COURSE STRUCTURE & DETAILED SYLLABUS

MECHANICAL ENGINEERING

B. TECH FOURTH YEAR FIRST SEMESTER

(Applicable for the batches admitted from 2020-2021)

ACE

Engineering College

Ankushapur(V), Ghatkesar(M), Medchal Malkajgiri (Dist.), Telangana - 501 301.

(An Autonomous Institution, Affiliated to JNTUH ,Hyderabad)

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Ankushapur(V), Ghatkesar(M), Medchal Malkajgiri Dist - 501 301
(Autonomous)

B.TECH. FOURTH YEAR FIRST SEMESTER
MECHANICAL ENGINEERING
COURSE STRUCTURE

IV Year							I Semester
S.No.	Course Type	Course Code	Course Title	Periods Per Week			Credits
				L	T	P	
1	PCC	ME701PC	Refrigeration & Air Conditioning	3	0	0	3
2	PEC		Professional Elective – II	3	0	0	3
3	PEC		Professional Elective – III	3	0	0	3
4	PEC		Professional Elective – IV	3	0	0	3
5	OEC		Open Elective – II	3	0	0	3
6	PROJ	ME703PC	Industrial Oriented Mini Project/ Summer Internship	0	0	0	2*
7	PROJ	ME705PC	Seminar	0	0	2	1
8	PROJ	ME706PC	Project Stage - I	0	0	6	3
Total				**15**	**0**	**12**	**21**

***MC – Satisfactory/Unsatisfactory**

Note: Industrial Oriented Mini Project/ Summer Internship is to be carried out during the summer vacation between 6th and 7th semesters. Students should submit report of Industrial Oriented Mini Project/ Summer Internship for evaluation.

Note: Students should take Open Electives from the List of Open Electives Offered by Other Departments/Branches Only.

ME701PC: REFRIGERATION & AIR CONDITIONING

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME701PC	**Core**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Thermodynamics

Course Objectives:

1. Learning the fundamental principles and different methods of refrigeration and air conditioning.
2. Study of various refrigeration cycles and evaluate performance using Mollier charts and/ or refrigerant property tables.
3. Comparative study of different refrigerants with respect to properties, applications and environmental issues.
4. Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
5. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems.

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

1. To Differentiate between different types of refrigeration systems.
2. Applications & analysis of Conventional Refrigeration cycle.
3. Understanding of various components of Refrigeration cycles.
4. To Thermodynamically analyse refrigeration and air conditioning systems and evaluate performance parameters.
5. To Apply the principles of Psychometrics to design the air conditioning loads for the industrial applications.

UNIT – I

Introduction to Refrigeration: - Necessity and applications – Unit of refrigeration and C.O.P. – Mechanical Refrigeration – Types of Ideal cycle of refrigeration.

Air Refrigeration: Bell Coleman cycle and Brayton Cycle, Open and Dense air systems – Actual air refrigeration system – Refrigeration needs of Air craft's- Air systems – Application of Air Refrigeration, Justification – Types of systems – Problems.

UNIT – II

Vapour compression refrigeration – working principle and essential components of the plant – Simple Vapour compression refrigeration cycle – COP – Representation of cycle on T-S and p-h charts – effect of sub cooling and super heating – cycle analysis – Actual cycle Influence of various parameters on system performance – Use of p-h charts – Problems.

UNIT – III

System Components: Compressors – General classification – comparison – Advantages and Disadvantages. Condensers – classification – Working Principles. Evaporators – classification – Working Principles. Expansion devices – Types – Working Principles. Refrigerants – Desirable properties – common refrigerants used – Nomenclature – Ozone Depletion – Global Warming – Azeotropes and Zeotropes.

UNIT – IV

Vapor Absorption System – Calculation of max COP – description and working of NH3 – water system

-Li – Br system. Principle of operation Three Fluid absorption system, salient features. Steam Jet Refrigeration System Working Principle and Basic Components

Principle and operation of (i) Thermoelectric refrigerator (ii) Vortex tube or Hilsch tube.

