Scheme of Instruction & Syllabi

of

Bachelor of Technology

2nd Year

(Mechanical Engineering)

(With effective from academic session 2022-23)

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs) FOR B.TECH IN MECHANICAL ENGINEERING

The B.TECH program aims to:

PEO1: Develop competent Mechanical engineering technicians with professional skills, knowledge, abilities & attitude for wage employment and/or to become entrepreneur.

PEO2: Provide opportunities and develop competence to work as a leader, manager or team member in multidisciplinary Mechanical engineering works and projects.

PEO3: Develop effective communication skills - Verbal, Written and Graphical, to justify technical solutions for diverse targets associated with mechanical engineering works.

PEO4: Provide opportunities and develop students in terms of social, economic and environment sensitive as responsible professionals.

PEO5: Develop understanding towards use of different codes - local, national and international, for execution of mechanical engineering works.

PEO6: Encourage and provide necessary knowledge, skills and opportunities for higher education and exploring different learning strategies for life-long learning.

PEO7: Provide opportunities and develop responsible professionals in terms of ethics and value systems.

PROGRAM OUTCOMES (POs) FOR B.TECH IN MECHANICAL ENGINEERING

After successful completion of the B.TECH program, learners shall be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2**. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5**. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6**. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10**. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11**. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1	Learners will be able to apply technical skills and modern engineering tools for mechanical engineering day to day practice
PSO2	Learners will be able to participate in practical aspects and problem solving of mechanical engineering field that requires analytical and design requirements.
PSO3	Learners will be able to pursue of lifelong learning and professional development to face the challenging and emerging needs of our society.
PSO4	Learners will comply with small to large concepts of components and mechanical engineering practical and field works to bring out safer and aesthetic environment to live.

INVERTIS UNIVERSITY BAREILLY

Established by Govt. of U.P. u/s 2F of UGC Act, 1956 vide U.P. Act 22 of 2010.

STUDY AND EVALUATION SCHEME

(With effective from academic session 2022-2023)

B. Tech. in Mechanical Engineering

YEAR II, SEMESTER III

S. No.	Category	Course Code	Course Title/ Subjects	Hours per week			Evaluation Scheme		Total	Credits
				L	T	P	CA	EE		
THEORY										
1	Basic Science Courses	BAS-321	Materials Science	2	1	0	25	50	75	3
2	Professional Core Courses	BME-301	Thermodynamics	2	1	0	25	50	75	3
3	Engineering Science Courses	BME-302	Engineering Mechanics	2	1	0	25	50	75	3
4	Engineering Science Courses	BME-303	Fluid Mechanics	3	1	0	30	70	100	4
5	Professional Core Courses	BME-304	Strength of Materials	3	1	0	30	70	100	4
6	Humanities & Social Sciences including Management	BAS-322 /BHU-322	Mechanical Engineering Aptitude	2	1	0	25	50	75	3
7	Engineering Science Course	MFG13	Product Design	4	0	0	30	70	100	4
PRACTICALS AND PROJECTS										
8	Basic Science Courses	BAS-371	Materials Science lab	0	0	2	10	15	25	1
9	Professional Core Courses	BME- 351	Thermodynamics Lab	0	0	2	10	15	50	1
10	Engineering Science Courses	BME-352	Engineering Mechanics Lab	0	0	2	10	15	50	1
			TOTAL	18	6	6	210	455	675	27

L-Lecture, **T**- Tutorial , **P**- Practical ,**CA**- Continuous Assessment, **EE**- End Semester Examination

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STUDY AND EVALUATION SCHEME

(With effective from academic session 2022-2023)

B. Tech. in Mechanical Engineering

YEAR II, SEMESTER IV

Sl. No.	Category	Course Code	Course Title/ Subjects	Hours per week			Evaluation Scheme		Total	Credits
				L	T	P	CA	EE		
THEORY										
1	Professional Core Courses	BME-402	Fluid Machines	2	1	0	25	50	75	3
2	Professional Core Courses	BME-401	Applied Thermodynamics	2	1	0	25	50	75	3
3	Professional Core Courses	BME-403	Measurement and Metrology	2	1	0	25	50	75	3
4	Basic Science Course	BAS-401	Mathematics III (PDE, Probability & Statistics)	3	1	0	30	70	100	4
5	Humanities & Social Sciences including Management	BHU-422	Mechanical Engineering Reasoning	2	1	0	25	50	75	3
6	Mandatory courses	BMC-001	Environmental Science*	0	0	0	-	-	-	0
7	Engineering Science Course	MFG24	Product Manufacturing	4	0	0	30	70	100	4
PRACTICALS AND PROJECTS										
8	Professional Core Courses	BME-451	Fluid Machines lab	0	0	2	10	15	25	1
9	Professional Core Courses	BME-452	Applied Thermodynamics lab	0	0	2	10	15	25	1
10	Professional Core Courses	BME-453	Measurement and Metrology Lab	0	0	2	10	15	25	1
			TOTAL	**15**	**5**	**6**	**190**	**385**	**575**	**23**

L-Lecture, **T**- Tutorial , **P**- Practical ,**CA**- Continuous Assessment, **EE**- End Semester Examination

* THERE WILL BE MCQ PAPER OF 25 MARKS. PASSING REQUIRED FOR COMPLETING THE DEGREE.

