

**SCHOOL OF ENGINEERING AND TECHNOLOGY
SRI PADMAVATI MAHILA VISVAVIDYALAYAM
(WOMEN'S UNIVERSITY)**



Accredited by NAAC with 'A' Grade

ISO 9001:2021 Certified

Syllabus

for

Minor Degree Programme– R20

Department of Mechanical Engineering

Semester: II-II

20METM01: MECHANICAL ENGINEERING DESIGN

Credits – 4
L:T:P::3:1:0

Sessional Marks: 30
University Exam Marks: 70

Course Objectives

To expose the students to the following

1. Apply knowledge of mathematics in design engineering
2. Design a system, component, or process to meet desired needs within realistic constraints.
3. Identify, formulate, and solve engineering problems
4. Use the techniques, skills, and modern engineering tools necessary for engineering practice.

Course Outcomes

After successful completion of course the student should be able to

- CO1. Knowledge on basic machine elements used in machine design
- CO2. Analyze the stress and strain on mechanical components and understand, identify and quantify failure modes for mechanical parts.
- CO3. Design machine elements to withstand the loads and deformations for a given application, while considering additional specifications.
- CO4. Approach a design problem with the knowledge of Mechanisms
- CO5. Proficient indesigning with analytical knowledge.

UNIT-I

Introduction to Mechanical engineering design: traditional design methods, different design models, Problem formulation, Design considerations, engineering materials and processes and their selection, BIS designation of steels, Mechanical properties, Load determination, manufacturing considerations in design.

UNIT-II

Stress and Strain: Concept of stress and strain. Hooke's law, Stress-Strain diagrams for ferrous and non-ferrous materials, factor of safety, elongation of tapering bars of circular and rectangular cross sections, elongation due to selfweight, thermal stress, complex stresses: stresses on an inclined plane under different uniaxial, biaxial and tri-axial stress conditions, principal planes and principal stresses, mohr's circle.

UNIT-III

Design against static loads: Modes of failure, Factory of safety, Axial, bending and torsional stresses, Stress concentration factors. Static failure theories.

Fluctuations and fatigue stresses, Soderberg, Goodman and modified Goodman diagrams, fatigue failure, design consideration in fatigue

UNIT-IV

Basics of mechanisms: Classification of links and kinematic pairs – Sliding, Turning, Rolling, Screw and spherical pairs- Lower and higher pairs- Degree of freedom, Mobility – Kutzbach criterion, Gruebler’s criterion-Grashof’s Law.

UNIT-V

Industrial Design: Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, assess the quality of industrial design.

Design for Manufacturing: Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production.

Text Books

1. Joseph E. Shigely, “Mechanical Engineering Design”, TMH Publishers, New Delhi, 9th edition, 2011
2. Karl. T. Ulrich, Steven D Eppinger, “Product Design and Development”, Irwin McGraw Hill, 2000.
3. V.B. Bhandari , “Design of Machine Elements”, TMH Publishers, New Delhi, 2 edition, 2013.
4. R.S. Khurmi and J.K. Gupta, “Machine Design”, S. Chand Publishers, New Delhi.

Reference Books

1. Sadhu Singh, “Machine Design”, Khanna Publishers, New Delhi.
2. Spotts. M.F, “Design of Machine Elements”, PHI Publishers, New Delhi.
3. Norton .R.L, “Machine Design”, Tata McGraw Hill Publishers, 2nd edition, 2002.
4. Pandya and Shah, “Machine Design”, Charotar Publishers, Anand, 17th edition, 2009.

