LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
(An Autonomous Institution)
DEPARTMENT OF MECHANICAL ENGINEERING
SCHEME OF INSTRUCTIONS & EXAMINATIONS [LR-23]
(w.e.f. Academic Year 2026-27)
B.E. VII-Semester

S. No.	Course Code	Category	Course Title	Scheme of Instruction				Scheme of Examination			Credits
				L	T	P/D	Contact Hours/Week	Maximum Marks CIE	Maximum Marks SEE	Duration in Hours	
Theory Course											
1	U23ME701	PCC	Metrology and Instrumentation	3	-	-	3	40	60	3	3
2	U23ME702	PCC	Refrigeration and Air Conditioning	3	-	-	3	40	60	3	3
3	-	PEC	Professional Elective Course III	3	-	-	3	40	60	3	3
4	-	OEC	Open Elective Course-III	3	-	-	3	40	60	3	3
Practical/ Laboratory Course											
5	U23ME7L1	PCC	Metrology and Instrumentation Lab	-	-	2	2	25	50	3	1
6	U23ME7L2	PCC	CAE Lab	-	-	3	3	25	50	3	1.5
Skill Development Course											
7	U23MA7L1	BSC	Aptitude and Reasoning	-	-	2	2	25	50	3	1
Internship											
8	U23ME7P1	PROJ	Internship-II (During Vacation after VI Semester)	-	-	2	2	50	-	-	1
Project											
9	U23ME7P2	PROJ	Major Project (Phase-I)	-	-	4	4	25	-	-	2
Total				**12**	**0**	**13**	**25**	**310**	**390**	**21**	**18.5**

L: Lecture (Hrs/Wk/Sem) **T**: Tutorial (Hrs/Wk/Sem) **P**: Practical **D**: Drawing (Hrs/Wk/Sem)

Professional Elective Course-III		
1.	U23ME703	Energy Conservation and Management
2.	U23ME704	Fatigue and Fracture Analysis
3.	U23ME705	Additive Manufacturing Technology
4.	U23ME706	Tool Design
5.	U23ME707	Mechanical Vibrations

CIE: Continuous Internal Evaluation
BSC: Basic Science Courses
OEC: Open Elective Courses
PROJ: Project
ME: Mechanical Engineering
SEE: Semester End Examination
PCC: Professional Core Courses
PEC: Professional Elective Courses
MA: Mathematics
MB: Management Studies

Note:
1. Each contact hour is a Clock Hour.
2. The duration of the practical class is three hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

Course Code	Course Title						Elective/Core
U23ME701	Metrology and Instrumentation						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Familiarize with Limits & fits, I.S.O. system and the instruments used to measure these limits.
2. Gain knowledge of various precision linear and angular measuring instruments.
3. Learn the importance of form and how to measure form errors.
4. Understand the working principles of various instruments used for the measurement of strain, forces, pressure, temperature and vibrations.

Course Outcomes:

After completing the course, the student will be able to:

1. Compare different types of limits, fits and tolerances and their applications.
2. Interpret Linear and angular measurements using different measuring instruments.
3. Develop the design of limit gauges, evaluate roughness and its measurement.
4. Summarize basic measuring system, static and dynamic characteristics of instruments.
5. Apply various principles to measure pressure, temperature, displacement, force, torque and vibrations.

Unit-I

Introduction to Engineering Metrology, Role of metrology in quality assurance, Linear and Angular measurements – Slip gauges and End bars – Gauge material and manufacturing methods, Different types of Micrometers, Height gauges, Tomlinson gauges. Precision polygon, Sine bar, Auto collimator. Limits and Fits, ISO system: Types of interchangeability Taylor's Principle or plain limit gauges, Use of Plug, Ring and Snap gauges. Indicating type limit gauges, Laser Interferometers.

Unit-II

Comparators: Dial indicator, Sigma and Mechanical comparator, free flow and Back pressure type Pneumatic comparator. Optical projector, Chart gauges, screen gauges and measuring methods. Tool maker's Microscope applications. Form measurements – Measurement of Straightness and Flatness. Roundness measurement with bench centers and talyrond, Coordinate Measuring Machine in complex geometries.

Unit-III

Surface Roughness Measurements, Profilometer, Taylor Hobson Talysurf. Application of Thread metrology - 2 wire, 3 wire method and best wire methods, Gear measurement - Gear tooth thickness, Parkinson gear tester, General geometric tests for testing machine tools – Lathe, drill and Mill.

UNIT-IV

Elements of instrumentation system. Static and Dynamic characteristics. Instrument types - zero, first and second order instruments, Types of errors. Displacement transducers. LVDT. Strain measurement -Wire and foil type resistance strain gauges. Rosette Gauges. Bonding procedure. Lead resistance compensation. Adjacent arm and self-compensating gauges. Proving ring. Strain gauge load cells, measurement of axial load and torsion by strain gauges. Piezo-electric load cell.

Unit-V

Introduction to Seismic Transducers -displacement and acceleration measurement, Pressure measurement -Bourdon pressure gauge, bulk modulus gauge, pirani gauge, Temperature measurement by thermo couples. Laws of thermo electricity. Types of materials used in thermocouples. Protection tubes. Extension wire. Series and parallel circuits. Ambient temperature compensation.

Suggested Reading:

1. I.C. Gupta – ―Engineering metrology‖, Dhanpat Rai Publications, New Delhi
2. Rega Rajendra, ―Principles of Engineering Metrology‖, Jaico Publishing House, Mumbai.
3. RK Jain, "Engineering Metrology", Khanna Publications, 1996.
4. Doeblin,"Measurement Systems Application and Design‖, Tata Mc¬Graw Hill,5th ed., 2004.

Course Code	Course Title						Core / Elective
U23ME702	Refrigeration & Air Conditioning						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Understand the basic concepts of refrigeration and air conditioning systems.
2. Study the methods of refrigeration for commercial and industrial applications.
3. Study the lower temperature applications: cryogenics by using cascade systems.
4. Study typical conditions required for various food product processes and applications of refrigeration and air conditioning.
5. Solving the problems related to cooling and heating system (HVAC).

Course Outcomes:

After completing the course, the student will be able to:

1. Identify various natural and artificial methods of refrigeration. State the importance of refrigerant selection and the environmental issues related to the use of CFCs.
2. Formulate equations for different types of refrigerants used in vapour compression refrigeration system. Justify the selection of single or multistage system based on operating temperature range.
3. Explain the working principles of vapour absorption, thermoelectric and steam-jet refrigeration systems.
4. Select a suitable refrigerant absorbent mixture for Vapour absorption refrigeration system.
5. Analyze various problems on psychrometric processes, know the construction and application of Psychrometric chart.
6. Design an air conditioning system based on given inside and outside conditions and evaluate cooling and heating loads in an air-conditioning system.

Unit-I

Introduction to Refrigeration: Definition of Refrigeration and Air-conditioning, Necessity of Refrigeration, Methods of Refrigeration, Unit of Refrigeration and C.O.P. Reversed Carnot cycle. Properties of Refrigerants, Classification of Refrigerants, Ozone depletion & Global warming, Green House Effect and Future of Refrigerants.

Air Refrigeration Systems: Analysis of Bell-Coleman Cycle, Application to aircraft refrigeration, Simple cooling system and Bootstrap refrigeration system.

Unit-II

Vapour compression system: Working principle and essential components of Simple vapor compression Refrigeration cycle, Compressor, condenser, evaporator, and expansion devices, Analysis of cycle, C.O.P, Representation of the cycle on T-S, P-H and H-S charts. Performance improvement of simple vapour compression refrigeration cycle by means of flash chamber and accumulator Dry and wet compression, Compound compression with water inter cooler and Flash intercooler, Cascade refrigeration system-Analysis and advantages.

Unit-III

Vapour Absorption Refrigeration System: Simple absorption systems, COP, Practical ammonia absorption refrigeration system, Lithium bromide absorption system, Electrolux refrigerator, Common refrigerants and absorbents properties, Comparison with vapor compression refrigeration system Steam Jet Refrigeration: Principle of working, Analysis of the system, Advantages, limitations and applications.

Non-Conventional Refrigeration Systems: Principle and operation of Thermoelectric Refrigeration Systems, Seebeck effect - Peltier effect -Thomson effect, Analysis, Pulse tube refrigeration system.

Unit-IV

Psychrometry: Psychrometric properties, Psychrometric chart, construction, Representation of Psychrometric processes on the chart.

Introduction to Air Conditioning: Requirements of comfort air conditioning, Thermodynamics of human body, Body temperature, Metabolism, Body defense and Human tolerance, Effect of heat on performance, ASHRE comfort chart and Effective temperature.

Unit-V

Cooling Load Calculations in Air Conditioning: Concept of bypass factor, Sensible heat factor, Apparatus Dew Point, Room Sensible Heat Factor (RSHF), Gross Sensible Heat Factor (GSHF), Different heating and cooling loads, Problems. Design of air conditioning systems: All fresh air, Re-circulated air with bypassed air, Design of Summer, winter and Year-round air-conditioning systems.

