Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University formerly University of Pune)

Structure and Syllabus of

B.Tech. (Mechanical - Sandwich)

Pattern 'E11'

Effective from Academic Year 2015-16

(Final Year B. Tech.)

Prepared by: - Board of Studies in Mechanical Engineering

Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune

Signed by

Chairman – BOS **Chairman – Academic Board**

STRUCTURE MODULE VII

Subject No.	Subject Code	Subject Name	Teaching Scheme (Hrs/week)			Credits
			Lect.	Tutorial	Practical	
S1	ME42101 ME42103 ME42105 ME42117	*Elective Group I Kinematic Analysis & Synthesis Tribology Mechanics of Composite Materials Industrial Fluid Power	3	0	0	3
S2	ME42109 ME42111 ME42113 ME42115	**Elective Group II Heat Exchange Devices Turbo machines Thermal Power Plants Energy Conservation and Management	3	0	0	3
S3	ME40101	Design of Mechanical Systems	3	0	0	3
S4	ME40103	CAD/CAM/CAE	3	0	0	3
S5	ME40106	Vibration Analysis	3	0	0	3
T1	ME42201 ME42203 ME42205 ME42217	*Elective Group I Kinematic Analysis & Synthesis Tribology Mechanics of Composite Materials Industrial Fluid Power	0	1	0	1
T2	ME42209 ME42211 ME42213 ME42215	**Elective Group II Heat Exchange Devices Turbo machines Thermal Power Plants Energy Conservation and Management	0	1	0	1
P1	ME41301	Design of Mechanical Systems	0	0	2	1
P2	ME40303	CAD/CAM/CAE	0	0	2	1
P3	ME40306	Vibration Analysis	0	0	2	1
		Total	**12**	**2**	**10**	**20**

STRUCTURE MODULE VIII

Subject No.	Subject Code	Subject Name	Teaching Scheme (Hrs/week)			Credits
			Lect.	Tutorial	Practical	
PS1	ME47308	Project				10
PS2	ME47310	Seminar				2
PS3	ME47306	Industrial Inplant Training				10
		Total				**22**

Remarks:

Module	Remarks
3	**Same as Mechanical Module 3 (Pattern E11)**
4	**Same as Mechanical Module 4 (Pattern E11)**
5	**Same as Mechanical Module 5 (Pattern E11 Revised)**
6	**Same as Mechanical Module 6 (Pattern E11 Revised)**

Vision, Mission and PEOs of B. Tech. Mechanical Engineering

Vision

To be recognized as one of the preeminent Mechanical Engineering Programs

Mission

- To be recognized as a leading Mechanical Engineering Department in the field of Knowledge, Skill and Research
- To prepare students competent to make their careers in Mechanical Engineering
- To strengthen collaborations with Industries, Academia and Research Organizations to enrich learning environment and to enhance Research Culture
- To provide value education to students to make them responsible citizen

Program Educational Objectives

To achieve the mission of the program, Mechanical Engineering graduates will be able:

1. To acquire and develop careers in industries, Research organizations, academia and demonstrate entrepreneurial skill

2. To work independently as well as in team to formulate, design, execute solutions for engineering problems and also analyze ,synthesize technical data for application to product , process, system design & development

3. To develop expertise towards use of modern engineering tools, instruments, programming languages and software's

4. To understand &contribute towards social, environmental issues, following professional ethics and codes of conduct and embrace lifelong learning for continuous improvement

PO No.	Program Outcomes
	Graduates of the Mechanical Engineering program will attain
1	**An ability to apply knowledge of Mathematics, Science, and Engineering**
2	**An ability to identify, formulate and solve engineering problems**
3	**An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health, and safety, manufacturability, and sustainability**
4	**An ability to Conduct investigation of complex problems using research literature and research methods , analysis & interpretation of data & synthesis of information to provide valid conclusions.**
5	**An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice**
6	**An ability to apply reasoning by knowledge gain to assess societal, safety, and cultural issues and the consequent responsibility relevant to engineering practice.**
7	**The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context**
8	**An ability to apply ethical principles & commit to professional ethics, responsibilities & prescribed norms of engineering practice.**
9	**An ability to function effectively as an individual, and as a member or leader in multidisciplinary teams**
10	**An ability to communicate effectively**
11	**An ability to demonstrate knowledge & understanding of engineering and management principles & apply these to one's own work, as a member and leader in a team to manage projects in multidisciplinary environment.**
12	**A recognition of the need for and an ability to engage in life-long learning**

MODULE VII

ME42117 : Industrial Fluid power

Credits: 03 **Teaching Scheme: 3 Hours / Week**

Unit 1: Introduction to Fluid Power and Source of Power (8 Hours)

Part A: Fluid power systems: Components, advantages, applications. Hydraulic fluids, Properties of fluids, selection of fluids. sources of contamination and contamination control.

Pumps: Types, classification, working and constructional details , characteristics . Power units and accessories, Types of power units, reservoir assembly.

Part B: pressure switches, temperature switches, pipes, hoses, connectors, Seals

Accumulators : Types, selection/design procedure, applications of accumulators.

Unit 2: Fluid Power Control (8 Hours)

Part A: Control of fluid power, pressure control, directional control, flow control valves. Direct operated and pilot operated relief valves, pressure reducing valve, Principle of flow control valves, pressure compensated, temperature compensated flow control valves, directional control valves : types, constructional details ,characteristics, centre positions. Cartridge valves.