L – Lecture **T** – Tutorial **P**- Practical

CA – Continues Assessment **EE** – End Sem Assessment

BAS-321	Materials Science	2 1 0	3 credits

Pre-requisites: None.

Course Objectives: The basic objectives of this course are-

1. To review physics and chemistry in the context of materials science & engineering.
2. To describe the different types of bonding in solids, and the physical ramifications of these differences.
3. To demonstrate diffraction, including interpretation of basic x-ray data.
4. To evaluate and qualitatively derive a material's Young's modulus from a potential energy curve.

Course Outcomes: After learning the course, the students should be able to:

CO 1. Identify crystal structures for various materials and understand the defects in such structures

CO 2. Understand and Classify tailor material properties of ferrous and non-ferrous alloys

CO 3. Draw the Phase diagram and iron carbon equilibrium diagram.

CO 4. Differentiate between types of ferrous, nonferrous materials and its alloys and analyze the various diagrams

CO 5. Judge the significance of the various materials used in manufacturing process along with their imperfections and the testing procedures used.

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

Module 1:

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

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

Module 2:

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non- destructive testing (NDT)

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and

Module 3:

Monotectic reactions. Iron Iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

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

Alloying of steel, properties of stainless steel and tool steels, managing steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys

Text Books:

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction" , 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

BME-301	Thermodynamics	2 1 0	3 credits

Pre-requisites: None.

Course Objectives: The basic objectives of this course is-

1. To provide a good platform to mechanical engineering students to understand, model and appreciate concept of dynamics involved in thermal energy transformation and to carry out experimental investigation and analysis at later stages of graduation.

2. To apply the knowledge of mathematics, science and engineering fundamentals to model the energy conversion phenomenon and identify, formulate power production based on the fundamental's laws of thermal engineering.
3. To investigate the effectiveness of energy conversion process in mechanical power generation for the benefit of mankind.

Course Outcomes: After learning the course, the students should be able to:

CO 1. Recall energy balance to systems and control volumes, in situations involving heat and work interactions

CO 2. Understand changes in thermodynamic properties of substances

CO 3. To estimate the performance of energy conversion devices

CO 4. To differentiate between high grade and low-grade energies.

CO 5. Effectiveness of simple and complex one-component pressure-temperature diagrams and the use of volume-temperature and pressure-volume phase diagrams and the steam tables to test engineering devices and systems.

CO 6. Classify equilibrium states of a wide range of systems ranging from mixtures of gases, pure condensed phases, and mixtures of gases, liquids, and solids that can each include multiple components.

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

Module 1:

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

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

Module 2:

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

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.

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

Module 3:

Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.

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

Text Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals of Thermodynamics*, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.
4. Nag, P.K, 1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co. Ltd.

BME-302	Engineering Mechanics	2 1 0	3 credits

Pre-requisites: None.

Course Objectives: The basic objective of this subject are-

1. To make the students to know the importance of this subject in the field of Engineering particularly Civil & Mechanical Engineering.
2. To make them learn the fundamentals of Mechanics, equation of static equilibrium & dynamic equilibrium

of particles and rigid bodies and the effect of friction on equilibrium.

3. To learn kinematics, kinetics of particle and rigid body, related principles and to implement the above know how to solve practical problems.

Course Outcomes: After the completion of the course, the students will be able to-

CO 1. State the basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts).

CO 2. Understand the basic concepts of the dynamics– force, momentum, work and energy.

CO 3. Apply various laws of mechanics to solve engineering problems like Newton's laws of motion.

CO 4. Analyse dynamics concepts - the Work-Energy principle, Impulse-Momentum principle and the coefficient of restitution and differentiate between the centroid and centre of gravity.

CO 5. Appraise given information and determine which concepts apply, and choose an appropriate solution strategy.

CO 6 Design a mechanical vibratory system for a given conditions to reduce the vibrations amplitude.

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

Module 1*: Introduction to Engineering Mechanics covering,* Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces etc.
Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;
Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines;

Module 2*: Centroid and Centre of Gravity covering,* Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia

of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere.
Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency.
Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, and polar coordinates), 3-D curvilinear motion; Relative & constrained, Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct & oblique).
Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous center of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;

Module 3: *Mechanical Vibrations covering,* Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums;
Tutorials *from the above modules covering*, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack

Text/Reference Books:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar (2010), Singer's Engineering Mechanics
8. Bansal R.K. (2010), A Text Book of Engineering Mechanics, Laxmi Publication

BME-303	Fluid Mechanics	3 1 0	4 credits

Pre-requisites: None.

Course Objectives: The basic objectives of this subjects are-

1. To introduce and explain the students about the fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering etc.
2. To give fundamental knowledge of fluid, its properties and behavior under various conditions of

internal and external flows.

3. 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, the Newton's law of viscosity.

Course Outcome: After learning the course, the students should be able to:

CO1. Recall fundamental concepts of fluid mechanics, fluid properties and pressure flow visualization using timelines, path lines, streamlines, and streamlines, flow regimes.

