

SEMESTER : EIGHT																
Sr. No.	Subject Code	Subject	TEACHING SCHEME					EXAMINATION SCHEME								
			HOURS / WEEK			Total HOURS/WEEK	CREDITS	THEORY					PRACTICAL			
			Lecture	Tutorial	P/D			Duration Of Paper (Hr.)	Max. Marks Theory Paper	Internal Marks	Total	Min. Passing Marks	Max. Marks		Total	Min. Passing Marks
													Int.	Ext.		
THEORY																
01	8ME01	Operation Research Techniques	3	--		3	3	3	80	20	100	40	--	--	--	--
02	8ME02	I.C. Engines	3	--		3	3	3	80	20	100	40	--	--	--	--
03	8ME03	Professional Elective-III	3	--		3	3	3	80	20	100	40	--	--	--	--
04	8ME04	Professional Elective- IV	3	--		3	3	3	80	20	100	40	--	--	--	--
PRACTICALS / DRAWING / DESIGN																
05	8ME05	I.C. Engines- lab.	--	--	2	2	1	--	--	--	--	--	25	25	50	25
06	8ME06	Prof. Elective-IV –lab.	--	--	2	2	1	--	--	--	--	--	25	25	50	25
07	8ME07	Project	--	--	12	12	6						75	75	150	75
Total			12	--	16	28	20	--	--	--	400	--	--	--	250	--
Grand Total															650	
8ME03 Prof. Elect. –III : (i) Automobile Engineering (ii) Production Planning & Control (iii) Product Design																
8ME04 : Prof. Elect. IV: (i) Design of Transmission Systems (ii) Refrigeration & Air Conditioning (iii) Finite Element Analysis																

**SYLLABUS PRESCRIBED FOR BACHELOR OF MECHANICAL
ENGINEERING
SEMESTER PATTERN (CHOICE BASED CREDIT GRADE SYSTEM)
SEMESTER: SEVEN**

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 acquisition, sampling theorem, Quantizing theory, Analog to digital conversion, Analog to digital converter, 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-controllers, Programmable logic controller. (6Hrs)

SECTION-B

Unit IV: Control Valves –

Study of different control components and pneumatic & Hydraulic system- Construction, working 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, Power chucking 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 by Aciatore and M.B.Histant, Tata McGraw Hill edition.
2. Pneumatics and Hydraulics by H.L.Stewart.

REFERENCE BOOKS:

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

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 Outcome: 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 contributorsto 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, 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 behaviour. . (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. . (7-Hrs)

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-Hill Education(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, intercooling 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 Sysytem, 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 JetPropulsion). (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 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; Godfrey 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 associativity 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 programming5- 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, CIMshop 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:

- 3) Computer aided Design and Manufacturing by Sadhu Singh
- 4) Production system, Automation and CIM, Mikhal Groover, Pearson Publication.
- 5) 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 multicylinder 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 – 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 vacuum 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, Vacuum and air brake system, Antibraking 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 :

TEXTBOOKS :

1. Automobile Engineering- Vol.I & II, Kirpal Singh, Standard Publishers Distributors
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 PROFESSIONAL ELECTIVE – II

(iii) DESIGN OF TRANSMISSION SYSTEM

COURSE LEARNINGS 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 transmissionsystems 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, Fatiguestrength ,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 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 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 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 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 PROFESSIONAL ELECTIVE-II

7ME05 (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 – Simple Methods – 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- ϵ) 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 convection over flat plate/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. Prodiyogi, 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.***

PROFESSIONAL ELECTIVE –II

7ME08 (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 & Demostraion 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 LEARNINGS OBJECTIVES:

- 1-To **apply** standard design procedure available for Design of Transmission of Mechanical elements.
- 2-**learned** 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 .