Part B:: check valves, pilot operated check valves

Unit 3: Actuators and Hydraulic circuits (8 Hours)

Part A: Linear and Rotary actuators, types, constructional details, characteristics. hydraulic circuits for different applications

Part B: symbols of fluid power components, trouble shooting

Unit 4: Pneumatics (8 Hours)

Part A: Filters, regulators, lubricators, mufflers, dryers. Direction control valves, rotary and reciprocating actuators, logic elements ,pneumatic and electro pneumatic circuits for different applications

Part B: Compressors, selection of compressors, compressed air distribution system

Unit 5: System Design (8 Hours)

Part A: Design of hydraulic/pneumatic circuits for practical applications, Selection of different components

Part B: Study of catalogues of pumps and valves.

Text Books:

1 A. Esposito - 'Fluid Power with application', Pearson Education,New Delhi
2 Peter Croser, Frank Ebel ;'Pneumatics';Festo Didactic GmbH & Co

Reference Books:

1 D.A.Pease – 'Basic Fluid Power', Prentice hall
2 J.Pippenger,T.Hicks; 'Industrial Hydraulics',McGraw Hill Book Co.

3 Yeaple F; 'Fluid Power Design Handbook';MarcelDekker,Newyork
4 Vickers ; Industrial Hydraulics Manual
5 D.Merkle,B.Schrader,M.Thomes;'Hydraulics'; Festo Didactic GmbH & Co
6 ISO 1219;Fluid Systems and components, Graphic Symbols
7 Sullivan James A;'Fluid Power Theory &Applications'; Prentice Hall, New Jercy

Course Outcomes:

The student will be able to –

1. Analyze Hydraulic Systems.
2. Develop Simple Hydraulic Circuits.
3. Select hydraulic components from data sheets for simple hydraulic circuits.
4. Analyze Pneumatic Systems
5. Develop Simple Pneumatic Circuits.

ME42217 : Industrial Fluid power

Credits:01 **Teaching Scheme: 1 Hour / Week**

List of Tutorials:

1.Accumulator Sizing
2.Pump And Motor Efficiencies
3.Meter In Circuit
4.Meter Out Circuits
5special Speed Control Circuits
6.Hi Lo Circuit
7 Regenerative Circuit
8 Cascaded Pneumatic Circuit
9 Pump Data Sheets
10 Data Sheets For Valves
11 Hydraulic Circuit Design
12 Hydraulic Component Selection
13 Pneumatic Circuit Design
14 Trouble Shooting

Text Books:

1. Esposito - 'Fluid Power with application', Pearson Education,New Delhi
2. Peter Croser, Frank Ebel ;'Pneumatics';Festo Didactic GmbH & Co

Reference Books:

1. D.A.Pease – 'Basic Fluid Power', Prentice hall
2. J.Pippenger,T.Hicks; 'Industrial Hydraulics',McGraw Hill Book Co.
3. Yeaple F; 'Fluid Power Design Handbook';MarcelDekker,Newyork
4. Vickers ; Industrial Hydraulics Manual
5. D.Merkle,B.Schrader,M.Thomes;'Hydraulics'; Festo Didactic GmbH & Co
6. ISO 1219;Fluid Systems and components, Graphic Symbols
7. Sullivan James A;'Fluid Power Theory &Applications'; Prentice Hall, New Jercy

Course Outcomes:

The student will be able to –

1. Analyze Hydraulic Systems.
2. Develop Simple Hydraulic Circuits.
3. Select hydraulic components from data sheets for simple hydraulic circuits.
4. Analyze Pneumatic Systems
5. Develop Simple Pneumatic Circuits

ME42103: TRIBOLOGY

Credits: 03 **Teaching Scheme: 3 Hours / Week**

Unit I: Friction and Wear (8 Hrs)

Part A: Friction: Laws of Friction, Types of Friction, Theories of friction, friction measurement.

Wear: Classification of Wear, Wear Mechanisms, Quantitative Laws of Wear, Wear measurement.

Part B: Friction and wear in metals and non-metals.

Unit II: Basic equations for fluid film lubrication and Hydrodynamic thrust bearings (8 Hrs)

Part A: Modes of lubrication**,** Types of lubricants, properties of lubricants,Mechanics of fluid flow, Reynold's equation.

Hydrodynamic thrust bearings: Pressure development mechanism, Plane slider bearing with fixed inclination, Tilting pad slider bearings, parallel step slider bearing.

Part B: Plane slider bearing with exponential film profile, Finite width thrust bearings.

Unit III: Hydrodynamic Journal Bearings (8 Hrs)

Part A: Mechanism of pressure development in journal bearing, Infinitely long bearing analysis, Infinitely short bearing analysis, Petroff's equation, theoretical and practical considerations in bearing design, Design procedure, Hydrodynamic instability.

Part B: Oil supply grooves in journal bearing,Bearing materials, Finite length journal bearing.

Unit IV: Squeeze film bearings and Gas Lubricated bearings (8 Hrs)

Part A: Squeeze film bearings: Introduction, infinitely long parallel rectangular plates, lubrication between parallel circular plates, lubrication between cylinder and a flat plane.

Gas Lubricated Bearings: Introduction, Governing equation.

Part B: Squeeze film damper, Applications of gas lubricated bearings.

Unit V: Hydrostatic bearings and Elastohydrodynamic lubrication (8 Hrs)

Part A: Hydrostatic bearings: Introduction, classification, hydrostatic circular step bearings, friction and pumping losses, stiffness calculation of hydrostatic circular step bearing

Elastohydrodynamic lubrication: Introduction, Hetrz contact stress theory, lubricant rheology, different regimes in EHL, Grubin theory, Pressure and film thickness distribution in EHL contacts.

Part B: Advantages and applications of Hydrostatic thrust bearings, examples of EHL point contact and line contact.

