NOTIFICATION

No. 67 /2022 Date : 18/06/2022

Subject : Implementation of new Syllabi of Semester VII & VIII of B.E. (Mechanical Engg.) (C.B.C.S.) as per A.I.C.T.E. Model Curriculum…

It is notified for general information of all concerned that the authorities of the University have accepted to implement new Syllabi of **Semester VII & VIII of B.E. (Mechanical Engineering)** (C.B.C.S.) as per A.I.C.T.E. Model Curriculum to be implemented from the academic session 2022-23 onwards as per ñ**Appendix – A**ò as given below:

Sd/-
(Dr.T.R.Deshmukh)
Registrar

ñ**Appendix A**ò

SYLLABUS OF B.E. SEM. VII & VIII (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 to digitalconvertor, 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-controlrs, Programmable logic controller. (6Hrs)

SECTION - B

Unit IV: 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 Hill edition.
2. Pneumatics and Hydrautics by H.L.Stewart.

Reference Books:

1) Introduction to Mechatronics by Appus Kuttan K.K.- OxfordUniversity Press.
2) Mechatronics ï 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 techniques
3-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 and equipment 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 Publications
2.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, organizationstructure & 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 behaviour. (6-Hrs)

UNIT III: a) Functions of personnel management, Human resource planning, Recruitment, training and development, workersparticipation 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 Hours)

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 University Press
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 power generation.

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 for minimum work in tow stage compression, inter-cooling and its effects, Overall, isothermal and adiabatic efficiencies, IHP, BHP, requirements and after cooler. (7 Hours)

UNIT-II: **Rotary Compressors** :- Comparison between reciprocating and rotary 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, Numericals 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, Psychrometry, Psychrometric chart, Psychrometric processes related to Air conditioning, Adiabatic Mixing of two Air-streams. Elementary simple problems based on Psychrometric 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 numerical treatment 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.

Reference Books:

1. Thermal engineering by Mahesh M.Rathore; Tata McGraw-Hill in New Delhi
2. Gas Turbines Theory- By Cohen and C.F.Rogers, P.H.I.H.Saravanamuttoo Heritage Publishers,
3. Gas Turbines and Rotary compressors, Khajuria and Dubey, Dhanpat Rai & 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 CAM for 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- Servo and 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 PROFESSIONAL ELECTIVE – II
(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 cooling systems, antifreeze mixtures.
3. To study electrical system, battery capacity and ratings, starter motor drives, ignition systems, ignition timing and 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 balancing and alignment, power steering.
6. To study suspension systems, shock absorbers, different lubricants and their properties, engine lubrication systems, oil pumps, chassis lubrication, 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 ï 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 ï 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 meshand 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 ï R.K.Rajput; Laxmi publications, New Delhi.
3. Iqbal Hussain, ñElectric & Hybrid Vehicles ï Design Fundamentalsò, 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, ñElectric Vehicle Technology Explainedò, John Wiley & Sons, 2003.

7ME05 PROFESSIONAL ELECTIVE – II
(iii) DESIGN OF TRANSMISSION SYSTEM

Course Learning Objectives:

1. To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
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 and machines elements includes -

1. Slection 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 ï Torque Converter Diagram ,working of Torque converter , Application of Torque Converter. 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 boxs. (07 Hrs.)

UNIT V CAMS :
Cam Design: Types, pressure angle and under cutting base circle determination, forces and surface stresses. (6 Hrs.)

UNIT VI CLUTCHES AND BRAKES
a) Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches, Concept & working of Electromagnetic 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 Sonôs Publications.
3) Prabhu. T.J., ñDesign of Transmission Elementsò, 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., ñHand book of Mechanical Designò, II Edition, Tata McGrawHill.
4) Machine Design fundamentals ï 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 PROFESSINAL ELECTIVE- II
(iv) COMPUTATIONAL FLUID DYNAMICS

Course Learning Objectives:

- To numerically **solve** governing partial differential equations for physical problems in fluid mechanics and heat 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 numerical solution 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 initial conditions; physical behaviour, overview of finite difference, finite element and finite volume methods. Overview of numerical methods. (7-Hrs)

Unit II: Finite Difference Method - Derivation of finite difference equations ï Simple Methods ï General Methods for 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-ļ) 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. and Malalasekara, W., Second Edition (Indian Reprint) Pearson Education, 2008.
2. Muralidhar, K., &Sundarajan, T. (2003). Computational fluid flow and heat transfer. Alpha Science International.
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, Pearson Education, 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 in industrial 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 Practicals: (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 power generation.

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 Practicals: (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 /drafting software.
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.**

7ME08 PROFESSIONAL ELECTIVE–II

(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 proper functioning.
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 Practicals (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 changing number of steps, the direction of rotation and speed E vehicle.

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

7ME08 PROFESSIONAL ELECTIVE-II
(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 ï 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.

7ME08 PROFESSIONAL ELECTIVE –II
(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 physical systems.
- To understand and simulate several flow situations with forced/natural convection with Internal and external 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

****

SEMESTER: VIII

8ME01 OPERATION RESEARCH TECHNIQUES

Course Learning Objectives (CLOs):

1. To study operation research models and linear programming methods.
2. To understand transportation models and assignment models.
3. To study waiting line models and understand the concept of sequencing.
4. To study replacement models and simulation models.
5. To understand the concept network models, CPM and PERT analysis.

Course Outcomes (CO):

1. Understand the knowledge of OR and OR models.
2. Analyze the transportation problems and related issues.
3. Understand the concept network models, CPM and PERT analysis.
4. Understand the concept replacement models and solve the problem on simulation techniques.

