SYLLABUS OF B.E. SEM. VII (MECHANICAL ENGINEERING) [C.B.C.S.]

SEMESTER VII

7ME01 MECHATRONICS

Course Learning Objectives (CLOs):

1. To study various types of switches, sensors, motors and their working.
1. To understand the concept of computer process control.
2. To study various parts of mechatronic system.
3. To study various types of valves and their working.
4. To understand and create pneumatic and hydraulic circuits for various industrial applications.

Course outcomes (CO):

2. Understand the concept of computer process control.
3. Create the working models for various mechatronics system for industrial applications.
4. Create mini projects on material handling systems like pick and place type robot, machine loading system etc.
5. Create pneumatic and hydraulic circuits for various industrial applications.

SECTION-A

Unit I: Introduction to Mechatronics:
Definition, Block diagram & Example, Basics of Sensors, Position & Speed Sensors, Proximity Sensors & Switches, LVDT, Digital optical encoder, Temperature Sensors Actuators-Functions, Electromagnetic Principles, Solenoids and Relays, working of DC motors and stepper motors, hydraulic and pneumatic actuators. **(6 Hrs)**

Unit II: Data Acquisition: Analog signal processing using operational amplifier- Introduction, types of amplifiers, sample and hold circuit, introduction to data acaquisiton, sampling thermo, Quantizing theory, Analog to digital conversion, Analog todigitalconvertor, Digital to analog conversion, Multiplexer. **(6Hrs)**

Unit III: Mechatronic Systems – control architecture Introduction, Control architecture, Analog circuits, digital circuits, Design of logic networks, sequential logic, flip-flops, application of flip-flops, micro-controls, Programmable logic controller. **(6 Hrs)**

SECTION-B

UnitIV: Control Valves
Study of different control components and pneumatic & Hydraulic system- Construction, worling and function of Directional control valve, Flow control valves, Pressure relief valve, pressure reducing valve, sequence valve with symbols. **(7 Hrs)**

Unit V: Pneumatic System
Design and analysis of pneumatic circuits, Synchronizing, Powerchucking operations, controlling the rate of speed of piston, circuit to move with piece around a corner, circuit to move a workpiece at a constant speed. **(6 Hrs)**

Unit VI: Hydraulic System
Design analysis of Hydraulic systems-Sequencing, pneumo-hydraulic, regeneration circuit, circuit to control tool movement on lathers, grinders, etc**.** **(7Hrs)**

BOOKS RECOMMENDED:

Text Books:

1. Introduction to Mechatronics and Measurement systems- 2/e byAciatore and M.B.Histant, Tata McGraw Hilledition.
2. Pneumatics and Hydrautics by H.L.Stewart.

Reference Books:

1) Introduction to Mechatronics by Appus Kuttan K.K.- OxfordUniversity Press.
2) Mechatronics – A multidisciplinary approach 4/e by W.Bolton-Pearson Publication,
3) Automation, Production systems and CIM by M.PGroover- PearsonPublication.

7ME02 PRODUCTIVITY TECHNIQUES

Course Learning Objectives:

1-To measure and evaluate productivity
2-To Plan and implement various productivity techniques3-Reengineer the process for improve productivity
4-To implement BPR tools for improving the productivity

Course Outcomes: After learning the course the students should be able to:

1. Understand Productivity.
2. Differentiate Method Study & Work Measurement.
3. Apply Ergonomics Principles.
4. Analyze Wedge payment & Incentive Plans.
5. Implement reengineering.
6. Understand different Maintenance methods.

SECTION-A

UNIT-I: **Productivity** Definition, Concept and Importance of productivity, Difference between Production and Productivity, Tools of productivity, Reasons for low productivity, Factors that help increasing productivity, Productivity index, Productivity ratio , Kinds of productivity measurement, Causes of low productivity and techniques of their elimination, Factors affecting productivity, Technical methods to improve productivity, Main contributors to productivity improvement, Advantages from increased productivity. **(7 Hrs)**

UNIT-II: **Method Study** Definition, Concept , Objectives and Procedure of method study, Process chart symbols, recording techniques like Flow process charts, Operation, Flow and Two handed Process charts, Flow diagram, String diagram, Multiple Activity chart, Operation Analysis, Analysis of motion, Motion economy, Design of work place layout, Therbligs, SIMO chart. **(7 Hrs)**