Air Conditioning Systems: Types, Components of air conditioner equipments, Humidifier, Dehumidifier, Filter, Grills, Fans and Blowers, Duct material, Function of Dampers, Diffusers. Applications of Refrigeration and Air conditioning Food Preservation, Transport air conditioning, and Industrial applications.

Suggested Reading:

1. Arora C.P., ―Refrigeration and Air conditioning‖, Tata McGraw Hill, New Delhi, 2009.
2. Arora, S.C. and Domkundwar, S., ―A Course in Refrigeration and Air conditioning‖, Dhanpat Rai & Sons, New Delhi, 2010.
3. Jain, V.K., ―Refrigeration and Air Conditioning‖, S Chand & Company, New Delhi, 2010
4. Stocker, W.S., ―Refrigeration and Air conditioning ―, McGraw Hill, New Delhi, 2009.
5. RK Rajput.,‖Refrigeration & Air conditioning‖, SK Kataria & Sons New Delhi, Third Edition 2015.

Course Code	Course Title						Core / Elective
U23ME703	Energy Conservation and Management						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Understand the fundamental principles of energy conservation, thermodynamic efficiency, and cost-effective energy utilization in industrial systems.
2. Analyze heat, mechanical, electrical, and chemical energy systems, including their transportation, storage, and conversion processes.
3. Evaluate different sources of energy losses and perform calculations related to efficiency, power, and performance of energy systems.
4. Develop knowledge of comprehensive energy conservation planning methods for identifying and implementing energy-saving measures in organizations.
5. Apply modeling techniques and forecasting methods for industrial energy supply, demand, and conservation strategies.

Course Outcomes:

After completing the course, the student will be able to:

1. Explain the principles of energy conservation, various forms of energy, and their applications in industrial processes.
2. Calculate heat energy, steam quality, power transmission, and efficiency of mechanical and thermal energy systems.
3. Analyze combustion systems, electrical machines, and identify losses in chemical and electrical energy conversions.
4. Prepare and implement comprehensive energy conservation plans for industrial organizations using systematic approaches.
5. Develop industrial energy conservation models and forecast energy supply-demand requirements for effective decision-making.

UNIT-I

Definition, Principles of Energy Conservation - Maximum Thermodynamic efficiency. Maximum Cost - effectiveness in energy use. Various forms of energy - Heat Mechanical. Electrical energy and Chemical energy. Identification of potential sources of energy losses - Transportation, operation and conversion from one from to another.

UNIT-II

Heat energy and storage - Media of transport of heat energy - steam, oil and flue gases. Calculation of steam quality. Calculation of amount of heat energy available. Recuperators. Constructional details, Selection of materials to store heat energy. Concept of power. Modes of mechanical energy transport - Gears, pulleys, belts, shafts etc., Calculation of power. Sources of loss of power in energy conversion into electricity, potential energy (i.e., pumps).

UNIT-III

Chemical energy - combustion of fuels - petrol, diesel and coal. Loss due to quality of fuel, conversion

into other form of energy - boilers, I.C. engines. Calculation related to losses. Electrical energy - Working principle of motors and generators. Calculation of efficiency of generators. Losses during transmission and energy conversion - into mechanical energy, thermal energy. Calculation of effecting parameters.

UNIT-IV

Procedure for Comprehensive Energy Conservation Planning (CECP) -Specifying targets, Identifying energy in-efficient facilities. Synthesize evaluation and optimization of alternative conservation measures in view of organization costs. Flow chart of organization's functions. Collection of accountable data. Application of CECP method. An example.

UNIT-V

Industrial energy conservation modeling - Methodology - Definition of production system – A primary copper production system, Model construction - Mathematical Programming. Market penetration, Structure of energy conservation model. Data preparation - coefficients needed in a model, Unit production cost and unit energy requirements. Model exercise, verification and validation. Methodology for forecasting Industrial Energy Supply and Demand.

Suggested Reading:

1. Gottschalk C.M., "Industrial Energy Conservation", John Wiley & Sons, 1996.
2. Chaturvedi P., and Joshi S., "Strategy for Energy Conservation in India", Concept Publishing Co., New Delhi, 1997.
2. A.S. Hovan George Dr. A. Shaji George, Dr. A. Shahul Hameed, Energy Conservation & Management, 1st Book Rivers, 2024.
3. Thipse, Energy Conservation and Management, Narosa Publication, 2014.
4. BenardMakaa, Energy Conservation and Management for Professionals, River Publishers, 2025.

Course Code	Course Title						Core / Elective
U23ME704	Fatigue and Fracture Analysis						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
Machine Design	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Provide a fundamental understanding of fatigue behavior, classification, and testing methods for engineering materials.
2. Develop knowledge of crack initiation, propagation mechanisms, and the role of microstructure in fatigue failure.
3. Introduce fracture mechanics concepts such as energy release rate, stress intensity factor, and crack growth behavior.
4. Familiarize students with elastic-plastic fracture mechanics concepts including J-integral and crack tip opening displacement (CTOD).
5. Enable application of fatigue and fracture principles in material selection, design, and life prediction of engineering components.

Course Outcomes:

After completing the course, the student will be able to:

1. Explain different types of fatigue and analyze fatigue behavior using stress-life and strain-life approaches.
2. Evaluate crack initiation and propagation mechanisms in various materials based on microstructural and macrostructural factors.
3. Apply fracture mechanics concepts such as stress intensity factor and energy release rate to predict crack growth.
4. Analyze elastic-plastic fracture behavior using J-integral and CTOD approaches, including numerical methods.
5. Assess fatigue and fracture performance of advanced materials and apply crack growth laws for safe and reliable design.

Unit-I

Introduction: historical overview, Types of fatigue – low cycle fatigue, high cycle fatigue, very high cycle (giga cycle) fatigue, Fatigue test methods and equipment, Total life approaches based on cyclic stress and cyclic strain, Cyclic hardening and softening in single crystals and polycrystals

Unit-II

Crack initiation and propagation, Mechanisms, Macrostructural and microstructural aspects, Use of Fracture mechanics in fatigue. Fatigue behaviour of different materials Metallic materials and weldments, Ceramics, Polymers, Composites, Metallic glasses, Shape memory alloys,

Unit-III

Energy Principle: Energy release rate – Criterion for crack growth – Crack resistance curve – Principles of crack arrest – Crack arrest in practice. Fatigue Crack Growth: Fatigue crack growth test, stress intensity factor, factors affecting stress intensity factor – Variable amplitude service loading, retardation model.

Unit-IV

Elastic Plastic Fracture Mechanics: Elastic plastic fracture concept – Crack tip opening displacement – J-integral technique; Determination of J-using FEM.

Unit-V

Fatigue behaviour of ultrafine grained materials, Nano crystalline materials, Biomaterials, Metallic foams. Application of Fracture Mechanics: Fracture design – Selection of materials – fatigue crack growth rate curve – Stress intensity factor range – Use of crack growth law.

Suggested Reading:

1. Broek, D., Elementary Engineering Fracture Mechanics, Springer Science & Business Media, 2012.
2. John M. Barson and Stanely T. Rolfe, Fracture and Fatigue Control in Structures, Prentice Hall, 1987.
3. Fatigue of Materials, Suresh, Cambridge India, 2015.
4. Fracture Mechanics, Fundamentals and Applications, T.L. Anderson, CRC Press 2017.
5. Prasanth Kumar, "Elements of fracture mechanics", Wheeter publication, 1999.

Course Code	Course Title						Core / Elective
U23ME705	Additive Manufacturing Technology						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Understand the fundamental concepts of Additive Manufacturing, its advantages and limitations.
2. Familiar the working principle, advantages, disadvantages and applications of liquid, solid and Powder based Additive Manufacturing Technologies.
3. Able to understand the method of manufacturing of liquid based, powder based and solid based techniques.
4. Understand the manufacturing procedure of a prototype using FDM technique.
5. Identify diversified applications of Additive Manufacturing Technologies.

Course Outcomes:

After completing the course, the student will be able to:

1. Summarize the fundamental concepts of Additive Manufacturing, its advantages and limitations.
2. Interpret the working principle and process parameters of Additive Manufacturing processes
3. Apply the methodology to manufacture the products using LOM and FDM technologies and study their applications, advantages and case studies
4. Explain the working principle, advantages, disadvantages and applications of liquid, solid and Powder based Additive Manufacturing Technologies.
5. Summarize the diversified applications of Additive Manufacturing Technologies.
6. Explore the applications of Additive Manufacturing processes in various fields

Unit-I

Introduction: Prototyping fundamentals: Need for time compression in product development, Historical development, Fundamentals of Additive Manufacturing, Additive Manufacturing Process Chain, Advantages and Limitations of Additive Manufacturing, Additive Manufacturing wheel, commonly used Terms, Classification of Additive Manufacturing processes. Fundamental Automated Processes: Distinction between Additive Manufacturing and Conventional Machining Processes.