Total Contact Hours: 40 hours

Text Books

Structure and syllabus of Final Year B.Tech. Mechanical Sandwich Pattern E-11, A.Y. 2015-16

1. Introduction to Tribology of bearings: B.C Majumdar, S. Chand and company ltd. New Delhi (2008)
2. Engineering Tribology: PrasantaSahoo, Prentice Hall of India, New Delhi (2005)

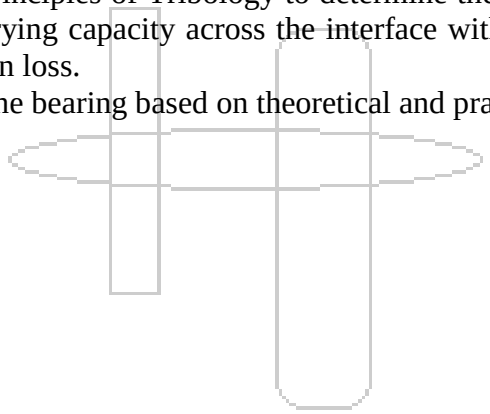
Reference Books

1. The Principles of lubrication: A. Cameron. Longmans Green & Co. Ltd.
2. Theory of Lubrication: B. C. Majumdar, M. Sarangi, M. K. Ghosh, Tata McGraw Hill Education, (2013).
3. Engineering Tribology: G. W Stachowiak, , A. W. Batchelor, Boston: Butterworth-Heinemann, 2001.

Course Outcomes:

The student will be able to –

1. Recognize laws of friction and theories of friction.
2. Understand mechanisms and quantitative laws of wear.
3. Identify modes of lubrication: boundary, mixed, EHL, hydrodynamic, hydrostatic lubrication.
4. Apply principles of Tribology to determine the solution to the problem of load carrying capacity across the interface with the acceptable magnitude of friction loss.
5. Design the bearing based on theoretical and practical considerations.



ME 42203: Tribology

Credits: 01 **Teaching Scheme:** Tutorial 1**Hours / Week**

List of Tutorials

1. Two assignments from unit 1
2. Two assignments from unit 2
3. Two assignments from unit 3
4. Two assignments from unit 4
5. Two assignments from unit 5

Text Books:

1. Introduction to Tribology of bearings: B.C Majumdar, S. Chand and company ltd. New Delhi (2008)
2. Engineering Tribology: PrasantaSahoo, Prentice Hall of India, New Delhi (2005)

Reference Books :

1. Basic Lubrication Theory: A. Cameron.
   The principles of lubrication: A. Cameron. Longmans Green & Co. Ltd.
2. Theory of Lubrication: B. C. Majumdar, M. Sarangi, M. K. Ghosh, Tata McGraw Hill Education, (2013).
3. Engineering Tribology: G. W Stachowiak, , A. W. Batchelor, Boston: Butterworth-Heinemann, 2001.

Course Outcomes:

The student will be able to –

1. Recognize laws of friction and theories of friction.
2. Understand mechanisms and quantitative laws of wear.
3. Identify modes of lubrication: boundary, mixed, EHL, hydrodynamic, hydrostatic lubrication.
4. Apply principles of Tribology to determine the solution to the problem of load carrying capacity across the interface with the acceptable magnitude of friction loss.
5. Design the bearing based on theoretical and practical considerations.

ME 42111 Turbo machines

Credits: 3 **Teaching Scheme: 3 Hours / Week**

Unit 1: Basics and Dimensional Analysis (12 Hours)

Part A:

1. Review of Fluid Mechanics
2. Velocity Triangles
3. Specific work equation
4. Efficiencies
5. Vane Congruent Flow and Deviations
6. Dimensional Analysis

Part B: Problems based on A

Unit 2: Centrifugal Machines (9 Hours)

Part A:

1. Basic Concepts
2. Analysis of centrifugal fans
3. Design of Fans
4. Operation of Fans
5. Centrifugal Pumps
6. Cavitation

Part B: Problems based on A

Unit 3: Axial Machines (7 Hours)

Part A:

1. Axial Fans
2. Axial Compressors
3. Loss Determination
4. Off Design Analysis

Part B: Problems based on A

Unit 4: Hydraulic Turbines (5 Hours)

Part A:

1. Analysis of turbines
2. Design Methodology
3, Cavitation analysis

Part B: Problems based on A

Unit 5: Wind and Gas Turbines (7 Hours)

Part A:

1. Wind turbines analysis
2. Wind turbine design
3. Gas turbine analysis

Part B: Problems based on A

Text Books:

1. "Turbines Compressors and Fans", Yahya S. M., Tata McGraw Hill
2. "A Treatise on Turbomachines", G. Gopalakrishnan and D. Prithviraj, ScitechPublcns.
3. "Gas Turbine Theory", Saravanamuttoo, Cohen H., and Rogers GFC, Pearson

Reference Books:

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1. “Theory of Hydraulic Machinery”, Vasandani V. P., Khanna Publishers, Delhi
2. “Hydraulic Machines”, Lal J.,Metropolitan Book Co., Delhi.

Course Outcomes:

The student will be able to –

1. Ability to analyse and design fans, pumps etc.
2. Analysis and design of water turbines
3. Analysis of cavitation in pumps and turbines
4. Gas turbines – analysis
5. Wind turbines – design and analysis

ME42211 : Turbo Machines

Credits:1 **Teaching Scheme:1 Hour / Week**

List of Tutorials:

1. Specific work, angle calculations
2. Dimensional Analysis
3. Fan Design
4. Cavitation, Operation
5. Axial Compressor
6. Gas and wind turbines

Text Books:

1. "Turbines Compressors and Fans", Yahya S. M., Tata McGraw Hill
2. "A Treatise on Turbomachines", G. Gopalakrishnan and D. Prithviraj, ScitechPublcns.
3. "Gas Turbine Theory", Saravanamuttoo, Cohen H., and Rogers GFC, Pearson