CO2. Understand the fluid mechanics fundamentals, including concepts of mass and momentum conservation, basic equation of fluid forces on planar and curved surfaces, concepts of static, thermodynamic, stagnation, total, and dynamic pressures.

CO3. Apply principles of dimensional analysis and similitude to simple problems and use dimensionless parameters.

CO4. Analyze flow rates, pressure changes, minor and major head losses for viscous flows through pipes, ducts, simple networks and the effects of pumps, fans, and blowers in such systems.

CO5. Monitor simple pipe systems to deliver fluids under specified conditions, principles of flow measurements such as direct methods, flow-restriction methods, linear methods, traversing methods, open-channel flow meters.

CO6. Design various systems using dimensional analysis and explain the concepts of viscous boundary layers, flow separation, wakes, profile drag, drag coefficients and drag forces.

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

Module 1: Fluids and Their Properties: Introduction of fluid, fluid classifications, hypothesis of continuum, Shear stress in a moving fluid, molecular structure of material, fluid density, viscosity, causes of viscosity in gases and liquids, surface tension, capillary effect, vapor pressure, cavitation, compressibility and the bulk modulus

Pressures and Head: Types of Pressure, Pascal's law of pressure at a point, variation of pressure vertically in a fluid under gravity, equality of pressure at the same level in a static fluid, general equation for the variation of pressure due to gravity from a point to point in a static fluid, pressure and head

Module 2: Static Forces on Surface and Buoyancy: Fluid static, action of fluid pressure on surface, resultant force and center of pressure on a plane surface under uniform pressure, resultant force and center of pressure on a plane surface immersed in a liquid, pressure diagrams, forces on a curved surface due to hydrostatic pressure, buoyancy, equilibrium of floating bodies, stability of a submerged body, stability of floating bodies, determination of the metacentric height, determination of the position of the metacenter relative to the center of buoyancy.

Motion of Fluid Particles and Streams: Fluid flow, different types of flow, frames of reference, analyzing, motion of a fluid particle, acceleration of a fluid particle, discharge and mean velocity, continuity of flow, continuity equations for 2-D and 3-D flow in Cartesian coordinates of system.

The Energy Equation and its Application: Momentum and fluid flow, Momentum equation for 2-D and 3-D flow along a stream line, momentum correction factor, Euler's equation of motion along a stream line, Mechanical energy of a flowing fluid – Bernoulli's theorem, kinetic energy correction factor, pitot tube, determination of volumetric flow rate via pitot tube, changes of pressure in tapering pipe, principle of venturi meter, pipe orifices, theory of small orifices discharging to atmosphere, theory of large orifices, Rotameter, elementary theory of notches and weirs, flow in a curved path

Module 3: Two-Dimensional Ideal Fluid Flow: Rotational and irrotational flow, circulation and vorticity, streamlines and the stream functions, velocity potential and potential flow, relation between stream function and velocity potential; flow nets, stream function and velocity potential for uniform flow, vortex flow.

Dimensional Analysis And Similarities: Dimension reasoning, dimensional homogeneity, dimensional analysis using Rayleigh's method, Buckingham π-theorem, significance of dimensionless, use of dimensionless numbers in experimental investigation, geometric similarity, dynamic similarity, Kinematic similarity, model testing-Model laws, Undistorted and Distorted models.

Flow through pipes: Major energy losses, Minor energy losses, Hydraulic gradient and total energy lines, Pipes in series and parallel, Equivalent pipes, Siphon, power transmission through pipe, Flow through nozzle at end of pipe, Water hammer in pipes

Reference Books:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, S.K.Kataria & Sons
2. Fluid Mechanics and Hydraulic Machines by R.K. Bansal, Laxmi Publications
3. Fluid Mechanics and Hydraulic Machines by R.K. Rajput, S.Chand & Co.
4. Fluid Mechanics by Frank .M. White, McGraw Hill Publishing Company Ltd.
5. Fundamentals of Fluid Mechanics by Munson, Wiley India Pvt. Ltd
6. Fluid Mechanics by A. K. Mohanty, PHI Learning Pvt. Ltd.
7. Laboratory Manual Hydraulics and Hydraulic Machines by R V Raikar

BME-304	Strength of Materials	3 1 0	4 credits

Pre-requisites: None.

Course Objectives: The basic objectives of this subjects are-

1. To provide basic knowledge in mechanics of materials so that the students can solve real engineering problems and design engineering systems
2. Understand the concepts of stress and strain at a point as well as the stress-strain relationships for homogenous, isotropic materials, thin-wall spherical and cylindrical pressure vessels.

Course Outcome: After learning the course, the students should be able to:

CO 1. Define the mechanical properties of materials, stress-strain and various mechanical components like helical spring, leaf spring, column and struts.
CO 2. Understand how different components will fail under load with help of theories of failure for brittle and ductile materials.
CO 3. Apply concepts of stress, strain and principal stresses in 1D, 2D and 3D objects and calculate the stresses induced.
CO 4. Analyze the unsymmetrical bending and shear center.
CO 5. Evaluate force, stress, displacement in simple structures using different methods and justify the different types of stresses in thick and thin cylinders,
CO 6. Create stress-strain model for any mechanical component

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

Module 1: Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle.
Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

Module 2: Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs. Columns and Struts

Module 3: Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure

Text Books:

1.Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2.R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3.Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGrawHill Publishing Co. Ltd., New Delhi 2005.

