Shri Shankaracharya Technical Campus, Bhilai

(An Autonomous Institute Affiliated to CSVTU Bhilai)

SCHEME OF TEACHING AND EXAMINATION
B. Tech. Eight Semester- MECHANICAL ENGINEERING

Effective from 2023-2024 Batch

Sl. No.	Board of Studies (BOS)	Courses	Category	Course Code	Period per Week			Scheme of Examination Theory/Lab			Total Marks	Credit
					L	T	P	ESE	CT	TA		
1	Mechanical Engineering	Industrial Engineering and Management	PEC	**ME107801**	3	1	-	100	20	30	150	4
4	Mechanical Engineering	Professional Elective IV *	HSMC	table IV	2	1	-	100	20	30	150	3
5	Mechanical Engineering	Open Elective III **	HSMC	table V	3	-	-	100	20	30	150	3
6	Mechanical Engineering	Industrial Engineering and Management Lab	PEC	**ME107891**	-	-	2	25	-	25	50	1
7	Mechanical Engineering	Micro and Nano Manufacturing Lab	PCC	**ME107892**	-	-	2	25	-	25	50	1
8	Mechanical Engineering	Capstone Project Phase II	PSI	**ME107893**	-	-	16	300	-	150	450	8
Total					**8**	**2**	**20**	**650**	**60**	**290**	**1000**	**20**

L : Lecture, T: Tutorial, P : Practical, ESE : End Semester Exam CT : Class test TA: Teacher's assessment

*** Table IV : Professional Elective - IV**

Sl. No.	Board of Studies (BOS)	Courses (Subject)	Course Code
1	Mechanical Engineering	Energy Audit and Management	ME107821
2	Mechanical Engineering	Non Destructive Testing Methods	ME107822
3	Mechanical Engineering	Tribology	ME107823
4	Mechanical Engineering	Mechatronics	ME107824
5	Mechanical Engineering	Non Conventional Energy Sources	ME107825

*** Table IV : Open Elective - III**

Board of Studies (BOS)	Courses (Subject)	Course Code
Mechanical Engineering	Theory of Composite Materials	ME100841
Mechanical Engineering	Microfluidics	ME100842
Mechanical Engineering	Micro and Nano manufacturing	ME100843

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SYLLABUS

B.TECH. (MECHANICAL ENGINEERING)

EIGHT SEMESTER

		July 2022	1.00	Applicable for AY 2022-23 Onwards
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Subject Code ME107801	Industrial Engineering and Management	L = 3	T = 1	P = 0	Credits = 4
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: **1.** To impart capability of successfully planning, Controlling, and implementing projects. **2.** Understand and apply the principles of math, science, technology and engineering, involving Industry-relevant problems. **3.** Contribute to the profitable growth of industrial economic sectors by using IE analytical tools, effective computational approaches, and systems Thinking methodologies. **4.** Maintain high standards of professional and Ethical responsibility. **5.** Practice life-long learning to sustain technical Currency and excellence throughout one's career.	**Students will be able to:** CO1: Ability to apply mathematics and science in Industrial engineering. CO2: Ability to design and conduct experiments, as well as to analyze and interpret data. CO3: Ability to identify, formulates, and solves engineering problems. CO4: Ability to use the techniques, skills, and modern engineering tools necessary for industrial engineering practice. CO5: Ability to design, develop, implement and improve integrated systems that include people, materials, information, equipment, and people.

UNIT 1 **Introduction** History & development, objective, place of Industrial Engineering in an organization. **Plant Layout and Plant Location** Objective & Principles, factors affecting layout, types of layouts. Need for a suitable location, Plant location problems factors affecting location, quantitative method for evaluation of plant location.	**CO1** **4Hrs**
UNIT 2 **Basic concepts and Functions of management** Nature, Purpose and Objectives of basic functions of management, Authority and Responsibility, Social responsibility of manager, ethics and management. **Marketing Management** Marketing Environment, Marketing Mix, Advertising and Sales Promotion, Channels of Distribution	**CO2** **5 Hrs.**
UNIT 3 **Work Study** Purpose, objectives and applications of work study, Productivity and work study. **Method Study** Introduction, procedure, flow process charts, Multiple activity chart, motion economy principles, Therbligs, cycle graph and chronocycle graph.	**CO3** **6 Hrs.**
UNIT 4	**CO4**