Course Outcomes - Program Outcomes - Program Specific Outcomes (CO-PO-PSO)**Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	M				L			M			H	M	
CO2	H	H	H				M			M		L	M	H	H
CO3	H	H	H				M			M		L	M	H	M
CO4	H	H	M	M			M			M		L	M	H	M
CO5	H	H	H	L			M			M		L	M	H	

Semester: III-I**20METM02: BASICS OF THERMAL ENGINEERING****Credits – 4****Sessional Marks: 30****L: T: P:: 3:1:0****University Exam Marks: 70****Course Objectives**

To expose the students to the following

1. Principles of classical thermodynamics and develops understanding of mass, energy, heat, work, efficiency, ideal and real thermodynamic cycles and processes.
2. Demonstrate first and second laws of thermodynamics, perfect gas law, properties of real gases, and the general energy equation for closed and open systems.
3. Familiarize with the engine components.
4. Understand analytical techniques of internal combustion engines performance.
5. Know environmental and fuel economy challenges of internal combustion engines.

Course Outcomes

After successful completion of course the student should be able to

- CO1. Understand fundamental thermodynamic properties, first and second laws of thermodynamics, solve problems for flow & non-flow processes using the properties and relationships of thermodynamics.
- CO2. Know the new concept of Entropy and its importance and Analyze basic thermodynamic cycles.
- CO3. Recognize the different types of Compressors.
- CO4. Analyze the Gas Turbines and Jet Propulsions.
- CO5. Compare and contrast measurement errors or modeling limitations of internal combustion engines.

Points Applicable to University Examinations

- Steam tables book is allowed

UNIT I

Basic Concepts: Scope of Thermodynamics – Macroscopic and Microscopic properties thermodynamic system – Control Volume – Thermodynamic Properties – Processes and cycles – Thermodynamic Equilibrium – Quasi static process – Zeroth Law of Thermo dynamics.

First Law of Thermodynamics: Energy – Different forms of stored energy – closed systems and steady flow systems – First law applied to flow process and non flow processes.

Second Law of Thermodynamics: Limitations of first law – Heat engines– Kelvin Planks statement of second law – Clausius inequality – refrigeration and heat pump reversibility and irreversibility.

UNIT II

Entropy: Clausius theorem – The property of entropy –Principle of increase of entropy – Entropy changes in various thermodynamic processes.

Air standard cycles: Carnot cycle – Stirling cycle – Eriksson cycle – Otto cycle – Diesel cycle – Duel cycle – Comparison of cycles – Brayton cycle-problems.

UNIT III

Compressors: positive displacement: reciprocating-single stage and multi stage compressors–isothermal efficiency–rotary-helical screw, scroll, sliding vane, lobe and liquid ring–non-positive displacement compressors: centrifugal compressors and axial flow compressors–velocity diagrams–isentropic efficiency.

UNIT IV

Gas Turbines: Open and closed cycle arrangements–ideal and actual cycles and their analysis–methods to improve the efficiency.

Jet Propulsion: Air breathing engines–turbo jet, turbo prop and ram jet–rocket engines–liquid and solid propellant

UNIT V

I.C. Engines: classification–working principles–valve and port timing diagrams–carburetor–fuel injection system–ignition system–cooling and lubrication–stages of combustion in S I Engines–stages of combustion in C I Engines–detonation–knock–fuel ratings.

Performance and Emission of I C Engines: Performance parameters–engine power, engine efficiencies–problems–engine emissions and controlling methods.

Text Books

1. R K Rajput, “Thermal Engineering”, Seventh edition, Laxmi Publications (P) Limited.
2. V Ganesan, “Internal Combustion Engines”, Third edition, Tata McGraw Hill.

Reference Books

1. R S Khurmi and J K Gupta, “Thermal Engineering”, S. Chand & Company Limited.
2. R S Khurmi and N Khurmi, “Steam Tables with Mollier Diagram in SI units”, S.Chand& Company Limited.
3. V M Domkundwar, “Internal Combustion Engines”, Dhanpat Rai& Co. (P) Limited.
4. Eastop& Mc Conkey, “Applied Thermodynamics for Engineering Technologies”, Pearson.
5. R K Rajput, “Steam Tables with Mollier Diagram (SI Units)”, Laxmi Publications (P) Limited.