BAS322/BHU322	Mechanical Engineering Aptitude	2 1 0	3 Credits

Pre-requisites: None.

Course Objectives: The basic objectives of this subjects are-

1. To have a general understanding of aptitude related proficiency
2. To practice and enhance the analytical abilities
3. To be efficient in the various competitive exams

Course Outcomes: After learning the course, the students should be able to:

CO 1. Have a general knowledge of aptitude related proficiency
CO 2. Understand the analytical abilities
CO 3. Apply the concepts to solve the general life problems using the general and engineering Aptitude

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	4	3	4							1	3
CO2	3	3	3			2					1	1
CO3	1	3	3	2	1	2	2				1	1

Detailed Syllabus:

Module 1: Computation of whole numbers, fractions and relationships between numbers, Percentage, Ratio & Proportion, Square roots, Averages, Interest, Profit and Loss, Discount, Partnership Business, Mixture and Allegation, Time and distance, Time & Work,

Module 2: Basic algebraic identities of School Algebra & Elementary surds, Graphs of Linear Equations, Triangle and its various kinds of centers, Congruence and similarity of triangles, Circle and its chords, tangents, angles subtended by chords of a circle, common tangents to two or more circles, Triangle, Quadrilaterals, Regular Polygons, Circle, Right Prism, Right Circular Cone, Right Circular Cylinder, Sphere, Hemispheres,

Module 3: Rectangular Parallelepiped, Regular Right Pyramid with triangular or square base, Trigonometric ratio, Degree and Radian Measures, Standard Identities, Complementary angles, Heights and Distances, Histogram, Frequency polygon, Bar diagram & Pie chart.

Text Books:

1. Quantitative Aptitude for Competitive Examinations by R.S. Aggarwal
2. The Pearson Guide to Quantitative Aptitude for Competitive Examinations by Dinesh Khattar
3. Rapid Quantitative Aptitude with Shortcut Tricks for Competitive Exams by Disha Experts
4. Quantitative **Aptitude** for All Competitive Examinations by Abhijit Guha
5. Quantitative Aptitude by Rakesh Sharma

BAS-371	**Material Science lab**	**0 0 2**	**1 credit**

Course Objectives: The basic objectives of this subjects are-

1. Objective is to give a broad understanding of common materials related to mechanical engineering with an emphasis on the fundamentals of structure-property-application relationships.
2. Demonstrate through laboratory performance, knowledge of physical and mechanical properties of materials including heat treatment and destructive and non-destructive testing of materials.
3. Select appropriate materials for specific engineering applications considering manufacturing and working conditions

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

CO 1. Conduct different mechanical test like tensile test, fatigue test.
CO 2. Draw stress strain diagram for ductile and brittle materials
CO 3. Determine experimentally the tensile, compression and fatigue strength of different materials.
CO 4. Analyze structures of metallic materials and their effects on mechanical properties.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	3	2	1	1		3	2	1	1
CO2	2	1	1	3	2	1	1		3	2		1
CO3	3	3	1	1	2		2		3	1		1
CO4	3	3	1	3	3	2	2		3	2	1	1

At Least 8 of the following

1. To study the imperfection.
2. To study the Bravais lattices with the help of models.
3. To study of crystal structures of different given specimen (Brass, Cu, CI, MS)
4. Study of corrosion and its effects.
5. To study the solidification curve of given metal.
6. To Study heat treatment processes (annealing and tempering) applied to a given specimen.
7. Impact testing of samples – Charpy and Izod tests
8. To study the microstructure of mild steel with the help of microscope.
9. Creep study and testing
10. To study thermosetting.

BME-351	Thermodynamics Lab	0 0 2	1 credit

Course Objectives: The basic objectives of this subjects are-

1. Understand the systems in the energy perspective to classify as open, closed or isolated.
2. Understand the Isobaric, Isochoric, Isothermal, Adiabatic and polytrophic type of flow and non-flow processes.
3. Apply the laws of thermodynamics to the practical problems.

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

CO 1. Recall the knowledge of open, closed or isolated type of thermodynamic systems in the energy perspective
CO 2. Describe different types of IC Engines.
CO 3. Apply the laws of thermodynamics to the practical problems.
CO 4. Analyze and differentiate among various boilers.
CO 5. Perform test on Diesel and Petrol Engine test rig.

Mapping of course outcomes with program outcomes

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

At least 10 of the following

1. To study and sketch about the locomotive boiler.
2. To study and sketch about Lancashire boiler.

3. Study and working of two stroke petrol engines
4. Study and working of four stroke petrol engines
5. Determination of Indicated HP of IC engine by Morse Tower
6. To study and sketch about the model of Babcock and Wilcox Boiler.
7. Study of Gas Turbine Model
8. Study and working of two stroke diesel engines
9. Study and working of four stroke Diesel engines
10. Study of Steam Engine Model
11. To study and sketch about vapour compression refrigeration system.
12. To study and sketch simple steam engine model.