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Work Measurement Definition, types, Time Study- selection & timing the job, rating, allowances, Numerical on Normal and standard time calculation. **Job Evaluation and Merit Rating** Definition, objectives, methods	**4 Hrs.**
UNIT 5 **Wages and Incentives** Terminology, characteristics, factors, types of incentives, wage incentive plan, Rowan plan, Taylor's differential piece rate system, Emerson's efficiency plan, Halsey's 50-50 plan, Bedaux plan, Group task & Bonus system. **Human Resource Management** Nature and Scope of Human Resource Planning, Recruitment and Selection, Training and Development, Career Growth, Grievances, Motivation – needs and types, Maslow hierarchy of needs theory, Herzberg two factor theory	**CO5** **6 Hrs.**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Industrial Engineering and Production Management	Martand Telsang	S. Chand.
2	Industrial Engineering & Management	S. Dalele & Mansoor Ali	Standard Publishers

Reference Books:

S. No.	Title	Author(s)	Publisher
1	Industrial Engineering & Management, A new perspective	Philip E Hicks	McGgraw Hill
2	Introduction of work study	ILO, Geneva	Universal Publishing Corporation, Bombay
3	Motion and Time Study	Ralph M. Bannes	John Wiley & Sons
4	Human Resource Management	Luthans Fred	McGraw Hill, Inc.
5	Marketing Management	Kotler Philip	Prentice Hall of India

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SYLLABUS

B. Tech. Eight Semester- MECHANICAL ENGINEERING

Subject Code ME107821	Energy Audit and Management	L = 2	T = 1	P = 0	Credits = 3
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: 1. Familiarizing with management especially with management in energy sector engineering. 2. Fundamentals of product strategy management. 3. Studying methods of energy accounting and energy auditing in energy sector, industry and final consumption. 4. Finding opportunities to increase the rational use of energy.	**Students will be able to:** CO1: The students understand the concept of energy management and energy management opportunities. CO2: To understand the different methods used to control peak demand. CO3: To know energy auditing procedure. CO4: To understand the different methods used for the economic analysis of energy projects. CO5: The students will be able to understand the different methods used to reduce energy consumption.

UNIT 1 Overview History of Energy Management: Energy forecasting, Limitations of energy resources. Renewable energy recourses. Load management. Energy management. Demand side management (DSM) Energy conservation in realistic distribution system. Short term load forecasting for decentralized load management.	**CO1** **4Hrs**
UNIT 2 Energy Situation and Global Energy Sources World energy consumption. Energy in developing countries. Firewood crises. Indian energy sources. Non-conventional renewable energy sources. Potential of renewable energy sources. Solar energy types. Wind energy. Wave, tidal and OTEC. Super-conductors in power system. Wind power generation for large scale generation of electricity. Wind driven induction generators.	**CO2** **5 Hrs.**
UNIT 3 Energy Auditing as Applicable to an Industry Classification of energy audit System optimization. Power factor improvement. Preventive maintenance. Process modification. Non-conventional energy sources. Electricity tariffs. Types of off-peak tariffs.	**CO3** **6 Hrs.**
UNIT 4 Elements of Energy Auditing and Metering Methodologies (Case Studies): Capacity utilization. Technology up-gradation. Fine tuning, Energy conservation. Concept and methods of energy conservation.	**CO4** **4 Hrs.**
UNIT 5 Demand Side Management Introduction to DSM. Concept of DSM. Benefits from DSM.DSM techniques. Time of day pricing, multi-utility exchange model. Time of day	**CO5**

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pricing models for planning, load management. Load priority technique. Peak clipping. Peak shifting. Valley filling. Strategic conservation. Energy efficient equipment, Socioeconomic awareness programs.	**6 Hrs.**

Text Books:

S. No.	Title	Author(s)	Publisher
1.	Energy Demand: Analysis, Management and Conservation	Ashok. V. Desai (ED)	Wiley Eastern Ltd., New Delhi
2.	Energy technology	S. Rao, Parulekar	Khanna Publication

Reference Books:

S. No.	Title	Author(s)	Publisher
1.	Demand Side Management	Jyothi Prakash	Tata McGraw-Hill Publishers
2.	Renewable Energy Sources and Conservation Technology	N. K. Bansal, Kleeman Millin	Tata McGraw-Hill Publishers

SYLLABUS
B. Tech. Eight Semester- MECHANICAL ENGINEERING

Subject Code ME107822	Non-Destructive Testing Methods	L = 2	T = 1	P = 0	Credits = 3
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: 1. Understand the concept of nondestructive testing. 2. Describe the various types of NDT tests carried out on components. 3. Describe ultrasonic method of testing the materials. 4. Analyze the different types of tests carried out on components and surfaces. 5. Understand the properties of materials suitable for NDT test. 6. Understand the radiography uses in engineering.	**Students will be able to:** CO1: Identify the requirements of testing criteria as per material composition CO2: Understand the theory of non-destructive testing methods is used. CO3: Determine the type of requirement of non-destructive test. CO4: Distinguish between the various NDT test as Ultrasonic and Eddy current methods. CO5: Describe the various types of non-destructive test used to determine the surface cracks.