Unit-II

Liquid-based Additive Manufacturing Systems: Stereo Lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Polyjet: Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Solid-based Additive Manufacturing System: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Unit-III

Powder Based Additive Manufacturing Systems: Working principle, Specifications, Materials used, Process, Applications, Advantages and Disadvantages, Case studies of the following Additive Manufacturing Technologies like Selective laser sintering (SLS), Selective Laser Melting (SLM) and Direct Metal Laser Sintering (DMLS), Laser Engineered Net Shaping (LENS), Electron Beam Melting (EBM).

UNIT-IV

Data Formats & Software: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs, Newly Proposed Formats. Software's Features: Magics, Mimics, Solid View, View Expert, 3DRhino, 3Ddoctor, Flash Print, Object Studio, Cura, ITK Snap, 3-matic, Simplant, 3-matic, Simplant, Mesh Lab, Ansys for Additive Manufacturing

Unit-V

Applications of Additive Manufacturing: Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Electronic Industry, Jewellery Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Biopolymers, Packaging, Disaster Management, Entertainment and Sports industry.

Suggested Reading:

1. Chee Kai Chua and Kah Fai Leong, "Additive Manufacturing and Additive Manufacturing Principles and Applications" Fifth Edition, World scientific
2. Additive Manufacturing Technologies: Additive Manufacturing, Rapid Prototyping, and Direct Digital Manufacturing- Ian Gibson, David W Rosen, Brent Stucker, Springer, Second Edition, 2010.
3. Rapid Prototyping & Engineering Applications – Frank W.Liou, CRC Press, Taylor & Francis Group, 2011.
4. Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.

Course Code	Course Title						Core / Elective
U23ME706	Tool Design						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Various forces involved in the machining operations.
2. Heat generation in machining & coolant operation.
3. Tools, jigs and fixture, suitable for a particular machining operation.

Course Outcomes:

After completing the course, the student will be able to:

1. Calculate the values of various forces involved in the machining operations.
2. Design various single and multipoint cutting tools.
3. Analyze heat generation in machining & coolant operation.
4. Illustrate the properties of various cutting tool materials and hence select an appropriate tool material for particular machining application.
5. Identify appropriate combination of tools, jigs and fixture, suitable for a particular machining operation.
6. Design assembly of jigs and fixtures on simple work-piece.

Unit-I

Metal Cutting: Classification of metal cutting operations, mechanics of metal cutting, tool signature, built up edge formation, mechanism of chip formation, types of chips, oblique and orthogonal cutting - Merchant ‘s force diagram, two component tool dynamometers, Merchant ‘s theory of metal cutting, Lee and Schaffler ‘s theory of metal cutting.

Unit-II

Tool Wear and Tool Life: Sources of heat in metal cutting, heat dissipation and distribution to chip, tool and work piece, methods of evaluating temperature at tool-chip interface. Machinability, factors affecting machinability, Taylor ‘s tool life equation, crater wear and flank wear, mechanics of tool wear and various types of tool failure. Effects of tool geometry, feed, depth of cut, cutting speed on tool wear.

Unit-III

Cutting Tool Materials: Essential requirements of a tool material, tool materials - HCS, HSS, Cast alloys, Carbides, Ceramic tools, Diamond tool bits. Essential requirements of a good cutting fluid, types of cutting fluids and their relative applications. Economics of machining - introduction, economic tool life, optimal cutting speed to maximum production and maximum profit.

UNIT-IV

Press Tools: Press tool design - press operations, press working terminology, working of cutting die press operations - strip layout, punching, blanking-center of pressure, drawing and deep drawing, bending dies and forging - forging die design.

Unit-V

Jigs and Fixtures: Design of jigs and fixtures. Locating devices, clamping devices, principles of design of jigs and fixtures, some examples Design of Cutting Tools: Broach design, elements of twist drill, HSS twist drill design, design of rotary milling cutter. Design of single point cutting tool.

Suggested Reading:

1. Donaldson [2001], Tool Design, TMH Publishers, New Delhi
2. Roy A. Lindberg [2002], Processes and Materials of Manufacture, PHI Publishers, New Delhi.
3. G. R. Nagpal [2004], Tool Engineering & Design, Khanna Publishers, New Delhi.
4. ASTME [1987], Fundamentals of Tool Design, PHI Publishers, New Delhi.
5. Amitha Ghose and Mallik [2004], Manufacturing Science, EWP Publishers, New Delhi.

Course Code	Course Title						Core / Elective
U23ME707	Mechanical Vibrations						Elective
Pre requisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Grasping the fundamental concepts and principles of mechanical vibrations, including single and multi degrees of freedom.
2. Learn the methods and instruments for measuring and analyzing the vibrations of real life applications.
3. Develop the skills in mathematical modeling of mechanical systems subjected to vibration.
4. Understand the role of damping in mechanical systems and how it influences energy dissipation.
5. Analyze the systems subjected to harmonic excitations and understanding frequency response.

Course Outcomes:

After completing the course, the student will be able to:

1. Identify and distinguish the different types of vibrations and gain a clear understanding of SHM, and analyze the torsional & flexural vibrations.
2. Analyze and solve the problems related to undamped vibrations in single degree of and will be able to find the natural frequencies of undamped vibrations.
3. Calculate and interpret damping ratios for various mechanical systems, understanding their impact on mechanical vibrations characteristics.
4. Evaluate the transient responses in forced vibrations considering factors like initial conditions and damping effects.
5. Analyze forced vibrations in systems with two degrees of freedom considering both harmonic and transient excitations.
6. Conduct the parametric studies using numerical methods to investigate the impact variations in system parameters on the dynamic response of multi degrees of freedom .

Unit-I

Introduction: Types of vibrations, Simple Harmonic Motion (S.H.M), principle of super position applied to Simple Harmonic Motions. Beats, Fourier theorem and simple problems. Vibration measuring instruments & Whirling of Shafts Vibrometer meter and accelerometer. Whirling of shafts with and without air damping. Discussion of speeds above and below critical speeds.

Unit-II

Undamped free vibrations: Single degree of freedom systems. Mass Undamped free vibration-natural frequency of free vibration, stiffness of spring elements, effect of mass of spring, Compound Pendulum.

Damped free vibrations: Single degree freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping, critical and over damping, Logarithmic decrement.

Unit-III

Forced Vibration: Single degree of freedom systems, steady state solution with viscous damping due to harmonic force. Solution by Complex algebra, Reciprocating and rotating unbalance, vibration isolation-transmissibility ratio. Due to harmonic excitation and support motion.

Unit-IV

Systems with two degrees of freedom: Introduction, principle modes and Normal modes of vibration, co-ordinate coupling, generalized and principal co-ordinates, Free vibration in terms of initial conditions. Geared systems. Forced Oscillations-Harmonic excitation. Applications: a) Vehicle suspension. b) Dynamic vibration absorber. c) Dynamics of reciprocating Engines.

Unit-V

Numerical methods for Multi degree Freedom systems: Introduction, Influence coefficients, Maxwell reciprocal theorem, Dunkerley's equation. Orthogonality of principal modes, Method of matrix iteration-Method of determination of all the natural frequencies using sweeping matrix and Orthogonality principle. Holzer's method, Stodola method

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Suggested Reading:

1. Rao S .S Mechanical Vibrations, 5 Edition, Prentice Hall, 2011
2. V.P.Singh, Mechanical vibrations, Dhanpat Rai Publications, 2015
3. Thomson, W. T., and Dahleh, M. D., Theory of Vibration with Applications, 5th Edition, Pearson Education, 2011.
4. J S Rao, Vibration condition monitoring of machines, CRC Press, 2000

Course Code	Course Title						Core / Elective
U23ME7L1	Metrology and Instrumentation Lab						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	2	25	50	1

Course Objectives:

The objective of the course is to:

1. Provide practical knowledge of precision measurement techniques using standard metrology instruments.
2. Develop skills in measuring linear dimensions, angles, roundness, and thread parameters with high accuracy.
3. Familiarize students with tolerance analysis, gauges, and calibration procedures of measuring instruments.
4. Introduce the principles and working of various transducers used in instrumentation systems.
5. Impart hands-on experience in calibration and performance evaluation of sensors for temperature, displacement, and strain measurement.

Course Outcomes:

After completing the course, the student will be able to:

1. Use measuring and gauging instruments for inspection of precision linear, geometric forms, angular and surface finish measurements.
2. Evaluate tolerances, taper angles, roundness, and roughness for a component
3. Calibrate the precision measuring instruments.
4. Perform calibration of various instruments for measuring pressure, temperature, displacement, speed, vibration etc.
5. Develop the ability to apply the principles in instruments and measuring techniques.
6. Demonstrate work in designing the instrumentation for a particular purpose and Special purpose devices.

METROLOGY

1. Linear measurements with inside, outside and depth micrometers & Vernier calipers.
2. Measurement of roundness errors with Bench Centre method and V-block method.
3. Measurement of thread elements with Tool Maker‟s Microscope
4. Measurement of angles with Sinebar, Bevel protractor and Precision level.
5. Tolerance measurement with Comparator and GO -No GO Gauge.
6. Calibration of Outside micrometer and Dial gauge.