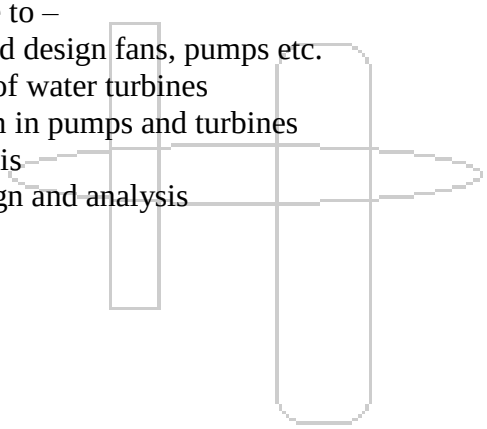
Reference Books:

1. "Theory of Hydraulic Machinery", Vasandani V. P., Khanna Publishers, Delhi
2. "Hydraulic Machines", Lal J.,Metropolitan Book Co., Delhi.

Course Outcomes:

The student will be able to –

1. Ability to analyse and design fans, pumps etc.
2. Analysis and design of water turbines
3. Analysis of cavitation in pumps and turbines
4. Gas turbines – analysis
5. Wind turbines – design and analysis



ME42113: THERMAL POWER PLANTS

Credits: 03 **Teaching Scheme: 3 Hours / Week**

Unit I: Power Plants (8 Hrs)

Part A: Schematic Diagrams and relative merits of Steam, Gas, Diesel and Hydro Power Plants, Factors affecting Selection of site, Nuclear Power Plants Classification, Types of Various Reactors with working of various Components.

Part B: Present status of Power generation in India. Nuclear Power plants In India, Waste Disposal of nuclear power plants, VVER power plants.

Unit II: High pressure boilers and Improved Rankine Cycle (12 Hrs)

Part A: High Pressure Boilers**,** High pressure boilers types, construction and working, Principle of Fluidized bed combustion, Types of fluidized bed combustion boilers (CFBCB, PFBCB). Improved Rankine Cycle,Rankine Cycle with Reheating and Regeneration, Steam Power Plants with Process Heating (reheating, regeneration and combined reheat regeneration).

Part B: Recent trends in FBCB

Unit III: Essential Components of the power plants (4 Hrs)

Part A: DM Plant, Air Preheater, superheater, fuel treatment unit, nuclear safety standards.

Part B: Equipments used for handling, storage, preparation, feeding, burning of coal fired boilers, Ash handling & dust collection

Unit IV: Steam Condensers (8 Hrs)

Part A: Necessity of condensers, types of condensers, Dalton's law of partial pressures, condenser vacuum and vacuum efficiency, condenser efficiency, air pumps, capacity of air extraction pumps, , cooling water requirements.

Part B: Cooling towers and cooling ponds

Unit V: Economics of Power Generation (8 Hrs)

Part A: Load duration, load curves, demand factor, average factor, capacity factor, reserve factor, diversity factor, plant use factor, construction of load duration curves, effect of variable load on power plant design and operation. Selection of power plant from site to waste disposal, life cycle costing, Fuel costs, Present worth concept,

Part B: Project proposal preparation

Text Books

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1. Arora, and Domkundwar “A Course in Power Plant Engineering”, 5th Edition, Dhanpat Rai and Co
2. P. K. Nag, “Power Plant Engineering”, Tata Mcgraw Hill, New Delhi
3. Yadav R “Steam and gas turbines and Power Plant Engineering”,., Central publishing house

Reference Books

1. Rajput R. K. “Power Plant Engineering”, , Laxmi Publication, New Delhi
2. Sharma P. C., “Power Plant Engineering”, S. Kataria and sons, New Delhi
3. Wesisman and Eckart “Modern Power Plant Engineering” ,Prentice Hall of India
4. Wakil M. M “Power Plant Engineering”, Tata McGraw Hill and Co., New Delhi
5. Rai G. D “Introduction to Power Plant Technology” ,Khanna Publishing

ME 42213 Thermal Power Plants

Credits:01 **Teaching Scheme : 1 Hours / Week**

List of Tutorials:

1. Classification, present status and recent trends in power plants
2. Classification, present status and recent trends of nuclear reactors
3. Analysis based problem solving for Improved Rankine cycle and condenser
4. Trial on diesel power plant for load performance
5. Trial on Steam power plant for load performance
6. Report writing based on visit to Thermal power plant

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Text Books

4. Arora, and Domkundwar "A Course in Power Plant Engineering", 5th Edition, Dhanpat Rai and Co
5. P. K. Nag, "Power Plant Engineering", Tata Mcgraw Hill, New Delhi
6. Yadav R "Steam and gas turbines and Power Plant Engineering",., Central publishing house

Reference Books

6. Rajput R. K. "Power Plant Engineering", , Laxmi Publication, New Delhi
7. Sharma P. C., "Power Plant Engineering", S. Kataria and sons, New Delhi
8. Wesisman and Eckart "Modern Power Plant Engineering" ,Prentice Hall of India
9. Wakil M. M "Power Plant Engineering", Tata McGraw Hill and Co., New Delhi
10. Rai G. D "Introduction to Power Plant Technology" ,Khanna Publishing

Course Outcomes: (Theory + Tut)

The student will be able to –

1. Compare different power plants, their present status and recent trends.
2. Do Mathematical analysis of Improved Rankine cycle and condenser
3. Demonstrate essential and supplementary Power plant components
4. Perform Testing of thermal power plant and data analysis to draw conclusions
5. Perform analysis for power plant economics.

