MASTER OF TECHNOLOGY

Mechanical Engineering

Semester - I

Teaching Scheme

Course Code	Course Name	Lecture hours	Tutorial hours	Practical hours	Credit
ME 5008	Engineering Design for Infrastructure	3	0	3	5
ME 5009	Power Generation I	3	1	0	4
ME 5010	Advanced Manufacturing Techniques-I for Industrial Infrastructure	3	0	3	5
ME 5011	Advanced Material Science and Characterization	3	0	3	5
ME 50XX	Departmental Elective-I	3	0	0	4
	Total	**15**	**1**	**9**	**23**

Departmental Elective-I

Course Code	Course Name
ME 5012	Design of Experiments for Engineering Applications

Mechanical Engineering

Semester : I

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">ME 5008</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Engineering Design for Infrastructure</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>3</td><td>5</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Introduction to Machine Design</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Design Fundamentals, Methods and Material Selection:
Morphology of Design The Design Process Computer Aided Engineering Concurrent Engineering Competition Bench Marking Creativity Theory of Problem solving (TRIZ) Value Analysis - Design for Manufacture, Design for Assembly Design for casting, Forging, Metal Forming, Machining and Welding- Material Selection
Behaviour under Dynamic Loads and Design Approaches: Design of static and dynamic loads - Stress intensity factor and fracture toughness Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms- safe design approaches -Effect of surface and metallurgical parameters on fatigue Fracture of nonmetallic materials Failure analysis, sources of failure, procedure of failure analysis.
Integrated Design of Equipment for infrastructure:
Design of hoisting elements: Welded and roller chains - wire ropes - Design of ropes. Integrated Design of systems consisting of pulleys, Cam & Follower, fly-wheel etc. Example - Design of Elevators, Escalators, design and applications of Belt conveyors, Valve gear Mechanisms, Machine Tools.
Engineering Design for Infrastructure Laboratory:
The laboratory work is concentrated towards learning and solving problems in the domain of advanced computational research-advanced analysis of mechanical components and equipments-use of specialized/dedicative packages like Abacus/Nastran/Adams etc., for fracture analysis-analysis of nonlinear systems-machine elements under dynamic loads.
Project Work:
Students will be encouraged to perform a projectthey will be advised to solve research oriented problems.</td></tr>
<tr><td>VI</td><td>References Books:</td><td colspan="4">1. Engineering Design, 5th Edition by George E. Dieter and Linda C. Schmidt. McGraw Hill, 2013.
2. Rudenko, N., Materials handling equipment, ELnvee Publishers, 1970.
3. Spivakovsy, A.O. and Dyachkov, V.K., Conveying Machines, Volumes I and II, MIR Publishers, 1985.
4. Shigley, J.E., Mechanical Engineering Design, McGraw Hill, 1986.
5. Design of Machine Elements by Bhandari V. B., Third Edition, McGraw Hill Education, 2010.
6. Machine Design an Integrated Approach by Norton R. L., Fifth Edition, Pearson India, 2013.
7. P.S.G. Tech., Design Data Book, Kalaikathir Achchagam, Coimbatore, 2003</td></tr>
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<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">ME 5009</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Power Generation I</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>5</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Applied Thermodynamics, Basics of Power Plants</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Review of Current Energy scenario of India and worldwide, India power policies, plans for existing and futuristic power generation. Pros and cons of existing power plants in India, possible extensions of Indian power plants. Sustainable and alternative options of power generation of Indian Power Sectors. Analysis of Power plants, power plant economy, load duration curve, coal fuelled electric generation units.
Steam Power Generation: Reheat-regenerative cycle, binary cycle, topping and superimposed cycle. Steam generators: Modern generators, supercritical boilers, fuel and ash handling systems, Condensers and Cooling Towers, environmental aspects.
Gas Power Generation: Analysis of a Gas Turbine plant, Combined Cycle (CC) Power Plants, steam turbine (ST) and gas turbine (GT) power plants, Thermodynamics of multiplied coupled cycles. Advantages of CC plants, Gas-based CC plants- choices of GT and ST plants, Coal based CC plants-PFBC and IGCC plants, STIG and Repowering, Environmental impact, Scope of CC plants.
Hydro power Generation: Introduction, Potential of hydropower in India- its development and future prospect. General hydrology, Design consideration of hydraulic structure of power generation Classification of hydroelectric power plants. Pondage and storage. Operating principles of different types of hydel plants like run-off-the-river type. Storage reservoir plant-pumped storage plant. Selection of prime mover, speed and pressure regulation, methods of governing, starting and stopping of water turbines, operation of hydro turbines.
Nuclear Power Generation: Introduction, Why Nuclear Power for Developing Countries. Nuclear Reactors, Components, General Problems of Reactor Operation, Design, Location of Nuclear Power Plant, Nuclear Power Station in India. Power generation, controls, transmission and distributions. Power grids.</td></tr>
<tr><td>VI</td><td>References Books:</td><td colspan="4">1. Eastop T. D., Applied Thermodynamics for Engineering Technologists, Pearson Education.
2. Rolf Kehlhofer, Bert Rukes, Frank Hahnemann, Combined-Cycle Gas and Steam Turbine Power Plants, PennWell Books 2008.
3. El-Wakil M. M., Power Plant Technology, McGraw Hill Education.
4. Nag P. K., Power Plant Engineering, McGraw Hill Education.
5. S.L. Rao, Powering India, Academic Foundation (2011)
6. R V Shahi , Indian Power Sector- challenges and Response, Excel Publication, 2006.</td></tr>
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Semester : I