SECTION – A

UNIT I: Operations Research : Introduction, characteristics, Phases, Limitations, Models and classification of O.R.Models.
Linear Programming: Formulation, Standard Form, Graphical and simplex methods, Primal-Dual relationship. (8 Hrs)

UNIT II: **Transportation Models: Introduction**, LP Formulation of transportation problems, Methods for finding initial solution, MODI method.
Assignment Models : Introduction, Mathematical statement and solution methods of assignm. Problems, variations of assignment Problems. (6 Hrs)

UNIT III: **Network Models :** Network construction, PERT analysis, CPM analysis, cost analysis & Crashing the network, Updating resources smoothing and leveling. (6 Hrs)

SECTION-B

UNITIV: Waiting line models : Introduction, characteristics, classification, analysis of M/M/1 and M/M/s models.
Sequencing : processing of n jobs through two machines, n jobs through m machines, two jobs through m machines**.** (7 Hrs)

UNIT V: **Replacement models :** introduction, value of money, individual and group replacement policies.
` **Simulation :** introduction, Monte Carlo simulation, advantages and limitations, applications of simulation to queuing models, inventory models, maintenance models , etc. (7 Hrs)

UNITVI: **Dynamic programming**: introduction, characteristics, applications of dynamic programming to capital budgeting, production scheduling, travelling sales men, cargo loading problems, etc. (6 Hrs)

RECOMMENDED BOOKS:

Text Books:

1. Operations Research and Theory applications- II ed.J.K.Sharma; Macmilan Business Books
2. Operations Research; Prem kumar Gupta, D.S.Hira; S.Chand & Co. ltd.

Reference Books:

1. Introduction to Research Operation, 7th Edition; Hiller/Lieberman; Tata Mc-graw Hills.
2. Operations Research : An Introduction, 7th Edition, H.A.Taha; PHI.
3. Operations Research: Principles and practices; 2nd Edition, Ravindran, Philips, Solberg, John Willey & Sons.
4. Operations Research: Kapoor.

8ME02 : I. C. ENGINES

Course Learning Objectives (CLOs):

1. To study basic of engines, Air standard cycles, Fuel air cycle, actual cycle and review of other losses in IC engines.
2. To study conventional fuels, requirement, properties, fuel additive and limitations of fossil fuels.
3. To study stages of combustion, factors influencing various stages, Detonation, Factors and effect of detonation, rating of fuel and combustion chambers.
4. To study delay period, diesel knock, cetane rating, requirements of combustion chamber and methods of generating turbulence.
5. To Evaluate performance of Engines by using heat balance sheet, excess air calculation and determination of friction power, effect of supercharging.
6. To study Emission from Engines, EURO emission norms and Recent trends in Engines.

Course Outcomes (COs):

1. Remember fundamentals of I.C. engines, their types and cycle analysis.
2. Remember the knowledge of fuels and alternative fuels, study of fuel injection pump.
3. Remember the concept of combustion of CI engine.
4. Understand the concept of supercharging its objectives, advantages and limitations.

SECTION-A

UNIT I: **Introduction to IC Engines and cycle analysis:** Basic of I.C. Engines , Details of two stroke and four stroke engines, Air standard cycles, Fuel air cycle and actual cycle. Variation in specific heat, Dissociation and their effect on engine performance. Review of other losses in IC engines. (7 Hrs)

UNIT II: Fuels and alternative fuels : Conventional fuels for IC engines, requirement, properties, fuel additive, limitations of fossil fuels. Review of various alternative/non-conventional fuels . Studies of fuel injection systems : Fuel pump and their working, differenttypes of fuel feed systems, studies of injectors nozzles, Bosch type fuel pump. (8 Hrs)

UNIT III: **Combustion SI Engine:**- Stages of combustion, factors influencing various stages, Normal and abnormal combustion, Detonation, Factors responsible for detonation. Effect of detonation. Octane rating of fuel, Requirement of combustion chambers for SI engines, important types, relative advantages and disadvantages and application. (8 Hrs.)

SECTION - B

UNIT IV: Combustion in CI. Engines:- Stages of combustion in CI Engines, Delay period, factor affecting delay period, diesel knock, cetanerating, Requirements of combustion chamber for CI Engines. Methods of generating turbulence in combustion chamber. Typesof combustion chambers for CI Engies. (8 Hours)

UNIT V: **Performance testing of IC Engines:** Evaluation of various performance parameters of IC Engines including heat balance, sheet and excess air calculation. Methods of determination of friction power. Supercharging : Basic principles, objectives, arrangements for super charging, advantages and limitations ofsuper charging. (8 Hours)

UNIT VI: **Emission from IC Engines :** review, their effect on human health, cause of formation and approaches to control this pollutants. Study of BIS, EURO emission norms, IC Engines: Recent trends: Microprocessor based engines, management multi-point fuel injection engines, common rail direct injections engines, variablevalve timing engines. (8 Hours)

BOOKS RECOMMENDED:

Text Books:

1. Internal combustion Engines - M.L.Mathur & Sharma Dhanpatrai &Sons.
2. Internal combustion Engines ï V.Ganeshan, Tata Mcgraw Hills.

Reference Books:

1. Internal combustion Engines Fundaments- John B. Heywood, Mcgraw Hills
2. Internal combustion Engines & Air Pollution- Obert E.F.Intext Educational.

8ME03 PROFESSIONAL ELECTIVE – III
(i) ENERGY CONSERVATION & MANAGEMENT

Course Learning Objectives:

Students are expected to learn the importance and the need for conserving the Energy and apply the knowledge gain through methodologies and the management techniques in the energy conservation.

Course Outcome:

After learning the course the students should be able:

1. To understand the basic knowledge of different terms & principles of energy conservation, audit and management.
2. To Evaluate the energy saving & conservation in different mechanical utilities
3. To understand efficient heat & electricity utilization, saving and recovery in different thermal and electrical system.
4. To prepare energy audit report for different energy conservation instances.