ME42109 : HEAT EXCHANGE DEVICES

Credits: 03 **Teaching Scheme: 03 Hours / Week**

Unit 1: Introduction to Heat Exchange Devices (8 Hours)
Part A: Engineering significance, Classification, Selection and Applications, LMTD, ε - NTU methods. Introduction to TEMA standards
Part B: Constructional details of different Heat Exchangers
Unit 2: Basic Thermal Design Theory-The LMTD approach (8 Hours)
Part A: Heat transfer and pressure loss, Flow configuration, Exchanger Analysis: Logarithmic mean temperature difference for parallel and counter flow heat exchangers. LMTD correction factor.
Part B: Selection of appropriate correlations for heat transfer and pressure loss. LMTD correction factors charts for various Heat Exchangers
Unit 3: Basic Thermal Design Theory-The ε - NTU approach (8 Hours)
Part A: The ε - NTU method for parallel and counter flow heat exchangers. Design considerations for heat exchangers. Introduction to compact heat exchanger
Part B: Fouling factor considerations, Introduction to heat pipes
Unit 4: Additional Considerations in Thermal Design of Heat Exchangers (8 Hours)
Part A: Design standards and codes, key terms in heat exchanger design, material selection, and thickness calculation for major components such as tube sheet, shell, tubes, flanges and nozzles. TEMA standards
Part B: Introduction to Helical baffle heat exchangers and their design considerations, flow induced vibrations
Unit 5: Cooling Towers, Condensing System (8 Hours)
Part A: Design of surface and evaporative condensers, Introduction to Cooling towers and their design and selection aspects.
Part B: Introduction to simulation and optimization of heat exchangers, Heat transfer enhancement

Text Books:

1. Aurther P Frass, “Heat Exchanger design” 2nd Edition, John Wiley and Sons, New York.
2. T. Taborek, G. F. Hewitt and N. Afgan, “Heat Exchangers Theory and Practice” McGraw Hill Book Co.
3. Walker, “Industrial Heat Exchangers a Basic guide”, McGraw Hill Book Co.

Reference Books:

1.Kern and Kraus, “Heat Exchanger Design Handbook”
2. Kuppan, “Heat Exchanger Design handbook”
3. “TEMA Standards”

Course Outcomes:

The student will be able to –

1. Know common heat exchanger types, their advantages and limitations;
2. Get aware of and will understand use and significance of heat transfer and friction coefficient correlations, and will know how to select the appropriate ones for the case in hand;
3. Know how to deal appropriately with rating and sizing problems in heat exchanger design;
4. Know how to consider fouling of surfaces, incorporate fouling in designs, and take care of fouling during heat exchanger operation;
5. Learn how to design common types of heat exchangers; namely hair-pin, shell-and-tube, plate and compact heat exchangers, and will tempt to understand their uses in some new engineering areas or in innovative applications.

ME42209 : HEAT EXCHANGE DEVICES

Credits: 01 **Teaching Scheme: 1 Hours / Week**

List of Tutorials:

1. Tut I - Design of Heat Exchanger for sizing - Unit No II
2. Tut II- Design of Heat Exchanger for rating - Unit No III
3. Tut III - Design of Multipass/Cross flow Heat Exchanger - Unit No III
4. Tut IV - Design of Condenser/Compact/Plate Heat Exchanger - Unit No I-V

Text Books:

1. Aurther P Frass, "Heat Exchanger design" 2nd Edition, John Wiley and Sons, New York.
2. T. Taborek, G. F. Hewitt and N. Afgan, "Heat Exchangers Theory and Practice" McGraw Hill Book Co.
3. Walker, "Industrial Heat Exchangers a Basic guide", McGraw Hill Book Co.

Reference Books:

1.Kern and Kraus, "Heat Exchanger Design Handbook"
2. Kuppan, "Heat Exchanger Design handbook"
3. "TEMA Standards"

Course Outcomes:

The student will be able to –

1. Select type of Heat exchanger for given application. Select/Design geometry of Heat exchanger for given application
2. Will understand how to select and use appropriate heat transfer and friction coefficient correlations for the case in hand;
3. Know how to land with appropriate solution for rating and sizing problems in heat exchanger design;
4. Deal with fouling of surfaces at design stage of heat exchangers;
5. Design common types of heat exchangers;

ME40101 : DESIGN OF MECHANICAL SYSTEMS

Credits: 03 **Teaching Scheme:** Theory 3 Hrs/Week

UnitI **(8 Hrs)**

Part A:

Worm Gears : Worm and worm gear terminology and geometrical relationship, Types of worm and worm gears, Standard dimensions, Force analysis of worm gear drives, Friction in Worm gears and its efficiency, Worm and worm-wheel material, Strength and wear ratings of worm gears as per IS-7443-1974 , Thermal consideration in worm gear drive

Part B:

Types and Constructional details of worm & worm Gear, Methods of lubrication and Manufacturing, Types of failures in worm gearing.

Unit II **(8 Hrs)**

Part A:

Design of Cylinders and Pressure vessels:

Thick and thin cylinders – Thin cylindrical and spherical vessels – Lame's equation ,Clavarino's and Birnie's equation, Design of hydraulic and pneumatic cylinders , Auto frettage and compound cylinders – Gasketed joints in cylindrical vessels. Modes of failures in pressure vessels. Unfired pressure vessels – Classification of pressure vessels as per I. S. 2825 –1965- categories and types of welded joints – weld joint efficiency –Corrosion, erosion and protection vessels, stresses induced in pressure vessels, materials of construction. Thickness of cylindrical and spherical shells and design of end closures as per code – Nozzles and Openings in pressure vessels –Reinforcement of openings in shell and end closures. Area compensation method.

Part B:

Types of vessel supports and their design, Types of gaskets and their constructional details.

Unit III **(8 Hrs)**

Part A:

Design of Material Handling System:

Material handling system concept, basic principles, objectives of material handling system, unit load and containerization. Flat belt and troughed belt conveyors, capacity of conveyor, rubber covered and fabric ply belts, belt tensions, types of conveyor pulleys, types of belt idlers, types of tension take-up systems, power requirement of horizontal and inclined belt conveyors.