INSTRUMENTATION

1. Calibration of transducer for temperature measurement.
2. Study and calibration of LVDT transducer for displacement measurement.
3. Calibration of strain gauge for temperature measurement.
4. Calibration of thermocouple for temperature measurement.
5. Calibration of capacitive transducer for angular displacement.

Course Code	Course Title					Core / Elective
U23ME7L2	CAE Lab					Elective
Prerequisite	Contact Hours Per Week			CIE	SEE	Credits
	L	T	P			
-	-	-	3	25	50	1.5

Course Objectives:

The objective of the course is to:

1. Introduce fundamentals of the analysis software, its features and applications.
2. Understand and handle design problems in a systematic manner.
3. Promote equipment and develop application capability of the concepts sciences to engineering design and processes.
4. Know the concept of discretization of continuum. Loading conditions and analyze the structure using pre-processor and postprocessor conditions.

Course Outcomes:

After completing the course, the student will be able to:

1. Classifying the types of Trusses and Beams (2D & 3D) with various cross sections and to determine Stress, Strains and deflections under static, thermal loading.
2. Generalized Plane stress, plane strain conditions & axi-symmetric loading on in plane members to predicting the failure behavior and finding the SCF.
3. Analyse connecting rod with tetrahedron and brick elements, performing static analysis on flat & curved shells to determine stresses, strains with different boundary conditions.
4. Simulate steady state heat transfer analysis of chimney, Transient heat transfer of castings, Non linear, Buckling analysis of shells CFD analysis.
5. Predict the natural frequencies and modes shapes using Modal, Harmonic analysis. Also finding the critical load using Buckling analysis.

List of Experiments:

1. Analysis of Plane Truss & Spatial Truss with various cross sections and materials to determine member forces, member strains & stresses, joint deflections under static and thermal loading.
2. 2D & 3D beam analysis with different sections, different materials for different loads (forces and moments with different end supports.
3. 1D, 2D and 3D meshing with different element sizes for different CAD geometry.
4. Static analysis of plates with a hole to determine the deformations, the Stresses to study the failure behavior and SCF.
5. Plane stress, plane strain and axi-symmetric loading on the in plane members with in plane landing to study the stresses and strains.
6. Static analysis of connecting rod with tetrahedron and brick elements.
7. Buckling analysis of plates, shells and beams to estimate BF and modes.
8. Modal analysis of beams, plates and shells for natural frequencies and mode shapes.
9. Harmonic analysis of a Shaft subjected to periodic force and transient analysis of plate subjected to

stepped and ramped loading with varying time.

10. Steady state heat transfer Analysis Cross section of chimney and transient heat transfer analysis of solidification of castings.
11. CFD analysis of aero foil design.
12. Use of MATLAB / Python for finding B matrix, stiffness matrix and loading matrices of beam/in plane/solid elements and interfacing with CAE software's

Note: Any 10 experiments to be conducted.

Course code	Course title						Core/Elective
U23MA7L2	**Aptitude and Reasoning**						**Core**
Pre-requisites	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
	-	-		2	25	50	1

Course Objectives:

The objective of the course is to

1. Acquire the concepts of mathematical aptitude and reasoning.
2. Develop the innovative and creative thinking through basic mathematical concepts.
3. Improve analytical and problems solving skills.
4. Enhance logical thinking and mathematical ability.
5. Empower with the basic tools of mathematical aptitude.

Course Outcomes:

At the end of the course students will be able to

1. Build proficiency in quantitative reasoning
2. Improve critical thinking skills
3. Enhance analytical skills
4. Demonstrate quantitative aptitude concepts
5. Adapt principles of quantitative aptitude to achieve qualitative results.

List of Experiments:

1) Basic concepts: combined mean, average principles, wrong values taken, number added or deleted, average speed.
2) Percentages -Basic Concepts, conversions, finding percentages from given numbers, quantity increases or decreases by given percentage, population increase by given percentage, comparisons, consumption when a commodity price increase or decrease and applications.
3) Data Interpretation - Introduction to Data Interpretation, quantitative and qualitative data, Tabular Data, Line Graphs, Bar Chart, Pie Charts, X-Y Charts.
4) Number Series, Letter Series, Series completion and correction, Coding and Decoding. Word analogy- Applied analogy, Classifications, verbal classification.
5) Reasoning Logical Diagrams - Simple diagrammatic relationship, Multi diagrammatic relationship, Venn- diagrams, Analytical reasoning.
   - Reasoning Ability - Blood Relations, Seating arrangements, Directions, Decision making.
   - Number Systems: Basic Concepts,
6) Number Systems: Natural numbers, whole numbers, integers, fractions, Rational Numbers, Irrational Numbers, Real Numbers, Divisibility Rules, Logic Equations, Remainder theorem, Unit digit calculation.
   - Progressions & Inequalities: Basic Concepts, Types: arithmetic, geometric, harmonic progression and applications.
7) Profit and Loss: Basic Concepts, discounts, marked price and list price, dishonest shopkeeper with manipulated weights, successive discounts etc.
   - Interest (Simple and Compound): Basic Concepts, Yearly, Half-yearly, and quarterly calculations, multiples, differences between simple and compound interest.
8) Ratio and Proportion: Basic Concepts of ratio and proportion, continued or equal proportions,

mean proportions, invest proportion, alternative proportion, division proportion, compound proportion, duplication of ratio, finding values, coins and currencies, etc.

9) Speed, Time and Distance: Basic Concepts, Single train problems, two train problems: some point same side, some point opposite sides, relative speed, different points meeting at common points, different points same side (different timings vs. same timings), ratios, number of stoppages, average speed, etc.
10) Time and Work: Basic Concepts, comparative work, mixed work, alternative work, middle leave and middle join, ratio efficiency.
11) Permutations and combinations: Basic Concepts, differences between permutations and combinations, alternative arrangement, fixed positions, items drawing from a single group, items drawing from a multiple group, total ways of arrangement with repetitions and without repetitions, handshakes or line joining between two points or number of matches, sides and diagonals, etc.
12) Clocks and Calendars: Basic Concepts, Angle between minute hand and hour hand, reflex angle, hours hand angle, time gap between minute hand and hour hand, relative time: coincide, opposite sides and right angle, mirror images, faulty clock (slow/fast), miscellaneous, calendar.
13) Geometry and Mensuration: Basic concepts, types of angles.
    - Plane figures: rectangles, squares, triangles, quadrilateral, areas, perimeters, etc.
    - Solid figures: cubes, cuboids, cylinders-area (total surface area and lateral surface area), volumes, perimeters.
    - Others: Parallelogram, Rhombus, Trapezium, Circle, Sector, Segment, Cone, Sphere, Hemisphere, etc.

Suggested Readings:

1. Aptitude and reasoning skills lab Manual, LIET, HYD.

Course Code	Course Title						Core / Elective
U23ME7P1	Internship-II						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	50	-	1

Course Objectives:

The objective of the course is to

1. Give an experience to the students in solving real life practical problems with all its constraints.
2. Give an opportunity to integrate different aspects of learning with reference to real life problems.
3. Enhance the confidence of the students while communicating with industry engineers and give an opportunity for useful interaction with them and familiarize with work culture and ethics of the industry.

Course Outcomes:

After completing the course, the student will be able to:

1. Design/develop a small and simple product in hardware or software.
2. Complete the task or realize a prespecified target, with limited scope, rather than taking up a complex task and leave it.
3. Find alternate viable solutions for a given problem and evaluate these alternatives with reference to prespecified criteria.
4. Implement the selected solution and document the same.
5. Write a technical report and present it to appropriate audience

Summer Internship is introduced as part of the curricula for encouraging students to work on problems of interest to industries. A batch of two or three students will be attached to a person from an Industry / R & D Organization / National Laboratory for a period of 8 weeks. This will be during the summer vacation following the completion of the VI semester course. One faculty member will act as an internal guide for each batch to monitor the progress and interacts with the Industry guide. After the completion of the project, students will submit a brief technical report on the project executed and present the work through a seminar talk to be organized by the department. Award of sessional marks are based on the performance of the student at the work place and awarded by industry guide and internal guide (25 Marks) followed by presentation before the committee constituted by the department (25 Marks). One faculty member will coordinate the overall activity of Summer Internship.

*Students after undergoing summer internship of 6 Weeks duration at the end of semester VI the grades Excellent, Good, Average will be allotted after evaluation in VII semester

Course Code	Course Title						Core / Elective
U23ME7P2	Major Project (Phase-I)						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	4	25	-	2

Course Objectives:

The objective of the course is to:

1. Identify and define a real-world engineering problem
2. Conduct a comprehensive literature review on the selected topic
3. Develop a clear project proposal with methodology and expected outcomes
4. Plan and organize project work effectively

Course Outcomes:

After completing the course, the student will be able to:

1. Formulate and define an engineering problem with clarity.
2. Analyze existing literature and identify research gaps.
3. Develop a structured project proposal and methodology.
4. Demonstrate planning and preliminary design skills.
5. Present and document the project work effectively.

