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Mechanical Engineering Department

VIII-SEM B.Tech. Mechanical	Subject Code	Subject Name / Title	Maximum Marks Allotted					Contract Hrs. per weeks			Total Credits
			Theory			Practical					
			End Sem	Mid Sem MST	Quiz Assignment	End Sem	Lab Work	L	T	P	
	ME-1881 (E-VII) (A)	Additive Manufacturing	70	20	10	-	-	3	-	-	3

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

CO1	Understand the working principle and process parameters of AM processes
CO2	Apply the suitable process for fabricating a given product
CO3	Use suitable post processes based on product application
CO4	Explore the applications of AM processes in various fields

UNIT-I

Types of Manufacturing: Introduction of Substractive, Formative, Additive Manufacturing Additive Manufacturing: AM evolution, Distinction Between AM & CNC machining, Advantages of AM. AM process chain: Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup.

UNIT-II

Classification of AM processes: Liquid polymer system, discrete particle system, molten material systems, solid sheet system such as : Steriolithography, Fused Deposition Modeling, Solid Based Curing, Selective Laser sintering, Laminated Object Modeling.

UNIT-III

Design for AM: Motivation, DFMA concepts and objectives, AM unique capabilities, Exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports,

UNIT-IV

AM Applications: Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Re-manufacturing. Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries

UNIT-V

Post processing of AM parts: Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.

Future Directions of AM: Introduction, new types of products and employment and digiproneurship.

REFRENCES:

1. Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles & Applications", World Scientific, 2003.
2. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
3. Ali K. Kamrani, Emand Abouel Nasr, "Rapid Prototyping: Theory & Practice", Springer, 2006.
4. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001.

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	ME-1881 (E-VII) (B)	Unconventional Machining Process	70	20	10	-	-	3	-	-	3

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

CO 1	Identify the selection of processes.
CO 2	Design the components of Abrasive Jet Machining process.
CO 3	Analyze surface properties after machining without distructing the material.
CO 4	Match the matrial and tool with respect to process.
CO 5	Illustrate the chemical, electrical, thermal and mechanical machining process.
CO 6	Develop the economic aspects of the different unconventional machining process.
CO 7	Mention the real rim application of unconventional machining process.

UNIT-I:

Introduction - Classification - process economy - Mechanical machining - Types - Ultrasonic machining (USM) - Abrasive Jet Machining (AJM) - Abrasive Flow Machining (AFM) - Water Jet Machining (WJM) - Operating principle - Process parameters - Applications - Limitations.

UNIT-II:

Electro chemical machining - Chemical material removal - Types - Electro chemical machining (ECM) - Electro chemical drilling (ECD) - Electro chemical grinding (ECG) - Electro chemical honing (ECH) - Shaped tube electrolytic machining - Operating principle - Process parameters - Applications - Limitations.

UNIT-III:

Thermo electrical machining - Types – Electrical discharge machining (EDM) - Electrical discharge wire cutting (EDWC) - Electron beam machining (EBM) - Ion Beam Machining (IBM)-Plasma Arc Machining (PAM) - Operating principle - Process parameters - Applications – Limitations

UNIT-IV:

Laser materials processing - Laser types - Processes - Laser beam machining (LBM) – Laser cutting (LC) – Laser drilling (LD) - Laser marking and engraving (LM) - Laser micromachining (LMM) - Laser engineered net shaping (LENS) - Applications - Limitations.

UNIT-V:

Special processing technologies - Rapid Prototyping - Methods - Fused Deposition Modeling (FDM) - Laminated Object Manufacturing (LOM) - Selective laser sintering (SLA) - Solid Ground curing (SGC) - 3D printing (3DP) - Processing of integrated circuits - Micro and nano fabrication technologies.

References:

1. Abdel, H. and El-Hofy, G. “Advanced Machining Processes”, McGraw-Hill, USA, 2005.
2. Wellar, E.J. "Non-Traditional Machining Processes", Society of Manufacturing
3.Pandey & Singh, “Production Engg. Science”, Standard Publications

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			End Sem	Mid Sem MST	Quiz Assignment	End Sem	Lab Work	L	T	P	
	ME-1881 (E-VII) (C)	Power Plant Engineering	70	20	10	-	-	3	-	-	3

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

CO1	Describe and analyze different sources of energy, demand supply, and energy conversion cycle.
CO2	Understand and analyze the working layout of steam power plant, different systems of the plant, equipments.
CO3	Understand and analyze Nuclear Power Plant, Atomic Structure and Radioactivity, its components and safety issues.
CO4	Understand and analyze Hydro power stations and related equipments and rainfall data.
CO5	Formulate and Solve problems on Power stations economics and rainfall data and storage.