UNIT – V

Introduction to Air Conditioning: Psychometric Properties & Processes – Sensible and latent heat loads – Characterization – Need for Ventilation, Consideration of Infiltration – Load concepts of RSHF, ASHF, ESHF and ADP. Concept of human comfort and effective temperature –Comfort Air conditioning – Industrial air conditioning and Requirements – Air conditioning Load Calculations.

Air Conditioning systems - Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers, deodorants, fans and blowers.

Heat Pump – Heat sources – different heat pump circuits – Applications.

Text Books:

1. Refrigeration and Air conditioning / CP Arora / Mc Graw Hill.
2. Refrigeration and Air-Conditioning / RC Aora / PHI.

Reference Books:

1. Principles of Refrigeration - Dossat / Pearson.
2. Basic Refrigeration and Air-Conditioning / Ananthanarayanan / Mc Graw Hill.

ME711PE: ADDITIVE MANUFACTURING (PE - II)

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME711PE	**Core**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Manufacturing Processes, Engineering Materials

Course Objectives:

1. To understand the fundamental concepts of Additive Manufacturing (i.e. Rapid Prototyping) and 3-D printing, its advantages and limitations.
2. To classify various types of Additive Manufacturing Processes and know their working principle, advantages, limitations etc.
3. To have a holistic view of various applications of these technologies in relevant fields such as mechanical, Bio-medical, Aerospace, electronics etc.
4. Apply various liquid and solid based RPT systems.
5. Recognize various STL formats and slicing methods and tessellation.

Course Outcomes:

1. Describe various CAD issues for 3D printing and rapid prototyping and related operations for STL model manipulation.
2. Formulate and solve typical problems on reverse engineering for surface reconstruction from physical prototype models through digitizing and spline-based surface fitting.
3. Formulate and solve typical problems on reverse engineering for surface reconstruction from digitized mesh models through topological modelling and subdivision surface fitting.
4. Explain and summarize the principles and key characteristics of additive manufacturing technologies and commonly used 3D printing and additive manufacturing systems.
5. Explain and summarize typical rapid tooling processes for quick batch production of plastic and metal parts.

UNIT – I

Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes.

UNIT – II

Liquid-based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies Solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT – III

Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification; Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP

UNIT – IV

Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Rapid Prototyping Software's: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.

UNIT – V

RP Applications: Application - Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.

Text Books:

1. Rapid prototyping; Principles and Applications /Chua C.K., Leong K.F. and LIM C.S/World Scientific Publications.
2. Rapid Manufacturing /D.T. Pham and S.S. Dimov/Springer.

Reference Books:

1. Terry Wohlers, Wholers Report 2000, Wohlers Associates.
2. Rapid Prototyping and Manufacturing /PaulF.Jacobs/ASME.

ME712PE: AUTOMATION IN MANUFACTURING (PE – II)

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME712PE/MT821PE	**Core**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Course Objectives:

1. To know about the Automation and types of Automations in the industries.
2. To understand the different Automated flow lines in the Industries.
3. To perform one or more processing and/or assembly operations on a starting raw material, part, or set of parts.
4. To perform a sequence of automated or mechanized assembly operations Flexible manufacturing system (FMS)—a highly automated machine cell that produces part.
5. To know product families often consists of workstations comprising CNC machine tools.

Course Outcomes:

1. Students will understand the process of automation and types.
2. Students will get exposure to workstation, which refers to the location in the factory where some well-defined task or operation is accomplished by an automated machine.
3. Worker-and-machine combination or a worker using hand tools.
4. Understand the Automated Material handling equipments and types.
5. Student gets exposure on portable power tools.

UNIT – I

Introduction: Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools. Mechanical feeding and tool changing and machine tool control transfer the automaton.

UNIT - II

Automated flow lines: Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration.

Analysis of Automated flow lines: General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

UNIT – III

Assembly system and line balancing: Assembly process and systems assembly line, line balancing methods, ways of

improving line balance, flexible assembly lines.

UNIT - IV:

Automated material handling: Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems.