Major Project Phase–I Guidelines

The aim of Major Project Phase–I is to identify, define, and formulate the project problem along with a detailed proposal and preliminary design. This phase focuses on literature review, feasibility analysis, and development of a clear project plan. Students are expected to build a strong foundation for the execution phase to be carried out in Major Project Phase–II.

Major Project Phase–I is conducted with **2 teaching hours per week** and carries a total of **25 marks**. Students shall finalize their project title and submit a detailed proposal in consultation with the project guide within two weeks from the commencement of instruction. The proposal should include problem statement, objectives, literature review, methodology, and expected outcomes.

Project work will be continuously monitored through student presentations and interactions. The evaluation will be carried out by a committee comprising faculty members along with the project supervisor.

- A mid-review may be conducted to assess progress in problem identification, literature survey, and methodology formulation
- The final evaluation, carrying 25 marks, will be based on the quality of the project proposal, presentation, and preliminary work carried out

Each department will establish common norms for documentation and submission of the Phase–I report. Students are required to submit a report including problem definition, literature review, and proposed methodology at the end of the semester.

LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
(An Autonomous Institution)
DEPARTMENT OF MECHANICAL ENGINEERING
SCHEME OF INSTRUCTIONS & EXAMINATIONS [LR-23]
(w.e.f. Academic Year 2026-27)
B.E. VIII-Semester

S. No.	Course Code	Category	Course Title	Scheme of Instruction				Scheme of Examination			CREDITS
				L	T	P/D	Contact Hours/Week	Maximum Marks		Duration in Hours	
								CIE	SEE		
Theory Course											
1	-	PEC	Professional Elective Course IV	3	-	-	3	40	60	3	3
2	-	PEC	Professional Elective Course V	3	-	-	3	40	60	3	3
3	-	OEC	Open Elective Course IV	3	-	-	3	40	60	3	3
Project											
4	U23ME8P1	PROJ	Technical Seminar	-	-	2	2	50	-	-	1
5	U23ME8P2	PROJ	Major Project (Phase-II)	-	-	16	16	50	150	-	8
Total				**9**	**-**	**18**	**27**	**220**	**330**	**9**	**18**

L: Lecture (Hrs/Wk/Sem) **T**: Tutorial (Hrs/Wk/Sem) **P**: Practical **D**: Drawing (Hrs/Wk/Sem)

Professional Elective Course-IV		
1.	U23ME801	Product Development and Process Planning
2.	U23ME802	Hybrid Electric Vehicles
3.	U23ME803	Finite Element Analysis
4.	U23ME804	Sustainable Manufacturing
5.	U23ME805	AI & ML for Mechanical Systems
Professional Elective Course-V		
6.	U23ME806	Manufacturing Automation
7.	U23ME807	Industry 4.0: Principles and Technologies
8.	U23ME808	Mechatronics
9.	U23ME809	MEMS: Design and Manufacture
10.	U23ME810	Supply Chain Management

CIE: Continuous Internal Evaluation
SEE: Semester End Examination
OEC: Open Elective Courses
PEC: Professional Elective Courses
PROJ: Project
ME: Mechanical Engineering

Note:
1. Each contact hour is a Clock Hour.
2. The duration of the practical class is three hours, however it can be extended wherever necessary to enable the student to complete the experiment.

Course Code	Course Title						Core / Elective
U23ME801	Product Development and Process Planning						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

Course Objectives:

The objective of the course are:

1. Understand the basic structure of Product Design, Product Development Process and Explain the techniques uses in product design and development.
2. Develop ability for analyzing the life cycle assessment and Justify physical prototype in line with design for robustness.
3. Demonstrate the importance of integrating design and manufacturing to optimize production cost, quality and flexibility
4. Course emphasizes on methodologies for various steps of product design such as user study, need/problem identification, benchmarking, aspects of human factors in product design, creative concept generation.
5. Understand the modern approaches, ergonomics considerations in product design, integration of design, manufacturing and production control.

Course Outcomes:

After completing the course, the student will be able to:

1. Interpret basic structure of Product Design, Product Development Process and Scope of Product Development.
2. Apply the knowledge of Benchmarking, Establishing Engineering Specifications and Product Architecture in product design
3. Explain the techniques of Product Function, product design and product architecture
4. Design & Develop as per the industrial ergonomics and Justify the use of physical prototype in line with design for robustness.
5. Utilize the computers for the management of the manufacturing process

Unit-I

Introduction: Product development, Examples of product development, Need of developing products, Importance of engineering design, Characteristics of successful product development. Design and development of products, duration and cost of product development & its challenges. A generic development process, various phases of product development, the AMF development process, the AMF organization. Product Development Planning, Qualifications of product design Engineer. Criteria for success / failure of a product.

Unit-II

Identifying Customer needs: Customer Satisfactions, hierarchy of human needs-need gathering methods, Organizing and Prioritizing Customer Needs, Importance of customer needs, **Product Specification and Concept generation:** Specifications, Establishment and setting, activity of concept generation- Clarify the problem, Search externally, internally and explore systematically & reflect the results. A Bench-marking Approach, Support Tools for the Bench-marking Process, product design specification-case studies

Unit-III

Concept Selection and Testing, Product architecture: Overview of methodology, concept screening, and concept scoring, -systematic methods for designing –functional decomposition – physical decomposition –functional representation –morphological methods-TRIZ- axiomatic design. Implications and establishing of product architecture. Steps involved in product architecture. A Concept Selection Process, Pugh Concept Selection Charts.

UNIT-IV

Industrial ergonomics: Man- machine considerations, Ergonomic considerations in product design, advanced techniques for higher productivity. Just -in –time (JIT & Kaizen), Design for Six Sigma and Kanban System. Modern approaches to product design, cost evaluation –categories of cost overhead costs –activity-based costing –methods of developing cost estimates – manufacturing cost –value analysis in costing. **Rapid prototyping:** Prototype basics – Principles of prototyping, Types of Prototypes, Uses of Prototypes, Rapid Prototyping Technique,

Unit-V

Industrial Design: Need for industrial design, integrate process design and robust design – Integrating CAE, CAD, and CAM tools. Role of computer in product design and manufacturing, creation of manufacturing data base, Computer Integrated Manufacturing (CIM), Communication network, production flow analysis, Group Technology, Computer Aided Product Design and Process Planning. Integrating product design, manufacture and production control.

Suggested Reading:

1. Niebel, B.W., and Draper, A.B., Product design and process Engineering, Mc Graw Hill Kogalkusha Ltd., Tokyo, 1974.
2. Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development “, 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9
3. Product Design and Manufacturing - A C Chitale and R C Gupta, PH1, - 3rd Edition, 2003.
4. Kevin N. Otto, Kristin L. Wood, “Product Design: Techniques in Reverse Engineering and New Product Development”, Pearson Education India; 1 edition, January 2003.
5. Karl Ulrich and Steven Eppinger, “Product Design and Development” 5th Edition, July 2017

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Course Code	Course Title						Core / Elective
U23ME802	Hybrid Vehicles Technology						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
-	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Explain the history of Electric vehicles and development
2. Discuss the Social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies
3. Explore to basic concept of electric traction, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives etc.
4. Analyse the Fuel Cell based energy storage and Super Capacitor based energy storage etc.
5. Explore to types of Driving Cycles, Range modelling for Battery Electric Vehicle, Hybrid (ICE & others) etc.

Course Outcomes:

After completing the course, the student will be able to:

1. Choose the appropriate source of energy for the hybrid electric vehicle based on driving cycle.
2. Analyze the power and energy need of the various hybrid electric vehicle.
3. Estimate the energy consumption of the Hybrid Vehicles.
4. Evaluate energy efficiency of the vehicle for its drive trains.
5. Elaborate the types of storage systems such as battery based, fuel cell based.
6. Explain the types of Driving Cycles, Fuel Cell EV, Solar Powered Vehicles.

Unit-I

Introduction To Electric Vehicle: History of Electric Vehicles, Development towards 21st Century, Types of Electric Vehicles in use today – Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, Solar Powered Vehicles. Motion and Dynamic Equations of the Electric Vehicles: various forces acting on the Vehicle in static and dynamic conditions.

Unit-II

Introduction To Hybrid and Electric Vehicles: Social and environmental importance of hybrid and electric vehicles, impact of modern drive- trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid Drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis

Unit-III

Electric Drive Trains: Basic concept of electric traction, introduction to various electric drivetrain topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency

Unit-IV

Types of Storage Systems: Introduction to Energy Storage Requirements in Hybrid and Electric

Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Calculation for the rating.

Unit-V

Modelling of Hybrid Electric Vehicle Range: Driving Cycles, Types of Driving Cycles, Range modelling for Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, Solar Powered Vehicles. Case study of 2 wheeler, 3 wheeler and 4 wheeler vehicles.

