Bachelor of Technology (Mechanical Engineering)
Kurukshetra University, Kurukshetra
SCHEME OF EXAMINATIONS w.e.f: (2025-26) (Semester - IV)

Note:

S. No	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						End Semester Exam	Internal Assessment	Practical Exam	Total	
1	B24-ESC -202	Materials Engineering	3:0:0	3	3	70	30	--	100	3
2	B24-MEC-202	Fluid Mechanics and Machines	4:1:0	5	5	70	30	--	100	3
3	B24-MEC-204	Mechanical Vibrations and Tribology	3:1:0	4	4	70	30	--	100	3
4	B24-MEC-206	Mechanics of Solids-II	3:1:0	4	4	70	30	--	100	3
5	B24-MEC-208	Manufacturing Technology	3:0:0	3	3	70	30	--	100	3
6	B24-HSM-202	Innovation, Start-up and Entrepreneurship	3:0:0	3	3	70	30	--	100	3
7	B24-ESC-204	Materials Engineering Lab	0:0:2	2	1	--	40	60	100	3
8	B24-MEC-210	Fluid Mechanics and Machines Lab	0:0:2	2	1	--	40	60	100	3
9	B24-MEC-212	Mechanical Vibrations and Tribology Lab	0:0:2	2	1	--	40	60	100	3
10	B24-MAC-202	Essence of Indian Traditional Knowledge	3:0:0	3	1	--	100	--	100	3
		Total		**31**	**26**	**420**	**400**	**180**	**1000**	

- **All students have to undertake the industrial training for 4 to 6 weeks after 4th semester which will be evaluated in 5th semester.**

	B. Tech. (4th Semester) Mechanical Engineering						
B24-ESC-202	**MATERIALS ENGINEERING**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3**
Purpose:	To develop capacity to identify crystal structure, designate various steels, create phase diagrams, analyse material failure mechanisms, perform heat treatment, study green energy materials and basic functioning of sophisticated material characterization techniques. with overall objective of developing the understanding of microstructure-property relations.						
Course Outcomes							
CO 1	Students will be able to identify and differentiate various types of the crystal structures and deformation mechanisms in various materials.						
CO 2	Students will be able to designate various types of steels as per BIS and AISI-SAE standard specifications of steels						
CO 3	Students will be able to draw various types of phase diagrams, Fe-C diagram and TTT curve.						
CO-4	Students will be able to classify heat treatment processes and will be able to select suitable heat treatment process for any industrial application.						
CO 4	Students will be able to explain various mechanisms of deformation and failure mechanisms like Creep and Fatigue.						
CO 5	Students will be able to study various materials used for green energy production.						
CO 6	Students will be able to explain the basic principles involved in the working of various types of material characterization techniques and will develop the capability to select a particular material characterization process for any given application.						

UNIT I

Crystallography: Review of Crystal Structure, Space Lattice, Co-ordination Number, Number of Atoms per Unit Cell, Atomic Packing Factor; Numerical Problems Related to Crystallography.

Imperfection in Metal Crystals: Crystal Imperfections and their Classifications, Point Defects, Line Defects, Edge & Screw Dislocations, Surface Defects, Volume Defects.

Introduction to Engineering materials and Standard Materials Designation: Introduction to Engineering materials, Steel Terminology, Indian Standard specifications for steels as per BIS: Based on *Ultimate Tensile Strength* and based on *Composition*, AISI-SAE standard designation for Steels and Aluminium Alloys

UNIT II

Phase Diagrams: Basic concepts and terms, Alloy Systems, Solid solutions, Hume- Rothery's Rules, Phase Diagrams, Gibbs Phase Rule, Cooling curves, Binary phase diagrams, The Lever Rule, Applications of Phase Diagrams, Phase Transformation, Allotropic Forms of Iron, Micro-

constituents of Fe-C system, Iron-iron carbide phase diagram, Modified Iron Carbon Phase Diagrams, Isothermal Transformation, TTT Curve, CCT curve.
Heat Treatment: Heat treatment of steels, Annealing, Normalising, Hardening, Tempering, Ageing, Austempering and Martempering, Surface hardening and Case hardening processes, Major Defects in Metals or Alloys due to faulty Heat treatment.

UNIT III

Deformation of Metal: Elastic and Plastic Deformation, *Mechanism of Plastic Deformation*: **Slip**; Critical Resolved Shear Stress, **Twinning**, Conventional and True Stress Strain Curves for Polycrystalline Materials, Yield Point Phenomenon, Bauschinger Effect, Work Hardening.