UNIT 1 **Overview of NDT** NDT Versus Mechanical testing, Overview of the Non-Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, various physical characteristics of materials and their applications in NDT, Visual inspection.	**CO1** **4Hrs**
UNIT 2 **Surface NDE Methods** Liquid Penetrant Testing- Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.	**CO2** **5 Hrs.**
UNIT 3 **Thermography and Eddy Current Testing** Principles, Contact and non-contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.	**CO3** **6 Hrs.**
UNIT 4 **Ultrasonic Testing and Acoustic Emission** Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan.	**CO4**

Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique IV Principle, AE parameters, Applications.	**4 Hrs.**
UNIT 5 **Radiography** Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetrometers, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography.	**CO5** **6 Hrs.**

Text Books:

S. No.	Title	Author(s)	Publisher
1.	Practical Non-Destructive Testing	Baldev Raj, T. Jayakumar, M. Thavasimuthu	Narosa Publishing House
2.	Non-Destructive Testing Techniques	Ravi Prakash	1st Revised Edition, New Age International Publishers

Reference Books:

S. No.	Title	Author(s)	Publisher
1.	Non-Destructive Evaluation and Quality Control	ASM Metals Handbook	American Society of Metals, Metals Park, Ohio, USA
2.	Introduction to Non-destructive testing: a training guide	Paul E Mix	Wiley, 2nd Edition New Jersey
3.	Handbook of Non-destructive evaluation	Charles, J. Hellier	McGraw Hill, New York

SYLLABUS
B. Tech. Eight Semester- MECHANICAL ENGINEERING

Subject Code ME107823	Tribology	L = 2	T = 1	P = 0	Credits = 3
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: 1. To provide the knowledge and importance of Tribology in Design, friction, wear and lubrication aspects of machine components. 2. To introduce the concept of surface engineering and its importance in tribology. 3. To understand the behavior of Tribological components. 4. To understand the principles of lubrication, lubrication regimes, theories of hydrodynamic and theadvanced lubrication techniques. 5. To select proper grade lubricant for specific application.	**Student will be able to:** **CO1:** Ability to understand the role of wear & friction and the need of lubrication in Industry and industrial components. **CO2:** Ability to identify different types of sliding and rolling friction, Wear and related theories **CO3:** Ability to identify, formulates, and solve tribological problems. **CO4:** Ability to distinguish among the different Lubricant regime. To address the underlying concepts, methods and application of Industrial lubrication. **CO5:** Determine the application of Lubricants.

UNIT 1 **Introduction** Tribology in design, tribology in industry Viscosity, flow of fluids, viscosity and its variation absolute and kinematic viscosity, temperature variation, viscosity index determination of viscosity, different viscometers, Tribological considerations Nature of surfaces and their contact.	**CO1** **4Hrs**
UNIT 2 **Friction and wear** Role of friction and laws of static friction, causes of friction, theories of friction, Laws of rolling friction; Friction of metals and non-metals; Friction measurements. Definition of wear, mechanism of wear, types and measurement of wear, friction affecting wear, Theories of wear; Wear of metals and non-metals.	**CO2** **5 Hrs.**
UNIT 3 **Hydrostatic lubrication** Principle of hydrostatic lubrication, General requirements of bearing materials, types of bearing materials, Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, Hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.	**CO3** **6 Hrs.**
UNIT 4 **Hydrodynamic theory of lubrication** Principle of hydrodynamic lubrication, Various theories of lubrication, Petroff's equation, Friction in sliding bearing, hydro dynamic theory applied to journal bearing, minimum oil film	**CO4**

thickness., oil whip and whirl, anti –friction bearing, hydrodynamic thrust bearing.	**4 Hrs.**
UNIT 5 **Lubrication and lubricants** Introduction, dry friction; Boundary lubrication; classic hydrodynamics, hydrostatic and elasto hydrodynamic lubrication, Functions of lubricants, Types of lubricants and their industrial uses; SAE classification, recycling, disposal of oils, properties of liquid and grease lubricants; lubricant additives, general properties and selection.	**CO5** **5 Hrs.**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Fundamentals of Tribology	BasuSen Gupta and Ahuja	PHI
2	Tribology in Industry	Sushil Kumar Srivatsava	S.Chand & Co.