UNIT-III-Work Measurement Definition, Concept and Objectives of work measurement, Stop watch procedure for collecting time study data, Time estimating techniques like analytical estimating, Predetermine Motion Time System-PMTS, Elemental Motion Time System, Basic Motion Time System, Method Time Measurement, Work factor. **(7 Hrs)**

SECTION-B

UNIT-IV-Ergonomics Introduction, Principles, Work system design, Man-machine system, Human behavior andequipment design, Tools, Techniques and applications, Effect of environment on performance of worker. **(7 Hrs)**

UNIT-V- Performance Rating, Wage Payment & Incentive Plans Introduction, Various incentive schemes,Performance Rating. **Contemporary Issues in Productivity** Activities of National Productivity Council and other organizations, Productivity Scenario and changes. **(7 Hrs)**

UNIT-VI: **Business Process Re-engineering (BPR)** Introduction, Development of Business Process Re-engine, BPR is not for everyone, Advantages of BPR, Steps involved in BPR, Application of BPR, Training for BPR, When to reengineer, Ways to fail at BPR, Requirements of BPR, Human Resource Engineering, Fundamentals of BPR, Implementation methodology of BPR, Organizational re-engineering, Organizational reengineering process, Reengineering values, Approach to reengineering, Re-engineering tools, What re-engineering is not, Kinds of changes that occurs in re-engineering, succeeding. **(7 Hrs)**

RECOMMENDED BOOKS:

Text Books:

1.Work Study, Khanna , Dhanpat Rai Publications2.Total Quality Management , K.C.Arora, Katsons
3.Industrial Engineering and Management, Khana, Dhanpat Rai.

Reference Books:

1. Introduction to Work study, ILO, Oxford
2. Industrial Engineering and Management, Reddy, New Age
3. Industrial Engineering and Management, Verma.

7ME03 INDUSTRIAL MANAGEMENT & COSTING

Course Learning Objectives (CLOs):

1. To study basic concepts & techniques of management.
2. To study the concept of marketing management.
3. To understand the personnel management & materials management techniques.
4. To study the estimation procedure for raw material and machining processes in manufacturing.
5. To study the costing process & costing techniques.
6. To study business finance, financial statements and depreciation analysis.

Course Objectives (COs):

1. Understand the working of business environment.
2. Understand the management thoughts, its evolution and functions.
3. Apply standard and scientific techniques in materials management.
4. Evaluate time, costs, cost sheet and depreciation of industry.

SECTION-A

UNIT I: Concept, Principles and Techniques of Management; Evolution of management thoughts, functions of management, organization structure & relationship. **(6-Hrs)**

UNIT II: Marketing and Management : Marketing strategy market research, buying, motives, types of market, new product development, Product life cycle, Sales Organization, advertising, methods of selling,consumer behavior. **(6-Hrs)**

UNIT III: a) Functions of personnel management, Human resource planning, Recruitment, training and development, workers participation in management, joint consultation, collective bargaining.
b) Materials management, classes of materials, scope of material control, scope and function of purchasing department, purchasing procedure, inventory control, ordering procedure, material identification, store function. . **(7Hrs)**

SECTION-B

UNIT IV: Objectives, functions, principle factors of estimating and estimating procedure, Estimation of weights & materials, Estimation of machining time, estimation of fabrication cost, forging cost, and foundry cost. **(6-Hrs)**

UNIT V : a) Introduction to costing and costing Techniques: Definitions, objectives, elements of costs, components of cost, job costing, simple process costing, normal and subnormal losses in process, waste, scrap. **(8 Hrs)**

UNITVI: a) Financing of Business: - Basis of business finance, need of finance, Kinds of capital, sources of fixed& working capital.
b) Financial statements :- Profit and loss statement, balance sheet
c) Depreciation Analysis: - Causes and significance, methods of calculation of depreciation. **(7 Hrs)**

BOOKS RECOMMENDED:

Text Books:

1. Management-principles, processes and practicals, Anil Bhat, Aryakumar; Oxford UniversityPress
2. Management Accounting; Paresh Shah; Oxford University Press
3. Estimating and costing; TTTI Madras.

Reference Books:

1. Essentials of Management; Koontz, Harold; McGraw-HillEducation(India)
2. Cost Accounting; Jawahar Lal; Tata Mcgraw Hill Publishing
3. Cost Accounting by Bhar.