Fatigue Failure of Materials: Fatigue, fatigue-failure models, Fatigue loads, Mechanism of Fatigue Failure, Theories of Fatigue, Factors affecting fatigue, SN diagram, Fatigue Life calculations, Fatigue Tests.

Creep: Creep Curve, Types of Creep, Factors affecting Creep, Mechanism of Creep, Creep Resistant Material, Creep Tests, Improving creep resistance.

UNIT IV

Materials for green energy: Biodiesel, Bioethanol**,** Production methods of Biofuels**;** Overview of key fuel cell technologies- various types of fuel cells, materials for electrodes, electrolytes and other components, working mechanisms, hydrogen generation and storage; limitations, recent progress in fuel cells.

Materials Characterization Techniques: Characterization techniques such as X-Ray Diffraction (XRD), Scanning Electron Microscopy(SEM), Energy dispersive X-ray spectroscopy (SEM-EDX), Transmission Electron Microscopy(TEM), Atomic force microscopy(AFM), Scanning tunneling microscopy(STM).

Text Books:

1. Fundamentals of Material Science and Engineering by W. D. Callister, Wiley.
2. Material science and metallurgy by O.P Khanna, Dhanpat Rai Publication.
3. Material Science by S.L. Kakani, New Age Publishers.
4. The Science and Engineering of Materials by Donald R. Askeland , Chapman & Hall.
5. Material Science by Narula, TMH.
6. Machine Design by Robert Norton, Pearson.
7. Phase Transformation in Metals and Alloys by D. A. Porter & K. E. Easterling
8. Fuel Cell Systems Explained by Larminie and A. Dicks, , 2nd Edition, Wiley.
9. Principles of Fuel Cells by Xianguo Li, Taylor and Francis.
10. Fuel Cells: From Fundamentals to Applications by S. Srinivasan, Springer.
11. Fundamental of Light Microscopy and Electronic Imaging by Douglas B. Murphy, Kindle Edition 2001.
12. Concise Encyclopedia of Materials Characterization by Robert Cahn, 2nd Edition (Advances in Materials Science and Engineering) Elsevier Publication 2005.

Note: The paper setter will set the paper as per the question paper templates provided.

	B. Tech. (4th Semester) Mechanical Engineering						
B24-MEC-202	**FLUID MECHANICS AND MACHINES**						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs.)**
4	**1**	**-**	**5**	**70**	**30**	**100**	**3**
Purpose	To build a fundamental understanding of concepts of Fluid Mechanics and their application in rotodynamic machines.						
Course Outcomes							
CO 1	The students will be able to understand the basic concepts of fluid statics, kinematics and dynamics; and apply mass and momentum conservation laws to mathematically analyze simple flow situations.						
CO 2	The students will be able to understand laminar, turbulent and boundary layer flows and solve problems for the same.						
CO 3	The students will be able to apply dimensional analysis to simple flow problems and understand the basics of hydraulic machines.						
CO 4	The students will be able to design and evaluate the performance of hydraulic turbines and pumps.						

UNIT-I

Fluid Statics: Properties of fluids, Newton's law of viscosity, hydrostatic law, hydrostatic forces on submerged plane and curved surfaces, buoyancy, stability of floating and submerged bodies, Problems.

Fluid Kinematics: Types of fluid flows, stream, streak and path lines; flow rate and continuity equation, differential equation of continuity in cartesian and polar coordinates, rotation and vorticity, circulation, stream and potential functions, flow net. Problems.

Fluid Dynamics: Concept of system and control volume, Euler's equation, Navier-Stokes equation, Bernoulli's equation and its practical applications, Impulse momentum equation. Problems.

UNIT-II

Viscous Flow: Flow regimes and Reynold's number, relationship between shear stress and pressure gradient. Exact flow solutions, Couette and Poisuielle flow, laminar flow through circular conduits. Problems.

Turbulent Flow Through Pipes: Darcy Weisbach equation, friction factor, Moody's diagram, minor losses in pipes, hydraulic gradient and total energy lines, series and parallel connection of pipes, branched pipes; equivalent pipe, power transmission through pipes. Problems.

Boundary Layer Flow: Concept of boundary layer, measures of boundary layer thickness, Blasius solution, von-Karman momentum integral equation, laminar and turbulent boundary layer flows, separation of boundary layer and its control. Problems.