Reference Books:

S. No.	Title	Author(s)	Publisher
1	Tribology	H. G. Phakatkar and R. R. Ghorpade	Nirali Publications
2	Tribology	B. C. Majumdar	McGraw Hill Co Ltd.
3	Standard Hand Book of Lubrication Engg.	O'Conner and Royle	McGraw Hills Co Ltd.
4	Introduction to Tribology	J. Halling	Wykeham Publications Ltd.
5	Engineering Tribology	Prasanta Sahoo	PHI

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B. Tech. Eight Semester- MECHANICAL ENGINEERING

Subject Code ME107824	Mechatronics	L = 2	T = 1	P = 0	Credits = 3
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: 1. The main objective of the course is to apply knowledge of mechatronics for understanding and solving engineering problems 2. To acquire knowledge and hands-on competence in applying the concepts of mechatronics in the design and development of mechanical systems.	**Students will be able to:** CO1: Discuss the basics of mechatronics and their scope. CO2: Describe sensors and transducers. CO3: Describe Hydraulic, Pneumatic & Electrical actuators. CO4: Demonstrate an understanding of data acquisition system and control system. CO5: Demonstrate an understanding of design mechatronics systems.

UNIT 1 **Introduction** Origin, Definition, Benefits, Challenges, Commercial activities, Physics of miniaturization, Scaling laws. Intermolecular forces, States of matter, Continuum assumption, Governing equations, Constitutive relations.	**CO1** **8 Hrs.**
UNIT 2 **Micro-Scale Fluid Mechanics** Gas and liquid flows, Boundary conditions, Slip theory, Transition to turbulence, Low Re flows, Entrance effects, Hydraulic resistance and Circuit analysis, Straight channel of different cross-sections, Channels in series and parallel.	**CO2** **6 Hrs.**
UNIT 3 **Electrokinetics** Electro hydro dynamics fundamentals, Electro-osmosis, Debye layer, Thin EDL limit, Ideal electroosmotic flow, Ideal EOF with back pressure, Cascade electroosmotic micropump, EOF of power-law fluids.	**CO3** **6 Hrs.**
UNIT 4 **Microfabrication Techniques** Materials, Clean room, Silicon crystallography, Miller indices, Oxidation, photolithography-mask, spin coating, exposure and development, Etching, Bulk and Surface micromachining, Wafer bonding, Polymer microfabrication, PMMA/COC/PDMS substrates, micromolding, hot embossing, fluidic interconnections.	**CO4** **4 Hrs.**
UNIT 5 **Microfluidics Components** Micropumps, Check-valve pumps, Valve-less pumps, Peristaltic pumps, Rotary pumps, Centrifugal pumps, Ultrasonic pump, EHD pump, MHD pumps, Microvalves, Pneumatic valves, Thermopneumatic valves, Thermomechanical valves, Piezoelectric valves, Electrostatic valves, Electromagnetic valves, Capillary force valves.	**CO5** **5 Hrs.**

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Text Books:

S. No.	Title	Author(s)	Publisher
1	Fundamentals and applications of Microfluidics	N.T. Nguyen and S. T. Werely	Artech House
2	Theoretical Microfluidics	H. Bruus	Oxford University Press

Reference Books:

S. No.	Title	Author(s)	Publisher
1	Fundamentals of Microfabrication	M. J. Madou	CRC Press
2	Introduction to microfluidics	P. Tabeling	Oxford University Press
3	Micro- and Nanoscale Fluid Mechanics: Transport in Microfluidic Devices	B. J. Kirby	Cambridge University Press
4	Microfluidics	S. Colin	John Wiley & Sons
5	Microfluidics for Biotechnology	J. Berthier and P. Silberzan	Artech House

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SYLLABUS

B. Tech. Eight Semester- MECHANICAL ENGINEERING

Subject Code ME107825	Non-Conventional Energy Sources	L = 2	T = 1	P = 0	Credits = 3
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: 1. Discuss non-conventional sources of energy and explain the working of different solar energy applications. 2. Explain the working principle of solar energy and working of solar energy conversion systems 3. Describe different biogas plants and working of different gasifiers 4. Discuss wind energy conversion systems and explain sources of geothermal energy. 5. Describe the working principle of different fuel cells & OTEC.	**Students will be able to:** CO1: Ability to describe various sources of renewable energy, CO2: Ability to explain the working of flat plate and concentrating solar collectors, discuss methods of storing solar energy and applications of solar energy. CO3: Ability to describe various biogas generation methods, discuss various factors affecting the selection of biogas plants, explain the working and summarize the advantages and limitations of biomass gasifiers. CO4: Ability to discuss different wind energy conversion technologies, explain the working of different geothermal energy resources, describe the applications of geothermal energy. CO5: Ability to describe the working principle of different fuel cells, explain the working of open cycle and closed cycle OTEC systems, explain the working of single and double basin tidal power systems.