SECTION – A

Unit-I: Energy Scenario and importance of energy conservation:

Energy Scenario: Classification of Energy, Indian energy scenario, Sectorial energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its importance, energy strategy for the future. Energy Conservation Act 2001 and related policies: Schemes of Bureau of Energy Efficiency (BEE), State Designated Agencies, Electricity Act 2003. Clean Development Mechanism (CDM). (7-Hrs)

Unit-II: Thermal Systems: Boilers and Industrial furnaces: Energy conservation opportunities in Boilers, efficiency testing, excess air control, performance evaluation, analysis of losses, feed water treatment, blow down, energy conservation opportunities. Boiler efficiency calculation, evaporation ratio and efficiency for coal, oil and gas. Steam distribution & use ï steam traps, condensate recovery, flash steam utilization. Electrical, Induction furnaces- Energy saving measures. (7-Hrs)

Unit-III: Thermal Systems: Fans, Blowers and HVAC:

Energy conservation in Pumps, Fans (flow control) and blowers, Pumps and Pumping systems - Classification, Performance, Factors affecting pump performance, efficiency. Compressed Air Systems, Performance monitoring and compressed air-distribution system. Factors affecting cooling tower performance and Energy saving opportunities. Refrigeration and air conditioning systems ï Waste heat recovery recuperators, heat sheets, heat pipes, heat pumps. Energy conservation methods. (7-Hrs)

SECTION - B

Unit-IV: Electrical Systems:

AC / DC current systems, Demand control, power factor correction, load management, Motor drives: motor efficiency testing, energy efficient motors, motor speed control, electrical distribution systems ï Transformers ï Power quality ï harmonic distortion. Reduction of losses ï Power factor. Lighting: lighting levels, efficient options. (7-Hrs)

Unit-V: Energy auditing:

Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering. (7Hrs)

Unit-VI: Energy Management and Economics:

Energy resource management ï Energy Management information systems (EMIS) ï Energy Monitoring and Targeting: Defining monitoring & targeting, elements of monitoring & targeting.

Energy economics ï discount rate, payback period, internal rate of Return, life cycle costing ï Financing energy conservation Projects. (7-Hrs)

BOOKS RECOMMENDED:

Text Books:

1. L.C. Witte, P.S. Schmidt, D.R. Brown, Industrial Energy Management and Utilisation, Hemisphere Publ, Washington, 1988.
2. O. Callaghn, P.W. Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981.
3. IDryden, I.G.C. The Efficient Use of Energy, Butterworths, London, 1982.

Reference Books:

1. Turner, W.C. Energy Management Hand Book, Wiley, New York, 1982.
2. 4Murphy, W.R. and Mc KAY, G. Energy Management, Butterworths, London 1987.
3. Energy Conservation Guidebook, Dale R Patrick, Stephen W Fardo, 2nd Edition, CRC Press .
4. Handbook of Energy Audits, Albert Thumann, 6th Edition, The Fairmont Press.
5. Trivedi, P.R, Jolka K.R., Energy Management, Commonwealth Publication, New Delhi,1997.

8ME03 PROFESSIONAL ELECTIVE – III
(ii) RODUCTION PLANNING AND CONTROL

Course Learning Objectives (CLOs);

1. To understand the importance of production planning and control, its functions, advantages.
2. To apply the skills of calculating for sales forecasts using various forecasting methods.
3. To remember concept of machine capacity, loading of machines and man machine activity charts.
4. To study the concept of inventory control & various cases of inventory system and modern techniques/philosophies of management like CIM, JIT, MRP-I and MRP-II.

Course Outcomes (COs):

1. Understand the importance of production planning and control, its functions, advantages.
2. Apply the skills of calculating for sales forecasts using various forecasting methods.
3. Remember concept of machine capacity, loading of machines and man machine activity charts.
4. Understand concept of inventory control & various cases of inventory system and modern techniques/philosophies of management like CIM, JIT, MRP-I and MRP-II.

SECTION – A

Unit I :- INTRODUCTION:
Objectives and Advantages of PPC, Production procedure, functions of PPC, production consumptions cycle, centralized & decentralized PPC, Pre-requisite of PPC. (7-Hrs)

Unit II :- PRODUCTION FORCASTING :-
Introduction, definition and importance of forecasts, Qualitative model: Delphi techniques, Quantitative models :- Simple movingaverage, weighted moving average, simple experimental smoothing.
Forecasing error and selection of forecasting model. Types of forecaste: Constant, linear cycle forecaster, Verification and conrolling, The moving range chart, Average MR, out of control conditions. (8-Hrs)

Unit III: PRODUCTION PLANNING : - The production order, Procedure for formulating Production order, masier Program, Basic problems in production planning, Quantities in batch production, criteria for batch, size determination, minimum cost batch size, productionrange, Maximum profit Batch size, Maximum return, Rate ofreturn,Economic Batch size. (7-Hrs)

SECTION – B

Unit IV : MACHINE OUTPUT :
Machine output, multi machine supervision by one operator,
Machine interference, Ashcroft labels, average number of consecutive servicing task, the Ashcraft Number. (7-Hrs)

Unit V: ANALYTICAL STRUCTURE OF INVENTORY:- Definition
of inventory, Types of inventory and the classification, structureof inventory problems and its analysis, the relevant cost, objectives of carrying inventories, selective inventory analysis. Static Model :- General characteristic, incremental analysis, opportunity cost, cost of risk, decision criteria under uncertaincy. (7-Hrs)

Unit VI: A) DYNAMIC MODEL :- CERTAINITY CASE ;- General characteristic, optimum lot size model win constant demand,quntity discounts. Risk Case :- General characteritics, P-system and Q-system.