Part B:

Introduction to screw conveyors, capacity of screw conveyor, power requirements, types of screw flights, feed & discharge arrangements.

Unit IV **(8 Hrs)**

Part A:

Optimum Design:

Objectives of optimum design –Johnson's Method of Optimum Design (MOD). Adequate and optimum design. Primary, subsidiary and limit equations – Optimum design with normal specifications of simple machine elements like tension bar, transmission shaft, helical spring–

Introduction to optimum design with redundant specifications.

Statistical consideration in design :

Frequency distribution – Histogram and frequency polygon – Normal distribution – Units of measurement of central tendency and dispersion – Standard variable – population combinations – Design and natural tolerances –Design for assembly- Statistical analysis of tolerances – Mechanical reliability and factor of safety.

Part B:

Optimum Design of Gear, Clutch, Brake.

Unit V **(8 Hrs)**

Part A:

Design of I.C. Engine components:

Introduction to selection of material for I. C. engine components, Design of cylinder and cylinder head, construction of cylinder liners, design of piston and piston-pins, piston rings, design of connecting rod, design of crank-shaft and crank-pin.

Part B:

Fly wheel design, Design of valve gear system.

Text Books

1. Bhandari V. B., "Design of Machine Elements", Tata McGraw Hill Education (India) Pvt. Ltd., New Delhi.
2. Patil S. P., "Mechanical System Design", Jaico Publishing House, Mumbai
3. Ray T. K., "Mechanical Handling of Materials", Asian Book Pvt. Ltd., Delhi

Reference Books

1. IS-2825-1969 code for unfired pressure vessels
2. Rudenko N., "Material Handling Equipment", PEACE Publishers, Moscow
3. Johnson R.C., "Optimum Design of Mechanical Elements" John Wiley &Sons.Inc., London.
4. "Design Data", P.S.G. College of Technology, Coimbatore.
5. Joshi M. V., Mahajani V. V., "Process Equipment Design", MacMillan India, Ltd.,Delhi
6. Ullman D.G., "The Mechanical Design Process", McGraw Hill International Editions
7. John F Harvey, "Theory and Design of Pressure vessels", CBS publishers & distributors, Delhi
8. Willium C. Orthwine, "Machine Components Design I and II", Jaico Publishing House, Mumbai.

Course Outcome

1. Students will be able to Design as per IS code the Mechanical components like worm gears, Unfired Pressure vessels.
2. Students will be able to Design components of IC Engine.
3. Students will be able to Design Mechanical systems like IC Engine, Belt Conveyor, Pressure vessels.
4. Students will be able to apply statistical considerations in designing engineering component or product.
5. Students will be able to Optimize the Design for Mechanical Elements like Shaft, Gear, and Spring.

ME40103-CAD/CAM/CAE

Credits:03 **Teaching Scheme: 3 Hours / Week**

Unit 1: Computer Graphics **(6 Hours)**

Part A: Introduction to Basic Transformations - Translation, Rotation, Scaling, Reflection, Homogenous Coordinate system , Concatenated Transformation, Mapping of Geometric Models, Inverse Transformations.

Part B: Projections - Orthographic, Isometric, Oblique, Perspective.

Unit 2: Geometric Modelling **(10 Hours)**

Part A:

Curves

Introduction to Parametric representation of curves and its advantages. Analytic Curves- Line, Circle, Parabolas, Hyperbolas, Ellipses, Conics. Synthetic Curves- Hermite Cubic Spline, Bezier Curve, B-Spline Curve.

Surfaces

Introduction to Parametric representation of Surfaces. Analytic Surfaces-Plane, Ruled, Tabulated, Revolved surfaces. Synthetic Surfaces- Bezier Surface, B-Spline Surface

Solids

Introduction to different volume modeling techniques - Constructive Solid Geometry, Boundary Representation, Pure Primitive instancing, Spatial Occupancy Enumeration, Feature Based Modelling.

Part B:curve manipulation

Unit 3: Finite Element Analysis **(8 Hours)**

Part A: Introduction to Finite Element Modelling, Coordinate and Shape function, Potential Energy Approach, Assembly of Global Stiffness Matrix and Load Vector, Properties of Stiffness Matrix, Finite Element Equations.

One dimensional Finite Element Analysis

Linear bar element, Quadratic bar element, frame element. Development of Finite Element Models of discrete systems like linear elastic spring, Torsion of Circular Shaft.

Part B: Galerkin's Approach

Unit 4: Two Dimensional Finite Element Analysis **(8 Hours)**

Part A: Three noded triangular elements, Development of Finite Element Models for plane stress, plain strain, Axisymmetric stress analysis applications.

Part B: Qudartic Shape function

Unit 5: Computer Aided Manufacturing **(8 Hours)**

Part A: Introduction, Integrating CAD, NC and CAM, Preparing CAD data for NC, The Basic components of NC System, Machine Axes and Coordinate system, Positioning System, NC Motion Control System, Point-to-Point and Continuous Path Machining, The Structure and syllabus of Final Year B.Tech. Mechanical Sandwich Pattern E-11, A.Y. 2015-16

NC Procedure, Machine Zero, Job Zero, Manual part Programming (G and M code), The APT Language.