Suggested Reading:

1. Hoogers G., Fuel Cell Technology Hand Book, CRC Press, 2003.
2. Karl Kordesch & Gunter R. Simader., Fuel Cells and Their Applications, 1st ed., VCH Publishers, NY, 2001.
3. Barbir F., PEM Fuel Cells: Theory and Practice, 2nd edition, Elsevier/Academic Press, 2013.
4. Subhash C., Singal and Kevin Kendall, High Temperature Fuel Cells: Fundamentals, Design and Applications, Elsevier Advanced Technology, 2003.
5. O'Hayre R. P., S. Cha., W. Colella., F. B. Prinz., Fuel Cell Fundamentals, Wiley, NY, 3rd edition, 2016.

Course Code	Course Title						Core / Elective
U23ME803	Finite Element Techniques						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
Mechanics of Solids	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Provide the overview on Finite Element Techniques, Material models, and Applications in Mechanical Engineering.
2. Understanding of Basics of Finite Element Analysis.
3. Formulate the axial, truss, beam and 2d problems.
4. Formulate the heat conduction and dynamics problems.
5. Perform engineering simulations using FE software (ANSYS).

Course Outcomes:

After completing the course, the student will be able to:

1. Summarize basic equations of elasticity and formulate finite element modelling of one dimensional element using Potential energy approach.
2. Formulate finite element modelling of truss and frame elements along with the concepts of transformation from local to global matrices.
3. Interpolate Hermitian shape function of beam element in natural coordinate system.
4. Develop stiffness matrix for a plane stress & plane strain conditions on a CST, Axi-symmetric elements by interpolating shape functions in natural coordinate system.
5. Formulate finite element model to steady state heat transfer analysis using one & two dimensional elements.
6. Formulate mass and stiffness matrices of 1D & beam elements to establish Eigen values &Eigen vectors using Lagarangian and Hamilton principles.

Unit-I

Introduction: Introduction to Finite Element Technique for solving field problems, Introduction to Elasticity; Stress and Equilibrium, Strain Displacement relations. Stress strain relations Steps in Finite Element Analysis.

One dimensional problems: Finite element modelling coordinates and shapes functions, Potential Energy approach: Assembly of Global stiffness matrix and load vector, Finite element equations, Treatment of boundary conditions, Galerkin‘s approach.

Unit-II

Analysis of Trusses: Derivation of Stiffness Matrix for Plane Truss, Displacement and Stress Calculations.

Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node beam element, Load Vector, Deflection.

Unit-III

Finite element modelling of two dimensional: stress analysis with constant strain triangles and treatment of boundary conditions. Finite element modelling of axi-symmetric solids subjected to axi-

symmetric loading with triangular elements.

Unit-IV

Two dimensional four noded iso-parametric elements and numerical integration. Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional analysis of thin plate, Analysis of circular shaft subjected to torsion.

Unit-V

Dynamic Analysis: Formulation of finite element model, element matrices, Evaluation of Eigen values and Eigen vectors for a stepped bar and a beam,

Introduction to finite element formulation of three dimensional problems in stress analysis, Convergence requirements. Introduction to Finite Element Analysis Software.

Suggested Reading:

1. G. Ramamurthy, Applied Finite Element Analysis, I.K. International Publishing House Pvt.Ltd., New Delhi, 2009.
2. Tirupathi R, Chandraputla and Ashok D Belagundu, Introduction to Finite Elements in Engineering, PHI,1997.
3. Segerlind L J, Applied Finite Element Analysis, Wiley Eastern, 1984.
4. Reddy JN, An Introduction to Finite Element Method, McGraw-Hill, 1984.
5. Cook, R. D., Malkus, D. S., and Plesha, M. E., "*Concepts and Applications of Finite Element Analysis*", John Wiley & Sons, 4th Ed, 2002.
6. Singiresu S. Rao, The Finite Element Method in Engineering Hardcover, 2010.

Course Code	Course Title						Core / Elective
U23ME804	Sustainable Manufacturing						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Understand the fundamentals of Sustainable Manufacturing and various tools and techniques of sustainability.
2. Know the principles of sustainable design.
3. Understand the role of customer and user needs assessment for sustainability.

Course Outcomes:

After completing the course, the student will be able to:

1. Summarize the basic concepts in sustainability
2. Apply sustainable engineering design tools for life cycle assessment (LCA) and examine the features of various LCA Software
3. Interpret the Principles of Sustainable Breakthrough Design
4. Summarize the various design concepts for sustainability
5. Identify Customer and User Needs Assessment for sustainable manufacturing

UNIT-I

Basic Concepts in Sustainability, Understanding the language of sustainable engineering design, construction and operation. Natural resources terminology, Carrying capacity, Sustainable development, corporate responsibility, biophysical constraints, environmental management.

UNIT-II

Tools and Techniques of Sustainability, Sustainable Engineering Design Tools – Life cycle analysis, carbon foot printing. Life cycle assessment (LCA), Types of LCA‘s: baseline, comparative, streamlined .LCA inventory analysis: processor input- output. Hybrid inventory analysis. Sustainable Product Design. Whole Systems design. Light weighting and materials reduction. .Design for durability, Repair and upgrade, disassembly and recycling. Energy use in design. Reducing energy losses in design.

UNIT-III

Fundamental Concepts &Principles for Sustainable Break through Design Infrastructure for managing flows of materials, energy and activities; sustainable value creation approaches for all stake holders, environmental design characteristics; design changes & continual improvement; inclusivesustainabledesignprinciples,crowdsourcing,multiple-objectivedesigns; infrastructures that support system thinking; knowledge management for sustainable design, learning systems and experimentation; smart data systems, understanding variation.

UNIT-IV

Sustainable Design: Industrial ecology, multiple life cycle design, principles of design, green

engineering, cradle to cradle design, The Natural Step, bio-mimicry, design for reuse, dematerialization, modularization, design for flexibility, design for disassembly, design for inverse manufacturing, design for the environment, etc.

UNIT-V

Customer and User Needs Assessment Identification &breakdown structures that describe customers & stakeholders, green marketing, socially conscious consumerism, sources of customer information, collecting information, analyzing customer behavior, translating the voice of the customer, use analysis, structuring customer needs, service gap analysis, prioritizing customer needs, strategic design, Kano technique.

Suggested Reading:

1. Clarke, Abigail & John K.Gershenson, Design for the Life Cycle. Life-cycle Engineering Laboratory, Michigan Technological University, 2006.
2. Finster, MarkP., Sustainable Perspectives to Design and Innovation, 2013.
3. Ramaswamy, Rohit,Design and Management of Service Processes: Keeping Customers for Life, Prentice Hall, 1996.
4. Schmitt, Brent, Customer Experience Management, Wiley and Sons, 2003.
5. J. Paulo Davim, Sustainable Manufacturing, Wiley-ISTE, 2010.

Course Code	Course Title						Core / Elective
U23ME805	AI & ML for Mechanical Systems						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Understand the evolution and key challenges of modern mechanical systems in Industry 4.0.
2. Apply statistical methods for analysis and decision-making in engineering problems.
3. Analyze artificial intelligence techniques for solving search and optimization problems.
4. Develop machine learning models for mechanical system applications.
5. Implement embedded system solutions using Raspberry Pi and related tools

Course Outcomes:

After completing the course, the student will be able to:

1. Explain the concepts and challenges of intelligent mechanical systems.
2. Apply statistical techniques for data analysis and interpretation.
3. Analyze and implement AI search algorithms and heuristic methods.
4. Develop and evaluate machine learning models for engineering applications.
5. Design and implement basic embedded systems with sensor integration for mechanical applications.

UNIT-I

Introduction to Mechanical Systems: Evolution in the context of Industry 4.0, Key issues: Adaptability, Intelligence, Autonomy, Safety, Sustainability, Interoperability, Flexibility of Mechanical Systems.

UNIT-II

Introduction of Statistics; Descriptive statistics: Central tendency measures, Dispersion measures, data distributions, center limit theorem, sampling, sampling methods; Inferential Statistics: Hypothesis testing, confidence level, degree of freedom, P-value, Chi-square test, ANOVA, Correlation V's Regression, Uses of Correlation and regression.

UNIT-III

Artificial Intelligence: Brief review of AI history, Problem formulation: Graph structure, Graph implementation, state space representation, search graph and search tree, Search Algorithms: random search, Depth-first, breadth-first search and uniform-cost search. Heuristic: Best first search, A* and AO* algorithm, generalization of search problems. Ontology; Fuzzy; Meta-heuristics.

UNIT-IV

Machine Learning: Overview of supervised and unsupervised learning; Supervised Learning: Linear Regression, Non-linear Regression Model evaluation methods, Logistic Regression, Neural Networks; Unsupervised Learning: K-means clustering, C-means Clustering. Convolutional Neural Networks (CNN), Pooling, Padding Operations, Interpretability in CNNs, Limitations in CNN. Cases with respect to different mechanical systems.