Automated storage systems, Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT – V

Fundamentals of Industrial controls: Review of control theory, logic controls, sensors and actuators, Data communication and LAN in Manufacturing.

Business process Re-engineering: Introduction to BPE logistics, ERP, Software configuration of BPE.

Text Books:

1. Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover 3e./PE/PHI, 2009.

Reference Books:

1. Computer Aided Manufacturing, Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang, Pearson, 2009.
2. Automation by W. Buekinsham.

ME713PE: MEMS (PE – II)

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME713PE	**Core**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Fluid Mechanics

Course Objectives: At the end of this course the student will be able to

1. Integrate the knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
2. Understand the rudiments of Micro fabrication techniques.
3. Identify and understand the various sensors and actuators'.
4. Different materials used for MEMS.
5. Applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

Course Outcomes:

Students will be able to understand working principles of currently available micro sensors, actuators, and motors, valves, pumps, and fluidics used in Microsystems.

1. Students will be able to apply scaling laws that are used extensively in the conceptual design of micro devices and systems. Students will be able to differentiate between the positive and negative consequences of scaling down certain physical quantities that are pertinent to Microsystems.
2. Students will be able to use materials for common micro components and devices.
3. Students will be able to choose a micromachining technique, such as bulk micromachining and surface micromachining for a specific MEMS fabrication process.
4. Students will be able to understand the basic principles and applications of micro-fabrication processes, such as photolithography, ion implantation, diffusion, oxidation, CVD, PVD, and etching.
5. Students will be able to consider recent advancements in the field of MEMS and devices.
6. Students will be able communicate their results and findings orally via formal presentations and in writing through reports.

UNIT – I

Introduction to MEMS and Micro fabrication: MEMS Roadmap MEMS markets-MEMS foundries- Benefits of Miniaturization -Benefits of Scaling. Micro fabrication: Basic Fabrication Processes– oxidation -film deposition lithography–etching-ion implantation– diffusion.

UNIT - II:

Surface Micromachining and Bulk Micromachining: Surface Micromachining: Basic process flow– release–stiction-material choices-residual stress-Electroplating. Bulk Micromachining: LIGA-Wet Etch- based-dissolved wafer process-SOI MEMS–Scream–MEMS–RIE–DRIE.

UNIT – III

Mechanics of MEMS Materials: Stress–strain-material properties-measurement & characterization of mechanical parameters. Microstructural Elements: bending moment and strain-flexural rigidity- residual stress boundary conditions-spring combinations.

UNIT – IV

MEMS Devices: Pressure sensors-Accelerometers-Gyroscopes-RF MEMS Switch-Temperature sensors Humidity sensors. Micro actuators: Electrostatic–piezoelectric–SMA–Thermoelectric- electromagnetic.

UNIT – V

Fluid Dynamics and Micro pumps: Viscosity–density-surface tension-continuity equation-Newton's second law-Navier-Stokes equation and its interpretation-flow types.

Micro fluidics: Electro kinetics electro osmosis–electrophoresis-fabrication methods-Lab ona Chip–micropumps-microvalves.

Text Books:

1. MEMS & Microsystems Design and Manufacture/ Tai-Ran Hsu/ Tata Mc Graw Hill.
2. Microelectromechanical Systems / Bhattacharyya / Cengage.

Reference Books:

1. Foundations of MEMS /Chang Liu / Pearson.
2. MEMS/ Mahalik/ Mc Graw Hill.
3. MEMS and MOEMS Technology and Applications/ PHI.
4. Microsystems Design/ Stephen D. Senturia /Springer.
5. Introductory MEMS – Fabrication and Applications/ Thomas M. Adams and Richard A Layton/ Springer.
6. Microelectronic Devices/ Dipankar Nagchaudhuri/ Pearson Education Asia.