Course Outcomes - Program Outcomes - Program Specific Outcomes (CO-PO-PSO)**Mapping**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	H	M				L				M			H	L	
CO 2		M	H							M			M	H	L
CO 3	L	M	H							M			H	M	L
CO 4		H	L	M			M			M				H	M
CO 5	H	M	M							M	L		M	H	

Semester: III-II

20METM03: MANUFACTURING TECHNOLOGY

Credits - 4

Sessional Marks: 30

L: T: P: 3:1:0

University Exam Marks: 70

Course Objectives

To expose the students to the following

1. Process-level dependence of manufacturing systems through tolerances
2. Variety of manufacturing processes including their typical use and capabilities.
3. Important effects that manufacturing processes may have on the material properties of the processed part with a focus on the most common processes.
4. Thermal and mechanical aspects, such as force, stress, strain, and temperature, of the most common processes.
5. Provide a technical understanding of common processes to aid in appropriate process selection for the material and required tolerances

Course Outcomes

After successful completion of course the student should be able to

- CO1. Learn the basic operation of various methods of melting and casting.
CO2. Learn how various principles of gating and different casting processes and its remedies.
CO3. Study the classification of welding processes and types of welds.
CO4. Learn the types of welds and its defects, remedies destructive non-destructive testing of welds.
CO5. Study the types, properties and processes of plastic.

UNIT I

Metal Casting Processes -Sand Casting – Sand Mould – Type of patterns – Pattern Materials – Pattern allowances – Molding sand, Properties and testing – Cores: Types and applications – Molding machines – Types and applications– Melting furnaces. Principle of special casting processes- Shell, Investment – Ceramic mould – Pressure die casting –Centrifugal Casting – CO₂ process – Stir casting - Defects in casting.

UNIT II

Joining Processes - Fusion welding processes – Type of Gas welding – Flame characteristics – Filler and Flux materials – Arc welding, Electrodes, Coating and specifications – Principles and types of Resistance welding – Solid state welding – Laser beam welding - Gas metal arc welding –Submerged arc welding – Electro slag welding – Gas Tungsten arc welding - Electron Beam Welding- Weld defects – Brazing and soldering – methods and process capabilities –Adhesive bonding, Types and applications.

UNIT III

Metal Forming Processes- Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – Characteristics of the processes – Typical forging operations. Rolling of metals – Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts – Principle of rod and wire drawing – Tube drawing – Principles of

Extrusion – Types – Hot and Cold extrusion. Sheet metal characteristics – Typical shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal– Metal spinning. Introduction to High energy rate forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming.

UNIT IV

Powder metallurgy: Powder production method - mechanism of milling, ball mills, physical methods, powder making, powder treatment and handling, toxicity of powders, compaction - casting and die compaction, powder rolling, sintering and its types.

UNIT V

Manufacture of Plastic Components: Types and characteristics of plastics –Molding of thermoplastics – working principles and typical applications – injection molding – Plunger and screw machines – Compression Molding, Transfer Molding –Typical industrial applications Introduction to blow molding –Rotational molding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics

Text Books

1. S.K Hajra Choudhary and AK Hajra Choudhary, “Elements of workshop Technology”, Volume I, Media promoters and Publishers Private Limited, Mumbai, 1997.
2. P.N. Rao, “Manufacturing Technology Foundry, Forming and Welding”, 4th Edition, Tata McGraw Hill, 2003

Reference Books

1. R.K. Jain, “Production Technology”, Khanna Publishers, 17th edition, 2012.
2. Paul Degarma E, Black J.T and Ronald A. Kosher, “Materials and Process in Manufacturing”, 8th Edition, Prentice – Hall of India, 1997.
3. Rosenthal, “Principles of Metal Castings”, 2nd Edition, Tata McGraw Hill, 2001.
4. R.K. Rajput, “Manufacturing Technology”, 1st Edition, Laxmi Publishers, 2007.
5. Kalpakjian, “Manufacturing Technology”, Pearson Education India Edition, 2006.