UNIT-V

Introduction to Raspberry Pi; Installation of Raspbian OS on Raspberry Pi; Controlling LED using Raspberry Pi; Integrating IR Sensor with Raspberry Pi; Controlling LED with IR Sensor; Integrating Temperature and amp; Humidity Sensor with Raspberry Pi read Current Environment Values Collecting the sensor data using Raspberry Pi; Matlab toolboxes - Simulink, Mechanical Systems implementation: From features to software components, Mapping software components to ECUs

Suggested Reading:

1. Rajkumar, Dionisio De Niz, and Mark Klein, Cyber-Physical Systems, Wesley Professional.
2. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press, 2015.
3. Robert Levine et al., "A Comprehensive guide to AI and Expert Systems", McGraw Hill Inc, 1986.
4. E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems: A Cyber-Physical Systems Approach", 2011.
5. C. Cassandras, S. Lafortune, "Introduction to Discrete Event Systems", Springer,2007.
6. Constance Heitmeyer and Dino Mandrioli, "Formal methods for real-time computing", Wiley publisher, 1996.
7. Montgomery Douglas, 2017. Design of Experiments, John Wiley and Sons, Inc

Course Code	Course Title						Core / Elective
U23ME806	Manufacturing Automation						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Understand the importance of Automation in the field of machine tool based manufacturing
2. Get the knowledge of various elements of manufacturing automation- like CAD, CAM, NC, CNC, AM, hydraulic & pneumatic controls & FMS.
3. Understand the concepts of product design and role of manufacturing automation.

Course Outcomes:

After completing the course, the student will be able to:

1. Explain the importance of automation in the field of machine tool based manufacturing.
2. Identify the various concepts of CAD and Numerical control machines.
3. Compare the concepts of CAM and CNC machining.
4. Explain the techniques of Additive Manufacturing Technologies.
5. Summarize the concepts of pneumatics & hydraulics systems and controls, and various elements of Flexible Manufacturing System

Unit-I

Introduction to Automation: Why automation, Current trends, Rigid automation: Part handling, Machine tools, CAD, CAM, CIM: Basic Concepts of CIM: Elements of CIM, Benefits of CIM. Automation principles and strategies. Basic elements of an automated system, levels of automation. Hardware components for automation and process control, PLC: Programmable logic Controllers.

Unit-II

Computer Aided Design: Fundamentals of CAD - Geometric modeling for downstream applications and analysis methods. Solid Modeling Techniques: Boundary Representation (B-rep) & Constructive Solid Geometry (CSG). Numerical Control of Machine tools, Features and elements of NC, NC Part Programming. Manual and Computer Aided Part Programming for simple components.

Unit-III

Computer Aided Manufacturing: Flexible automation - Computer control of Machine Tools and Machining Centers, CNC technology, Micro-controllers, CNC-Adaptive Control, Direct Numerical Control, Feedback devices and control system. Automated material handling, assembly and Flexible fixturing.

UNIT-IV

Introduction to Additive Manufacturing: Need for time compression in product development, Fundamentals of additive manufacturing, AM process chain, Classification of AM processes, advantages, limitations and applications. Distinction between Additive Manufacturing and Conventional Machining processes.

Unit-V

Low cost automation & FMS: Mechanical & Electro mechanical systems, Pneumatics and Hydraulics, Illustrative Examples and case studies. Cellular Manufacturing, Flexible Manufacturing Systems: What is an FMS, FMS Components, FMS Applications & Benefits, and FMS Planning &Implementation issues.

Suggested Reading:

1. Mikell P. Groover, Automation, Production Systems and Computer-Integrated Manufacturing, Prentice Hall.
2. Serope Kalpakjian and Steven R. Schmid, Manufacturing- Engineering and Technology, 7th Edition, Pearson.
3. CAD CAM principles, practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE).
4. Chee Kai Chua and Kah Fai Leong, 3D Printing and Additive Manufacturing Principles and Applications, Fifth Edition of Rapid Prototyping, 5th Edition, World Scientific press, 2017.
5. Ibrahim Zeid, CAD/CAM, Theory and Practice, Mc Graw Hill, 1998.

Course Code	Course Title						Core / Elective
U23ME807	Industry 4.0: Principles and Technologies						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
-	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Understand the foundational concepts of Industry 4.0, its historical evolution, and its impact on modern manufacturing systems.
2. Explore cutting-edge technologies (IoT, AI, big data) and frameworks shaping Industry 4.0-driven business transformations.
3. Design a phased roadmap for adopting smart manufacturing, logistics, and predictive analytics in Industry 4.0.
4. Examine the role of IIoT, robotics, and sensor technologies in industrial automation and maintenance.
5. Develop strategies to overcome challenges and leverage opportunities in the future workforce and Industry 4.0 ecosystems.

Course Outcomes:

After completing the course, the student will be able to:

1. Explain the evolution of industrial revolutions and compare Industry 4.0 systems with traditional factories.
2. Analyze the key components (IoT, AI, big data) and frameworks driving Industry 4.0 transformations.
3. Develop a strategic roadmap for implementing smart manufacturing and logistics in Industry 4.0.
4. Evaluate applications of IIoT and advanced robotics in industrial automation.
5. Propose strategies to address workforce and technological challenges in the Industry 4.0 era.

Unit-I

Introduction, Idea of Industry 4.0, Various Industrial Revolutions, Origin concept of Industry4.0, Production system, how is India preparing for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory.

Unit-II

Trends in Industry 4.0: Introduction, Main Concepts and Components of Industry 4.0, State of Art Technologies, Proposed Framework for Industry 4.0, Trends of Industrial Big Data and Smart Business Transformation.

Unit-III

Roadmap for Industry 4.0: Introduction, Proposed Framework for Technology Roadmap: Strategy Phase, Development Phase, Smart Manufacturing, Types of Smart Devices, Smart Logistics, Smart Cities, Predictive Analytics.

Unit-IV

Advances in the Era of Industry 4.0: Introduction, Recent Technological Components of Robots-

Advanced Sensor Technologies, Internet of Things, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly, Idiot- Industrial Iota.

Unit-V

The Role of Industry 4.0 and Future Aspects: Introduction, Challenges & Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world.

Suggested Reading:

1. YilmazUygun, Industry 4.0: Principles, Effects and Challenges, Nova Science Publishers In, 2020.
2. Dominik T. Matt, VladimírModrák, Helmut Zsifkovits, Industry 4.0 for SMEs: Challenges, Opportunities and Requirements, 1st Edition, Palgrave Macmillan, 2020.
3. Alp Ustundag, EmreCevikcan, Industry 4.0: Managing The Digital Transformation, Springer, 2018.
4. Christoph Jan Bartodziej, The concept Industry 4.0- An Empirical Analysis of Technologies and Applications in Production Logistics, Springer Gabler, 2017.
5. Alasdair Gilchrist, Industry 4.0 The Industrial Internet of Things, Apress Publisher, 2016.

Course Code	Course Title						Core / Elective
U23ME808	Mechatronics						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Learn the architecture of mechatronic systems
2. Introduce concept of sensors & actuators to measure & control various physical quantities like volume, pressure, temperature
3. Learn to design simple control systems
4. Learn PLC programming to build simple control systems

Course Outcomes:

After completing the course, the student will be able to:

1. Illustrate the architecture of mechatronic systems.
2. Design some simple measurement systems using different sensors.
3. Demonstrated ability to design basic control systems using different actuators.
4. Execute PLC programs for industrial Applications.
5. Demonstrate an understanding of analogue and digital interfacing

UNIT-I

Introduction: Definition of Mechatronics, Mechatronics in manufacturing, Products, and design. Comparison between Traditional and Mechatronics approach.

UNIT-II

Review of fundamentals of electronics: Data conversion devices, sensors, microsensors, transducers, signal processing devices, relays, contactors and timers. Micro-processors controllers and PLCs.

UNIT-III

Drives: Stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, transfer systems.

UNIT-IV

Hydraulic systems: Flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, pumps. Design of hydraulic circuits. Pneumatics: production, distribution and conditioning of compressed air, system components and graphic representations, design of systems. Description

UNIT-V

Description of PID controllers: CNC machines and part programming. Industrial Robotics.

Suggested Reading:

1. HMT ltd. Mechatronics, Tata Mcgraw-Hill, New Delhi, 1988.
2. G.W. Kurtz, J.K. Schueller, P.W. Claar . II, Machine design for mobile and industrial

applications, SAE,1994.
3. T.O. Boucher, Computer Automation in Manufacturing - an Introduction, Chappman and Hall, 1996
4. Devdas Shetty, Richard Klok “Mechatronic system design”, 2nd edition, Cengage Learning,
5. Boltan, W., “Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering”, Longman, Singapore, 1999 With effect from the academic year 2020-2021 38
6. Krishna Kant; Computer Based Industrial Control; Prentice Hall of India Pvt. Ltd. 1999.
7. Herbert Taub & Donald Schilling: Digital Integrated Electronics, McGraw Hill International Edition, 1977.
8. David Alciatoare, Michael Histand, “Introduction to Mechatronics and Measurement Systems”, McGraw Hill, 2002.