UNIT 1 **Introduction** Energy source, India's production and reserves of commercial energy sources, need for nonconventional energy sources, energy alternatives, solar, thermal, photovoltaic. Water power, wind biomass, ocean temperature difference, tidal and waves, geothermal, tar sands and oil shale, nuclear (Brief descriptions); advantages and disadvantages, comparison (Qualitative and Quantitative). **Solar Radiation:** Extra-Terrestrial radiation, spectral distribution of extra-terrestrial radiation, solar constant, solar radiation at the earth's surface, beam, diffuse and global radiation, solar radiation data	**CO1** **4 Hrs.**
UNIT 2 Solar energy storage system, Application of solar energy: solar water heating, space heating and cooling, solar photovoltaic, solar cooking, solar distillation & desalination, Solar industrial process heating, Solar power generation. Solar Green Houses, Solar thermo mechanical power, solar refrigeration & air conditioning, Solar ponds.	**CO2** **5 Hrs.**

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UNIT 3 **Energy from Biomass:** Type of biomass sources, Energy plantation, Methods for obtaining energy from biomass, Biomass conversion technologies-wet and dry processes, Biodigestion, Community/Industrial biogas plants, Factors affecting biodigestion, Design of a biogas plant, Classification, advantages and disadvantages of biogas plants, Problems related to biogas plants, Utilization of biogas. Thermal gasification of biomass, Gasifier- classification, chemistry, advantages, disadvantages and application. Alcohol fuels from biomass: overview, feedstock, methods for alcohol production, Ethanol as an alternative liquid fuel; engine performance with alcohol fuels, biodiesel from biomass.	**CO3** **6 Hrs.**
UNIT 4 **Wind Energy:** Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, wind machines; Types of wind machines and their characteristics, horizontal and vertical axis wind mills, elementary design principles; coefficient of performance of a wind mill rotor, aerodynamic considerations of wind mill design, numerical examples. **Tidal Power:** Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, limitations. **Geothermal Energy Conversion:** Principle of working, types of geothermal station with schematic diagram, geothermal plants in the world, problems associated with geothermal conversion, scope of geothermal energy.	**CO4** **4 Hrs.**
UNIT 5 **Chemical Energy sources:** Fuel cells -principle of operation of fuel cell, types of fuel cells –hydrogen- oxygen, solid-oxide, alkaline, polymer electrolyte membrane fuel cells, advantages, disadvantages and conversion efficiency of fuel cells, applications of fuel cells. **Energy from the oceans:** Ocean thermal energy conversion-open cycle and closed cycle systems, energy from tides – basic principle of tidal power, components of tidal power plants, single basin and double basin systems, ocean waves – wave energy conversion systems.	**CO5** **5 Hrs.**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Non-Conventional Energy Sources	G D Rai	Khanna Publishers. Delhi, 2010
2	Solar Energy-Principles of Thermal Collection & Storage	S P Sukhatme	Tata McGraw Hill Publishing Company Ltd., New Delhi

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Reference Books:

S. No.	Title	Author(s)	Publisher
1	Solar Energy Thermal processes	John A Duffie & William A Beckman	Wiley Interscience publication
2	Solar Energy - Fundamentals and Applications	P Garg & J Prakash	Wiley Interscience publication
3	Biomass to Renewable Energy Processes	Jay Cheng,	CRC press, 2009

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SYLLABUS

B. Tech. Eight Semester- MECHANICAL ENGINEERING

Subject Code ME100841	Theory of Composite Materials	L = 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: 1. To be familiar with classification & characteristics of composite material and their application. 2. To gain the knowledge about manufacturing methods, testing and environmental issue related with composite material. 3. To train students to be able to design composite structures, select composite materials, conduct stress analyses of selected practical applications using laminated plate theories appropriate strength criteria.	**Students will be able to:** CO1: Understand the basics of composite materials and their related structures and applications CO2: Understand the various manufacturing and testing methodologies related with environmental issues CO3: Understand the properties of composite materials such as stress, strain, temperature and failure CO4: Understand the laws related composite materials and effects of stress and environment on composite behaviour CO5: Understand the Static, dynamic and stability analysis of composite laminates.