UNIT-I:

Introduction: (A) Review of power development in India, Review of world and Indian energy situation in respect of demand, supply and resources in the historic context. Generalized energy conversion system: Primary and secondary energy source, their inter-convertibility. Introduction to methods of converting various energy sources to electric power.
(B) Non Conventional energy sources, a review on non conventional energy conversions. new source of energy (e.g.) solar, wind, tidal, geothermal, bio-thermal, biogas and hybrid energy systems, fuel cells, thermoelectric modules, MHD-Converter.

UNIT-II:

Fossil fuel steam stations: Basic principles of site selection and station design, effect of climatic factors on station and equipment design, choice of steam cycle and main equipment, recent trends in turbine and boiler sizes and steam conditions, plant design and layout, outdoor and indoor plant, system components, fuel handling, burning systems, element of feed water treatment plant, condensing plant and circulating water systems, cooling towers, turbine room and auxiliary plant equipment, instrumentation, testing and plant heat balance.

UNIT-III:

Nuclear Power Station: Importance of nuclear power development in the world and Indian context, Review of atomic structure and radio activity, binding energy concept, fission and fusion reaction,

fissionable and fertile materials, thermal neutron fission, important nuclear fuels, moderators and coolants, their relative merits, thermal and fast breeder reactors, principles of reactor control, safety and reliability features.

UNIT-IV:

Hydro-Power Station: Elements of Hydrological computations, rainfall run off, flow and power duration curves, mass curves, storage capacity, salient features of various types of hydro stations, component such as dams, spillways, intake systems, head works, pressure tunnels, penstocks, reservoir, balancing reservoirs, Micro and mini hydro machines, selection of hydraulic turbines for power stations, selection of site.

UNIT-V:

Power Station Economics: Estimation and prediction of load. Maximum demand, load factor, diversity factor, plant factor and their influence on plant design, operation and economics; comparison of hydro and nuclear power plants typical cost structures, simple problems on cost analysis, economic performance and tariffs, interconnected system and their advantages, elements of load dispatch in interconnected systems.

References:

1- Nag PK; Power plant Engg; TMH
2- Al-Wakil MM; Power plant Technology; TMH
3- Sharma PC; Power plant Engg; Kataria and sons, delhi
4- Domkundwar; Power Plant Engg; Dhanpatrai & sons.
5- Rajput RK; A text book of Power plant Engg.; Laxmi Publications.
6- Yadav R; Steam and gas turbine and power plant

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	ME-1881 (E-VII) (D)	Micro & Nano Manufacturing	70	20	10	-	-	3	-	-	3

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

CO1	Understand manufacturing considerations at the micro and nano scale.
CO2	Create and characterize nanostructures for a particular industrial application
CO3	Select appropriate manufacturing methods to create micro sized components
CO4	Design and select industrially-viable processes, equipment and manufacturing tools for specific industrial products

UNIT-I:

Introduction: Importance of Nano-technology, Emergence of Nanotechnology, Bottom-up and Top-down approaches, challenges in Nanotechnology.

UNIT-II:

Nano materials Synthesis and Processing: Methods for creating Nanostructures; Processes for producing ultra-fine powders - Mechanical grinding; Wet Chemical Synthesis of nanomaterials - sol-gel process, Liquid solid reactions; Gas Phase synthesis of nanomaterials- Furnace, Flame assisted ultrasonic spray pyrolysis; Gas Condensation Processing GPC), Chemical Vapour Condensation (CVC)- Cold Plasma Methods, Laser ablation, Vapour - liquid -solid growth, particle precipitation aided CVD, summary of Gas CondensationProcessing (GPC).

UNIT-III:

Structural Characterization: X-ray diffraction, Small angle X-ray Scattering, Optical Microscope and their description, Scanning Electron Microscopy (SEM), Scanning Probe Microscopy (SPM), TEM and EDAX analysis, Scanning Tunneling Microscopy (STM), Atomic force Microscopy (AFM).