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 analyse 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

SYLLABUS PRESCRIBED FOR BACHELOR OF MECHANICAL ENGINEERING SEMESTER PATTERN (CHOICE BASED CREDIT GRADE SYSTEM) SEMESTER: EIGHTH

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 assignment 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

UNIT IV: 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; TataMacgraw 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 , Detailsof 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, different types 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, cetane rating, Requirements of combustion chamber for CI Engines. Methods of generating turbulence in combustion chamber. Types of combustion chambers for CI Engines. (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 of super 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 injection engines, variable valve timing engines. (8 Hours)

Books Recommended:

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Internal combustion Engines Fundamentals- John B. Heywood, McgrawHills
- 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 – 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 – 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 – Transformers – Power quality – harmonic distortion. Reduction of losses – 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. (7-Hrs)

Unit-VI: Energy Management and Economics

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

Energy economics – discount rate, payback period, internal rate of Return, life cycle costing

– 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

REFERENCES BOOKS:

- 1Turner, 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 elhi, 1997.

8ME03 PROFESSIONAL ELECTIVE –III

(ii) PRODUCTION 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, centralised & decentralised PPC, Pre-requisite of PPC.(7-Hrs)

Unit II :- PRODUCTION FORECASTING:-

Introduction, definition and importance of forecasts, Qualitative model: Delphi techniques, Quantitative models :- Simple moving average, weighted moving average, simple exponential smoothing.

Forecasting error and selection of forecasting model. Types of forecast: Constant, linear cycle forecaster, Verification and controlling, 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, production range, Maximum profit Batch size, Maximum return, Rate of return, 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 Ashcroft Number. (7-Hrs)

Unit V: ANALYTICAL STRUCTURE OF INVENTORY:- Definition

of inventory, Types of inventory and the classification, structure of 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 uncertainty. (7-Hrs)

Unit VI: A) DYNAMIC MODEL :- CERTAINTY CASE :- General

characteristic, optimum lot size model with constant demand, quantity discounts. Risk Case :- General characteristics, P-system and Q-system.

B) Material Requirement planning (MRP) :- Introduction to MRP, Manufacturing Resource Planning (MRP-II), 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 –Universal Publishing Corporation Ltd. Mumbai
2. Production Control – John E. Biegel- 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, Prentice Hall of 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 successful 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 S's, 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:

Siddal's classification of design approach, Optimization by differential calculus, Lagrangian multipliers, Linear programming, geometric programming, Johnson's 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 as 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, “Product Design and Development “, 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9.
2. Clive L. Dym, Patrick Little, “Engineering Design: A Project-based Introduction”, 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7

Reference Books:

1. George E.Dieter, Linda C.Schmidt, “Engineering Design”, McGraw-Hill International Edition, 4th Edition, 2009, ISBN 978-007-127189-9
2. Kevin Otto, Kristin Wood, “Product Design”, Indian Reprint 2004, Pearson Education, ISBN 9788177588217
3. Yousef Haik, T. M. M. Shahin, “Engineering Design Process”, 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141

8ME03 PROFESSINAL ELECTIVE-III
8ME03 (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, humanexperts and artificial experts,

algorithmic and heuristic methods, difference between conventional programs and expert systems, Architecture of expert systems. (8Hours)

Unit III : Knowledge Representation – Rule based methods, rule execution, forward chaining and backward chaining, 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, stages in 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 – 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, defuzzification, 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 Dan W. Peterson, PHI
3. Fuzzy Logic by John Yen, Reza Langari, Pearson

REFERENCE BOOKS:

- 1) Expert Systems – 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 CONDITIONING

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 condensation 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 134a, HFC. (8- Hours)

Unit II: Multi stage pressure systems- multistage compression: choice of intermediate pressure, complete multi-stage compressions. Multi evaporator systems; single compression individual expansion valve, 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 : Psychrometric properties of moist air psychrometric chart, concept of thermodynamic wet –bulb temperature, representations of Psychrometric process on Psychrometric charts, mixing of air, evaporating cooling, air washers. Human comfort:- metabolism of human body, factors influencing comfort, concept of effective temperature, optimum effective temperature & comfort charts. (7 Hours)

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

Unit VI : Load calculation & applied Psychrometry-basic consideration of heat gains/losses sensible & latent, heat due to occupancy lighting, 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 Hill Publication.
2. Refrigeration & air conditioning; Arora, Domkundwar; Dhanpat Rai Publication.

REFERENCE BOOKS:

1. Principles of Refrigeration; J.Dossat; Pearson Education, Asia publication
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 & Gaussian 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, Galerkin's Method, stiffness (Displacement) Method. (7Hrs)

Unit II : Matrix Algebra & Gaussian Elimination : Matrix Multiplication, Transposition, Diagonal Matrix, Symetric Matrix, Upper Triangular Matrix, Determinant of Matrix, Matrix Inversion Eigen values & Elgenvectors, Gaussian elimination.