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<tr><td>I</td><td>Course Code</td><td colspan="4">ME 5010</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Advanced Manufacturing Techniques-I for Industrial Infrastructure</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>3</td><td>5</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Manufacturing Processes, Basic FEM and Statistics</td></tr>
<tr><td>V</td><td>Pedagogy</td><td colspan="4">Lectures, Seminars, Demonstrations, Hands On, Team Activities, Projects</td></tr>
<tr><td>VI</td><td>Course Content</td><td colspan="4">Materials Technology:
This covers the technically important materials of interest to various manufacturing industries. Their specific manufacturing processes, properties and application fields, with particular emphasis on the infrastructure sectors related to aerospace, marine and automobile, would be explained. There would also be emphasis on manufacturing metrology, measuring and testing technology in component testing, data acquisition and processing, statistical analysis and design of experiments.
Machining Technology:
This covers topics related to sustainable machining processes and process planning. In addition, machining process simulation and practical fundamentals with special emphasis on the finite element method will be discussed. Emphasis would be on the problems related to companies in the HVM sector (e.g. automotive, aerospace, defence, medical engineering) where at least 25% of the process time for components arises from machining.
Forming Technology:
This provides an advanced knowledge of the forming manufacturing technology and the corresponding forming machines and processes. In addition, practical fundamentals with special emphasis on the finite element method will be discussed. Transformation of sheet metal to automotive/aerospace components would be focused.
Introduction to Additive Manufacturing and Digital Manufacturing.
Laboratory Work:
The laboratory work strictly incorporates experimental research. The laboratory work is performed in groups. Before the laboratory, the experiments need to be prepared. This means that each student has to possess an adequate knowledge of the theoretical foundations and practical implementation of the experiment.
Scientific Project Work:
The Scientific Project includes a study-related homework in a team work format. Thereby, each student has to show his/her own preparation to evaluate their own performance. After the submission of the work, the results should be presented in the form of a presentation by each student.</td></tr>
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VII	References Books:	1. Material and Processes in Manufacturing, Paul De Garmo, J.T. Black, and Ronald A. Kohser, Prentice Hall of India Private Limited, 2001. 2. Nontraditional Manufacturing Processes, Benedict. G.F., Marcel Dekker Inc., 1987. 3. Modern Machining Processes, Pandey P. C. and Shan H. S., McGraw Hill Education, 1980. 4. Mechanical Metallurgy, George E Dieter, McGraw Hill Education. 5. Elsevier, Springer, and Wiley ebooks from http://iitram.ac.in/library/index.php/ecollection/ebooks