ME721PE: POWER PLANT ENGINEERING (PE – III)

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME721PE	**Core**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: None

Course Objectives: The goal of this course is to become prepared for professional engineering design of conventional and alternative power-generation plants. The learning objectives include

1. Basic knowledge of Different types of Power Plants, site selection criteria of each one of them.
2. Understanding of Thermal Power Plant Operation, turbine governing, different types of high-pressure boilers including supercritical and supercharged boilers, Fluidized bed combustion systems.
3. Design of chimney in thermal power plants, knowledge of cooling tower operation, numerical on surface condenser design.
4. Basic knowledge of Different types of nuclear power plants including Pressurized water reactor, Boiling water reactor, gas cooled reactor, liquid metal fast breeder reactor.
5. Understanding of Power Plant Economics, Energy Storage including compressed air energy and pumped hydro etc.
6. Discussing environmental and safety aspects of power plant operation.

Course Outcomes: At the end of the course students are able to:

1. Understand the concept of Rankine cycle.
2. Understand working of boilers including water tube, fire tube and high pressure boilers and determine efficiencies.
3. Analyze the flow of steam through nozzles.
4. Evaluate the performance of condensers and steam turbines.
5. Evaluate the performance of gas turbines.

UNIT – I

Introduction to the Sources of Energy – Resources and Development of Power in India.

Steam Power Plant: Plant Layout, Working of different Circuits, Fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.

Combustion Process: Properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.

UNIT – II

Internal Combustion Engine Plant: Diesel Power Plant: Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging.

Gas Turbine Plant: Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison.

UNIT – III

Hydro Electric Power Plant: Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways.

Hydro Projects and Plant: Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants.

UNIT - IV

Nuclear Power Station: Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation. Types of Reactors: Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

UNIT – V

Power Plant Economics and Environmental Considerations: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.

Text Books:

1. Power Plant Engineering/ P. K. Nag / Mc Graw Hill.
2. Power Plant Engineering / Hegde / Pearson.

Reference Books:

1. Power Plant Engineering / Gupta / PHI.
2. Power Plant Engineering / A K Raja / New age.

MT701PC/ME722PE: AUTOMOBILE ENGINEERING (PE – III)

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
MT701PC/ME722PE	**Core**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Course Objectives:

1. The anatomy of the automobile in general.
2. The location and importance of each part.
3. The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles, and wheels.
4. Suspension, frame, springs, and other connections.
5. Emissions, ignition, controls, electrical systems and ventilation.

Course Outcomes:

1. Identify the different parts of the automobile.
2. Explain the working of various parts like engine, transmission, clutch, brakes.
3. Describe how the steering and the suspension systems operate.
4. Understand the environmental implications of automobile emissions.
5. Develop a strong base for understanding future developments in the automobile industry.

UNIT – I

Introduction: Layout of automobile – introduction chassis and body components. Types of Automobile engines. – Power unit – Introduction to engine lubrication – engine servicing

Fuel System: S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters – carburetor – types – air filters – petrol injection. Introduction to MPFI and GDI Systems.

C.I. Engines: Requirements of diesel injection systems, types of injection systems, DI Systems IDI systems. Fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. Introduction to CRDI and TDI Systems.

UNIT – II

Cooling System: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporative cooling

pressure sealed cooling – antifreeze solutions.

Ignition System: Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser, and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

Electrical System: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

UNIT – III

Transmission System: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, constant mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

Suspension System: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, independent suspension system.

UNIT - IV

Braking System: Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes.

Steering System: Steering geometry – camber, castor, king pin rake, combined angle toein, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

UNIT – V

Emissions from Automobiles – Pollution standards National and international – Pollution Control – Techniques – Multipoint fuel injection for SI Engines. Common rail diesel injection Energy alternatives

Solar, Photo-voltaic, hydrogen, Biomass, alcohols, LPG, CNG, liquid Fuels, and gaseous fuels, Hydrogen as a fuel for IC Engines. - Their merits and demerits. Standard Vehicle maintenance practice.

Text Books:

1. Automobile Engineering / William H Crouse.
2. A Text Book Automobile Engineering–Manzoor, Nawazish Mehdi & Yosuf Ali, Frontline Publications.