7ME04 ENERGY CONVERSION– II

Course Learning Objectives (CLOs):

1. To study the construction, working and overall performance of a reciprocating compressor.
2. To study the construction, working and overall performance of a rotary compressor.
3. To study the vapour compression refrigeration system with reference to domestic refrigerator.
4. To study various types of air conditioning systems.
5. To study various aspects of a gas turbine plant along with different techniques to improve its performance.

Course Outcomes (CO):

1. Understand the working of different types of compressors.
2. Analyze, handle and resolve the problems related to working of air compressor.
3. Understand the principle of working of refrigeration systems, air conditioning and its applications.
4. Understand various nuclear reactions and issues related to working and maintenance of nuclear powergeneration.

SECTION–A

UNIT-I: **Reciprocating, Air Compressions**: - Industrial uses of compressed air, Methods of compression and efficiencies of compression, Methods of reducing losses during compression single and multistage of compressions, clearance volume and its effect on work done and volumetric efficiency, condition forminimum work in tow stage compression, inter-cooling and itseffects, Overall, isothermal and adiabatic efficiencies, IHP, BHP,requirements and after cooler. **(7 Hours)**

UNIT-II: **Rotary Compressors** :- Comparison between reciprocating androtary compressors, difference between fans, blowers and compressors, general equations for rotary machines, Vane, Roots blower, construction, working and velocity diagrams of centrifugal and axial flow compressors, performance characteristics of blowers and compressors. **(8 Hours)**

UNIT-III: **Refrigeration:** Principle of refrigeration, Applications, Unit of refrigeration, Carnot vapour cycle,reversed heat engine, COP. Air refrigeration System, Vapour compression Refrigeration cycle Coefficient of Performance, Numerical based on simple saturated cycle. Vapour absorption refrigeration systems **(8 hours)**

SECTION-B

UNIT IV: Air-conditioning: Principle of Air conditioning, Classification and applications of Air conditioning system, Psychometric, Psychometric chart, Psychometric processes related to Air conditioning, Adiabatic Mixing of two Air-streams. Elementary simple problems based on Psychometric chart. **(7 hours)**

UNIT -V: **Classification of gas turbines**, construction and working Gas turbine ideal and actual cycles constant volume, constant pressure, (Open and Closed) cycle analysis, Inter cooling, Regeneration and reheating application, optimum and maximum pressure ratios, work rations, Performance characteristics. Fields of application of gas turbine power plant, Introduction to Jet Propulsion, Ram jet, turbo jet. (No numericaltreatment for Jet Propulsion). **(8 Hours)**

UNIT-VI: **Introduction to Automobiles and Electric vehicles:**

General lay out of the automobile, Classification of automobiles, various subsystems and their role. Basics of vehicle performance.

Introduction to Hybrid and Electric Vehicles: basic concept of hybrid and electric vehicles and their configurations, environmental importance of hybrid and electric vehicles, Basic concept of electric traction and architecture. Introduction to electric components used in hybrid and electric vehicles, Configuration and control of; drives use in EV. **(8 Hours)**

RECOMMENDED BOOKS:

Text Books:

1. Steam and gas turbines R, Yadav; Central Publication Allahabad.
2. Thermal Engineering, Domkundwar, Kothandarawar, Dhanpat Rai &Co.
3. Power Plant Engineering; R.K.Rajput; Laxmi publication.
4. Solar Energy by S.P.Sukhatme; Tata McGraw-Hill in New Delhi.

ReferenceBooks:

1. Thermal engineering by Mahesh M.Rathore; Tata McGraw-Hill inNew Delhi
2. Gas Turbines Theory- By Cohen and C.F.Rogers, P.H.I.H.Saravanamuttoo Heritage Publishers,
3. Gas Turbines and Rotarycompressors, Khajuria and Dubey, DhanpatRai & Co.
4. Thermal Engineering: R.K.Rajput, Laxmi Publication.
5. Renewable Energy; Godbfrey Boyle, Oxford University Press.

7ME05 PROFESSIONAL ELECTIVE– II

7ME05 (i) COMPUTER INTEGRATED MANUFACTURING

Course Learning Objectives:

1. Apply technical knowledge of manufacturing processes to the fabrication of mechanical parts.
2. To produce knowledgeable users of CAD systems.
3. Understand the various CAD/CAM and CNC processes.
4. To understand the associatively between design and manufacturing.