B) Material Requirment planning (MRP) :- Introduction to MRP, Manufacturing Resource Planning (MRP-IT), just in time (JIT), comparison of MRP, MRP-II, Entrepreneurship Resource Planning (ERP). (8 Hrs.)

BOOKS RECOMMENDED:

Text Books :

1. Elements of Production Planning and Control by Simuel Eilon ï Universal Publishing Corporation ltd. Mumbai
2. Production Control ï John E.Biegal- Prentice Hall of India.
3. Inventory Control, Theory & Practice- Start & Miller.

Reference Books:

1. Production Planning and control and Management:- K.C.Jain &L.N.Agrawal.
2. Production & Operation Mgmt.;- E.E.Adam, Jr.R.J.Ether, Prentics Hallof India.
3. Industrial Engineering and Production Management- M.Mahajan-Dhanpat Rai.

8ME03 PROFESSIONAL ELECTIVE–III
(iii) PRODUCT DESIGN & DEVELOPMENT

Course Learning Objectives:
This course aims at introducing the students to the basic concepts of engineering design and product development with focus on the front-end processes. At the end of this course the student is expected to demonstrate an understanding of the overview of all the product development processes and knowledge of concept generation and selection tools.

Course Outcomes:
After successfully completion of this course students will be able to:

1. Manage the development of an idea from concept through to production.
2. Employ research and analysis methodologies as it pertains to the product design process, meaning, and user experience.
3. Apply creative process techniques in synthesizing information, problem-solving and critical thinking.
4. Demonstrate, apply, explain, and recognize basic engineering, mechanical, and technical principles for decision making
5. Use sustainable materials and manufacturing processes & Carry out cost and benefit analysis through various cost models.

SECTION-A

UNIT I: Introduction to product design: The morphology of design, Primary design phases & flowcharting, Role of allowance, Process capability and tolerance in detailed design and assembly, detailed design phase. (6-Hrs)

UNIT II: Product design practices:
Product strategies, time to market, analysis of the product, the Three Sôs, standardization, Renard series, Simplification, Designer and his role, Basic design consideration, Procedures and problems faced by industrial designer, Role of aesthetics in product design, functional design practice. (6-Hrs)

UNIT III: Product design consideration:
Principal stress trajectories, balanced design, criteria and objectives of design, material toughness: resilience, designing for uniform strength, tension vis-à-vis compression.
Pure struts and pure columns, mapping of principal stresses, buckling and instability, theory of long columns, hollow columns, plastic design, practical ideas for material saving in design, ribs, corrugation, laminated, membranes. (6-Hrs)

SECTION-B

UNIT IV Design for production:
Producibility requirement, forging design, pressed component design, casting design, design for machining ease, the role of process engineer, ease of location and clamping, die casting and special casting, design of powder metallurgical parts, expanded metal and wire forms.
Introduction, properties & classification of plastics, phenol formaldehyde and urea formaldehyde resin products, compression moulding, transfer moulding, injection moulding, high-pressure laminates, forming and drawing of plastic sheets, design of plastic parts, natural & artificial rubber, engineering properties of rubber, Glass & ceramics. Plastic bush bearings, gears & fasteners in plastic, Design recommendation for rubber parts, Distortion in rubber, dimensional effects and tolerances, design factors for ceramics and glass parts, Wood. (6-Hrs)

UNIT V: Optimization & Economics in Design:
Siddalôs classification of design approach, Optimization by differential calculus, Language multipliers, Linear programming, geometric programming, Johnsonôs method of optimum design. Product value, design for safety, reliability and environmental considerations, manufacturing operations in relation to design, economic analysis, profit & competitiveness, break-even analysis, economics of a new product design. (6-Hrs)

UNIT VI: Human engineering, value engineering & role of computer in product design:
Human being vas applicator of forces, Anthropometry, design of controls& displays, man/machine information exchange, workplace layout from ergonomic consideration, noise, heating and ventilating, lighting.

Introduction to value, maximum value, normal degree of value, importance of value, creativity, steps to problem solving and value analysis, value analysis tests, value engineering idea generation check-list, cost reduction through value engineering, material and process selection in value engineering.

Introduction to product cycle & CAD/CAM, role of computers in manufacturing and design, creation of a manufacturing database, CIM, communication networks, GT, production flow analysis, MRP, FMS, JIT. **(7-Hrs)**
BOOKS RECOMMENDED:

Text Books:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, ñProduct Design and Development ñ, 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9.
2. Clive L. Dym, Patrick Little, ñEngineering Design: A Project-based Introductionò, 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7

Reference Books:
1. George E.Dieter, Linda C.Schmidt, ñEngineering Designò, McGraw-Hill International Edition, 4th Edition, 2009, ISBN 978-007-127189-9.

2. Kevin Otto, Kristin Wood, ñProduct Designò, Indian Reprint 2004, Pearson Education, ISBN 9788177588217.

3. Yousef Haik, T. M. M. Shahin, ñEngineering Design Processò, 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141.

8ME03 PROFESSINAL ELECTIVE-III
(iv) ARTIFICIAL INTELLIGENCE

Course Learning Objectives (CLOs):

1. To understand the basic concepts of Artificial Intelligence.
2. To understand the basic concepts of Expert System.
3. To study the methods of knowledge representation.
4. To understand the Expert system Tools, knowledge base editors, procedure oriented methods, object-oriented methods, logic-based methods, access-oriented methods.
5. To study the methods of Building an expert system.
6. To understand the concept of Fuzzy Engineering & applications of fuzzy expert systems for design of industrial controllers.