UNIT 1 **Introduction to Composites** Definition, classification/ types and characteristics of composite materials; Basic composite constituents – fiber and matrix; Properties of unidirectional long fiber and short fiber composites; Polymeric materials and polymeric composites; Honeycomb and Sandwich Composite Structure; Application areas of composites	**CO1** **8 Hrs.**
UNIT 2 **Manufacturing, Testing and Environmental Issues** Moulding, pultrusion, filament winding, other advanced manufacturing techniques; Quality inspection and testing – uniaxial tension test, uniaxial compression test, shear test, fracture toughness testing of composites. Environmental Issues related with composite manufacturing and their applications.	**CO2** **8 Hrs.**
UNIT 3 **Material Properties** Orthotropic and Anisotropic materials; properties relating stress to strain, properties relating temperature to strain, properties relating moisture to strain, properties relating stress (or strain) to failure, Failure Criterion – Maximum Stress and Maximum Strain; Review of force tensors, stress tensors, strain tensors	**CO3** **7 Hrs.**
UNIT 4 **Composite Laminates** Thin-plate theory, classical lamination theory; Angle-ply and cross ply laminates; Static, dynamic and stability analysis for simple cases of composite plates; Inter-laminar stress behavior; Composite Joints; Design with Composites.	**CO4** **6 Hrs.**

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UNIT 5 **Elastic Response Analysis** Hooke's law for orthotropic and anisotropic materials; Linear Elasticity for Anisotropic Materials; Unidirectional composite laminates; Rotations of Stresses, Strains; Residual Stresses; Stress and environmental effects on composites behavior.	**CO5** **6 Hrs.**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Mechanics of Composite Materials and Structures	M. Mukhopadhyay	Universities Press, India
2	Analysis and Performance of Fiber Composites	B. D. Agarwal, L. J. Broutman and K. Chandrashekhara	John Wiley and Sons, New York
3	Fiber Reinforced Composites: Materials, Manufacturing and Design	P. K. Mallick	Taylor & Francis

Reference Books:

S. No.	Title	Author(s)	Publisher
1	Primer on Composite Materials Analysis	J. C. Halpin	CRC Press
2	Composite Materials Technology: Processes and Properties	P. K. Mallick and S. Newman	Hanser Publishers
3	Stress Analysis of Fiber – Reinforced Composite Materials	M. W. Hyer	McGraw-Hill, Australia
4	Engineering Mechanics of Composite Materials	Issac M. Daniel and Ori Ishai	Oxford University Press

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Subject Code ME100842	Microfluidics	L = 2	T = 1	P = 0	Credits = 3
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: 1. Understanding some laws and forces relevant to microfluidics. 2. Understanding some advanced fluid mechanics relevant to micro scale device. 3. Demonstrate a basic understanding of principle and processes of electro kinetics. 4. Understanding microfabrication techniques and related materials. 5. Make reasonable decisions about the microfluidic components, selection, options and performance.	**Students will be able to:** CO1: Describe the basic laws and forces related to microfluidics. CO2: Describe the mechanism involved in advanced fluid mechanics. CO3: Describe the fundamentals of electro kinetics and analyze the flow related problems. CO4: Describe the various materials and techniques involved in microfabrication. CO5: Describe the performance of microfluidics components like micropumps and microvalves.

UNIT 1 **Introduction** Origin, Definition, Benefits, Challenges, Commercial activities, Physics of miniaturization, Scaling laws. Intermolecular forces, States of matter, Continuum assumption, Governing equations, Constitutive relations.	**CO1** **8 Hrs.**
UNIT 2 **Micro-Scale Fluid Mechanics** Gas and liquid flows, Boundary conditions, Slip theory, Transition to turbulence, Low Re flows, Entrance effects, Hydraulic resistance and Circuit analysis, Straight channel of different cross-sections, Channels in series and parallel.	**CO2** **6 Hrs.**
UNIT 3 **Electrokinetics** Electro hydro dynamics fundamentals, Electro-osmosis, Debye layer, Thin EDL limit, Ideal electroosmotic flow, Ideal EOF with back pressure, Cascade electroosmotic micropump, EOF of power-law fluids.	**CO3** **6 Hrs.**
UNIT 4 **Microfabrication Techniques** Materials, Clean room, Silicon crystallography, Miller indices, Oxidation, photolithography-mask, spin coating, exposure and development, Etching, Bulk and Surface micromachining, Wafer bonding, Polymer microfabrication, PMMA/COC/PDMS substrates, micromolding, hot embossing, fluidic interconnections.	**CO4** **4 Hrs.**
UNIT 5 **Microfluidics Components** Micropumps, Check-valve pumps, Valve-less pumps, Peristaltic pumps, Rotary pumps, Centrifugal pumps, Ultrasonic pump, EHD pump, MHD pumps, Microvalves, Pneumatic	**CO5**