(7 Hrs)

Unit III : ID Problems : Finite Element modeling, coordinate Shapefunction, Thepotential Energy approach, The Galerkin'sApproach, assemblies of the globalstiffness 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, galaerkin's 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 – 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 – D.V.Huttan, TataMcgraw Hill
3. Concept & Applications of Finite Element Analysis – Robert D.Cook
4. Finite & Boundary Element Method in Engineering – O.P.Gupta
5. An Introduction to Finite Element Method- J.N.Reddy, Tata McgrawHill, 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, robot Specifications. (8 Hrs.)

Unit II : Robots end-effectors-classification of end-effectors, mechanical grippers, hooking or Lifting grippers, grippers for molten metal , plastics, vacuum cups, magnetic grippers Electrostatic grippers, multiple grippers, internal & external grippers, drivesystems for grippers, 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 continuous path 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 and reverse transformation of two DOF & three DOF 2-D manipulator, homogeneous transformations.(6-Hrs)

Unit VI: Quantitative Techniques for economic performance of robots- Robot investment costs, 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), Microstereolithography), 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. Benefits 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. hardtooling.

(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 –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
1. Performance test on a single cylinder diesel engine.
 2. Performance test on a single cylinder petrol engine.
 3. Evaluation of the heat balance for single cylinder diesel engine.
 4. Performance test on a multi-cylinder petrol engine.
 5. Mors test on multi-cylinder petrol engine.
 6. Trial on petrol/ diesel engine to plot p-0 and p-V diagram.
 7. Measurement of exhaust gas emission from S.I.engine
 8. Measurement of smoke density of CI engine exhaust.

9. Study of Bosch type single plunger fuel pump.
10. 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 & Gaussian 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-LABCourse

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-Demostration 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,starin gages,etc.) micro controllers & ROS (Robot Operating System) in a Robotic system.
- 7- Industrial Robot application (Any one Miniproject)
- 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

NOTIFICATION

No. 88 /2022

Date : 21 /07/2022

Subject : Revised Syllabi of Semester V to VIII of B.E. Mechanical Engineering (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 revised syllabi of Semester **V to 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 **Appendix – A** as given below:

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

Appendix – A

SYLLABUS OF B.E. SEM. V TO VIII (MECHANICAL ENGINEERING) [C.B.C.S.]

(SME05) OPEN ELECTIVE – I (i) INDUSTRIAL ROBOTICS & APPLICATIONS

Course Learning Objectives (Clos) :

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 space.
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 different applications of robots in manufacturing and to understand importance of robot features for a particular application.

Course Outcomes (Cos):

1. Understand the concept of robotics, its history.
2. Remember robot anatomy and various configurations for different industrial applications
3. Understand the need of a particular type of robot depending on the its application in manufacturing.
4. Remember the concept of robot programming, their methods and programming languages.

SYLLABUS

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, robot Specifications. (8 Hrs.)

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

Unit IV: Robot Sensors: Contact type sensors- wrist force sensor, binary & analog touch sensor, , force, torque, encoders, position, velocity sensors, Non contact type sensors- vision sensor, proximity, range sensors. (7 Hrs.)

Unit V: Robot Programming: Programming Methods for Industrial Robot, Robot programming languages, VAL Commands, robot programming in Val & RAIL. (6-Hrs)

Unit VI: Robot Applications: Robot Applications in Industry- Material Handling, Part Processing, Assembly, Inspection and Quality Control, Feature requirements of Machine Loading-Unloading & Palletizing Robot, Welding Robot, Assembly Robot, Painting Robot, Part Sorting & Inspection Robot. Robot Applications in electronic component fabrication, assembling miniature components on PCBs, applying adhesives, inspections, testing (7 Hrs.)

RECOMMENDED BOOKS:

Text Books:

- 1) Industrial Robotics by M.P.Groover, McGraw Hill.
- 2) Robotics and Automation by R. K. Rajput, S. Chand Publications Ltd.
- 3) Robotics Technology & Flexible Automation by S.RDeb, Tata 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.