BME-352	**Engineering Mechanics Lab**	**0 0 2**	**1 credit**

Course Objectives: The basic objectives of this course are-

1. To develop a skill in dignity of precision, safety at work place, team working and development of right attitude.
2. To acquire skills in basic engineering practice
3. To identify the various test instrument's suitability.

Course Outcome: After studying this course, you should be able to:

CO 1. Conduct the experiments on different mechanical components like belt pulleys, gears etc.
CO 2. Clarify the concept of momentum and impact through experimentations.
CO 3. Perform different tests on UTM, Hardness machine and Izod-Charpy Machine.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	3	2	1	1	1			1
CO2	3	1		2	2	3						1
CO3	3	3		3	1	3	2	2				1

Atleast 8 of the following

1. To verify triangle and parallelogram law of forces with the help of Gravesand's Apparatus.
2. To study equilibrium of parallel forces in simple supported beam reaction.
3. To conduct the Impact-tests Izod and Charpy on Impact-testing machine to find the Toughness.
4. Friction experiments on inclined plane.
5. Simple & compound gear-train experiment. Worm & worm-wheel experiment for load lifting.

6. Torsion of rod/wire experiment.
7. Experiment on Moment of Inertia.

BME-401	Applied Thermodynamics	2 1 0	3 credits

Pre-requisites: Basic Knowledge of Thermodynamics

Course Objectives: The basic objectives of this course are-

1. This course aims to provide a good platform to mechanical engineering students to understand, model and appreciate concept of dynamics involved in thermal energy transformation.
2. To prepare them to carry out experimental investigation and analysis at later stages of graduation to apply the principles of the thermodynamics to the real life problems..
3. To instill upon to envisage appropriate experiments related to heat engines.

Outcomes: After completing this course, the students will be able to

CO 1. Get a good knowledge of various practical power cycles and heat pump cycles.
CO 2. Clarify the energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors
CO 3. Relate the phenomena occurring in high speed compressible flows.
CO 4. Outline and formulate power production based on the fundamental's laws of thermal engineering and analyze steam turbines, steam nozzle, different properties of moist air.
CO 5. Test the knowledge of mathematics, science and engineering fundamentals to model the energy conversion phenomenon and significance of compounding of turbines.

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

Module 1:

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.
Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super-critical and ultra-super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual Cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties.

Module 2:
Properties of dry and wet air, use of psychrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.
Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables

Module 3:
Isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, super saturation-compressible flow in diffusers, efficiency of nozzle and diffuser. Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors, Analysis of steam turbines, velocity and pressure compounding of steam turbines.

Text Books:

1. Sonntag, R. E, Bugrake, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals of Thermodynamics*, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.
4. Nag, P.K, 1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co. Ltd

BME-402	**Fluid Machines**	**2 1 0**	**3 credits**

Course Objectives: The basic objectives of this course are-

1. To introduce and explain fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc.
2. To give fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
3. 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.
4. To imbibe basic laws and equations used for analysis of static and dynamic fluids.

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

CO 1. Define basic terms, values and laws in the areas of fluids properties, statics, kinematics and dynamics of fluids,

CO 2. Represent the methods of implementing fluid mechanics laws.
CO 3. Practically apply tables and diagrams, and equations that define the associated laws of fluid mechanics.
CO 4. Analyze the operational parameters of hydraulic systems and machines, Outline and optimize operational parameters of hydraulic problems, systems & machines.
CO 5. Detect the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies.
CO 6. Predict the importance of fluid flow measurement and its applications in Industries and hydraulic design of pipes.

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

Module 1:
Introduction:
Classification of Fluid Machines & Devices, Application of momentum and 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 & *c*urve), Effect of inclination of jet with the surface.

Module 2:
Hydraulic Turbines:
Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel.
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.

Module 3:
Centrifugal Pumps:
Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Model testing, Cavitation & separation and their control, Performance characteristics.

Positive Displacement Pumps:
Reciprocating pump theory, Slip and coefficient of discharges, Indicator diagram, Effect and acceleration, Work saved by fitting air vessels, Comparison of centrifugal and reciprocating pumps, Positive rotary pumps, Gear and Vane pumps, Performance characteristics. Hydraulic ram, Jet pumps, Air lift pumps.

BOOKS:

1. Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvtltd. Hydraulic Machines: Theory & Design, V.P.Vasandhani, KhannaPub. Applied Hydraulics byAddison
2. Hydraulic Machines by R K Rajput, S.Chand & coLtd. Hydraulic Machines by D S Kumar

BME-403	Measurement & Metrology	2 1 0	3 credits

Course Objectives: The basic objectives of this course are-

1. To make the students able to take measurements of physical properties and inspection of engineering parts with various precision instruments and design the parts, tolerances and fits.
2. To enable the students to understand the principles of measuring instruments, gauges and their uses.
3. Evaluation and inspection of surface roughness.