UNIT-III

Dimensional Analysis: Need for dimensional analysis – methods of dimensional analysis – Dimensionless parameters – application of dimensionless parameters. Problems.

Hydraulic Pumps: Introduction, theory of Rotodynamic machines, Classification, various efficiencies, velocity components at entry and exit of the rotor, velocity triangles; Centrifugal pumps: working principle, work done by the impeller, performance curves, cavitation in pumps; Reciprocating pumps: working principle, indicator diagram, effect of friction and acceleration, air vessels, Problems.

UNIT-IV

Hydraulic Turbines: Introduction, Classification of water turbines, heads and efficiencies, velocity triangles, axial, radial and mixed flow turbines, Pelton wheel, Francis turbine and Kaplan turbines, working principles, work done, design of turbines, draft tube and types, specific speed, unit quantities, performance curves for turbines, governing of turbines. Problems.

Text Books:

1. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons
2. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, Tata McGraw Hill.
3. Fluid Mechanics and Fluid Machines - S.S. Rattan, Khanna Publishing House.
4. Fluid Mechanics and Hydraulic Machines – R. K. Rajput, S. Chand & Company

Reference Books:

1. Introduction to Fluid Mechanics – R.W. Fox, Alan T. McDonald, P.J. Pritchard, Wiley Publications.
2. Fluid Mechanics – Frank M. White, McGraw Hill
3. Fluid Mechanics – Streeter V L and Wylie E B, Mc Graw Hill
4. Mechanics of Fluids – I H Shames, Mc Graw Hill
5. Fluid Mechanics: Fundamentals and Applications - Yunus Cengel and John Cimbala, McGraw Hill.
6. Fluid Mechanics: Pijush K. Kundu, Ira M. Cohen and David R. Rowling, Academic Press.

Note: The paper setter will set the paper as per the question paper templates provided.

	B. Tech. (4th Semester) Mechanical Engineering						
B24-MEC-204	**MECHANICAL VIBRATIONS AND TRIBOLOGY**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of exam (Hours)**
3	**1**	**0**	**4**	**70**	**30**	**100**	**3**
Purpose:	To understand, analyze, derive and calculate various parameters of mechanical vibration systems with different degrees of freedom in different modes and conditions and to understand the basics of tribology.						
Course Outcomes							
CO1	Students will be able to understand the vibration fundamentals for a single degree of freedom system under free and damped vibrations, various spring/ shaft combinations and will also be able to solve mathematical problems based on the same.						
CO2	Students will be able to analyze different types of single degree of freedom forced vibration systems and damped, undamped, free and forced systems with two D.O.F. and will also be able to solve mathematical problems based on the same.						
CO3	Students will be able to evaluate frequencies and principal modes of vibrations for various spring-mass combinations and rotor-shaft systems and will be able to derive frequency expressions for continuous systems viz. transverse, longitudinal and torsional vibration for beams, bars and shafts respectively and will also be able to solve mathematical problems based on the same.						
CO4	Students will be able to understand the fundamentals of tribology, lubrication, friction and wear.						

UNIT-I

Fundamentals: Introduction, elements of a vibratory system, periodic and S.H.M., degrees of freedom (DOF), types of vibrations, work done by a harmonic force, beats, Problems.

Free vibration systems with single degree of freedom undamped systems: Introduction, differential equations, torsional vibrations, spring and shaft combinations: series & parallel, linear and torsional systems, compound pendulum, bifilar and trifilar suspensions, problems.

Free vibration systems with single degree of freedom damped systems: Introduction, types of damping, differential equations of damped free vibrations, initial conditions, logarithmic decrement, vibrational energy, Problems.

UNIT-II

Forced vibration systems with single degree of freedom damped systems: Introduction, excitation and sources, equations of motion, rotating and reciprocating unbalanced system, support motion, vibration isolation, force and motion transmissibility, forced vibration system with different types of damping, vibration measuring instruments, resonance, bandwidth, quality factor and half power points, critical speed of shaft with and without damping with single and multiple discs, problems.

Two degrees of freedom system: Introduction, torsional vibrations, principal modes of vibrations for two D.O.F., damped and undamped forced and free vibrations, semi-definite systems, coordinate coupling, spring and mass type vibration absorber, problems.

UNIT-III

Multi-degree of freedom systems: Introduction, principal modes of vibrations for three or more DOF, influence coefficients, orthogonality principle, matrix method, matrix iteration method, Dunkerley's equation, Holzer's Method, Rayleigh Method, Stodola method, problems.