Course Outcomes (COs):

1. Understand the concept of knowledge and knowledge base.
2. Apply the skills of development of expert system for industrial problems.
3. Remember the design pre-requisites and design procedure of expert system.
4. Understand the concept of fuzzy logic and will try to implement in project work.

SECTION – A

Unit-I : Introduction to Artificial Intelligence (AI): Overview of AI,definition and importance of knowledge based systems, representation of knowledge, knowledge organization, knowledgemanipulation, acquisition of knowledge. (6 Hours)

Unit II: Introduction to Expert Systems - Features of expert systems, knowledge engineering, basis expert system terminology, human experts and artificial experts, algorithmic nd heuristic methods, difference between conventional programs and expert systems,Architecture of expert systems. (8 Hrs.)

Unit III : Knowledge Representation ï Rule based methods, rule execution, forward chaining and backward chaning, knowledge representation using semantic nets, structure of semantic nets, Frame-based methods . (8 Hours)

SECTION – B

Unit IV : Expert system Tools – Types of tools for expert system building,system building aids, support facilities, debugging aids, I/O facilities, explanation facilities, knowledge base editors, stagesin the development of expert system tools, procedure oriented methods, object-oriented methods, logic-based methods, access-oriented methods. (7 Hours)

Unit V : Building an expert system ï Development phased in expert system building, development constraints, reliability, maintainability, examples of expert systems, difficulties in development of expert systems. (7 Hours)

Unit VI: Fuzzy Engineering - Fuzzy logic, fuzzy expert systems, fuzzy sets,membership functions, fuzzy rules for approximate reasoning, fuzzy inference generation, deffufication, development of rules matrix, applications of fuzzy expert systems for design of industrial controllers. (7 Hours)

RECOMMENDED BOOKS:

Text Books :
1. A guide to Expert Systems by Donald a. Waterman, Pearson
2. Introduction to Artificial intelligence & Expert Systems by DanW. Peterson, PHI
3. Fuzzy Logic by John Yen, Reza Langari, Pearson

Reference Books:

1) Expert Systems ï Theory & Practice, By Ermine, Jean Louis, PHI.
2) Expert systems in Engineering , By D.T.Pham.JFS Pub.
3) Expert system application by Sumit Vadera,Sigma press
4) Artificial Intelligence by Winston P.H.,Pearson.

8ME04 PROFESSIONAL ELECTIVE – IV
(i) REFRIGERATION & AIR CONDITIOING

Course Learning Objectives (CLOs):

1. Illustrate the fundamental principles and applications of refrigeration and air conditioning system Learning the fundamental principles and different methods of refrigeration and air conditioning.
2. Comparative study of different refrigerants with respect to properties, applications and environmental issues. Study the numbering system of Refrigerants and its classification.
3. Identify the basic components of a refrigeration cycle.Study of various refrigeration cycles and evaluate performance using P-H chart, Mollier charts and/ or refrigerant property tables. Obtain cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems
4. Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning. Operate and analyze the refrigeration and air conditioning systems.
5. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems.

Course Outcomes:

1. Understand the fundamental basics of simple vapour compression system, types of refrigerant used in refrigeration system.
2. Understand the multistage pressure system, its types and elementary treatment of refrigeration system.
3. Apply the knowledge of refrigeration system and its controls, defrosting.
4. Apply the concept air conditioning system as winter, summer air conditioning system applications and its related issues.

SECTION – A

Unit I : **Introduction to automotive air conditioning**- Vapour compression system:- Analysis of simple vapour compression system. Use of pressure enthalpy. Temperature entropy charts. Effect of operating conditions such as evaporation and condesion pressure, superheating and sub cooling Actual vapour compression system, Refrigerants :- classification: primary & secondary refrigerants, desirable properties of refrigerants; merits& demerits of commonly used refrigerants such as Ammonia R-12, R-22 and their selections and eco friendly refrigeration 134 a,HFC. (8- Hours)

Unit II: **Multi stage pressure systems**- multistage compression: choiceof intermediate pressure, complete multi-stage compressions. Multi evaporator systems; single compression individual expansion value, single compression multi expansion valve, individual compressor multi expansion valves, cascade systems, its applications to cryogenics Air liquefaction processes- Linde- Hampson (No numerical treatment to air liquefaction system) (7- Hours)

Unit III : **Refrigeration systems components & controls**:- brief study of refrigerants compressor, condensers, evaporators, expansion valves, drier, fillers, selection criteria for the components of vapours compression systems Flow controls, temperature controls, pressure controls and safety devices. Defrosting systems, testing & charging of refrigeration systems, leak detection. (No analytical treatment is expected) (7- Hours)

SECTION – B

Unit IV : Psychromeric properties of moisair psychrometric chart, concept of thermodynamic wet ï bulb temperature, representations of Psychromeric process on Psychromeric charts, mixing of air, evaporating cooling, air washers. Human comfort:- metabolism of human body, factors influencing comfort, concept of effectivetemperature, optimum effective temperature & comfort charts. (7 Hours)

Unit V : **Classification of air conditioning systems & applications**. Unitarysystem package, window type & split type air conditioning. Central system:-System components, types:- direct expansion system, all water system & all air system. Water, summers & year round air conditioning. Transmission & distribution. Types of supply air ducts, consideration for selection & location of outlet, distribution partners of outlet, location of return air opening &introduction to duct design.
(*No numerical treatment is expected*). (7 Hours)

Unit VI : Load calculation & applied Psychromety-basic consideration at heat gains/losses sensible & latent , heat due to occupancy lightening, appliances, products, process, air conditioning systems, safety factor cooling load estimates, heating load estimates. Sensible heat factor by pass factor, apparatus dew point, effective sensible heat factor. (7 Hours)

BOOKS RECOMMENDED:

Text Books :

1. Refrigeration & air conditioning; C.P.Arora; Tata Mcgraw HillPublication.
2. Refrigeration & air conditioning; Arora, Domkundwar; Dhanpat Rai Publication.