SME05 OPEN ELECTIVE –I (ii) MODERN MANUFACTURING TECHNIQUES

Course Learning Objectives (Clos) :

1. able to understand importance of nontraditional machining processes.
2. able to understand knowledge of Rapid Prototyping methods.
2. able to study the process of USM, AJM& ECM.
3. able to study and understand the process of surface finish and its applications.
4. to study the principle of working of EBM and its applications.

Course Outcomes (Cos) :

1. To make the students to understand the concept of advanced manufacturing techniques evolved in industrial manufacturing scenario.
2. To remember, learn and understand the advanced manufacturing techniques f USM, AJM, ECM, CM, EDM, PM, EBM & LSB.
3. To understand the need of a particular type of composite materials and its manufacturing methods.

SYLLABUS

Unit-I: Rapid Prototyping Method:- study of RP relevance in precision manufacturing, sterolithography ,fused deposition methods, materials, principle of prototyping and various applications . (7-Hrs)

Unit-II: Ultrasonic Machining:-elements of the process of UM, mechanics of material removal, process parameters, applications and limitations.

Abrasive water jet machining:- elements of the process of AWJM, mechanics of material removal, process parameters, applications and limitations. (7-Hrs)

Unit-III: Electro Chemical Process:- basic fundamentals of Electro Chemical grinding, metal removal rate in ECM, Tooling and applications.

Chemical Machining:- basic fundamentals of CM, principle of material removal-maskants-elements .Advantages and applications of CM. (7-Hrs)

Unit-IV: Thermal Metal Removal Process:- basic principle of spark erosion (EDM),wire cut EDM & Electric discharge grinding process ,principle of working and applications . (7-Hrs)

Unit-V: Electron Beam Machining:- generation and control of EBM for machining, theory of EBM, applications and limitations.

Laser Beam Machining:- process description, mechanism of material removal in LBM, process parameters, applications and limitations. (7-Hrs)

Unit-VI: Composite Materials:- classification of composites.

Manufacturing methods:- spray Lay-up, Wet/Hand Lay-up, Vacuum bagging, Resin transfer moulding (RTM) ,Resin Film infusion and applications of composites. (7-Hrs)

BOOKS RECOMMENDED:

Text Books:

1. Advanced machining process ,V.K.Jai, Allied publishers.
2. Modern machining process, Pande P.C. & Shah H.S.Tata Mc-Graw Hills.
3. Manufacturing Technology, Volume-II, Rao P.N., Tata Mc-Graw Hills.

Reference Books:

1. Principles of Modern Manufacturing, Mikell P.Groover, SI version, Wiley India Edition.
2. Manufacturing Technology, Kalpakzian, Pearson.
3. Production Technology, Volume-II, Khanna O.P., Dhanpat Rai Publisher, New Delhi.
4. Non-Conventional Machining , Mishra P.K.,Narosa Publisher, New Delhi.
5. Composite Materials i production, properties, testing and applications, K.Shrivasan, Narosa Publications,

SEMESTER SIXTH

6 ME04 PROF. ELECT. –I (i) NON-CONVENTIONAL ENERGY SOURCES

Course Learning Objectives (CLOs):

1. To study the introduction to renewable and non-renewable resources of energy.
2. To study the radiation transmission through covers & Solar Energy collections.
3. To study the solar energy utilization and solar energy storage.
4. To study energy from ocean and energy from wind.
5. To study biomass energy resources like biomass and biodiesel.
6. To study photo voltaic cell, fuel cell and geothermal energy.

Course Outcomes (COs):

Upon completion of the course, students will be able to:

1. Able to study the concept of renewable and non-renewable sources.
2. Apply the basic concept of solar energy utilization and storage.
3. Apply the concept of energy from ocean and wind.
4. Study the concept of bio-mass energy resources.

SECTION–A

UNIT I:

1. **Introduction:-** Renewable & Non-renewable sources. Need of renewable energy sources, Overview of Global and Indian Energy Scenario.
2. **Solar Radiation:** Solar constant, Definitions of basic earth-sun angles. Types of Solar radiation, Measurement of solar radiation using Pyrheliometer, Pyranometer and Sunshine Recorder, estimation of solar radiation intensity. (8 Hrs.)