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

CO 1. List the measuring instruments and perform measurement processes.
CO 2. Clarify the appropriate method and instruments for inspection of various gear elements and thread elements.
CO 3. Relate the standards of length, angles, they can understand the evaluation of surface finish and measure the parts with various comparators.
CO 4. The quality of the machine tool with alignment test can also be Analyzed by them
CO 5. Test the tolerances and fits for selected product quality.

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

Module-I:

General Concept: Need and Classification of measurements and instruments, Standards calibration, basic and auxiliary function, elements of a measurement system, mechanical versus electrical/ electronic instruments, primary, secondary and working standards.
Static and Dynamic Characteristics of Instruments: Range and span, accuracy and precision, Calibration, sensitivity and linearity, threshold and resolution, errors, dead time and dead zone. Sources of errors in measurements, Basic concepts of measurement methods,
Functional Element: Review of electro-mechanical sensors and transducers-variables resistance, resistance strain-gauges, gauge-factor bounded and unbounded strain gauges, surface preparation and Bonding Techniques, application of strain-gauges for direct, bending and torsion loads, hydraulic and pneumatic load cells.

Module-II:

Temperature Measurement: Bimetallic thermometers, liquid-in-glass thermometers and filled-in-system thermometers, thermocouples, metal resistance thermometers and thermistors.
Pressure and Flow Measurement: Bourdon Tube, Vacuum Measurement-Mcleod Gauge, Thermal Conductivity gauge and ionization gauge. Electromagneticflux-meters, Ultrasonic, Flow meters and Hot Wire anemometers.
Force, Torque and Power Measurement: Vibration read tachometer, stroboscope, proving Ring, Mechanical and Hydraulic Load cell, Torque on rotating shafts, Absorption, transmission and driving dynamometers.
Metrology and Inspection: Objective of metrology, Dimensional accuracy, Precision measurement.

Module-III:
Standards of Measurement: Line standard, end standard, wavelength standard, classification of standards.
Limits Fits and tolerance: Nominal size and basic dimension, Basics of fit, System of specifying tolerances, designation of holes, shafts and fits.
Principle of Measuring Instruments: Classification of measuring equipment, Technical specification of measuring equipment's, Principles of mechanical measuring instruments: lever method, Vernier method, screw & screw-nut method, Principle of electrical measuring instruments. variation of electrical parameter, electrical measuring gauges.
Linear Measuring: Vernier calipers, Vernier principle, errors in calipers,
Micrometers: Description of micrometer, sources of errors, types of micrometers, advantages and limitations.
Angular and Taper Measurement: Instrument for angular measurement, gauges for tapers.
Screw Thread Measurement: Classification of threads, elements of screw threads, measurement elements of a screw thread.
Measurement and Inspection: Dimensional Inspection- Tolerance, Limit, Gauging, Comparators.

Textbooks:

1. Holman J.P, Experimental Methods for Engineers, 6th Edition, McGraw Hill Inc (1994)
2. Doebijn E O, "Measurement System Application and Design", 5th Edition, McGraw Hill, Singapore (2004)
3. Beckwith T G Marangoni R D and Lienhard J H, "Mechanical Measurements", 5th Edition, Pearson Education India (1993)
4. Figloila RS and Beasley D E, "Theory and Design for Mechanical Measurement". 2nd, Edition, John wiley and Sons Inc, New York (1995)

BAS-401	Mathematics-III	3 1 0	4 credits

Course Objectives: The basic objectives of this course are-

1. To make student understand the method of solving algebraic, transcendental equations.
2. To expand the given periodic function defined in the given range in terms of sine and cosine multiple of terms as a Fourier series.
3. To enable students the root finding techniques used to solve practical engineering problems.

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

CO 1. Know how root finding techniques can be used to solve practical engineering problems.
CO 2. Understand the approximate value of the derivative & definite integral for a given data using numerical techniques.
CO 3. Solve the given periodic function defined in the given range in terms of sine and cosine multiple of terms as a Fourier series.
CO 4. Outline the functions used in integration techniques.
CO 5. Evaluate the analytical techniques to express periodic function as a Fourier sine and Cosine series

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

Module-I

Function of Complex Variable: Analytic Function, C-R equation, Cauchy's Integral theorem, Cauchy's integral formula for derivatives of analytic function, Taylor's and Laurent's series. Singularities, Residue theorem, Evaluation of real integrals.

Statistical Techniques-I: Moments, Moment generating function, skewness, Kurtosis, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curve etc. Correlation, Linear, non-linear and multiple regression analysis, probability theory.

Module-II

Statistical Techniques II: Binomial, Poisson and Normal distribution, Sampling theory (Small and large), Tests of signification: Chi-square test, t-test, Analysis of variance (one way), Application to engineering, medicine, agriculture etc. Time square series and forecasting (moving and semi-averages), Statistical quality control methods, Control charts, R, p, np and c charts.

BHU-422	Mechanical Engineering Reasoning	2 1 0	3 credits

Numerical Techniques-I: Zeroes of transcendental and polynomial equation using bisection method. Regula-falsi method and Newton-Raphson method, Rate of convergence of above methods.

Module-III

Interpolation: Finite differences, difference tables, Newton's forward and backward interpolation, Lagrange's and Newton's divide difference formula for unequal intervals.