Course Outcomes - Program Outcomes - Program Specific Outcomes (CO-PO-PSO)

Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	H	M								M			H	M	M
CO 2	H	M		M						M			H	M	M
CO 3	M	H	M							M			H	M	L
CO 4	H	H	L	M						M			H		M
CO 5	H	L	L	M	L					M			H	L	L

Semester: III-II

20METM04: PRODUCTION PLANNING AND CONTROL

Credits – 4

L: T: P:: 3:1:0

Sessional Marks: 30

University Exam Marks: 70

Course Objectives

To expose the students to the following

1. Learn Aggregate planning, MRP Work study, and scheduling
2. Learn Value analysis, design the plant layout for the specified production system

Course Outcomes

After successful completion of course the student should be able to

- CO1. Explain production systems and their characteristics.
- CO2. Evaluate MRP and JIT systems against traditional inventory control systems.
- CO3. Evaluate basics of variability and its role in the performance of a production system.
- CO4. Analyze aggregate planning strategies.
- CO5. Apply forecasting and scheduling techniques to production systems.
- CO6. Apply theory of constraints for effective management of production systems.

UNIT I

Introduction to Production Systems: Production Systems: Classification & Characterization, Overview of Production Planning and Control issues, Review of EOQ & inventory control systems.

Material Requirement Planning: Dependent Demand & Material Requirement Planning, Structure of MRP system, MRP Calculations, Planning Issues, Implementation Issues.

UNIT II

Just in Time Production Systems: Just-in-Time System: Evolution, Characteristics of JIT Systems, Continuous Improvement, Kanban System, Strategic Implications of JIT System.

Factory Physics: Basic factory dynamics, Variability basics, Push and pull production systems.

UNIT III

Aggregate Planning: Aggregate Planning: Purpose & Methods, Reactive and Aggressive Alternatives, Planning Strategies, LP Formulation, Master Production Scheduling.

UNIT IV

Scheduling: Scheduling in Manufacturing, Sequencing Operations for One Machine, Sequencing Operations for a two-station Flow Shop, Job Shop Dispatching.

Forecasting Methods: Demand Forecasting: Principles and Methods, Judgment methods, Causal methods, Time-series methods.

UNIT V

Theory of Constraints: Concept of bottleneck, Local and global optima, Five steps of TOC approach, Performance measures.

Text Books

1. Krajewski L.J. and Ritzmen L.P., “Operations Management: Strategy and Analysis”, 9th Edition, Pearson Education, 2010.
2. Chase R.B. Jacobs F.R. and Aquilano N.J., “Operations Management for Competitive Advantage”, 11th Edition, Tata McGraw Hill Book Company, New Delhi, 2010.

Reference Books

1. Hopp W. J. and Spearman M. L. “Factory Physics: Foundations of Manufacturing Management”, McGraw Hill International Edition, 3rd Edition, 2008.
2. Mukhopadhyay S.K., “Production Planning and Control”, 2nd Edition, PHI, Eastern Economy Edition, 2013

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CO1	M	M	M			L			M		M	M	M	M	M
CO2	H	H	H		H	M			M	M	M	M	M	M	M
CO3	M	H	H						M		M	H	M	M	M
CO4	H	H	H	H	H				M	M	M	M	M	H	M
CO5	H	H	H	H	H	M			M		M	M	M	H	M
CO6	M	H	H	M					M		M	M	M	M	M

Semester: IV-I

20METM05: RENEWABLE ENERGY TECHNOLOGIES

Credits – 4

Sessional Marks: 30

L: T: P:: 3:1:0

University Exam Marks: 70

COURSE OBJECTIVES

1. To know the sources of energy and their conversion to useful form, understand the properties of wind, its availability and construction and working principles of different types of wind mills.
2. To understand the construction and working principles of solar radiation measurement, analyze the different applications of solar energy.
3. To understand the mechanics of tides, concept of ocean thermal energy and their conversion to useful form of energy by different methods.
4. To understand the principle of working geothermal energy conversion and construction of different types of geothermal stations and problems associated with it, understand the formation of biomass, construction and working of different types of bio gas plants, their advantages and limitations.
5. To understand the properties of hydrogen and their production by different methods, its storage, transportation and safe burning, working principle of fuel cells and construction and working of different types of fuel cells and their applications.