Course Outcomes:

1. Able to specify a quality control method for analyzing a finished product.
2. To develop a strategy for implementing computer integrated manufacturing.
3. To synthesize and apply the concepts learnt

4. Describe various operation in numerical control system and part programming
5. Describe CNC machining and interfaces of CAM and CNC
6. Undertake, under supervision, laboratory experiments to design in CAD and to program in CAMfor machining.

SECTION A

Unit I - Computer aided design, Fundamentals of CAD, Design process, Application of computer for Design, The design of workstation, Function of graphic package , constructing the geometry, Transformation (2D), wire frame , Surface , Solid modeling, Benefits of CAD. **(7-Hrs)**

Unit II-Computer aided manufacturing:- Automation and its types, Numerical control, Basic concept, NC Control- point to point, Straight line, Continuous path control, Machine control unit, Drives in NC/CNC- Servoand Stepper motors, CNC & DNC types**(7-Hrs)**

Unit III-CNC Part Programming: Part programming manual, Computer assisted part programming, Programming formats, Programming codes, Programming for drilling, milling, turning. Programming with APT: MACRO statements, Subroutine and loops in programming. **(7-Hrs)**

SECTION B

Unit IV-Robotics: Technical features of robots, Geometric configurations of robots, Robot anatomy, Arm geometry, End effectors, Drives system, sensors- tactile, proximity range finder, machine vision, work cell controller and interlocking sensor commands, programming technique for robot, Application of robots in manufacturing, Economic justification of robots (Payback, Returns on Investment methods). **(7-Hrs)**

Unit V -Flexible Manufacturing System:
Basic concept, group technology, part families, part classification and coding system, GT machine cells, Types of FMS, FMS layout configurations, Planning of FMS, Types of CAPP. **(7-Hrs)**

Unit VI-Computer Integrated Manufacturing:
Concept, Elements of CIM system, Structure of CIM data base system, CIM wheel, CIM shop floor control and process monitoring, Automation.
Inspection and testing: - Online and offline inspection, Distributed inspection.
ASRS and its elements, AGVS, Guidance, routing and traffic control in AGV. **(7-Hrs)**

BOOKS RECOMMENDED:

Text Books:

1) Robotics by Rajput
2) CAD/CAM by P.N. Rao.

Reference Books:

1) Computer aided Design and Manufacturing by Sadhu Singh
2) Production system, Automation and CIM, Mikhal Groover, Pearson Publication.
3) CNC Machines: M. Aditham & B.S. Pabla, New Age International.

7ME05 (ii) AUTOMOBILE ENGINEERING

Course Learning Objectives (CLOs):

1. To study types of automobiles, chassis and engine types, engine parts, firing orders for multi-cylinder engines,general considerations of engine balancing.
2. To study the fuel feed systems, fuel pump, fuel filters, air filters, MPFI and CRDI systems, types of coolingsystems, antifreeze mixtures.
3. To study electrical system, battery capacity and ratings, starter motor drives, ignition systems, ignition timingand its effect on engine performance, ignition advance mechanisms.
4. To study the transmission system, types of clutches and gear boxes, overdrive, propeller shaft, differential gear,rear axle drives, automatic transmission.
5. To study braking system, types of brakes, steering system, steering gears, steering gear ratio, wheel balancingand alignment, power steering.
6. To study suspension systems, shock absorbers, different lubricants and their properties, engine lubricationsystems, oil pumps, chassis lubrication, and crankcase ventilation.

Course Outcomes (COs):

1. Understand the basics of automobile engineering and its components.
2. Idea creation of cooling system, electrical system and ignition system.
3. Analysis of transmission system and types of gears box.
4. Design and development of suspension and lubrication.