Reference Books:

1. Principles of Refrigeration; J.Dossat; Pearson Education, Asiapublication
2. Refrigeration & air conditioning- P.L.Balaney
3. Refrigeration & air conditioning- Manohar Prasad.

8ME04 PROFESSIONAL ELECTIVE – IV
(ii) FINITE ELEMENT ANALYSIS

Course Learning Objectives (CLOS):

1. To study the concept of FEM and various methods in it.
2. To understand the knowledge of application of Matrix Algebra & Gausian Elimination.
3. To study the finite element modeling approaches and understand the concept of boundary conditions.
4. To study 2D problems for Constant strain triangle, temperature effects, problem modeling and boundary conditions.
5. To study the concept of heat transfer and fluid flow.

Course Outcomes:

1. Apply the knowledge of principal of FEA, its types, governing equation, fundamental concept of solid mechanics.
2. Remember the mathematical understanding required for FEA and finite difference techniques.
3. Understand the knowledge of application of FEA such as related to stress on beams, three dimensional frames, heat transfer.
4. Apply the knowledge of FEA in project work.

SECTION - A

Unit I : Introduction : Application, Advantages, Steps of FEM, Stress and Equilibrium, Boundary conditions, Strain Displacement Relations, Stress-strain Relations, Von mises stress, Temperature effect, Potential Energy & Equilibrium, Gelerkinôs Method, stiffness (Displacement) Method. (7Hrs)

Unit II: **Matrix Algebra & Gausian Elimination :** Matrix Multiplication, Transposition, Diagonal Matrix, Symetric Matrix, Upper Triangular Matrix, Determinant of Matrix, Matrix Inversion Eligen values & Elgenvectors, Gaussian elimination. (7 Hrs)

Unit III: **ID Problems :** Finite Element modeling, coordinate Shapefunction, The potential Energy approah, The GalerkinôsApproach, assemblies of the global stiffness matrix and loacvectors, Properties of stiffness Matrix, Treatment of boundaryconditions, quadratic Shape Functions, Temperature Effects. (7 Hrs)

SECTION – B

Unit IV : **2D Problems for CST :** Constant strain triangle, isoperimetric Representation , potential Energy energy approach, element stiffness, galaerkinôs approach, temperature effects, problem modeling and boundary conditions. (7 Hrs)

Unit V : **Development of equations:** Truss equations, derivation of the stiffness, matrix for a bar element in local coordinate, global stiffness matrix, beam equation. Beam stiffness, example assemblage of beam stiffness matrix, plain stress & plain stress stiffness equations, basic concept of plain stress and plain strain, derivation of the CST stiffness matrix and equations Treatment of body and surface forces. (7 Hrs)

Unit VI : **Heat Transfer :** Derivation of the basic differential equations, Heat transfer with conduction, radiation, ID Formulation usingvariational method.
Fluid Flow : Derivation of the basic differential equations, Id Finite Element formulation, Computer Implementation (prepossessing, post processing, input data file, mesh generation) (7 Hrs)

BOOKS RECOMMENDED:

Text Books :

1. Introduction to Finite Element Engineering ï T.R.Chandrupatla, Belegunda; PHI
2. A First course in Finite Element Method- Darya Logon, ThompsonLearning (TL Publisher)

Reference Books:

1. The Finite Element Method in Engineering- S.S.Rao, Elsveir Pub., 4th Edition.
2. Fundamentals of Finite Element Method analysis ï D.V.Huttan, TataMc-graw Hill
3. Concept & Applications of Finite Element Analysis ï Robert D.Cook
4. Finite & Boundary Element Method in Engineering ï O.P.Gupta
5. An Introduction to Finite Element Method- J.N.Reddy, Tata Mc-graw Hill, 2nd Edition, 2005.

8ME04 PROFESSIONAL ELECTIVE – IV

(iii) ROBOTICS & INDUSTRIAL APPLICATIONS

Course Learning Objectives :

1. To understand basics of robotics, evolution of robots and their role in industrial automation.
2. To study the Robot's anatomy, joints types, wrist construction, robot standard configurations and their work spaces..
3. To study the construction and working of different types of end Effectors.
4. To study various robot drives, robot motion control and its levels.
5. To understand various methods of teaching and programming the robots.
6. To study principle of working and applications of different types of robot sensors.
7. To study robot kinematics viz. forward, reverse and homogeneous transformation.
8. To study different applications of robots in manufacturing and to understand importance of robot features for a particular application.
9. To study different Quantitative methods to perform economic evaluation of robot project.

Course Outcomes:

1. Understand the concept of robotics, its history.
2. Remember robot anatomy and various configurations for different industrial applications.
3. Understand the concept of kinematic analysis of robots.
4. Remember the concept robot programming, its methods and programming languages.

SECTION – A

Unit I : Fundamentals of Robotics- Introduction, Automation & Robotics- robot applications robotic systems, robot anatomy and robot configurations, Joint types used in robots, robot wrists, joint notation schemes, work value for various robot anatomies, robotSpecifications**.** (8 Hrs.)

Unit II : Robots end-effectors-classification of end-effectors, mechanicalgrippers, hooking or Lifting grippers, grippers for molten metal ,plastics, vacuum cups, magnetic grippers Electrostatic grippers,multiple grippers, internal & external grippers, drive systems for gripers, active & passive grippers. Design consideration in gripper, gripper analysis. (7 Hrs.)

Unit III: Robot drives & control-pneumatic power drives, hydraulic systems, electric drives, robot controllers- servo and non servo systems, motion control of robots, point to point and continuouspath control, teaching of robots, robot programming methods. (7 Hrs.)