Continuous systems: Introduction, lateral vibrations of strings, longitudinal vibrations of bars, transverse vibration of beams, torsional vibration of uniform shafts, problems.

UNIT-IV

Tribology: Introduction, tribology in design, tribology in industry, economic aspects. **Lubrication:** Introduction, basic modes of lubrication, lubricants, properties of lubricants: physical and chemical, types of additives, extreme pressure lubricants, recycling of used oils and oil conservation, disposal of scrap oil, oil emulsion.

Friction and wear: Introduction, laws of friction, kinds of friction, causes of friction, friction measurement, theories of friction, effect of surface preparation. Introduction to wear, types of wear, various factors affecting wear, measurement of wear, wear between solids and liquids, theories of wear.

Text Books:

1. Mechanical Vibrations by G. K. Grover, Nem Chand and Bros., Roorkee.
2. Elements of Mechanical Vibrations by Meirovitch, McGraw Hill.
3. Introductory course on theory and practice of Mechanical Vibration by J.S. Rao and K.Gupta, New Age International.
4. Friction and wear of Materials by E. Robinowicz, Johan Wiley
5. Tribology an Introduction by Sushil Kumar Srivastava
6. Introduction to Tribology and Bearings by B. C. Majumdar, S. Chand and Company Ltd. New Delhi.

Reference Books:

1. Mechanical Vibrations by S.S. Rao, Pearson Education Inc. Dorling Kindersley (India) Pvt. Ltd. New Delhi.
2. Mechanical Vibrations by V.P. Singh, Dhanpat Rai & Co. Pvt. Ltd., Delhi.
3. Engineering Tribology by Prashant Sahoo, PHI publications.
4. Principles of Tribology by J. Hailing, McMillan Press Ltd.

Note: The paper setter will set the paper as per the question paper template provided

	B. Tech. (4th Semester) Mechanical Engineering						
B24-MEC-206	**MECHANICS OF SOLIDS-II**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time (Hrs.)**
3	**1**	**0**	**4**	**70**	**30**	**100**	**3**

Purpose	The objective of this course is to show the concept of strain energy and different stresses in springs, pressure vessels, rotating rims/discs, links, curved bars under different loads. The course will help the students to build the fundamental concepts in order to solve engineering problems.
Course Outcomes	
CO1	Understand the concepts of strain energy and various theories of failures and solve the problems.
CO 2	Differentiate different types of stresses induced in thin and thick pressure vessels and solve the problems. Use of Lame's equation to calculate the stresses induced in thick pressure vessels.
CO 3	Able to compute stresses in ring, disk and cylinder due to rotation. Classify the different types of spring and analyze the stresses produced due to loading.
CO 4	Determine the stresses in crane hook, rings, chain link for different cross sections and also the deflection of curved bars and rings. Analyze the stresses due to unsymmetrical bending and determine the position of shear centre for different sections.

Unit I

Strain Energy & Impact Loading: Definitions, expressions for strain energy stored in a body when load is applied (i) gradually, (ii) suddenly and (iii) with impact, strain energy of beams in bending, beam deflections, strain energy of shafts in twisting, energy methods in determining spring deflection, Castigliano's theorem, Numerical.

Theories of Elastic Failures: Various theories of elastic failures with derivations and their limitations, comparisons and applications to problems of 2- dimensional stress system, Numerical.

Unit II

Thin Walled Vessels: Hoop & Longitudinal stresses & strains in cylindrical & spherical vessels & their derivations under internal pressure, wire wound cylinders, Numerical.

Thick Cylinders & Spheres: Derivation of Lame's equations, radial & hoop stresses and strains in thick and compound cylinders and spherical shells subjected to internal fluid pressure only, hub shrunk on a solid shaft, Numerical.

Unit III

Rotating Rims & Discs: Stresses in uniform rotating rings & discs, rotating discs of uniform strength, stresses in (I) rotating rims, neglecting the effect of spokes, (ii) rotating cylinders, hollow cylinders & solid cylinders. Numerical.

Springs: Stresses in closed coiled helical springs, Stresses in open coiled helical springs

subjected to axial loads and twisting couples, leaf springs, flat spiral springs, concentric springs, Numerical.

Unit IV

Bending of Curved Bars : Stresses in bars of initial large radius of curvature, bars of initial small radius of curvature, stresses in crane hooks, rings of circular & trapezoidal sections, deflection of curved bars & rings, stresses in simple chain links, deflection of simple chain links, Problems.