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Semester : I

<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">ME 5011</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Advanced Material Science and Characterization</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>3</td><td>5</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Basic of Materials Science and Manufacturing Processes</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Introduction to Materials science and characterization
Importance, properties and classification of materials, structure of materials, equilibrium diagrams, strengthening mechanisms teat treatments of steels, powder metallurgy. Introduction to manufacturing processes.
Mechanical testing and Metallography
Tension Test. Stress-strain Curve - The Important Parameters. Testing Machines for Tension - Compression Tests. Compression Test and Bend Test. Torsion Test. Hardness Tests, Microhardness Test. Nano-indentation Techniques. Impact Tests. Fractures and Failures, Fatigue Tests, Creep Tests. Wear in Materials and its Evaluation. Non-destructive Testing Methods. Preparation of Specimens. Examination of Macrostructures. Metallurgical Microscopes, Magnification, Resolution and Depth of Focus - Depth of Focus and Depth of Field. Image Resolution in a Microscope. Photography of Microstructures. Polarized Light in Microscopy of Materials. Differential Interference Contrast (DIC) Illumination. Hot Stage Microscopy. Colour Metallography. Quantitative Microscopy. Quantitative Phase Analysis by Microscopy - Automatic Phase Analysis Methods - The Principle of Phase Fractions. Other Applications of Quantitative Metallography. X-ray Based Methods and Electron Microscopy Nature of X-rays. Absorption of X-rays by Matter. X-ray Fluorescence. X-ray Diffraction. X-ray Diffraction Methods. Powder Method (Debye-Scherrer Method). Basic Factors Influencing the Indexing of Lines in a Powder Pattern. Phase Mixtures and Phase Diagrams. Effect of Grain Size and Orientation on the Diffraction Pattern. Diffraction of Electrons and Neutrons. Microscopy Using an Electron-beam. Electron Beam Sources. Transmission Electron Microscope (TEM) - Handling the Electron Beam in TEM. TEM Specimen Preparation. Applications of TEM.
Microprobe-analysis, Surface Analysis and Other Techniques
Wave-length Dispersion (WDX) and Energy Dispersion (EDX). Electron Probe Microanalysis. Applications of Microanalysis Systems- Elemental Mapping. Electron Spectrometers. Electron Energy Loss Spectrometry (EELS). Some Modern Techniques of Surface Analysis- X-ray Photoelectron Spectroscopy (XPS). Auger Electron Spectroscopy (AES). Raman Spectroscopy. Secondary Ion Mass Spectrometry (SIMS). Monitoring Phase Changes. Electrical Resistivity Measurements. Thermal Analysis (DTA, TGA, DSC Methods). Thermogravimetric Analysis. Dilatometry. Electro-chemical Measurements. A Note on Vacuum Systems - Ultra High Vacuum Systems. Measurement of Vacuum. Characterization of Powders - Measurement of Particle Size. Specific Surface and Other Technological Properties.
Projects /Exercises: One project related to Advanced Material science and characterization.</td></tr>
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VI	References Books:	1. An introduction to material characterization by P R khangaonkar 2. Mechanical metallurgy (SI units), by G.E. Dieter, Mc Graw Hill pub.2001 3. Principles of Industrial metal working process - G.W. Rowe, CBSpub. 2002. 4. Manufacturing Science, hy Amitabha Ghosh & A.K. Malik - East - Westpress 2001 5. Material science & Engg. By William D. Callister, Wiley india pvt. Ltd.

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<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">ME 5012 (Department Elective)</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Design of Experiments for Engineering Applications</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">NIL</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Overview and Basic Principles, Strategy, basic principle, guidelines and application of experiment design. Basic statistical concept, sampling and sampling distribution, hypothesis testing, sample size, confidence intervals.
Simple Designs and Analysis of Variance, analysis of fixed effects model, model adequate checking, determining sample size, regression approach and nonparametric approach in ANOVA.
Randomize block and Latin square design, Graeco-Latin Square design, balanced incomplete block design, overview of factorial design, two factorial and general factorial design, fitting response curve and surface, 2k factorial design, blocking and confounding in 2k factorial design, two level, three level, mixed level and fractional factorial design, fitting regression methods.
Response surface methods and approaches to process optimization, method of steepest ascent, analysis of second order response surface, experimental design for fitting response surface, robust design, experiments with Random factors, Nested and split plot design.</td></tr>
<tr><td>VI</td><td>References Books:</td><td colspan="4">1. Design and Analysis of Experiments, Montgomery, 9th Edition, Wiley India, (2017).
2. A. Ravindran, K. M. Ragsdell, G. V. Reklaitis. Engineering Optimization: Methods and Applications, 2nd Edition, Wiley, United States, (2002).
3. M K Sharma, Design and Analysis of Experiments, 2012, Prentice Hall India Learning Private Limited.
4. K. Krishnaiah, Applied Design of Experiments and Taguchi Methods, Prentice Hall India Learning Private Limited, 2012.
5. GEP Box and NR Draper , Empirical Model Building and Response Surfaces, Wiley (1987).</td></tr>
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