valves, Thermopneumatic valves, Thermomechanical valves, Piezoelectric valves, Electrostatic valves, Electromagnetic valves, Capillary force valves.	**5 Hrs.**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Fundamentals and applications of Microfluidics	N.T. Nguyen and S. T. Werely	Artech House
2	Theoretical Microfluidics	H. Bruus	Oxford University Press

Reference Books:

S. No.	Title	Author(s)	Publisher
1	Fundamentals of Microfabrication	M. J. Madou	CRC Press
2	Introduction to microfluidics	P. Tabeling	Oxford University Press
3	Micro- and Nanoscale Fluid Mechanics: Transport in Microfluidic Devices	B. J. Kirby	Cambridge University Press
4	Microfluidics	S. Colin	John Wiley & Sons
5	Microfluidics for Biotechnology	J. Berthier and P. Silberzan	Artech House

Shri Shankaracharya Technical Campus, Bhilai

(An Autonomous Institute Affiliated to CSVTU Bhilai)

SYLLABUS

B. Tech. Eight Semester- MECHANICAL ENGINEERING

Subject Code ME100843	Micro and Nano Manufacturing	L = 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	100	20	30	150	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: **6.** To give awareness of different techniques used in micro and nano manufacturing **7.** To give in-depth idea of the conventional techniques used in micro manufacturing **8.** To introduce Non-conventional micro-nano manufacturing and finishing approaches **9.** To introduce Micro and Nanofabrication Techniques and other processing routes in Micro and nano manufacturing **10.** To know different techniques used in Micro Joining and the metrology tools in micro and nano manufacturing.	**Students will be able to:** CO1: To understand the different techniques used in micro and nano manufacturing CO2: To understand in-depth idea of the conventional techniques used in micro manufacturing. CO3: To understand about non-conventional micro-nano manufacturing and finishing approaches. CO4: To understand on micro and nano finishing processes. CO5: To understand and know about different techniques used in micro joining and the metrology tools in micro and nano manufacturing.

UNIT 1 Introduction to Precision engineering, macro milling and micro drilling, Micro-electromechanical systems – merits and applications, Micro phenomenon in Electro-photography – applications, Bulk micromachining, Surface micromachining- steps, Micro instrumentation – applications, Micro Mechatronics, Nano finishing – finishing operations, Laser technology in micro manufacturing- Practical Lasers, application of technology fundamentals, Micro-energy and chemical system (MECS), Space Micro-propulsion, e-Beam Nanolithography – important techniques, Introduction to Nanotechnology, Carbon Nano-tubes – properties and structures, Molecular Logic Gates and Nano level Biosensors – applications.	**CO1** **8 Hrs**
UNIT 2 Introduction to mechanical micromachining, Micro drilling – process, tools and applications, Micro turning- process, tools and applications, Diamond Micro turning – process, tools and applications, Micro milling and Micro grinding – process, tools and applications, Micro extrusion- process and applications, Micro bending with Laser, Nano-Plastic forming and Roller Imprinting.	**CO2** **7 Hrs**
UNIT 3 Introduction to Non-conventional micro-nano manufacturing, Process, principle and applications – Abrasive Jet Micro Machining, WAJMM, Micro EDM, Micro WEDM, Micro EBM – Process principle, description and applications, Micro ECM, Micro LBM - Process principle, description and applications, Focused ion beams - Principle and applications.	**CO3** **7 Hrs.**

		July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairman (AC)	Chairman (BoS)	Date of release	Version	

UNIT 4 Introduction to Micro and Nano Finishing Processes, Magnetorheological Finishing (MRF), Processes, Magnetorheological abrasive flow finishing processes (MRAFF) – process principle and applications, Force analysis of MRAFF process, Magnetorheological Jet finishing processes, Working principle and polishing performance of MR Jet Machine, Elastic Emission Machining (EEM) – machine description, applications, Ion Beam Machining (IBM) – principle, mechanism of material removal, applications, Chemical Mechanical Polishing (CMP) – Schematic diagram, principle and applications.	**CO4** **7 Hrs.**
UNIT 5 Laser Micro welding – description and applications, Defects, Electron Beam Micro-welding – description and applications, Introduction to micro and nano measurement, defining the scale, uncertainty, Scanning Electron Microscopy – description, principle, Scanning White-light Interferometry – Principle and application, Optical Microscopy – description, application, Scanning Probe Microscopy, scanning tunneling microscopy-description, application, Confocal Microscopy - description, application, Introduction to On-Machine Metro	**CO5** **6 Hrs**