SECTION – B

Unit IV: Robot Sensors: Features, Contact type sensors:- wrist force sensor, binary & analog touch sensor,

Artificial skins, force, torque, encoders, position, velocity sensors, Non contact type sensors;- vision sensor, proximity, range sensors, safety measures in robot. (7 Hrs.)

Unit V: Robot Kinematics- Forward & reverse kinematics, forward andreverse transformation of two DOF & three DOF 2-D manipulator,homogeneous transformations. (6-Hrs)

Unit VI: Quantitative Techniques for economic performance of robots- Robot investment coats, robot operating expenses. Methods of economic evaluation, method of pay-back period, return on investment method, discounted cash flow method. VAL Command: robot programming in Val & RAIL. (7 Hrs.)

RECOMMENDED BOOKS:

Text Books:

1) Robotics Technology & Flexible Automation by S.RDeb, Tata McGrawHill.
2) Industrial Robotics by M.P.Groover, McGraw Hill.

Reference Books:

1. Robotics for Engineering, Korean Yoram, McGraw Hill.
2. Robots & Manufacturing automation by Asfahal, C.Ray, John Wiley.
3. Robotic Engineering by Richard D.Klafter, PHI.

8ME04 PROFESSIONAL ELECTIVE- IV
(iv) RAPID PROTOTYPING

Course Learning Objectives (CLOS):

1. Understand the fundamentals of Rapid Prototyping Techniques.
2. Understand the methodology for processing of RP Cad models.
3. Selection of appropriate RP fabrication techniques for the prototyping.
4. Study of prototyping techniques for Reverse engineering.
5. To acquire the necessary knowledge regarding RP softwares.

Course Outcomes (CO):

1. **Create** and develop overall awareness for design of Rapid prototype.
2. **Apply** fundamentals of RP techniques.
3. **Design and develop** the RP Toolings for using suitable rapid prototyping technique.
4. **Synthesis** of RP techniques for reverse engineering.

SECTION-A

Unit-I: Introduction to Product Design: Design definitions; Brief history of Industrial designs. Industrial Design chronology, stages in Product development. Cost associated in various stages of Product development.
Prototyping: What is Prototype?, Types of Prototype, Principles of Prototyping, Prototyping Technologies. (7-Hrs)

Unit-II: Basics of Rapid Prototyping: Rapid Prototyping: Working Principles and types of Rapid Prototyping machines. Input devices, Contact and non-contact type digitizers such as Coordinate measuring machines, Laser and White light scanners. **Fields of Application of RP**: Industrial, medical, etc. (7-Hrs)

Unit-III.RP Process: Photo polymerization (Stereo lithography (SL), Micro-stereo lithography), Powder Bed Fusion (Selective laser Sintering (SLS), Electron Beam melting (EBM)), Extrusion-Based RP Systems (Fused Deposition Modeling (FDM)), 3D Printing, Sheet Lamination (Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC)), Beam Deposition (Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD)). (8-Hrs)

SECTION-B

Unit-IV: Physics of RP Process:
Process Physics, Tooling, Process Analysis, Material and technological aspects, Applications, limitations and comparison of various rapid manufacturing processes. Classification of RP Methods.
Pre and Post processing: Pre-processing for RP, Post-processing of RP parts, Errors in RP parts, Part building errors in FDM, STL,LOM, SLS Parts. (6 Hrs.)

Unit-V: Rapid Tooling: What is Rapid tooling?, Types of Rapid toolings. Benifits of Rapid tooling.
Silicon rubber tooling, Aluminium filled epoxy tooling, Spray metal tooling, Cast kirksite, 3Q keltool, etc. Direct Rapid Tooling Direct. AIM. Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft Tooling vs. hard tooling. (6 Hrs.)

Unit-VI: Overview of RP Software: STL files, Overview of Solid view, magics, imics, magic communicator, etc. Internet based software, Collaboration tools. . (6-Hrs)

BOOKS RECOMMENDED:

Text Books:

1. Rapid Prototyping by Amitabha Ghosh , affiliated East ï west press pvt. ltd., New Delhi.
2. Rapid Prototyping by Adithan M. Edition 2018, Atlantic Publishers & distributer pvt.ltd.
3. Additive Manufacturing by C.P.Paul & A.N. Jinoop McGraw Hill 1st Edition 2021
4. Product Design & Development by Karl T.Ulrich & Steven D. Eppinger.,Tata McGraw Hill Publishing.
5. Rapid Prototyping Data Formats by V.V. Prathibha Bharathi. Notion press publishing.

Reference Books:

1. CAD & Rapid Prototyping for product design, Dauglas Bryden, Laurence King Publishing.
2. Rapid Prototyping (Principle and Application), Rafiq Noorani by Wiley Publishing.

8ME05 I.C. ENGINES - LAB.

Course Learning Objectives (CLOs):

1. To study basic of engines, Air standard cycles ,Fuel air cycle, actual cycle and review of other losses in IC engines.
2. To
3. To Evaluate performance of Engines by using heat balance sheet, excess air calculation and determination of friction power, effect of supercharging.
4. To study Emission from Engines, EURO emission norms and Recent trends in Engines.

Course Outcomes (COs):

1. Remember fundamentals of I.C. engines, their types and cycle analysis.
2. Apply the knowledge of a multi-cylinder petrol engine.
3. Evaluate performance of Engines by using heat balance sheet
4. Study of fuel injection pump and injectors.

List of Experiments (Any Six):

Any six of the following practical should be performed and Performance test on a single cylinder diesel engine.