Numerical Techniques-II: Solution of system of linear equations, Gauss-Seidal method, Crout method, Numerical differentiation, Numerical integration, Trapezoidal, Simpson's one third and three-eight rule, Solution of ordinary differential (First order, second order and simultaneously) equation by Euler's, Picard's and forth-order Runge-Kutta method.

Reference books:

1. Jain, Iyenger & jain, numerical method for Scientific and Engineering Computation New Age International, New Delhi, 2003.
2. Chandrika prasad, Advanced Mathematics for Engineers, Prasad Mudralaya, 1996.
3. E. Kreysig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
4. B.S. Grewal. Higher Engineering Mathematics, Khanna Publishers, 2005.
5. Devi Prasad, An Introduction to Numerical Analysis, Narosa Publication House, New Delhi 2006.
6. R.K. Jain & S.R.K. Lyenger, Advance Engineering mathematics, Narosa Publication House. 2002.

Text Books:

1. J.N. Kapur, Mathematical Statistical, S. Chand & Company Ltd. 2000
2. Peter V. O'Neil, Advance Engineering Mathematics Thomson (Cengage) Learning.

Course Objective:

The objective of this Course is to improve the reasoning skills of the students which will help the students in appearing various competitive examinations.

After the successful completion of the course the students will be able to (Course Outcomes)-

CO 1 Understand the basic concepts of LOGICAL REASONING Skills
CO2 Acquire satisfactory competency in use of VERBAL REASONING
CO3 Solve campus placements Logical Reasoning and Verbal Ability

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	3	3	2	3	3				1			2
CO2	3		1	2	1		2					2
CO3	3	3	3		1							2

Detailed Syllabus:-

Module 1:

Analogies, Similarities and Differences, Space visualization, Spatial orientation, Problem solving & Analysis, Judgment & Decision making, Visual memory, Discrimination & observation, Relationship concepts, Arithmetical Reasoning and figural classification, Arithmetic Number Series, Non-verbal series

Module 2:

Coding and Decoding, Statement conclusions, Syllogistic reasoning, Semantic Analog, Symbolic/ Number Analogy, Figural Analogy, Semantic Classification, Symbolic /Number Classification, Figural Classification, Semantic Series, Number Series, Figural Series, Problem Solving, Word Building, Numerical Operations

Module 3:

Symbolic Operations, Embedded Figures, Space Orientation & Visualization, Venn Diagrams, drawing inferences, Punched hole/ pattern–folding & Un-folding, Figural pattern–folding and completion, Critical thinking, Address matching, Date & city matching, Classification of center codes/ roll numbers, Small & Capital letters/ numbers coding, Decoding and classification

Text Books:

1. A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Aggarwal
2. A New Approach to Reasoning Verbal & Non-Verbal by B.S. Sijwali & Indu Sijwali
3. Shortcuts in Reasoning for Competitive Exams by Disha Expert.
4. Analytical Reasoning by MK Panday
5. How to Crack Test of Reasoning by Arihant Experts

BMC-001	Environmental Science	2 0 0	0 credits

Course Objectives: The basic objectives of the course are to-

1. Develop in students an appreciation of the modern scope of scientific inquiry in the field of Ecology and an understanding of the differences in the structure and function of different types of ecosystems
2. Make students familiar with the variety of ways that organisms interact with both the physical and the biological environment.
3. Able to deal students with the interconnectedness of multiple factors in environmental challenges and to nurture knowledge, respect, and love for the natural and human communities of central Maine, the place where they spend four formative years of their lives.

Course Outcome: After studying this course, you should be able to:

CO 1. Become familiar with the variety of ways that organisms interact with both the physical and the biological environment.

CO 2. Clarify the interconnectedness of multiple factors in environmental challenges

CO 3. Relate an appreciation of the modern scope of scientific inquiry in the field of Ecology
CO 4. Analyze the differences in the structure and function of different types of ecosystems.
CO 5. Nurture and monitor the knowledge, respect, and love for the natural and human communities of central Maine, the place where they spend four formative years of their lives.

Mapping of course outcomes with program outcomes:-

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

Detailed Syllabus:

Module-I

Environment Definition-Scope & Importance, Need for Public Awareness, Ecosystem-Food chain, Food-web, Ecological pyramids, Energy- photosynthesis, 10% Law, Food, Shelter, Economic & social security. Biogeochemical Cycles- Carbon, nitrogen & Sulphur cycle.

Module -II

Natural Resources- Forest Resources -Types & Functions, Deforestation- causes & impacts, Chipko Movement, Water Resources, Energy- Conventional & Non- Conventional Energy resources - Solar, water, wind, ocean thermal, fossil fuels (coal, oil & natural gas). Solid Waste Management, Public Health Aspects, Sustainable Development.

Module –III

Pollution- Air, water, noise, soil & automobile pollution, Indian Legislation of Air & water Act, Wild Life Act, Environmental Impact Assessment.

Global Warming, Acid Rain, Climate Change, Ozone Layer, Green House Effects, Urbanization, Population, Animal Husbandry, Environmental Education, Women Education.

