OpenFOAM', IIT Bombay (<http://spoken-tutorial.org/>)
2. <https://nptel.ac.in/courses/112105206/>
3. https://nptel.ac.in/keyword_search_result.php?word=hydraulic

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Manufacturing Technology I Lab

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MEL453

Objectives:

To study and practice the various operations that can be performed in casting, forging, sheet metal working, and powder metallurgy etc. and to equip with the practical knowledge required in the core industries.

List of Experiments: (At least 8 of the following)

Minimum eight experiments out of the following along-with study of the machines /processes

1. Design of pattern for a desired casting.
2. Pattern making with proper allowance.
3. Making a mould (with core) and casting.
4. Sand testing methods (at least one, such as grain fineness number determination)
5. Injection moulding with plastics
6. Forging - hand forging processes
7. Forging - power hammer study & operation
8. Tube bending with the use of sand and on tube bending m/c.
9. Press work experiment such as blanking/piercing, washer, making etc.
10. Wire drawing/extrusion on soft material.
11. Rolling-experiment.
12. Bending & spring back.
13. Powder metallurgy experiment.
14. Any other suitable experiment on manufacturing science / process/technique.
- 15*. Molding and Casting of Polyurethane parts.
- 16*. Metal Forming (Upsetting & Extrusion)

Course Outcomes:

Upon completion of this course, the students will be able to demonstrate and learn the working principle of different manufacturing processes, used for the fabrication of the objects.

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Fluid Machinery Lab

L-T-P
0-0-2
MEL454

Minimum 07 experiments out of the following along with study of the machines and processes

1. Impact of Jet experiment.
2. Experiment on Pelton wheel.
3. Experiment on Francis turbine.
4. Experiment on Kaplan turbine.
5. Experiment on Reciprocating pump.
6. Experiment on centrifugal pump.
7. Experiment on Hydraulic Jack/Press
8. Experiment on Hydraulic Brake
9. Experiment on Hydraulic Ram
10. Study through visit of any water pumping station/plant
11. Any other suitable experiment/test rig such as comparison & performance of different types of pumps and turbines.
12. Experiment on Compressor
13. Experiment for measurement of drag and lift on aerofoil in wind tunnel

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Computer Aided Machine Drawing II Lab

L-T-P
0-0-2
MEC 4L3

Objectives:

To provide an overview of how computers can be utilized in mechanical component design.
Note: All drawing conforms to BIS Codes.

Introduction: Conventional representation of machine components and materials, Conventional representation of surface finish, Roughness number symbol, Symbols of Machine elements and welded joints. Classification of Drawings: Machine drawings, Production drawing, part drawing and assembly drawing. Introduction to detail drawing and bill of materials (BOM).

Limits, Fits and Tolerances: General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, Commonly used holes and shafts. List of Standard Abbreviations used.

Part Modelling: Introduction to part modelling of simple machine components using any 3D software (like CATIA, PRO E, UGNX, Autodesk Inventor or SOLIDWORKS) covering all commands/ features to develop a part model (Minimum 24 machine components need to be developed).

Part Modelling & Assemblies of: Plummer Block Bearing, Machine Vice, Screw Jack, Engine Stuffing box, Lathe Tailstock, Feed Check Valve and Rams Bottom Safety Valve.

Course Outcomes:

Upon completion of this course, the students can use computer and CAD software for modelling mechanical components.

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