Reference Books:

1. A Text Book of Automobile Engineering by R K Rajput. Laxmi Publications.
2. Automotive Mechanics / Heitner.
3. Automotive Engineering / Newton Steeds & Garrett.
4. Automotive Engines / Srinivasan.
5. A Text Book of Automobile Engineering By Khalil U Siddiqui New Age International.

ME723PE: RENEWABLE ENERGY SOURCES (PE – III)

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME723PE	**Core**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Course Objectives:

1. To explain the concepts of Non-renewable and renewable energy systems.
2. To outline utilization of renewable energy sources for both domestic and industrial applications.
3. To analyse the environmental and cost economics of renewable energy sources in comparison with fossil fuels.
4. At the end of the course, the students are expected to identify the new methodologies / technologies for effective utilization of renewable energy.
5. Understanding working principles and concepts of different renewable energy technologies.

Course Outcomes:

1. Understanding of renewable energy sources.
2. Knowledge of working principle of various energy systems.
3. Capability to carry out basic design of renewable energy systems.
4. To understand the concept of energy Conservation.
5. To get the utilization of Biogas plants and geothermal energy.

UNIT – I

Global and National Energy Scenario: Over view of conventional & renewable energy sources, need & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, CO_2 reduction potential of renewable energy-concept of Hybrid systems.

UNIT – II

Solar Energy: Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal, applications of solar energy systems.

UNIT – III

Wind Energy: Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection, Types of wind turbines, Wind farms, wind Generation and Control. Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy – Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices. Wind mill component design, economics and demand side management, energy wheeling, and energy banking concepts. Safety and environmental aspects, wind energy potential and installation in India.

UNIT - IV

Biogas: Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

UNIT – V

Ocean Energy: Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.

1. **Small hydro Power Plant:** Importance of small hydro power plants and their Elements, types of turbines for small hydro, estimation of primary and secondary power.
2. **Geothermal Energy**: Geothermal power plants, various types, hot springs and steam ejection.

Text Books:

1. Renewable Energy Sources / Twidell, J.W. and Weir, A./ EFN Spon Ltd., 1986.
2. Non-Conventional Energy Sources / G.D Rai/ Khanna Publishers.

Reference Books:

1. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012.
2. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

ME731PE: COMPUTATIONAL FLUID DYNAMICS (PE – IV)

B.Tech.IV. Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME731PE	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Heat Transfer and Fluid Mechanics

Course Objective:

1. To apply the principles of Heat Transfer and Fluid Mechanics to formulate governing equations for physical problems and to solve those using different numerical techniques.
2. To learn the process of creating and exploring a mesh by using any available mesh-generation software packages.
3. To learn how to set suitable boundary conditions and numerical models using any available CFD software packages.
4. To explore the post-processing facilities of the CFD code to explore the results.
5. To assess the computational results against the published experimental and numerical data.

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

1. Differentiate between different types of Partial Differential Equations and to know and understand appropriate numerical techniques.
2. Solve the simple heat transfer and fluid flow problems using different numerical techniques, viz., FDM.
3. Understand and to appreciate the need for validation of numerical solution.
4. Understand transition from laminar to turbulent flow, effect of turbulence on time averaged Navier Stokes equations.
5. Understand and apply mixing length model, the k-e model, Reynolds stress equation model and Algebraic stress equation models.

UNIT – I

Basic Aspects of the Governing Equations – Physical Boundary Conditions – Methods of solutions of Physical Problems – Need for Computational Fluid Dynamics – Different numerical/CFD techniques – FDM, FEM, FVM etc., - Main working principle - CFD as a research and design tool – Applications in various branches of Engineering

Mathematical behavior of Partial Differential Equations (Governing Equations): Classification of linear/ quasi linear PDE – Examples - Physical Processes: Wave Equations and Equations of Heat Transfer and Fluid Flow – Mathematical Behavior - General characteristics – Its significance in understanding the physical and numerical aspects of the PDE – One way and Two way variables – Well posed problems – Initial and Boundary Conditions

Solution of Simultaneous Algebraic Equations: Direct Method – Gauss Elimination – LU Decomposition

Pivoting – Treatment of Banded Matrices – Thomas Algorithm Iterative Method: Gauss Seidel and Jordan Methods – Stability Criterion.