SECTION–A

Unit I : Classification of automobiles, chasis types, Power Unit- Functions and locations power for propulsion, engine parts- types, construction and functions, Multiple cylinder engines, General considerations of engine balancing, firing order. **(7 -Hrs)**

Unit II : Lubrication system: Purpose, types of lubricants, Types of lubricating system- splash, pressure and dry sump lubricating system.
Fuel supply system: types of fuel supply system, components of fuel supply system, M.P.F.I. and C.R.D.I.
Cooling system – purpose, types, bypass recirculation system and antifreeze mixture. **(6-Hrs)**

Unit III: Ignition system- types of ignition system- Battery and Electronic ignition system, Ignition timing, Ignition advance mechanism – centrifugal and vaccum type advanced mechanism.
Starting system- Purpose, starting drives- Bendix drive. **(7 Hrs)**

SECTION – B

Unit IV : Transmission system : Clutches, Single plate & multiplate, Gear Boxes :- Sliding mesh, constant mesh and synchromesh gear box, Automatic gear box.

Differential- Construction and working.

Suspension system- types, telescopic type, shock absorber. **(8 Hrs)**

Unit V: Braking system:- Mechanical, Hydraulic, Vaccum and air brake system, Anti-braking system. Steering system: - Layout, steering gears, wheel alignment, steering geometry, camber, caster, king pin inclination and toe in and out. Power steering- Principle and working.. **(7 Hrs)**

Unit VI: Electric &Hybrid vehicles. Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives.Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles,Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis,Hybridization of different energy storage devices **(8 Hrs)**

BOOKS RECOMMENDED :

Text Books:

1. Automobile Engineering- Vol.I & II, Kirpal Singh, Standard PublishersDistributors
2. Automobile Engineering – R.K.Rajput; Laxmi publications, New Delhi.
3. Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press, 2011.

Reference Books:

1. Automotive Mechanics; Crouse & Anglin, TMH.
2. Automotive Mechanics ; J Heitner; East West Press.
3. Automotive Mechanics ; S.Srinivisan; TMH.
4. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003.

7ME05 (iii) DESIGN OF TRANSMISSION SYSTEM

Course Learning Objectives:

1. To gain knowledge on the principles and procedure for the design of Mechanical power Transmissioncomponents.
2. To understand the standard procedure available for Design of Transmission of Mechanical elements.
3. To learn to use/selection of standard data and catalogues from data book.

Course Outcomes:

Upon the completion of this course the students will be able to design of transmission systems for engines andmachines elements includes -

1. Selection of belts, chains and rope drives
2. Failure theories Gears & design of spur gear
3. Interpret the concepts of design of fluid couplings and torque converters
4. Design of gear boxes
5. Design of design of cams, brakes and clutches

SECTION-A

UNIT I -Design of Flexible Elements:

a) Design &Selection of Flat belts,
b) Selection of V belts,
c) Selection of hoisting wire ropes
d) Selection of transmission roller chains and Sprockets. **(07 Hrs.)**

UNIT II -SPUR GEAR:

Speed ratios and number of teeth, Force analysis, Tooth stresses, Dynamic effects, Fatigue strength, Factor of safety, Gear materials, Design of straight tooth spur. **(06 Hrs.)**

UNIT III: FLUID COUPLING AND TORQUE CONVERTER:

a) Fluid Coupling- Fluid Coupling Diagram, Working Of Fluid Coupling, Application of Fluid Coupling.
b) Torque Converters – Torque Converter Diagram, working of Torque converter , Application of TorqueConverter. Difference between Fluid Coupling and Torque Converter. **(06 Hrs.)**

SECTION-B

UNIT IV GEAR BOXES:

Geometric progression, Standard step ratio, Ray diagram, kinematics layout, Design of sliding mesh gear box, working of constant mesh gear box, working of multi speed gear boxes. **(07 Hrs.)**

UNIT V CAMS:

Cam Design: Types, pressure angle and under cutting base circle determination, forces and surface stresses. **(06 Hrs.)**

UNIT VI CLUTCHES AND BRAKES

a) Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches, Concept & working ofElectromagnetic clutches.
b) Design of Band and Block brakes, external shoe brakes, Internal expanding shoe brake. **(07 Hrs.)**

BOOKS RECOMMENDED:

Text Books:

1) Machine Design- R.S.Khurmi and Gupta J.K., Published by S Chand.
2) Machine Design-Dr.P.C.Sharma, D.K.Agrawal, S.K.Kataria and Son's Publications.
3) Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai.