UNIT II:

1. **Solar Collectors:-**classifications of collectors- concentrating, non-concentrating collectors and Evacuated tube solar collectors, its construction, and working.
2. **Solar Energy Storage & Utilization:-**Methods of storage such as Mechanical, Thermal, Electrical, Thermo-chemical and Electromagnetic storage. Properties of storage materials and different arrangements of storages. Applications of solar energy in heating, cooling, pumping, power production, distillation, drying, etc. (7 Hrs.)

UNIT III: Direct Energy Conversion:

1. **Solar Photovoltaic cells:** Principle, Construction and Working, Conversion efficiency. Power output and performance.
2. **Fuel Cells:** working principle, types of fuel cells, applications.
3. **Geothermal Energy Resources:** Hot Dry Rock system, Vapour dominated, liquid dominated, flash steam, binary fluid and total flow concept of power generation. (8Hrs)

SECTION - B

UNIT IV: Energy from Ocean:

1. **Tidal Power:-**Types of tidal plants such as single and two basin plants, power developed & operation of tidal power plant.
2. **Ocean thermal energy conversion system:-** Construction and working of open cycle and closed cycle OTEC systems. (7 Hrs)

UNIT V: Wind Power:- Introduction, Principles of wind energy conversion, Operation, maintenance and economics. Wind patterns and Wind speed data, Types of wind mills, application for pumping and power generation. Conversion efficiency, Site selection. (8Hrs)

UNITVI: Biomass Energy Resources: Mechanism of green plant photosynthesis. Efficiency of conversion, solar energy plantation, Bio-gas – Types of biogas plants, factors affecting production rates. Types of gasifiers, Introduction to bio-diesel and ethanol as alternative fuels, properties of bio-fuel. (7 Hrs)

BOOKS RECOMMENDED:

Text Books:

1. Solar Energy; S.P. Sukhatme; TMH
2. Non-Conventional Energy Sources; G.D. Rai; Khanna Publications
3. Non-Conventional Energy Sources; B. H. Khan.

Reference Books:

1. Treatise on Solar Energy; H.P. Garg; John Wiley & Sons.
2. Renewable Energy Conversion, Transmission and Storage; Bent Sorensen; Elsevier Publication
3. Renewable Energy; Godfrey Boyle; Oxford University Press, Mumbai
4. Renewable Energy Sources and Emerging Technology; D.P. Kothari, K.C. Singal, Rakesh Ranjan; PHI.

6ME04 PROF. ELECT. – I (ii) PROJECT MANAGEMENT

Course Learning Objectives:

This course focuses on project management methodology that will allow students to learn how to initiate and manage projects efficiently and effectively. The overall learning shall resolve project identification evaluating its technical and economic feasibility and developing skills for its planning, and establishing controls. Relevant techniques, writing skills and monitoring methods shall be dealt with in details.

Course Outcomes:

Upon completion of the course, students will be able to:

- Apply project selection methods to evaluate the feasibility of projects.
- Use appropriate project management practices, tools, and methodologies.
- Define, analyze, refine, and document project requirements, assumptions, and constraints.
- Analyze and refine project time and cost estimates to define project baseline, schedule and budget.
- Organize and manage critical resources for effective project implementation
- Identify, analyze, quantify and mitigate risks in implementing project

SECTION – A

Unit I: Project Identification considering objectives and SWOT analysis, Screening of Project Ideas, Technical, Market, Financial, Socioeconomic and Ecological Appraisal of a project demand forecasting, secondary data, accuracy, confidence level, uncertainty. (7 hrs.)

Unit II: Technical feasibility: Process selection, Level of automation, plant capacity, acquiring technology, Appropriate technology plant location, Equipment selection & procurement, Govt. policies. Value analysis and project evaluation. (8 hrs.)

Unit III: Economic feasibility: Cost of Project, working capital analysis, fixed cost, means of finance, estimation of sales & production price analysis, Breakeven point, Projected cash flow statements, projected balance sheet, projected profit & loss statement, projected cash flow, rate of return, Discounted payback period, cost benefit analysis, return after taxes. (9 hrs.)

SECTION – B

Unit IV: Project Planning and Control: Work break down structure and network development. Basic Scheduling, Critical Path and four kinds of floats. Scheduling under probabilistic durations, Time Cost tradeoffs, CPM, PERT, Optimum project duration, Integrated resource Management. (9 hrs.)