UNIT – II

Finite Difference Method: Basic aspects of Discretization – Finite Difference formulae for first order and second order terms – Solution of physical problems with Elliptic type of Governing Equations for different boundary conditions - Numerical treatment of 1D and 2D problems in heat conduction, beams etc., - Solutions –Treatment of Curvelinear coordinates – Singularities – Finite Difference Discretization-Solution of 1D heat conduction problems in Heat conduction in curve linear coordinates.

UNIT – III

FDM: Solution of physical problems with Parabolic type of Governing Equations – Initial Condition – Explicit, implicit and semi implicit methods – Types of errors – Stability and Consistency – Von Neumann Stability criterion– Solution of simple physical problems in 1D and 2D – Transient Heat conduction problems- ADI scheme - Simple Hyperbolic type PDE - First order and Second order wave equations – Discretization using Explicit method - Stability criterion – Courant Number – CFL Condition - Its significance - Treatment of simple problems.

UNIT – IV

Finite Difference Solution of Unsteady Inviscid Flows: Lax – Wendroff Technique – Disadvantages – Maccormack's Technique

Fluid Flow Equations – Finite Difference Solutions of 2D Viscous Incompressible flow problems – Vorticity and Stream Function Formulation – Finite Difference treatment of Lid Driven Cavity Problem - Application to Cylindrical Coordinates with example of flow over infinitely long cylinder and sphere – Obtaining Elliptic Equations.

UNIT – V

Finite Difference Applications in Fluid flow problems: Fundamentals of fluid Flow modeling using Burger's Equation – Discretization using FTCS method with respect to Upwind Scheme and Transport Property – Upwind Scheme and Artificial Viscosity

Solutions of Navier Stokes Equations for Incompressible Fluid Flows: Staggered Grid – Marker and Cell (MAC) Formulation – Numerical Stability Considerations – Pressure correction method - SIMPLE Algorithm.

Text Books:

1. Computational Fluid Dynamics: The basics with applications/ John D Anderson/McGraw Hill Publications.
2. Numerical Heat Transfer and Fluid Flow/ S.V. Patankar/ Mc Graw Hill.

Reference Books:

1. Computational Fluid Flow and Heat Transfer / K Muralidharan and T Sudarajan/ Narosa Publishers.
2. Computational Methods for Fluid Dynamics / Firziger & Peric/ Springer.

ME732PE: TURBO MACHINERY (PE – IV)

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ME732PE	**Core**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Prerequisite: Thermal Engineering, Heat Transfer

Course Objectives:

1. Provide students with opportunities to apply basic flow equations.
2. Train the students to acquire the knowledge and skill of analyzing different turbo machines.
3. How to compare and chose machines for various operations.
4. Define Turbomachine & Identify the main parts of turbo machines, Classify turbo machines. and compare it with positive displacement machines.
5. Discuss the effect of Reynolds number, specific speed & dimensionless parameters and their physical significance on turbo machines.

Course Outcomes:

1. Ability to design and calculate different parameters for turbo machines.
2. Prerequisite to CFD and Industrial fluid power courses.
3. Ability to formulate design criteria.
4. Ability to understand thermodynamics and kinematics behind turbo machines.
5. Analyze the performance of turbo machinery.

UNIT – I

Introduction to Turbomachinery: Classification of turbo-machines, second law of thermodynamics applied to turbine and compressors work, nozzle, diffuser work, fluid equation, continuity, Euler‘s, Bernoulli‘s, equation and its applications, expansion and compression process, reheat factor, preheat factor.

UNIT - II

Fundamental Concepts of Axial and Radial Machines: Euler‘s equation of energy transfer, vane congruent flow, influence of relative circulation, thickness of vanes, number of vanes on velocity triangles, slip factor, Stodola, Stanitz and Balje‘s slip factor, suction pressure and net positive suction head, phenomena of cavitation in pumps, concept of specific speed, shape number, axial, radial and mixed flow machines, similarity laws.