UNIT-IV:

Microfabrication Techniques: Lithography, Thin Film Deposition and Doping, Etching and Substrate Removal, Substrate Bonding. MEMS Fabrication Techniques, Bulk Micromachining:

Processes used for shaping and sizing of microproducts and macro products and Nano finishing techniques , Surface Micromachining, High- Aspect-Ratio Micromachining.

UNIT-V:

MEMS devices and applications: Pressure sensor, inertial sensor, Optical MEMS and RFMEMS, Micro-actuators for dual-stage servosystems.

References:

1. Tai-Ran Hsu, "MEMS and Microsystems: Design and Manufacture," McGraw- Hill, 2008.
2. V. K. Jain, "Introduction to Micromachining", 2nd Edition, Alpha Science, 2014.
3. Mark James Jackson, "Microfabrication and Nanomanufacturing", CRC Press, 2005.
4. Gabor L. Hornyak, H.F.Tibbals, Joydeep Dutta & John J Moore, "Introduction to Nanoscience and Nanotechnology", CRC Press, 2009.
5. Ray F. Edgerton, "Physical Principles of Electron Microscopy: An Introduction toTEM, SEM, and AEM", Springer, 2005.
6. B.D. Cullity, "Elements of X-Ray Diffraction", 3 rd Edition, Prentice Hall, 2002.

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VIII-SEM B.Tech. Mechanical	Subject Code	Subject Name / Title	Maximum Marks Allotted					Contract Hrs. per weeks			Total Credits
			Theory			Practical					
			End Sem	Mid Sem MST	Quiz Assignment	End Sem	Lab Work	L	T	P	
	ME-1882 (OE-V) (A)	Product Design & Development	70	20	10	-	-	3	-	-	3

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

CO1	Put into practice various steps involved in the design of new product.
CO2	Realize strategies involved in Industrial design.
CO3	Understand the importance of economic factors in the product design.
CO4	Apply principles of value engineering to new product development.
CO5	Understand Product development cycle, especially Booz Allen & Hamilton new product development cycle & A T A R model in financial analysis
CO6	To implement principles important from environment conservation point of view in product design

UNIT-I:

Introduction, definition, design by innovation, evolution, essential factors of product design, production consumption cycle (pcc), fow and value addition in pcc, morphology of design, primary phases of design, role of allowances, process capability and tolerances in design and assembly.

UNIT-II:

Product design strategies in industry, pricing, quality, utility, luxiriousness, product analysis, simplification, designer and his role, Industrial design considerations, procedures, problems, types of models, role of aesthetics, functional design practices.

UNIT-III:

Economic factors influencing design, product value, economic analysis, profit, competitiveness, break even. Value engineering & product design, value, value analysis job plan, creativity, value analysis tests.

UNIT-IV:

New product development and product management- defining product by nature and demand, New product strategy, product classification, product development & management, product life

cycle, Booz Allen & Hamilton new product development cycle, A T A R model applied to financial analysis in business.

UNIT-V:

Product design and development for environment, introduction, importance, factors, scope of impact, global & local issues, guidelines for design, life cycle assessment.

References:

1. K. Chitale, R. C. Gupta, "Product Design and Manufacturing", PHI Publication, 2013 Reference Books:
2. Karl T. Ulrich, Stephen Eppinger, "Product Design and Development", McGraw Hill Publication, 2012

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VIII-SEM B.Tech. Mechanical	Subject Code	Subject Name / Title	Maximum Marks Allotted					Contract Hrs. per weeks			Total Credits
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	ME-1882 (OE-V) (B)	Industrial Tribology	70	20	10	-	-	3	-	-	3

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

CO1	To understand the concepts of tribology and its industrial significance.
CO2	To learn the theories of friction and its application to different materials.
CO3	To learn about different wear mechanisms and their testing methods.
CO4	To understand the purpose of lubrication, types of lubricants, theories of lubrication and applications of lubrication testing & selection.
CO5	To apply the knowledge of tribology in mechanical design, material processing and learn about different surface engineering methods.