Unit V: Project report: Preparation of project report, risk analysis, sensitivity analysis, methods of raising capital. (7 hrs.)

Unit VI: Initial review, performance analysis, ratio analysis, sickness, project revival, Project Monitoring with PERT/Cost, Organizational aspects, Computer packages and Project Completion environmental & social aspects. (8 hrs.)

BOOKS RECOMMENDED:

Text Books:

1. Prasanna Chandra, Projects: Planning, Analysis, Selection, Financing, Implementation, and Review, 9th Edition, McGraw Hill Education (India) Pvt. Ltd. 2019.
2. Choudhry S., Project Management, Tata McGraw-Hill, 1988.
3. P. Gopalakrishnan and V. E. Ramamoorthy, Textbook of Project Management, Laxmi Publications; Laxmi Publications Pvt Ltd., First edition 2014.
4. L.S. Srinath, PERT and CPM: Principles and Applications, Affiliated East-West Press (Pvt.) Ltd. 3rd Edition, 2001.
5. M. Y. Khan, P. K. Jain, Financial Management: Text, Problems and Cases, McGraw Hill Education; Eighth edition, 2018.

Reference Books:

1. Harold Kerzner, Project Management: A Systems Approach to Planning, Scheduling, and Controlling, Wiley; 13th edition, 2022.
2. A Guide to the Project Management Body of knowledge PMBOK Guide, 6th Edition, Project Management Institute 2017.
3. John M. Nicholas, Herman Steyn, Project Management for Business, Engineering, and Technology, A Butterworth-Heinemann Title; 3rd edition, 2008.

6ME04 PROF. ELECT. - I (ii) LEAN MANUFACTURING

Course Learning Objectives:

- To introduce basics of Lean Manufacturing System & Its Applications.
- To illustrate Different Concept & Elements of lean manufacturing
- To interpret different approaches for lean manufacturing implementation.
- To introduce concept of Six Sigma and its applications.

Course Outcomes (CO): After completion of course student will be able to:

- Explain the concept, history and applications of lean manufacturing
- Interpret different element of lean manufacturing
- Interpret different tools of lean manufacturing
- Apply lean manufacturing in real life situation.
- Identify the barriers in implementation of Lean Manufacturing
- Explain the concept of Six Sigma

Unit I: Introduction to lean manufacturing:

Historical evolution of lean manufacturing, objectives of lean manufacturing, key principles and implications of lean manufacturing, traditional versus lean manufacturing, 10 steps to lean production, necessity of lean manufacturing systems, limitations and applications of lean manufacturing. (7 Hrs)

Unit II: Concepts in lean manufacturing: Overview of Toyota Production System (TPS), Concept of value in lean, concept of waste in lean, the 7 wastes, their causes and effects. (6 Hrs.)

Unit III: Lean Tools and Methodology:

Primary tools of lean manufacturing such as 5S, Total productive maintenance (TPM), Pillars of TPM, Work Place Organization, Work Cell (6 Hrs)

Unit IV: Secondary Tools of Lean Manufacturing: Introduction and applications of: Just-In-Time (JIT), Kaizen, Poke Yoke, Kanban system, single minute exchange of die (SMED). (7 Hrs)

Unit V: Implementation of Lean Manufacturing : Different approaches for lean manufacturing implementation, important factors in lean implementation, barriers and limitation in lean implementation. (6 Hrs)

Unit VI: Introduction to Six Sigma : Meaning of Six Sigma, Why Six Sigma?, Six Sigma improvement model, building Six Sigma organization and culture, applications of Six Sigma. (7 Hrs)

Text Books :

1. Lean Thinking by James Womack and Daniel Jones, Free press.
2. The Toyota way of Field Book by Jeffery Liker and David Meier, McGraw Hill.
3. The Kaizen Blitz by Laraia, Moody and Hall, Wiley.

Reference Books:

1. Lean Production Simplified by Pascal Dennes, Productivity Press.
2. Statistical Quality Control, M. Mahajan, Dhanpatrai and Co. Pvt. Ltd.