Reference Books:

1) Machine Design Exercises - S.N. Trikha, Khanna Publications, Delhi
2) Machine Design - An Integrated Approach - Robert L. Norton - Pearson Education Asia.
3) Maitra G.M., Prasad L.V., "Hand book of Mechanical Design", II Edition, Tata McGrawHill.
4) Machine Design fundamentals –Mechanical designer workbook, J.E.Shigley, Published by Mc Graw hill.
5) Design of Machine Elements-V B Bhandari,McGraw hill .
6) Machine Elements in Mechanical M.F. Spotts , prentice hall india,
7) Machine Design, Black P.H., Published by Mc Graw Hill.
8) Design Data Book by- P.S.G. Coimbatore,
9) Design Data Book by V.B.Bhandari,

(Use of any data book from the above will be permitted during the examination).

7ME05 (iv) COMPUTATIONAL FLUID DYNAMICS

Course Learning Objectives:

- To numerically **solve** governing partial differential equations for physical problems in fluid mechanics andheat transfer.
- To **analyze** different mathematical models and computational methods for transport processes.
- To **study**, and **apply** discretization methods & schemes and analyze its effect on the accuracy of numericalsolution and computational time.
- To **demonstrate** the ability to use modern CFD software tools.

Course Outcomes:
On completion of the course, student will be able to:

- Numerically **solve** the governing partial differential equations of fluid flow and heat transfer problems.
- **Construct** and solve the different mathematical models and computational methods for fluid flows.
- **Apply** the discretization methods to solve fluid flow and heat transfer problems.
- **Choose** and justify the CFD schemes for the respective fluid flow/transport phenomena problem.
- **Perform** verification and validation of numerical model.
- **Demonstrate** the ability to use modern CFD software tools.

SECTION – A

Unit I: Governing equations and Boundary conditions:
Introduction to Computational Fluid Dynamics, Governing equations of fluid dynamics: Continuity, momentum and energy equations, Classification of partial differential equations: parabolic, elliptic, hyperbolic. Boundary and initialconditions; physical behavior, overview of finite difference, finite element and finite volume methods. Overview ofnumerical methods. **(7-Hrs)**

Unit II: Finite Difference Method - Derivation of finite difference equations – Simple Methods – General Methodsfor first and second order accuracy- explicit, implicit, stability requirement, boundary conditions. Convergence, Errors and analysis of stability. Methods of Solution: Solution of finite difference equations Solution procedures: direct and iterative methods. **(7-Hrs)**

Unit III: Finite volume method: fundamental concepts, discretization of 1-D steady state and 1-D unsteady state diffusion problems, explicit and implicit schemes, consistency, stability and convergence, discretization of 1-D and 2-D diffusion problems. Difference between the FDM and FVM methods. **(7-Hrs)**

SECTION – B

Unit IV: Grid Generation Method: Definition and types of grid, Transformation of equation, Matrices and Jacobians, Stretched Grids, Elliptic Grids, Adaptive grids. Numerical solution of the flow field: QUICK and SIMPLE algorithm. **(7-Hrs)**

Unit V: Turbulence models: Reynolds Average Navier-Stokes equation, RANS turbulence Models, two equation(k-Є) models, Large Eddy Simulation. (Elementary treatment only) **(7-Hrs)**

Unit VI: Introduction to CFD software and Applications:

Application of modern CFD software Open FOAM/ANSYS/FLUENT/STAR-CCM+/MATLAB: analysis for fluid and heat transfer problems. Heat transfer analysis in a double pipe heat exchanger. Internal fluid flow and heat transfer study in a centrifugal pump. Heat conduction study in 2D flat plate. Simulation of a generic convection- diffusion transport equation with forced/natural convention over flat plat/in pipe. External flow analysis over airfoil and over cylinder. **(7-Hrs)**

BOOKS RECOMMENDED:

Text Books:

1. Anderson, D., Tannehill, J. C., &Pletcher, R. H. (2016). Computational fluid mechanics and heat transfer.CRC Press.
2. Patankar, Suhas. Numerical heat transfer and fluid flow. Taylor & Francis, 2018.
3. Introduction to Computational Fluid Dynamics Anil W. Date Cambridge University Press, 2005.
4. Ghoshdastidar, P.S., Computer Simulation of flow and heat transfer, Tata McGraw.