COURSE OUTCOMES: Upon completion of this course, students should be able to:

CO1 Know the sources of energy and their conversion to useful form, understand the properties of wind, its availability and construction and working principles of different types of wind mills.

CO2 Understand the construction and working principles of solar radiation measurement, analyze the different applications of solar energy

CO3 Understand the mechanics of tides, concept of ocean thermal energy and their conversion to useful form of energy by different methods

CO4 Understand the principle of working geothermal energy conversion and construction of different types of geothermal stations and problems associated with it, understand the formation of biomass, construction and working of different types of bio gas plants, their advantages and limitations

CO5 Understand the properties of hydrogen and their production by different methods, its storage, transportation and safe burning, working principle of fuel cells and construction and working of different types of fuel cells and their applications.

UNIT – 1

Introduction: Energy sources, conventional and non-conventional energy sources advantages and disadvantages. Wind Energy: Properties of wind, availability of wind energy in world, 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 windmills.

UNIT – 2

Solar Energy: Introduction, extraterrestrial radiations, Terrestrial Solar radiations. Measurement of Solar Radiation: Pyrometer, sunshine recorder, schematic diagrams and principle of working. Solar Thermal

Conversion: collection of solar energy, liquid flat plate collectors, thermal application of solar energy, water heating, solar furnace, solar pump, space heating, electricity generation, solar distillation, greenhouse effect, solar pond, solar cooking, solar drying.

UNIT – 3

Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, limitations. Ocean Thermal Energy Conversion: Principle of working, Rankine cycle, OTEC power stations in the world, problems associated with OTEC.

UNIT – 4

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. Energy from Bio Mass: Photosynthesis, photosynthetic oxygen production, energy plantation, bio gas production from organic wastes by anaerobic fermentation, description of bio-gas plants, transportation of bio-gas, problems involved with biogas production, application of bio-gas, application of bio-gas in engines, advantages.

UNIT – 5

Hydrogen Energy: Properties of Hydrogen with respect to its utilization as a renewable form of energy, sources of hydrogen, production of hydrogen, electrolysis of water, thermal decomposition of water, thermo chemical production and bio-chemical production. Storage of Hydrogen, transportation of hydrogen, safe burning of hydrogen. Fuel Cells: Fuel cells-principle, classification, advantage and disadvantage, application and recent developments.

TEXT BOOKS

1. Renewable Energy – G. Boyle, 2nd edition, OUP, 2010.
2. Solar energy: by Subhas P Sukhatme-Tata McGraw Hill, 2nd Ed. 1996.
3. Non Conventional energy sources by G.D. Rai K Khanna Publishers 2003.

REFERENCE BOOKS

1. Renewable energy sources and conversion technology by N.K. Bansal, Manfred Kleeman and MechaelMeliss, Tata McGraw Hill, 1990
2. Renewable energy resources, John W. Twidell Anthony D. Weir. ELBS Pub, 2nd Ed. 2006.
3. Non Conventional Energy Resources- B.H. Khan, T M H, 2010.
4. Solar Energy, Fundamentals and Applications, Garg, Prakash, Tata McGraw Hill.2006.

Course Outcomes - Program Outcomes - Program Specific Outcomes (CO-PO-PSO) Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	H	M	M		M		L	M		L	L		M	L	H
CO2	H	M	M		M		M	M		L	L		M	L	H
CO3	H	M	M		M		M	M		L	L		M	L	H
CO4	H	M	M		M		L	M		L	L		M	L	H
CO5	H	M	M		M		M	M		L	<u>L</u>		M	L	H