UNIT – III

Gas Dynamics: Fundamental thermodynamic concepts, isentropic conditions, mach numbers, and area, Velocity relations, Dynamic Pressure, Normal shock relation for perfect gas. Supersonic flow, oblique shock waves. Normal shock recoveries, detached shocks, Aerofoil theory.

Centrifugal compressor: Types, Velocity triangles and efficiencies, Blade passage design, Diffuser and pressure recovery. Slip factor, Stanitz and Stodolas formula's, Effect of inlet mach numbers, Pre whirl, Performance.

UNIT - IV

Axial Flow Compressors: Flow Analysis, Work, and velocity triangles, Efficiencies, Thermodynamic analysis. Stage pressure rise, Degree of reaction, Stage Loading, General design, Effect of velocity, Incidence, Performance

Cascade Analysis: Geometrical and terminology. Blade force, Efficiencies, Losses, Free end force, Vortex Blades.

UNIT – V

Axial Flow Gas Turbines: Work done. Velocity triangle and efficiencies, Thermodynamic flow analysis, Degree of reaction, Zweifels relation, Design cascade analysis, Soderberg, Hawthrone, Ainley, Correlations, Secondary flow, Free vortex blade, Blade angles for variable degree of reaction. Actuator disc, Theory, Stress in blades, Blade assembling, Material and cooling of blades, Performances, Matching of compressors and turbines, off design performance.

Text Books:

1. Principles of Turbo Machines/DG Shepherd / Macmillan.
2. Turbines, Pumps, Compressors/Yahya/ Mc Graw Hill.

Reference Books:

1. A Treatise on Turbo machines / G. Gopal Krishnan and D. Prithviraj/ SciTech.
2. Gas Turbine Theory/ Saravanamuttoo/ Pearson.
3. Turbo Machines/ A Valan Arasu/ Vikas Publishing House Pvt. Ltd.

ME733PE: FLUID POWER SYSTEMS (PE – IV)

B.Tech.IV Year I Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ME733PE	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

Prerequisite: Fluid Mechanics and Hydraulics Machinery

Course Objectives:

1. To know the concepts of hydraulics & pneumatics, components of hydraulic and pneumatic circuits and applications of hydraulics and pneumatics in automobiles.
2. Design of hydraulic and pneumatic circuits for selected industrial applications.
3. Design and understand the electro-hydraulic and electro-pneumatic circuits.
4. Electrical controls in fluid power systems.
5. Understand standard symbols, pumps, control valves, control assemblies, and actuators.

Course Outcomes: After doing this, student should be able to

1. Understand the Properties of fluids, Fluids for hydraulic systems.
2. Governing laws. Distribution of fluid power, Design and analysis of typical hydraulic circuits.
3. Know accessories used in fluid power system, Filtration systems and maintenance of system.
4. Select suitable pump, motor, and other components for a specified application.
5. Design the circuit for a given application and execute the same in industry.

UNIT – I

Introduction to oil hydraulics and pneumatics, their structure, advantages, and limitations. ISO symbols, energy losses in hydraulic systems. Applications, Basic types, and constructions of Hydraulic pumps and motors. Pump and motor analysis. Perform an curves and parameters.

UNIT – II

Hydraulic actuators, types and constructional details, lever systems, control elements – direction, pressure and flow control valves. Valve configurations, General valve analysis, valve lap, flow forces and lateral forces on spool valves. Series and parallel pressure compensation flow control valves. Flapper valve Analysis and Design.

UNIT – III

Proportional control valves and servo valves. Nonlinearities in control systems (backlash, hysteresis, dead band and friction nonlinearities). Design and analysis of typical hydraulic circuits. Regenerative circuits, high low circuits, Synchronization circuits, and accumulator sizing.

UNIT – IV

Intensifier circuits Meter-in, Meter-out and Bleed-off circuits; Fail Safe and Counter balancing circuits, accessories used in fluid power system, Filtration systems and maintenance of system. Components of pneumatic systems; Direction, flow and pressure control valves in pneumatic systems. Development of single and multiple actuator circuits. Valves for logic functions; Time delay valve; Exhaust and supply air throttling.