Unsymmetrical Bending: Introduction to unsymmetrical bending, stresses due to unsymmetrical bending, deflection of beam due to unsymmetrical bending, shear center for angle, channel, and I- sections, Numerical.

Text Books:

1. Strength of Materials – R.K. Rajput, Dhanpat Rai & Sons.
2. Strength of Materials – Sadhu Singh, Khanna Publications.
3. Strength of Materials – R.K. Bansal, Laxmi Publications.
4. Strength of Materials – D.S. Bedi, Khanna Publications.

Reference Books:

1. Strength of Materials – Popov, PHI, New Delhi.
2. Strength of Materials – Robert l. Mott, Pearson, New Delhi
3. Strength of Material – Schaum's Outline Series – McGraw Hill
4. Strength of Material – Rider – ELBS

Note: The paper setter will set the paper as per the question paper templates provided

	B. Tech. (4th Semester) Mechanical Engineering						
B24-MEC-208	**MANUFACTURING TECHNOLOGY**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of exam (Hours)**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3**
Purpose:	To build a foundation in different manufacturing processes related to castings, metal forming, joining, powder metallurgy and plastic material shaping processes.						
Course Outcomes							
CO 1	After completing the course, students will be able to understand the casting fundamentals, and different casting processes.						
CO 2	The students will be able to understand and analyse the different metal forming processes.						
CO 3	The students will understand different welding processes with their applications.						
CO 4	The student will have the basic understanding of powder metallurgy processes and different plastic shaping processes.						

UNIT-I

Fundamentals of castings: Introduction to casting; basic requirements of casting processes, casting terminology, solidification process: cooling curves, prediction of solidification time, fluidity and pouring temperature, role of gating system, solidification shrinkage, casting defects.

Expandable-mould casting processes: Sand casting, cores and core making, other expendable-mould processes with multiple use patterns, shakeout, cleaning and finishing.

Multiple-use-mould casting processes: Permanent mould casting, die casting, squeeze casting and semisolid metal casting, centrifugal casting, cleaning, finishing and heat treating of castings, automation in foundry operations.

UNIT-II

Metal forming processes: Classifications of metal forming processes, bulk deformation processes, material behaviour in metal forming, temperature in metal forming, rolling: flat rolling, shape rolling, rolling mills, forging: open-die forging, impression-die forging, flashless forging, extrusion: types of extrusion, extrusion dies and presses, defects in extruded products, wire and bar drawing, tube drawing.

Sheet metal working: Cutting operations: shearing, blanking, and punching, engineering analysis of sheet-metal cutting, other sheet-metal-cutting operations, bending operations: v-bending and edge bending, springback effect, drawing: mechanics of drawing, defects in drawing.

UNIT-III

Joining processes: Principles of fusion welding processes, arc welding processes, consumable electrodes: shielded metal arc welding, gas metal arc welding, flux-cored arc welding, submerged arc welding, Arc welding processes-non-consumable electrodes: gas tungsten arc welding, plasma arc welding, resistance welding processes, electron-beam welding, laser beam welding, thermit welding.

Principles of solid-state welding processes: friction welding, explosive welding, ultrasonic welding processes. **Brazing, soldering, and adhesive bonding:** Principles of adhesive, brazing and soldering processes, origins of welding defects.

UNIT-IV

Powder metallurgy: Characterization of engineering powders: geometric features, other features production of metallic powders: atomization: other production methods, conventional pressing and sintering: blending and mixing of the powders, compaction, sintering, heat treatment and finishing, design considerations in powder metallurgy.

Shaping processes for plastics: Properties of polymer melts, extrusion, production of sheet and film, fiber and filament production (spinning), coating processes, injection moulding, compression and transfer moulding, blow moulding and rotational moulding, thermoforming.

Text Books:

1. Fundamentals of modern manufacturing: materials processing and systems by Mikell P. Grover,
   John Wiley and Sons.
2. Materials and processes in manufacturing by J.T. Black and R.A. Kohser, John Wiley and Sons.
3. Principles of Manufacturing Materials & Processes by Campbell J. S., Publisher – Mc Graw Hill.
4. Production Technology by R. K. Jain, Khanna Publishers
5. Manufacturing Technology-Foundry, Forming and Welding by P.N. Rao, Tata McGraw Hill
6. Advanced Manufacturing Process by Hofy, H.E., B and H Publication.
7. Manufacturing Science by Ghosh, A. and Mullik, A, East –West private Limited.