6ME05 OPEN ELECTIVE – II (i) RENEWABLE ENERGY TECHNOLOGIES

Course Learning Objectives (CLOs):

1. To study the introduction to renewable and non-renewable resources of energy.
2. To study the radiation transmission through covers & Solar Energy collections.
3. To study the solar energy utilization and solar energy storage.
4. To study energy from ocean and energy from wind.
5. To study biomass energy resources like biomass and biodiesel.
6. To study photo voltaic cell, fuel cell and geothermal energy.

Course Outcomes (COs):

Upon completion of the course, students will be able to:

1. Understand concept of renewable energy sources and its importance.
2. Understand the basic concept of radiation transmission through covers and solar energy collections, the basic concept of Solar energy utilization and storage.
3. Demonstrate, concept of energy from ocean and wind.
4. Understand the concept of bio-mass energy resources, concept of direct energy conversion and fuel cell.

SYLLABUS

UNIT I: Introduction:- Renewable & Non-renewable sources. Need of renewable energy sources, Overview of Global and Indian Energy Scenario.

Solar Radiation: Solar constant, Definitions of basic earth-sun angles. Types of Solar radiation, Measurement of solar radiation using Pyrheliometer, Pyranometer and Sunshine Recorder. (7Hrs)

UNIT II: Solar Collectors:- classifications of collectors- concentrating, non-concentrating collectors and Evacuated tube solar collectors, its construction, and working.

Solar Energy Storage & Utilization: Methods of storage such as Mechanical, Thermal, Electrical, Thermo-chemical and Electromagnetic storage. Applications of solar energy in heating, cooling, pumping, power production, distillation, drying, etc. (7Hrs)

UNIT III: Direct Energy Conversion:

1. **Solar Photo voltaic cells:** Principle, Construction and Working, Conversion efficiency.
2. **Fuel Cells:** working principle, types of fuel cells, applications.
3. **Geothermal Energy Resources:** Hot Dry Rock system, Vapour dominated, liquid dominated, flash steam, binary fluid and total flow concept of power generation. (7 Hrs)

UNIT IV: Energy from Ocean:

Tidal Power:- Types of tidal plants such as single and two basin plants, power developed & operation of tidal power plant. **Ocean thermal energy conversion system:-** Construction and working of open cycle and closed cycle OTEC systems. (7Hrs)

UNIT V: Wind Power: Introduction, Principles of wind energy conversion, Operation, maintenance and economics. Wind patterns and Wind speed data, Types of wind mills, application for pumping and power generation. Conversion efficiency, Site selection. (No derivations and numericals). (7 Hrs)

UNITVI: Biomass Energy Resources: Mechanism of green plant photosynthesis. Efficiency of conversion, solar energy plantation, Biogas-Types of biogas plants, factors affecting production rates. Types of gasifiers, Introduction to bio-diesel and ethanol as alternative fuels, properties of bio-fuel. (7Hrs)

BOOKS RECOMMENDED:

Text Books:

1. Solar Energy; S.P. Sukhatme; TMH.
2. Non-Conventional Energy Sources; G.D. Rai; Khanna Publications.
3. Non-Conventional Energy Sources; B. H. Khan.

Reference Books:

1. Treatise on Solar Energy; H.P. Garg; John Wiley & Sons.
2. Renewable Energy Conversion, Transmission and Storage; Bent Sorensen; Elsevier Publication.
3. Renewable Energy; Godfrey Boyle; Oxford University Press, Mumbai.
4. Renewable Energy Sources and Emerging Technology; D.P. Kothari, K.C. Singal, Rakesh Ranjan; PHI.

6ME05 OPEN ELECTIVE –II (ii) AUTOMOBILE ENGINEERING AND ELECTRIC VEHICLES

Course Learning Objectives (CLOs):

1. To study the Introduction of automobiles, engine types and working of SI and CI engines.
2. To study the fuel feed systems, their types and to understand the basics of cooling system.
3. To study the electrical system, Battery capacity and its ratings, starter motor drive and to understand the basics of lubrication system.
4. To study the basics of transmission system, clutches, gear boxes and suspension system.
5. To study the braking system, steering system, wheel balancing and alignment and to study the introduction of power steering.
6. To study the basics of Electric vehicle and to study the working of electric vehicles.