Reference books:

1. Introduction to Computational Fluid Dynamics: The Finite Volume Method, Versteeg, H. K. andMalalasekara, W., Second Edition (Indian Reprint) Pearson Education, 2008.
2. Muralidhar, K., &Sundarajan, T. (2003). Computational fluid flow and heat transfer. Alpha ScienceInternational.
3. Chung, T. J. (2010). Computational fluid dynamics. Cambridge university press.
4. Prodip Niyogi, Chakrabarty .S.K., Laha .M.K. Introduction to Computational Fluid Dynamics, PearsonEducation, 2005.

7ME06 MECHATRONICS – LAB.

Course Learning Objectives:

1. Understand key elements of Mechatronics system, representation into block diagram
2. Understand concept of transfer function, reduction and analysis
3. Understand principles of sensors, its characteristics, interfacing with DAQ microcontroller
4. Understand the concept of PLC system and its ladder programming, and significance of PLC systems inindustrial application
5. Understand the system modeling and analysis in time domain and frequency domain.
6. Understand control actions such as Proportional, derivative and integral and study its significance in industrial applications.

Course Outcomes:

1 - Identification of key elements of mechatronics system and its representation in terms of block diagram.
2 - Understanding the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O. 3 - Interfacing of Sensors, Actuators using appropriate DAQ micro-controller.
4 - Time and Frequency domain analysis of system model (for control application).5 - PID control implementation on real time systems.
6 - Development of PLC ladder programming and implementation of real life system.

List of Practical's: (Any- 5):

1. Study of pneumatic system
2. Study of PLC and implementation of real life system.
3. Study of Pick & Place robot.
4. Study of bottling plant
5. Study of digital to analog converter
6. Study of D.C. motor control unit.
7. To study applications of sensors and actuators

***Practical Examination:** Practical Examination shall consist of viva voce based on the term work and syllabus.

7ME07 ENERGY CONVERSION II–LAB.

Course Learning Objectives:

1. To study performance of a reciprocating compressor.
2. To study the construction, working and overall performance of a rotary compressor.
3. To study the vapour compression refrigeration system with reference to domestic refrigerator.
4. To study various types of air conditioning systems.
5. To study gas turbine plant with different techniques to improve its performance.

Course Outcomes: Students are able to-

1. Understand the working of different types of compressors.
2. Analyze, handle and resolve the problems related to working of air compressor.
3. Understand the principle of working of refrigeration systems, air conditioning and its applications.
4. Understand various nuclear reactions and issues related to working and maintenance of nuclear powergeneration.

List of Experiments (any 8):

Any six of the following:-

1. Trial on reciprocating compressor.
2. Trial on centrifugal blower.
3. Studies of domestic refrigerator.
4. COP calculation of vapour compression system.
5. Study of vapour absorption system
6. Study of room air conditioner.
7. Study of gas turbine with the help of models.
8. Study of general layout of conventional automobile and its subsystems.
9. Study of the general layout of electric vehicle.

***Practical Examination shall consist of viva voce based on above term work.**

7ME08 PROFESSIONAL ELECTIVE – II`
(i) COMPUTER INTEGRATED MANUFACTURING- LAB.

Course Learning Objectives:

1. Apply knowledge of manufacturing processes.
2. Knowledgeable users of CAD systems.
3. Understand the various CAD/CAM and CNC processes.
4. Understand the application based conceptual knowledge design and manufacturing for COE

Course Outcomes:

1. Able to specify a quality control & analyzing a finished product.
2. To apply strategy for implementing computer integrated manufacturing.
3. To synthesize and apply the concepts learnt
4. To understand laboratory experiments to design in CAD and to program in CAM for machining.

List of Practical's: (Any 6):

1. Preparation of Manual part program.
2. Preparation of CNC part program.
3. Study of anatomy, configuration of industrial robot.
4. Simulation of CNC Machining.
5. Performance on NC and CNC m/c.
6. Study of programming methods of industrial robots.
7. Creation of 2D Drawing (Sketching module) of any mechanical machine component using any modeling /draftingsoftware.

8. Creation of 3D drawing (part Module) of any mechanical machine parts using any modeling software.

***Practical Examination shall consist of viva voce based on above term work.**

(ii) AUTOMOBILE ENGINEERING – Lab.

Course Learning Objectives (CLOs):

1) To study types of automobiles and its parts functioning.
2) To study the fuel feed systems, cooling.
3) To study electrical system, battery capacity and ratings.
4) To study the transmission system
5) To study braking system
6) To study and understand suspension systems.