Course Code	Course Title						Core / Elective
U23ME809	MEMS: Design and Manufacture						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Provides a detailed overview to smart materials, piezoelectric materials structures and its characteristics.
2. Smart structures and modeling help in Vibration control using smart materials in various applications.
3. Familiarize with various microelectronic mechanical systems which find extensive usage in industrial applications.
4. Understand the principles and concepts of using MEMS, ER & MR Fluids for various applications

Course Outcomes:

After completing the course, the student will be able to:

1. Describe the overview of different kinds of smart materials and their applications.
2. Explain the principle concepts of Smart materials, structures, Fibre optics, ER & MR Fluids, Biomimetics and MEMS with principles of working.
3. Describe the various fabrication processes of smart materials and MEMS.
4. Analyze the properties of smart structures, MEMS, with the applications and select suitable procedure for fabrication.
5. Summarize the methods and uses of Micro fabrications, Biomimetics, types of polymers used in MEMS, Fibre optics, piezoelectric sensing and actuation.

UNIT I

Introduction to smart materials and MEMS: an overview- scaling issues in MEMS -Micro sensors, some examples –Micro actuators, some examples– Micro systems – Examples of smart systems.

UNIT II

Smart composites - piezoelectric materials, shape memory alloys, magnetic materials -Electro and magneto-statics, Electro active polymers and electrostrictive materials - measurement techniques for MEMS.

UNIT III

Fabrication processes - Structure of silicon and other materials Silicon wafer processing; Thin-film deposition, Lithography, Etching, LIGA, Micromachining, Thick-film processing, Smart material processing.

UNIT IV

Mechanics of materials- Stresses and deformation: bars and beams - Micro device suspensions: lumped modelling -Residual stress and stress gradients - Thermal loading; bimorph effect - Vibrations

of bars and beams - Gyroscopic effect

UNIT V

Electronics and packing - Semiconductor devices - Signal conditioning for micro systems devices- Vibration control of a beam - Integration of micro systems and microelectronics - Packaging of microsystems.

Suggested Reading:

1. Tai Ran Hsu, MEMS And Microsystems: Design and Manufacture,McGraw Hill Education, 2017.
2. Donald J. Leo, Engineering analysis of smart material systems, 1st Edition, John Wiley Sons, 2007.
3. Vijay K. Varadan, K. J. Vinoy, S. Gopalakrishnan, Smart Material Systems and MEMS: Design and Development Methodologies, Wiley, 2006.
4. Stephen D. Senturia, Microsystem Design,cbspd, 2006.
5. Mohamed Gad-el-Hak, MEMS: Design and Fabrication, Second Edition, CRC Press, 2006.

Course Code	Course Title						Core / Elective
U23ME810	Supply Chain Management						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Understand the basics of supply chain management and its decision-making process.
2. Learn about the key drivers that affect supply chain performance and how to measure them.
3. Explore how to design supply chain networks and choose locations for facilities.
4. Understand forecasting methods and how to plan supply and demand effectively.
5. Learn how to manage uncertainty, maintain safety inventory, and coordinate activities in a supply chain.

Course Outcomes:

After completing the course, the student will be able to:

1. Relate competitive and supply chain strategies
2. Identify drivers of supply chain performance
3. Analyze factors influencing network design.
4. Analyze the influence of forecasting in a supply chain
5. Evaluate the role of aggregate planning, inventory, IT and coordination in a supply

UNIT- I

Strategic Framework: Introduction to Supply Chain Management, Decision phases in a supply chain, Process views of a supply chain: push/pull and cycle views, Achieving Strategic fit, Expanding strategic scope.

UNIT-II

Supply Chain Drivers and Metrics: Drivers of supply chain performance, Framework for structuring Drivers, Obstacles to achieving strategic fit.

UNIT III

Designing Supply Chain Network: Factors influencing Distribution Network Design, Design options for a Distribution network, E-Business and Distribution network, Framework for Network Design Decisions, Models for Facility Location and Capacity Allocation.

UNIT IV

Forecasting in SC: Role of forecasting in a supply chain, Components of a forecast and forecasting methods, Risk management in forecasting.

Aggregate Planning and Inventories in SC: Aggregate planning problem in SC, Aggregate Planning Strategies, Planning Supply and Demand in a SC.

UNIT V

Managing uncertainty in a SC: Safety Inventory.
Coordination in SC: Modes of Transportation and their performance characteristics, Supply Chain IT framework, Coordination in a SC and Bullwhip Effect

Suggested Reading:

1. F. Robert Jacobs, Richard B. Chase, Ravi Shankar, Operations and Supply Chain Management, 17th Edition, McGraw Hill, 2023.
2. Sunil Chopra, Peter Meindl, Supply Chain Management: Strategy, Planning, and Operation, 7th Edition, Pearson, 2018.
3. Janat Shah, Supply Chain Management: Text and Cases, Second Edition, Pearson Education India, 2016.
4. Lora M. Cecere, Supply Chain Metrics that Matter, 1st Edition, John Wiley & Sons Inc, 2015.
5. David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi, Wendy Bishop, Designing and Managing the Supply Chain, 3nd Edition, McGraw Hill, 2008.

Course Code	Course Title						Core / Elective
U23ME8P1	Technical Seminar						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	50	-	1

Course Objectives:

1. Develop the ability to identify, collect, and review technical literature from journals and recent research in Mechanical Engineering.
2. Enhance skills in organizing, summarizing, and presenting technical information effectively.
3. Encourage analytical thinking for problem identification, formulation of objectives, and methodology development.
4. Improve communication skills through oral presentations, report writing, and participation in technical discussions.
5. Prepare students for final year projects by developing research-oriented and presentation skills.

Course Outcomes:

After completing the course, the student will be able to:

1. Interpretation and Solution of real life engineering problems by applying Knowledge.
2. Conduct literature survey on a current topic based on peer reviewed literature & Identify research gap in the literature
3. Develop presentation slides / report arranging the material coherently
4. Compile the content and prepare comprehensive report.
5. Demonstrate skills required for preparation of a technical report Present seminar and Write precise technical reports in a nutshell.
6. Participates effectively in multi-disciplinary and heterogeneous teams exhibiting team work, Inter-personal relationships, conflict management and leadership quality.

Technical Seminar helps the students to gather, organize, summarize and interpret technical literature with the purpose of formulating a proposal in final year. Students had also submitted a technical report summarizing state-of-the-art on an identified domain and topic. The students seminar work can be application oriented and/or will be based on some innovative/ theoretical and practical work. The student is expected to submit the seminar presentation and report in standard format approved by the internal evaluation committee. The topic for the seminar should essentially base on Journal publication and relevant to the latest trends in Mechanical engineering. The technical seminar will be undertaken preferably by a group of individual students. Each student is expected to present at least twice during the semester and the student is evaluated based on that.

The technical seminar must be distinctly structured and the students should include the following in their power point presentation aspects:

1. Introduction to the Technical Seminar topic field
2. Literature survey of the Field
3. Problem definition / statement / Objectives of the field and Specifications.
4. Methodology / Experimental Procedure/ Analysis of field
5. Consolidation of available information
6. Results and Discussions

7. Advantages / Disadvantages/ Applications
8. Conclusions
9. Future scope
10. References

Instructions to students:

1. Submit a one page synopsis of the seminar talk for display on the noticeboard.
2. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by question and answers session for 10 minutes.
3. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the department.

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule shall be discouraged. For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Guidelines for awarding the marks:		
S.No.	Description	Max Marks
1.	Contents and relevance	10
2.	Presentation skills	10
3.	Preparation of PPT slides	05
4.	Questions and answers	05
5.	Report in a prescribed format	20
Total Marks		**50**

Course Code	Course Title						Core / Elective
U23ME8P2	**Major Project (Phase-II)**						**Core**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	16	50	150	8

Course Objectives:

The objective of the course is to:

1. Develop further skills and knowledge gained during the programme by applying them
2. Analysis of a specific problem or issue, via a substantial piece of work carried out over an extended period.
3. Demonstrate proficiency in the design of a research project, application of appropriate research methods, collection and analysis of data and presentation of results.

Course Outcomes:

After completing the course, the student will be able to:

1. Do literature survey/industrial visit and identify the problem
2. Apply basic engineering fundamental in the domain of practical applications
3. Cultivate the habit of working in a team
4. Attempt a problem solution in a right approach
5. Correlate the theoretical and experimental/simulations results and draw the proper inferences
6. Prepare report as per the standard guidelines.

The aim of Major Project is to implement and evaluate the proposal made as part of Project. Students can also be encouraged to do full time as part of project work based on the common guidelines for all the departments. The students placed in project need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction. The department will appoint a project coordinator who will coordinate the following:

1. Re-grouping of students - deletion of project candidates from groups made as part of project Work
2. Re-Allotment of project students to supervisor
3. Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 1st week of VIII semester so that students get sufficient time for completion of the project. All projects will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for 50 marks can be conducted after completion of five weeks. The final viva voce of 150 marks can be conducted after 12 weeks of instruction. Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

Note: Three periods of contact load will be assigned to each project guide.