Part B: Rapid Prototyping
Overview of Rapid Prototyping, the Basic Process (RP Sequence), Rapid Prototyping Techniques , Applications of Rapid Prototyping , Benefits of RP

Text Books: ***(As per IEEE format)***

1. Ibrahim Zeid, "Mastering CAD/CAM", Tata McGraw Hill
2.Groover M. P., "Automation, production systems and computer integrated manufacturing" Prentice Hall of India
3.Chandrupatla T. R. and Belegunda A. D., "Introduction to finite elements in engineering", Prentice Hall of India
4. P.N. Rao -CAD/CAM, Principles & Applications-Tata McGraw Hill

Reference Books: ***(As per IEEE format)***

1.Ibrahim Zeid, "CAD/CAM - theory and practice", Tata McGraw Hill.
2. Segerling L. J., "Applied finite elements analysis", John Wiley and Sons.
3. Gebhardt A., "Rapid Prototyping", Hanser Publisher.
4. David F. Rogers, J. Alan Adams, Mathematical Elements for Computer Graphics, Tata McGraw-Hill Publishing Company Ltd., New Delhi-8.

Course Outcomes:

The student will be able to –

1. Able to use the underlying algorithms, mathematical concepts, supporting computer graphics. These include but are not limited to:Composite2D& 3D homogeneous matrices for translation, rotation, and scaling transformations.
2. Able to use and demonstrate fundamental knowledge of CAD/CAM.
3. Able to:─ Understand the basic theory behind the finite element method
   ─ Use the finite element method for the solution of practical engineering Problems
   ─ Use a commercial FE-package
4. Able to Create the G-code program (with a standard computer post processor) of a work-piece on a standard numerically controlled machine tool with CNC controls.

ME40301 :: DESIGN OF MECHANICAL SYSTEMS

Credits: 01 **Teaching Scheme: -** Laboratory 2 Hrs/Week

Design Project:

The term work shall consist of ONE design project. The design project shall consist of sheet involving assembly drawing with a part list & overall dimensions and sheets involving drawings of individual components with manufacturing tolerances, surface finish symbols, geometric tolerances specified on it so as to make it working drawing. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. Projects shall be in the form of design of mechanical systems such as -

- System involving worm gear box,
- Pressure vessel ,
- I C Engine Design,
- Material Handling System,
- Reciprocating Compressor Design, etc.

Design Assignments:

Three assignments based on any *one* of the following topics from each of the three groups.
A Case study approach is to be used.
Group I: Sr. No. 1 to 3, Group II: Sr. No. 4 to 6, Group III: Sr. No. 7 to 9.
1. Modern engineering materials and their applications / evaluation methods for material selection.
2. Piping design.
3. Aesthetic and Ergonomic Considerations in Design
4. Value engineering
5. Concurrent engineering
6. Reverse engineering.
7. Design for Manufacturing and Assembly.
8. Design of Crankshaft for IC Engine
9. Designs in relation to Patents, Trade Mark and Copy Right.

Text Books

1. Bhandari V. B., “Design of Machine Elements”, Tata McGraw Hill Education (India) Pvt. Ltd., New Delhi.
2. Patil S. P., “Mechanical System Design”, Jaico Publishing House, Mumbai
3. Ray T. K., “Mechanical Handling of Materials”, Asian Book Pvt. Ltd., Delhi

Reference Books

1. IS-2825-1969 code for unfired pressure vessels

2. Rudenko N., ”Material Handling Equipment”, PEACE Publishers, Moscow
3. Johnson R.C., “Optimum Design of Mechanical Elements” John Wiley &Sons.Inc., London.
4. “Design Data”, P.S.G. College of Technology, Coimbatore.
5. Joshi M. V., Mahajani V. V., “Process Equipment Design”, MacMillan India, Ltd.,Delhi
6. Ullman D.G., “The Mechanical Design Process”, McGraw Hill International Editions
7. John F Harvey, “Theory and Design of Pressure vessels”, CBS publishers & distributors, Delhi
8. Willium C. Orthwine, “Machine Components Design I and II”, Jaico Publishing House, Mumbai.
9.Handbook of Mechanical Engineering, Springer, New York

Course Outcome

1 Students will be able to Design Mechanical systems like IC Engine, Belt Conveyor, Pressure vessels and write design report.
2 Students will be able to Design Mechanical systems considering Aesthetics and Ergonomic considerations in design.
3 Students will be able to Design components and assembly applying DFMA principles.

ME40303 CAD/CAM/CAE

Credits:01 **Teaching Scheme: 2Hours / Week**

List of Practicals:

1. Write a program to fit Bezier / B-Spline curve for given control points. OR Write a program to find points on Bezier / B-Spline surfaces. (2 Hours)
2. Part Modeling, Assembly Modeling and preparation of Working Drawings from assembly model (2 Hours)
3. Surface modeling (2 Hours)
4. Analyzing 1D problem using Finite Element Method of any one mechanical component. (2 Hours)
5 Stress and deflection analysis of any three Mechanical component consisting of 2-D and 3-D elements using finite element package. (10 Hours)
6 Kinematic analysis of any mechanism using motion bundle software(4 Hours)
7. Programming and Manufacturing of one job on CNC Machine (4 Hours)

Text Books: ***(As per IEEE format)***

1. Ibrahim Zeid, "Mastering CAD/CAM", Tata McGraw Hill
2.Groover M. P., "Automation, production systems and computer integrated manufacturing" Prentice Hall of India
3.Chandrupatla T. R. and Belegunda A. D., "Introduction to finite elements in engineering", Prentice Hall of India
4. P.N. Rao -CAD/CAM, Principles & Applications-Tata McGraw Hill

Reference Books: ***(As per IEEE format)***

1.Ibrahim Zeid, "CAD/CAM - theory and practice", Tata McGraw Hill.
2. Segerling L. J., "Applied finite elements analysis", John Wiley and Sons.
3. Gebhardt A., "Rapid Prototyping", Hanser Publisher.
4. David F. Rogers, J. Alan Adams, Mathematical Elements for Computer Graphics, Tata McGraw-Hill Publishing Company Ltd., New Delhi-8.