Reference Books:

1. Welding and Welding Technology by Richard L. Little Tata McGraw Hill Ltd.
2. Manufacturing Processes and Systems by Ostwald Phillip F., Munoz Jairo, John Wiley & Sons
3. Elements of Manufacturing Processes by B.S. Nagendra Parasher, RK Mittal, PHI N. Delhi

4. Manufacturing Engineering and Technology by Serope Kalpakjian and Steven R. Schmid, Pearson publications.

Note: The paper setter will set the paper as per the question paper template provided.

		B. Tech. (4th Semester) Mechanical Engineering					
B24-HSM-202		**INNOVATION, START-UP AND ENTREPRENEURSHIP**					
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of exam (Hours)**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3**
Purpose	The objective of this Course is to inspire students and help them imbibe entrepreneurial mindset.						
CO 1	Understanding the essence of innovation and features of innovative processes; models and methods of innovative entrepreneurship, the role of innovation as a major factor in creating the value of companies						
CO 2	Understanding, the dynamic role of entrepreneurship and small businesses, types of business structure, organizing and managing a Small Business.						
CO 3	Understanding concept of start-ups, Control Strategic Marketing Planning, concept of incubation and proto type, new Product Development, Business Plan Creation.						
CO 4	Understanding risk analysis in business, financing methods, role of government in supporting entrepreneurship						

Unit -I

Introduction to Innovation and Entrepreneurial Idea Generation and Identifying Business Opportunities, Management Skills for Entrepreneurs, Innovations and their forms, Innovation - features and characteristics, Factors initiating innovations, Innovation process and its stages, Statistical measurement of innovation, Model of innovation, Source of innovation, Technological transfer, Information technology to support innovation, difference between technological and non-technological innovation

Unit-II

Introduction to Entrepreneurship and Start – Ups - Definitions, Traits of an entrepreneur, Intrapreneurship, Entrepreneurial Motivation ,Functions of Entrepreneur, Concept, Growth of Entrepreneurship in India, Types of Business Structures, Similarities /differences between entrepreneurs and managers, Business Ideas and their implementation, Discovering ideas and visualizing the business, Activity map, Types of startups, role of entrepreneurs in economic development, future of entrepreneurs, entrepreneurial process

Unit -III

Start ups - Initial idea generation and planning stages, and incubation referring to the development process of identifying and developing new ideas for products, services, or processes, and creating a working model or prototype to test the feasibility of the concept.

Market Analysis – Identifying the target market, Competition evaluation and Strategy Development, Five Cs of Opportunity Identification, Market Opportunity Identification in emerging technology companies, Process of creating and growing a new business venture, Business plan of the innovation project.

Unit -IV

Risk Analysis: Risk management in venture projects, Financing and Protection of Ideas- Financing methods available for start-ups in India, Communication of Ideas to potential investors – Investor Pitch, Patenting and Licenses, Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy, venture capital, angel investment, and crowdfunding.

Government support- programs and initiatives aimed at supporting the development of new ideas, innovations, and startups, funding and mentorship, IPR - legal protection of a person's or organization's rights to their invention, brand, or creative work

Suggested Readings:

1. Shrutin N Shetty, (2018), Design the Future: Simplifying Design Thinking to Help You, Notion Press
2. "Entrepreneurship development small business enterprises", Pearson, Poornima M Charantimath,2013.
3. Roy Rajiv, "Entrepreneurship", Oxford University Press, 2011.
4. "Innovation and Entrepreneurship",Harper business- Drucker.F, Peter, 2006.
5. "Entrepreneurship", Tata Mc-graw Hill Publishing Co.ltd new Delhi- Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd, 8th Edition, 2012
6. The Three-Box Solution: A Strategy for Leading Innovation By Vijay Govindarajan
7. Boutellier, Roman; Gassmann, Oliver; von Zedtwitz, Maximilian (2000). Managing Global Innovation. Berlin: Springer.. ISBN 3-540-66832-2.
8. Brown K. and Stephen P. Osborne (2005) Managing change and innovation in public service organisation. New York: Routledge
9. Cappellin R. and Wink R. (2009) International Knowledge and Innovation Networks Knowledge Creation and Innovation in Medium-technology Clusters. UK: Edward Elgar Publishing Limited.
10. Eveleens, C. (2010). Innovation management; a literature review of innovation process models and their implications. Working Paper HAN University of Applied Sciences.
11. Enterpreneurship Development- S.Chand & Co.,Delhi- S.S.Khanka 1999
12. Small-Scale Industries and Entrepreneurship. Himalaya Publishing House, Delhi – Vasant Desai 2003.
13. Entrepreneurship Management -Cynthia, Kaulgud, Aruna, Vikas Publishing House, Delhi, 2003.
14. Entrepreneurship Ideas in Action- L. Greene, Thomson Asia Pvt. Ltd., Singapore, 2007