1. Performance test on a single cylinder petrol engine.
2. Evaluation of the heat balance for single cylinder diesel engine.
3. Performance test on a multi-cylinder petrol engine.
4. Mors test on multi-cylinder petrol engine.
5. Trial on petrol/ diesel engine to plot p-0 and p-V diagram.
6. Measurement of exhaust gas emission from S.I.engine
7. Measurement of smoke density of CI engine exhaust.
8. Study of Bosch type single plunger fuel pump.
9. Study of various types of fuel injectors and nozzles.

***It shall consist of viva-voce based on term work and syllabus.**

8ME06 PROFESSIONAL ELECTIVES -IV
(i) REFRIGERATION & AIR CONDITIONING - LAB.

Course Learning Objectives (CLOs):

1. Illustrate the fundamental principles and applications of refrigeration and air conditioning system Learning the fundamental principles and different methods of refrigeration and air conditioning.
2. Identify the basic components of a refrigeration cycle. Obtain cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems
3. Study of various types of refrigeration systems for various applications like ice plant, water cooler etc.
4. Understand the basic air conditioning processes.
5. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems.

Course Outcomes (CO):

1. Understand the fundamental basics of simple vapour compression system, types of refrigerant used in refrigeration system.
2. Apply the knowledge of different applications of refrigeration systems.
3. Apply the knowledge of refrigeration system and its controls, defrosting.
4. Apply the concept air conditioning system.

List of Practicals:-

Any **six** of the following should be conducted and a report thereof should be submitted.

1. Trial on Vapour compression system.
2. Trial on Air-conditioning system.
3. Study of Electrolux system.
4. Study of Water cooler.
5. Study of window Air conditioner.
6. Study of household refrigerator.
7. Study of desert cooler.
8. Study of cold storage plant.
9. Testing and changing of refrigeration system.
10. Study of defrosting system.
11. Study/trial of ice plant.
12. Study of various refrigeration and air-conditioning controls.

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

8ME06 PROFESSIONAL ELECTIVE- IV
(ii) FINITE ELEMENT ANALYSIS- LAB.

Course Learning Objectives (CLOS):

1. To understand the knowledge of application of Matrix Algebra & Gausian Elimination.
2. Design of finite element modeling approaches and understand the concept of boundary conditions.
3. Formulation of 2D problems for Constant strain triangle, temperature effects, problem modeling and boundary conditions.
4. Understand concept FEA applied for heat transfer and fluid flow.

Course Outcomes:

1. Apply the knowledge of principal of FEA, its types, governing equation, fundamental concept of solid mechanics.
2. Remember the mathematical understanding required for FEA and finite difference techniques.
3. Application of FEA such as related to stress on beams, three dimensional frames.
4. Apply the knowledge of FEA in heat transfer and fluid flow.

List of Practicals (Any-5):

1. Study of a FEA modeling & FEA packages.
2. Stress Analysis of bars having
   i) Constant cross section area
   ii) Tapered cross section area
   iii) Stepped bar.
3. Stress Analysis of beam (Simply supported or Cantilever) carrying point load and uniformly distributed load.
4. Solve any one 2D problem on CST element.
5. Solve any one problem on truss element.
6. Solve any one problem on axi-symmetric element
7. Solve any one problem on steady state heat condition.

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

8ME06 PROFESSIONAL ELECTIVE-IV

(iii) ROBOTICS & INDUSTRIAL APPLICATIONS-LAB.

Course Learning Objectives:

1) To understand the basic concepts associated with the robot functioning and applications of Robots.
2) To study about the robot motion analysis of robot.
3) To study about the drives and control system used in Robots.
4) To understand the concepts of end effectors, sensors and vision system used in robots
5) To learn about robot programming.

Course Outcomes:

After successfully completion of this course students will be able to:
1) To know about fundamental knowledge about the robot
2) To know about robot motion analysis.
3) To know about drives and control system used in robots.
4) To know about end effectors, sensors and vision system.
5) To know about robot programming methods and languages.

List of Prcticals : (Any-5)

1. Study of components of a real Robot & its DH Parameters.
2. Demonstration of Robot with 2DOF,3DOF,4DOF,etc.
3. Study of positioning and orientation of Robot arm.
4. Programming of the Robot for Industrial Application (actual trial on robot ,if available or trial on simulation software).
5. Robotic Control Experiment demonstration using available hardware or software.
6. Integration of assorted sensors (IR, Potentiometer, staring gadges, etc.) micro controllers & ROS (Robot Operating System) in a Robotic system.
7. Industrial Robot application (Any one Mini project)
8. Study of Robot Simulation Software (on any one application).

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

8ME06 PROFESSIONAL ELECTIVE- IV

(iv) RAPID PROTOTYPING- LAB.

Course Learning Objectives (CLOS):

1- Study the fundamentals of Rapid Prototyping Techniques.
2- Understand the use of techniques for processing of Cad models for RP.
3- Use of suitable RP fabrication techniques for prototyping.
4-Use of prototyping techniques for reverse engineering.
5- To get the introduction regarding RP software.

Course Outcomes (CO):

1- Create and develop overall awareness for design of Rapid prototype.
2- Apply fundamentals of RP techniques.
3- Selection of appropriate tooling for rapid prototyping process.
4- Synthesis of RP techniques for reverse engineering.

List of Practical (Any-5):

1-To create a 3-D model of a machine component for RP
2- Generation of a Process Plan for fabrication of a product on the basis of CAD Model.
3- Fabrication of part on available RP setup.
4- Post processing of fabricated Additive Manufactured product/prototype.
5- Inspection of fabricated product/prototype for dimensional accuracy and defects.
6- Post processing of CAD model and generation of .stl file using suitable software.
7- Study of principles of various pixel generation techniques and forms of raw materials in RP.

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

8ME07 : PROJECT

****