Text Books:

1. Benny Joseph – "Environmental Studies" –Tata McgrawHill-2005
2. Dr. D.L. Manjunath, "Environmental Studies" –Pearson Education-2006.
3. R. Rajagopalan – "Environmental studies" –Oxford Publication – 2005.
4. M. Anji Reddy – " Text book of Environmental Science & Technology" –BS Publication.

Reference Books

1. P. Venugoplan Rao, "Principles of Environmental Science and Engineering" –Prentice Hall of India.
2. Meenakshi, "Environmental Science and Engineering" –Prentice Hall India.

BME-451	Fluid Machines Lab	0 0 2	1 credit

Course Objectives: The basic objective of the course are-

1. To able the students to compare the results of analytical models introduced in lecture to the actual behavior of real fluid flows;
2. To enable students to know the practice standard measurement techniques of fluid mechanics and their applications;
3. To develop a habit in the students to learn and practice writing technical reports; and work on small design projects.

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

CO 1. Label, name, and characterize flow patterns and regimes practically.
CO 2. Understand basic units of measurement, convert units, and appreciate their magnitudes.
CO 3. Estimate experimentally the basic properties and parameters of the flow.
CO 4. Calibrate the instruments by experimental analysis.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3								1	1
CO2	3	3	3	2	2	2	2				1	1
CO3	3	3	3	2	2	2	2				1	1
CO4	3	3	3								1	1

Note: Ensure to conduct at least 8 experiments from the list:

List of the Experiments:

1. To study the model of Hydro Electric Power Plant and draw its layout.
2. To study the constructional details of Kaplan turbine and draw its fluid flow charts
3. To study the constructional details of Francis turbine and draw its fluid flow chart
4. To study the constructional details of Pelton turbine and draw its fluid flow charts
5. To study the constructional details of Hydraulic Ram and determine its various efficiencies.
6. To study the constructional details of centrifugal pumps and draw its characteristics curves.
7. To study constructional details of gear oil pump and draw its characteristics curves.
8. To draw the following performance characteristics of Pelton turbine constant head, constant speed and constant efficiency curves.
9. To draw the following performance characteristics of Francis turbine constant head, constant speed

and constant efficiency curves.

BME-452	Applied Thermodynamics Lab	0-0-2	1 credit

Course Objectives: The basic objective of the course are-

1. To enable students to identify the various thermodynamic tools and how to use them and to discuss and practice standard measurement techniques used in thermodynamics
2. To understand the practicality of thermodynamics in daily life
3. To develop a habit in the students to work on small design projects.

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

CO 1. State the various thermodynamic tools and will be able to use them as well
CO 2. Paraphrase and practice standard measurement techniques in thermodynamics
CO 3. Estimate experimentally the various performance parameters of the different thermodynamic systems being used in daily life
CO 4. Focus to work on small design projects

Mapping of course outcomes with program outcomes:-

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	3	2	1					1	3
CO2	3	3	2		2	2		2	1		1	1
CO3	2	3	2	3	2	2	2				1	1
CO4	3	1	3			1					1	1

Note: Ensure to conduct at least 8 experiments from the list:

List of the Experiments:-

1. To study low pressure boilers and their accessories and mountings.
2. To study high pressure boilers and their accessories and mountings.
3. To study the working of impulse and reaction steam turbines.
4. To prepare heat balance sheet for given boiler.
5. To find power output & efficiency of a steam turbine.
6. To find the condenser efficiencies.
7. To study cooling tower and find its efficiency.
8. To study the working of Bomb calorimeter.
9. To study and find volumetric efficiency of a reciprocating air compressor.

BME-453	Measurement & Metrology lab	0	0	2	1 credit

Course Objectives: The basic objective of the course are-

1. To make familiar the students with the Metrology and instrumentation Laboratory course designed for measuring and gauging instruments for inspection of precision linear, geometric forms, angular and surface finish measurements.
2. The student can learn the measurements with and calibration of instruments and understand the machine tool alignment test.
3. To introduces the students with the theory and methods for conducting experimental work in the laboratory and calibration of various instruments for measuring pressure, temperature, displacement, speed, vibration etc.

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

CO 1. Recognize the use of instruments for measuring linear (internal and external), angular dimensions and surface roughness.

CO 2. Understand the alignment tests on various machine tools with experimentation.

CO 3. Relate the use of instruments for measuring pressure, flow, speed, displacement and temperature experimentally.

CO 4. Experimentally calibrate the Bourdon tube pressure gauge.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3		3							1	3
CO2	1	2	3	3	2	3	2				1	1
CO3	2	3	1	2	2	3	2				1	3
CO4	3	2	3		3						1	1

Note: Ensure to conduct at least 8 experiments from the list:

List of the Experiments:-

1. Study & working of simple measuring instruments- Vernier calipers, micrometer, tachometer.
2. Measurement of effective diameter of a screw thread using 3 wire methods.
3. Measurement of angle using sidebar & slip gauges. Study of limit gauges.
4. Study & angular measurement using level protector.
5. Study of dial indicator & its constructional details

6. Study and understanding of limit, fits, & Tolerances
7. Strain gauge measurement
8. Speed measurement using stroboscope
9. Experiment on Dynamometers