	B. Tech. (4th Semester) Mechanical Engineering						
B24-ESC-204	**MATERIALS ENGINEERING LAB**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Internal Assessment**	**Practical Exam**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3**
Purpose	To make the students prudent in metallographical sample preparation, microstructure analysis, basic heat treatment operations and production of Biofuels.						
Course Outcomes							
CO 1	Students will have the ability to design and conduct experiments, acquire data, analyze and interpret data						
CO 2	Students will have the ability to determine the grain size and microstructure in different Ferrous alloys by means of experiments.						
CO 3	Students will have the ability to identify and differentiate microstructures of different Non-Ferrous alloys.						
CO 4	Students will be able to perform various heat treatment processes using muffle furnace in the lab.						
CO 5	Students will have the ability to analyse microstructure of Heat-treated specimens and perform Fatigue and creep test on different materials.						
CO6	Students will be able to perform lab scale production of Biofuel.						

List of Experiments:

1. To Study various Crystal Structures through Ball Models.
2. To study the components and functions of Metallurgical Microscope.
3. To learn about the process of Specimen Preparation for metallographic examination.
4. To perform Standard test Methods for Estimation of Grain Size.
5. To perform Microstructural Analysis of Carbon Steels and low alloy steels.
6. To perform Microstructural Analysis of Cast Iron.
7. To perform Microstructural Analysis of Non-Ferrous Alloys: Brass & Bronze.
8. To perform Microstructural Analysis of Non-Ferrous Alloys: Aluminium Alloys.
9. To Perform annealing of a steel specimen and to analyze its microstructure.
10. To Perform Hardening of a steel specimen and to analyze its microstructure.
11. To perform Jominy End-Quench Hardenability Test.
12. To perform Fatigue test on fatigue testing machine.
13. To perform Creep test on creep testing machine.
14. To produce a sample of Biodiesel.
15. To study the functioning of fuel cells.

Note: At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

	B. Tech. (4th Semester) Mechanical Engineering						
B24-MEC-210	**FLUID MECHANICS AND MACHINES LAB**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Internal Assessment**	**Practical Exam**	**Total**	**Time**
-	**-**	**2**	**1**	**40**	**60**	**100**	**3**
Purpose	**To familiarize the students with the equipment and instrumentation of Fluid Mechanics and Machines**						
Course Outcomes							
CO1	**Collect, analyse and interpret data using fluid mechanics principles and experimentation methods.**						
CO2	**Determine the coefficient of discharge for various flow measurement devices.**						
CO3	**Calculate flow characteristics such as Reynolds number, friction factor from laboratory measurements.**						
CO4	**Analyze the performance characteristics of hydraulic pumps and turbines.**						
CO5	**Write individual and group reports, present objectives, describe test procedures and results, synthesize and discuss the test results.**						

List of Experiments:

1. To determine the meta-centric height of a floating body.
2. To verify the Bernoulli's Theorem.
3. To determine coefficient of discharge of an orifice meter.
4. To determine the coefficient of discharge of venturimeter.
5. To determine the coefficient of discharge of Notch.
6. To find critical Reynolds number for a pipe flow.
7. To determine the friction factor for the pipes.
8. Determination of the performance characteristics of Pelton Wheel.
9. Determination of the performance characteristics of a Francis Turbine.
10. Determination of the performance characteristics of a Kaplan Turbine.
11. Determination of the performance characteristics of a centrifugal pump.
12. Determination of the performance characteristics of a reciprocating pump.
13. Determination of the performance characteristics of a gear pump.
14. Determination of the performance characteristics of a Hydraulic Ram.

Note: Any 8 experiments from the above list are required to be performed by students in the laboratory.