Course Outcomes (COs):

1. Apply basic principles and knowledge of automobile engineering and its components for properfunctioning.
2. Analysis concept of cooling system, electrical system and ignition system.
3. Interpret basic concept of transmission system and types of gears box.
4. Remember the concept of suspension and lubrication.

List of Practical's (Any 6):

1) Classification of Automobiles & Automobile Chassis.
2) Study of Differential Mechanism of an Automobile .
3) Study & Application of Multiple Clutch of an Automobile
4)Study ,working and operation of Braking System (Hydraulic / Air Brake)
5) Study and Demonstration of different circuit of carburetor
6) Checking the spark plug and setting the port and check the ignition in the spark plug
7) Study & Demonstration of Electrical System of an Automobile
8) Study the assembly of Car Engine
9) Study and demonstration of E vehicle.
10) Study of types of Batteries and Batteries maintenance used in E vehicle.
11) To study the stepper motor and to execute microprocessor computer based control of the same by changingnumber of steps, the direction of rotation and speed E vehicle.

****Practical Examination shall consist of viva voce based on above term work.***

(iii) DESIGN OF TRANSMISSION SYSTEMS-LAB.

Course Learning Objectives:

1. To apply standard design procedure available for Design of Transmission of Mechanical elements.
2. To learn to use/selection of standard data from catalogues /data book.

Course Outcomes:

Upon the completion of this course the students will be able:

1. To implement and selection of belts, chains and rope drives
2. To **identify** failure spur gear and design its dimensions.
3. To **study** idea of fluid couplings and torque converters
4. To **interpret** design of gear boxes
5. To **analyze** failure theories of cams, brakes and clutches

List of Exercises for Term Work:

1. Sheet 1: Design of Flexible Elements (any one –flat belt drive, V belt drive or Wire rope).
2. Sheet 2: Design and Selection of Roller Chain with sprocket.
3. Sheet 3: Design of spur gear.
4. Sheet 4: Design Fluid Coupling.
5. Sheet 5: Design of Torque Converter.
6. Sheet 6: Design of sliding mesh gear box.
7. Sheet 7: Design of Plane flat Radial Cam.
8. Design of Clutch (any one - plate clutches, axial clutches, cone clutches, internal expanding rim clutches)
9. Design of Brake (any one - external shoe brakes or Internal expanding shoe brake).

[Note: - Minimum 5 term work should be submitted for lab work.]

***Practical Examination:-**shall consist of Viva-voce on the above syllabus and submission of term work.

(iv) COMPUTATIONAL FLUID DYNAMICS -LAB.

Course Objectives:

- To utilize the various computational tools to understand the fluid flow.
- To employ the various computational tools to comprehend heat transfer problems.
- To apply the knowledge of several numerical schemes to solve the governing equations of physicalsystems.
- To understand and simulate several flow situations with forced/natural convection with Internal andexternal flows.
- To validate the simulation results with that of existing experimental/analytical results.

Course Outcomes:

On completion of the course, student will be able to:

- Understand the computational software tools to analyze the fluid flow problems.
- Utilize various computational tools to comprehend heat transfer problems.
- Classify and evaluate the physics of problems and apply the appropriate discretization schemes.
- Analyze and understand the results through post-processing for a given problem.
- Compare the simulation results with that of existing experimental/analytical results.

List of Experiments: (Any six experiments)

1. Perform numerical analysis on flow through pipe with varying Reynolds Number.
2. To calculate hydrodynamic length and boundary layer thickness for pipe flow numerically.
3. To calculate lift and drag co-efficient for a cylinder by using numerical analysis.
4. External flow analysis over airfoil for different angle of attacks.
5. Fluid flow and heat transfer analysis in a double pipe heat exchanger.
6. Perform Numerical analysis on compressible flow in nozzle.
7. Perform Numerical analysis on heat conduction through wall.
8. Couette flow analysis for either explicit or implicit formulation (Parabolic equation).
9. Heat conduction in 2D flat plate with explicit and implicit formulation (Elliptic equation).
10. Perform Numerical analysis on steady flow past a cylinder
11. Study of different turbulent models to analyze the flow in a pipe for various Reynolds number.
12. Perform Numerical analysis on convective heat transfer.

*Practical Examination shall consist of viva voce based on above term work.

7ME09 : TECHNICAL SEMINAR & PROJECT