Text Books:

S. No.	Title	Author(s)	Publisher
1	Micro and Nano-manufacturing	Mark. J. Jackson,	Springer New York
2	Micro-fabrication and Nano-manufacturing - Pulsed water drop micromachining	Mark. J. Jackson,	CRC Press

Reference Books:

S. No.	Title	Author(s)	Publisher
1	Micro-manufacturing and Nanotechnology	Nitaigour Premchand Mahalik	Springer Berlin, Heidelberg
2	Micro-manufacturing Processes	V.K.Jain Wendt, J.	CRC Press

SYLLABUS
B. Tech. Eight Semester- MECHANICAL ENGINEERING

Subject Code ME107891	Industrial Engineering and Management Lab	L = 0	T = 0	P = 2	Credits = 1
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	25	-	25	50	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: 1. To impart capability of successfully planning, Controlling, and implementing projects. 2. Understand and apply the principles of maths, science, technology and engineering, involving industry-relevant problems. 4. Contribute to the profitable growth of industrial economic sectors by using IE analytical tools, effective computational approaches, and systems thinking methodologies. 5. Maintain high standards of professional and Ethical responsibility. 6. Practice life-long learning to sustain technical Currency and excellence throughout ones career.	**Students will be able to:** CO1: Ability to apply mathematics and science in Industrial engineering. CO2: Ability to design and conduct experiments, as well as to analyze and interpret data. CO3: Ability to identify, formulates, and solves engineering problems. CO4: Ability to use the techniques, skills, and modern engineering tools necessary for industrial engineering practice. CO5: Ability to design, develop, implement and improve integrated systems that include people, materials, information, equipment, and people.

EXPERIMENTS TO BE PERFORMED (MINIMUM TEN EXPERIMENTS)

1. To prepare the charts & diagrams for a selected problem according to the existing method and an improved method -men type flow process chart.
2. To prepare the charts & diagrams for a selected problem according to the existing method and an improved method -material type flow process chart
3. To prepare the charts & diagrams for a selected problem according to the existing method and an improved method -machine type flow process chart
4. To prepare the charts & diagrams for a selected problem according to the existing method and an improved method – multiple activity charts.
5. Study of principles of fundamentals of hand motion.
6. Study & applications of principles of motion economy.
7. Performance of micro motion study of a job.
8. Problems in assignment of men & machines.
9. Training for a performance rating using walking exercises / audio visual aids.
10. Calculation of allowance for a job.
11. Standard time calculation problems.
12. Problems of wage incentive.
13. Stop watch time study of a job.

SYLLABUS
B. Tech. Eight Semester- MECHANICAL ENGINEERING

Subject Code ME107892	Advance Manufacturing Lab	L = 0	T = 0	P = 2	Credits = 1
Evaluation Scheme	ESE	CT	TA	Total	ESE Duration
	25	-	25	50	3 Hours

Course Objectives	Course Outcomes
The objective of the course to: **1.** To familiarize the students with advanced machine tools. **2.** To familiarize the students with extrusion based additive manufacturing **3.** To acquaint the students with traditional and nontraditional machining process **4.** To introduce the manufacture of polymer composites. **5.** To introduce the concepts of thin film-based deposition process.	**Students will be able to:** CO1: To impart the knowledge of basic methodology of metal cutting. CO2: Program a CNC turning or milling machine for preparing a job. CO3: Evaluate the process parameters involved in CNC machining. CO4: Analyze the principles of Robot programming and carryout hands-on practice. CO5: Elaborate any nonconventional machining process and 3D printing.

EXPERIMENTS TO BE PERFORMED (MINIMUM TEN EXPERIMENTS)

1. Face milling operation using CNC simulator.
2. Drilling operation using CNC simulator.
3. Turning operation using CNC simulator.
4. Boring operation using CNC simulator.
5. Slotting operation using CNC simulator.
6. Making a pocket using CNC simulator.
7. Making a spigot using CNC simulator.
8. Pick & place operation by robotic arm.
9. Electrical discharge machining process using EDM simulator.
10. Extrusion based additive manufacturing.
11. Micro machining of 3D parts using mechanical micro machining system.