UNIT-I:

Basics of Tribology : Definition and historical background of tribology, Industrial significance of tribology, Tribological surfaces and physico-chemical characteristics of surface layers, surface roughness and its analysis, measurement techniques of surface roughness.

UNIT-II:

Friction : Types of friction, laws and modern theories of frictions, mechanisms of sliding friction, friction transition during sliding, stick-slip phenomenon, rolling and static friction, friction of metal and alloys, friction of ceramics, friction of polymers, friction measurement techniques.

UNIT-III:

Wear : Types of wear, Wear mechanisms (Adhesive wear, Abrasive wear, Erosive wear, Chemical wear, Fatigue wear, Fretting & fretting corrosion), wear debris, wear of materials, wear testing and measurement.

UNIT-IV:

Lubrication : Purpose of lubrication, types of lubricants and their properties, regimes of lubrication, Stribeck curve, Petroff's equation, Reynold's equation, theory of hydrodynamic and hydrostatic lubrication, elasto-hydrodynamic lubrication, lubrication testing and selection.

UNIT-V:

Applications of tribology: Common tribological components (bearings, seals, cam & tappets, gears), tribology in material processing, selection of materials for tribological design, surface treatment methods.

References:

1. I.M. Hutchings, Philip Shipway, Tribology (Friction and wear of engineering materials, second edition, Butterworth-Heinemann (am imprint of Elsevier)
2. Bharat Bhushan, Introduction to tribology, second edition, A John Wiley & Sons, Ltd. Publication
3. Theo Mang, Kirsten Bobzin, and Thorsten Bartels, Industrial tribology, Wiley-VCH
4. G. Stachowiak and A. Batchelor. Engineering Tribology, Elsevier Science, 4th edition, 2014.
5. Lansdown A R, Lubrication, A practical Guide to Lubricant selection, Pergamon Press

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			End Sem	Mid Sem MST	Quiz Assignment	End Sem	Lab Work	L	T	P	
	ME-1882 (OE-V) (C)	Introduction to Industry 4.0	70	20	10	-	-	3	-	-	3

Course Objective:

The Objective of this course is to make students familiar with Advanced topics such as : Industry 4.0, IOT, IIOT, CPS, AI, ML, Augmented & Virtual Realities, Additive Manufacturing, Block Chain Technology, etc.

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

CO1	State and define Smart Manufacturing and its Characteristics, Challenges.
CO2	Classify and Explain components of smart Manufacturing and Industry 4.0
CO3	Demonstrate IOT, IIOT, Block chain, in manufacturing
CO4	Examine the concept of AI and ML in Manufacturing, and Industrial Robot
CO5	Design and develop a 3-D product using Additive Manufacturing

UNIT-I:

Introduction To Industry 4.0 : Definition of Industry 4.0, Comparison of Industry 4.0 factory and today's factory, Difference between conventional automation and industry 4.0, How is India preparing for Industry 4.0.

UNIT-II:

A Conceptual Framework for Industry 4.0:
Internet of things(IoT) & Industrial Internet of Things(IIoT), Big Data, Cyber security, Augmented and virtual reality, Robotics and automation, 3D Printing, Simulation, System integration, Cloud Computing,

UNIT-III:

Advances in Robotics in the Era of Industry 4.0:
Introduction, Recent Technological Components of Robots- Advanced Sensor Technologies, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-Physical Robotics, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly.

UNIT-IV:

The Role of Augmented Reality in the Age of Industry 4.0:
Introduction, AR Hardware and Software Technology, Industrial Applications of AR..

UNIT-V:

Role of 3D printers in Industry 4.0:

Introduction of Additive Manufacturing (AM), Characteristics, Classifications, Comparison of conventional manufacturing with Additive manufacturing, AM Process Chain, AM Process, Applications, AM business ideas

References:

1. McEwen and H. Cassimally, Designing the Internet of Things, 1st edition,
2. Wiley, 2013, ISBN-10: 111843062X.
3. N. Vengurlekar and P. Bagal, Database Cloud Storage: The Essential Guide to Oracle Automatic StorageManagement, 1st edition, McGraw-Hill Education, 2013, ISBN-10: 0071790152.
4. 3 M. Kuniavsky, Smart Things: Ubiquitous Computing User Experience Design, 1st edition, Morgan Kaufmann,2010, ISBN-10: 0123748992.