	B. Tech. (4th Semester) Mechanical Engineering						
B24-MEC-212	**MECHANICAL VIBRATIONS AND TRIBOLOGY LAB**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Internal Assessment**	**Practical Exam**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3**
Purpose	To provide practical knowledge of free and forced vibration system fundamentals and the mechanisms of friction, wear and lubrication.						
Course Outcomes							
CO1	The students will be able to know practically the concepts of free and forced vibrations for a spring mass system and will determine the natural frequency.						
CO2	The students will be able to diagnose the machinery faults, their causes and sources using Machinery Fault Simulator (MFS).						
CO3	The students will understand the concept of sliding wear and abrasive wear using wear and friction monitoring apparatus and dry abrasion tester respectively.						
CO4	The students will be capable of measuring the extreme pressure properties of different lubricants using four ball tester.						

LIST OF EXPERIMENTS:

1. To study undamped free vibrations and determine the natural frequency of:
   - 1.1 Spring mass system
   - 1.2 Simple Pendulum
   - 1.3 Torsional spring type double pendulum and compare them with theoretical values.
2. To study the torsional vibration of a single rotor shaft system and determine the natural frequency.
3. To study the free vibration of system for different damper settings. Draw decay curve and determine the log decrement and damping factor. Find also the natural frequency.
4. To verify the Dunkerley's rule.
5. To determine the radius of gyration for:
   - 5.1 Bifilar suspension.
   - 5.2 Compound pendulum.
   - 5.3 Trifilar suspension.
6. To study the forced vibration system with damping, Load magnification factor vs. Frequency and phase angle vs frequency curves. Also determine the damping factor.
7. To find out and locate machinery faults viz. vibrations and unbalancing using Machinery Fault Simulator (MFS) in:
   - 7.1 Direct Driven reciprocating pump;
   - 7.2 Direct Driven centrifugal pump;
   - 7.3 Defective straight tooth gearbox pinions.
8. To determine the wear rate, friction force and coefficient of friction of a metallic pin/ball by using wear and friction monitor apparatus.
9. To determine abrasion index of a material with the help of dry abrasion test rig.
10. To evaluate the wear and extreme pressure properties of a lubricating oil by using four ball tester.

11. To determine the roughness of a specimen using surface roughness tester.

Note: At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

	B. Tech. (4th Semester) Mechanical Engineering						
B24-MAC-202	**Essence of Indian Traditional Knowledge**						
Lecture	**Tutorial**	**Practical**	**Credits**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of exam (Hours)**
2	**-**	**-**	**1**	**-**	**100**	**100**	**3**
Purpose	To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the importance of roots of knowledge system, analyse and apply to their day to day life.						
	Course Outcomes						
CO 1	The students will be able to understand , connect up and explain basics of Indian traditional knowledge in modern scientific perspective						
CO2	The students will be able to understand Holistic Health using Indian Knowledge System						
CO3	The students will be able to Manage thoughts and Emotions , will learn positivity, self-regulation and control						
CO4	The students will be able to Achieve Consciousness through Indian Knowledge System						

Unit-I

Introduction to Indian Traditional knowledge: Define traditional knowledge, importance, kinds of traditional knowledge. Philosophical systems, Basics of Rajyoga and Karamyoga, Benefits of Rajyoga and Karamyoga.

Unit-II

Holistic Health using Indian Knowledge System: Basic principles of natural life style, Benefits through five elements. Healing through food, Chakras and Mudras. Physical, Mental, Emotional and Spiritual health using traditional knowledge.

Unit-III

Positivity: Traditional approaches. Happiness: objective and subjective measures of wellbeing, life satisfaction. Resilience, Self-regulation and self-control, optimism, self-esteem. Managing thoughts and Emotions with the help of Rajyoga. Achieving Powers for Self Mastery.

Unit-IV

Achieving Consciousness through Indian Knowledge System: Emotional intelligence, Indian approach to Psychology. Consciousness; levels, body-mind relationship, self motivation, Self and Identity in modern Psychology and Indian thought., Spirituality and well being.

Refrence and Text Books:

- Mahadevan, M., Bhat, V.R. & Pavana N. (2022). Introduction to Indian Knowledge System: Concepts and Applications. PHI Learning
- Baumgardner, SR & Crothers, MK (2009). Positive Psychology. Prentice Hall/Pearson Education.
- Cornelissen, R.M., Misra G. & Varma S. (2014). Foundations & Applications of Indian Psychology. Pearson Education.
- Rajyoga Education and Consciousness Improvement Programme for Educators, Rajyoga Education and Research Foundation. Rajyoga Meditation Course, Thoughkart, Jaipur(Rajasthan), India.
- Prakartik Swasthya Shastra, Publisher Natural Lifestyle