Course Outcomes:

The student will be able to –
1. Do geometric modeling of Mechanical component
2. Do analysis of simple Mechanical components
3. Write G & M code for simple mechanical parts

ME47303:: PROJECT STAGE-2

Credits: 04 **Teaching Scheme : 2 Hours / Week**

Objectives:

• To train the students to apply their engineering knowledge to real life problem solving

The project work could be of the following nature: Design/development and Fabrication of models. Machines and prototypes based on new ideas, robotic and automation systems. Experimental set ups, test rigs/ equipments.

Thermal Systems

Energy audit/conservation studies

Extensive computational analysis of problems relevant to mechanical engineering, CAD/CA M/CAE

Modeling/simulation of product(s), mechanism(s) or system(s) and its validation or Comparison with available bench marks I results

The project work shall be taken up individually or in a group consisting of not more than 4 students.

A report containing maximum 30 pages shall be submitted based on the background. need and scope of the project. project specifications, activities involved in the project and activity plan. study of literature and basic theory. and work completed (if any).

Guidelines:

• Report shall be typed or printed.

• Figures and tables shall be on separate pages and attached at respective positions.

• Project title and approval sheets shall be attached at the beginning of the report followed by index and synopsis of the project.

• References shall be mentioned at the end followed by appendices (if any).

• When a group of students is doing a project. names of all the students shall be included on every certified report copy.

• Each group of students shall submit two copies of reports to the institute and one copy shall be prepared for each individual student.

Course Outcomes:

The student will be able to –

1) Student will be able to define methodology for executing the project work
2) Student will be able to apply theoretical concepts for solving the project problem
3) Students will be able to decide and apply the manufacturing techniques and instrumentation for the development of working / process model

ME42123: Dynamics-Kinematics

Credits: 03 **Teaching Scheme: 3 Hours / Week**

Unit I: Fundamentals and review of basics concepts (8 Hrs)
Part A: Vector representation, Free body diagrams, rectilinear motion: position, velocity, acceleration, translation frame of reference.
Part B: Newton laws, conservation of momentum, work-energy principle, Impact, determination of radius of gyration, instantaneous center of rotation of a simple mechanisms.

Unit II: Kinematics of particles - 2D (8 Hrs)
Part A: Curvilinear motion of a particle: position, velocity and acceleration, rectangular components, tangential and normal components, radial and transverse components, motion of a particle relative to 2D moving reference frame (translation).
Part B: Relative andconstrained motion of connected particles.

Unit III: Kinematics of particles - 3D (8 Hrs)
Part A: Space curvilinear motion: rectangular coordinates, cylindrical coordinates, spherical coordinates.
Part B: motion of a particle relative to 3D moving reference frame (translation).

Unit IV: 2D (Plane) Rigid body Kinematics (8 Hrs)
Part A: Introduction, Translation, rotation about a fixed axis, general plane motion, absolute and relative velocity in plane motion, absolute and relative acceleration in plane motion, plane motion of a particle relative to rotating frame of reference.
Part B: Instantaneous center of rotation in plane motion.

Unit V: 3D Rigid body Kinematics (8 Hrs)
Part A: Translation, fixed-axis rotation, parallel-pane motion, rotation about a fixed point, 3D motion of a particle relative to a rotating frame of reference.
Part B: Body and space cone, angular momentum: moments and products of inertia.

Total Contact Hours: 40 hours

Text Books:

1. Vector Mechanics for Engineer Dynamics: F. P. Beer and E.R. Johnston, Tata McGraw-Hill publication.
2. Engineering Mechanics Dynamics: A. Nelson, Tata McGraw-Hill publication.

Reference Books :

1. Engineering Mechanics Dynamics: R.C. Hibbeler, Prentice Hall publication.
2. Engineering Mechanics Dynamics: J.L. Meriam and L.G. Kraige, Wiley publication.

3. Engineering Mechanics : Statics and Dynamics, H. Shames, 4th Ed, PHI, 2002.

Course Outcomes:

The student will be able to –

1. Perform the kinematic anlalysis using vector approach.
2. Develop and use the relative motion equations that relate the velocity and acceleration of two points.
3. Analyse the relative kinematics of two points whose motion are constrained by taut inextensible cables.
4. Develop and use the velocity and acceleration equations for the analysis of planar motion of rigid bodies.
5. Solve kinematics problem involving 2-D and 3-D moving reference frame.

ME 42223: Dynamics-Kinematics (Tutorial)

Credits: 01 **Teaching Scheme:**Tutorial 1 **Hours / Week**

List of Tutorials

1. Two assignments from unit 1 (co1)
2. Two assignments from unit 2 (co1,2,3)
3. Two assignments from unit 3 (co1)
4. Two assignments from unit 4 (co1,4,5)
5. Two assignments from unit 5 (co1,5)

Text Books:

1. Vector Mechanics for Engineer Dynamics: F. P. Beer and E.R. Johnston, Tata McGraw-Hill publication.
2. Engineering Mechanics Dynamics: A. Nelson, Tata McGraw-Hill publication.

Reference Books :

1. Engineering Mechanics Dynamics: R.C. Hibbeler, Prentice Hall publication.
2. Engineering Mechanics Dynamics: J.L. Meriam and L.G. Kraige, Wiley publication.
3. Engineering Mechanics : Statics and Dynamics, H. Shames, 4th Ed, PHI, 2002.

Course Outcomes:

The student will be able to –

1. Perform the kinematic anlalysis using vector approach.
2. Develop and use the relative motion equations that relate the velocity and acceleration of two points.
3. Analyse the relative kinematics of two points whose motion are constrained by taut inextensible cables.
4. Develop and use the velocity and acceleration equations for the analysis of planar motion of rigid bodies.
5. Solve kinematics problem involving 2-D and 3-D moving reference frame.