UNIT – V

Examples of typical circuits using Displacement – Time and Travel-Step diagrams. Will-dependent control, Travel-dependent control and Time dependent control, combined control, Program Control, Electropneumatic control and air-hydraulic control, Ladder diagrams. Applications in Assembly, Feeding, Metal working, materials handling and plastics working.

Text Books:

1. Fluid Power Control systems/ Pippenger, J.J., and R. M. Koff/ New York: McGraw Hill.
2. "Fluid Power Systems: modeling, simulation and microcomputer control"/ John Watton/ Prentice Hall International.

Reference Books:

1. Fundamentals of Fluid Power Control. / John Watton/ 1 st Ed. Cambridge University Press, 2009.
2. "Fluid Power with applications"/ Anthony Esposito / Pearson Education.

ME700OE: BASIC MECHANICAL ENGINEERING (Open Elective – II)

B.Tech.IV Year I Semester								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
ME700OE	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

Course Objectives:

1. Understanding of the basic concepts of various aspects of Mechanical Engineering, fields of application, their merits, demerits, and limitations and applications.
2. To provide knowledge about application of conduction, convection and radiation heat transfer concepts to different practical applications.
3. Analysis of mechanisms.
4. Cam profile drawing for various followers.
5. Drawing displacement diagrams for followers with various types of motions.

Course Outcomes:

1. Understand the basic modes of heat transfer.
2. Designing a suitable mechanism depending on application
3. Selecting gear and gear train depending on application.

UNIT – I

Basic Concepts of Thermodynamics and Heat Transfer: Definitions – continuum concept – properties – point and path functions – systems – processes – thermodynamic equilibrium - laws of thermodynamic- First law applied to open and closed systems – steady and unsteady flow systems- Second law – heat engines and heat pumps – efficiency and Coefficient of Performance (COP). Heat transfer – conduction – general conduction equation in Cartesian coordinates – conduction in composite walls. Convection – free and forced convection – simple empirical correlations. Radiation – laws – black body and grey body radiation.

UNIT – II

IC Engines and Air Conditioning: I C engines – classification - construction and working - two and four stroke engines – S I and C.I. engines – powdered coal as an alternative to diesel fuel.

Air conditioning – air cycles, vapour compression cycle – vapour absorption cycle – psychrometric processes. Air cooling – methods and simple cooling load calculations. Systems applicable to mining environment.

UNIT – III

Power Transmission: Gears – nomenclature, laws of gearing, types of gears including rack and pinion, interference, gear trains, calculation of gear ratios, couplings - types, features and applications.

Basic concepts in hydraulic & pneumatic power and devices and their utilisation – simple calculations.

UNIT – IV

Kinematics of Machines: Mechanisms – basics – kinematic concepts and definitions – degree of freedom, mechanical advantage – transmission angle – description of common mechanisms – quick return mechanisms, straight line generators, dwell mechanisms, ratchets and escapements – universal joints.

Cams and followers – terminology and definitions, displacement diagrams – uniform velocity, parabolic and simple harmonic motions.

UNIT – V

Rotodynamic and Vibratory Machines: Fans and compressors – types, construction, working principle, characteristics and applications. Single stage and multistage air compressors – intercooling. Simple calculations for output and efficiency.

Vibration – Importance of free and forced vibration. Vibrators and shakers – construction, working principle, applications and limitations.

Note: HMT Data book to be permitted.

Text Books:

1. Elements of Mechanical Engineering/ S.N. Lal/ Cengage Learning.
2. Theory of Machines and Mechanisms / Shigley J.E., Pennock G.R. and Uicker J. J./ Oxford University Press, 2003.

Reference Books:

1. Rajput, R.K. Thermal Engineering, 6th Edition, Laxmi Publications, 2007.
2. Ballaney, P.L. Thermal Engineering, Khanna Publishers, 24th Edition, 2003.