Course Outcomes (COs):

1. Understand the basics of automobile engineering and its components.
2. Analyze & develop about the cooling system and its function.
3. Understand basic concept of transmission system and types of gears box, basic concept of electrical system and ignition system.
4. Apply the knowledge of suspension and lubrication.
5. Understand the concept of Electric vehicle.

SYLLABUS

UNIT I: Introduction, Classification of automobiles, chassis layout, basic working of SI and CI engines, engine parts, Multiple cylinder engines. (7 Hrs)

UNIT II: Fuel feed systems- fuel feed systems for petrol and diesel engines, Basic principles of Multipoint Fuel Injection Systems (MPFI) and Common Rail Diesel Injection Systems (CRDI). **Cooling system:** purpose, Air cooling and water cooling system, antifreeze mixtures. (7 Hrs)

UNIT III: The electrical system:- Battery Capacity, standard capacity ratings, starter motor drive-Bendix drive. Introduction to Ignition system. Introduction of charging unit for electric vehicle.

Lubrication: Types of lubricants and their applications in automobile. (7 Hrs)

UNIT IV: Transmission system:- Layout, Working principle of clutch, working of Gear Box:- Sliding mesh, Propeller shaft, Principle of differential.

Suspensions system: shock absorbers and independent suspension system. (8 Hrs)

UNIT V: Braking system: Working of Mechanical and hydraulic brakes.

Steering system:- Function, types of linkages, wheel balancing, wheel alignment, Introduction of camber, castor, king pin inclination, toe-in& toe-out & their effects. Introduction to power steering. (7 Hrs)

UNIT VI: Introduction to Electric Vehicle, need, Types of Electric vehicle, components, working, advantages, limitations. (6Hrs)

BOOKS RECOMMENDED:

Text Books:-

1. Automobile Engineering- Vol. I & II; Kirpal Singh; Standard Publishers Distributors
2. Automobile Engineering; R.K. Rajput; Laxmi Publications, New Delhi .
3. Electric and Hybrid Vehicles; Husain, I. CRC Press.

Reference Books:-

1. Automotive Mechanics; Crouse & Anglin; TMH.
2. Automotive Mechanics; J. Heitner; East West Press.
3. Automotive Mechanics; S. Srinivasan; TMH.
4. James Larminie, ñElectric Vehicle Technology Explainedò, John Wiley & Sons, 2003.

6ME08 COMPUTER AIDED DESIGN & SIMULATION -LAB. [Only Practical]

Course Learning Objectives (CLOs):

1. To understand fundamentals of CAD.
2. To study the solid modeling techniques.
3. To study the geometric transformation techniques.
4. To demonstrate Simulation of Mechanical Systems.

Course Outcomes (COs):

1. Understand the concept of CAD and simulation.
2. Apply knowledge using CAD modeling for component design
3. Apply the knowledge of geometric transformation.
4. Analyse the Mechanical & Manufacturing systems through simulation.

Practicals:- Any six practicals from the list should be performed.

1. Creation of 2D drawing (Sketching Module) of any mechanical machine component using any modeling/drawing software.
2. Creation of isometric view from given orthographic view of any mechanical machine part using any modeling software.
3. Creation of 3D drawing of any mechanical machine part using any modeling software.
4. Creation of assembly of Knuckle joint/ Cotter joint using any modeling software.
5. Creation of sheet metal component using any modeling software.
6. Simulation of Four bar chain mechanism using any modeling software.
7. Simulation of Slider crank chain mechanism using any modeling software.
8. Simulation of Cam and Follower mechanism.
9. Simulation of Spring-mass system.
10. Thermal Analysis of a 2D component
11. Stress analysis of plate with circular hole
12. Stress analysis of beams(cantilever or simply supported)

Practical Examination:-The practical examination shall consist of oral on the term work and syllabus.

Text Books:

- 1) P. N. Rao; CAD/CAM Principles and Applications; Mc-Graw Hills Publications.
- 2) Mikel P. Groover and Emory W. Zimmers: Computer Aided Design and Manufacturing, Prentice hall.
- 3) Ibrahim Zeid: Mastering in CAD- CAM, Tata McGraw Hill Publication.
- 4) Geoffrey Gordon, System Simulation; Prentice Hall.

Reference Books:

- 1) Mikell P. Groover: ñAutomation, Production systems & Computer Integrated Manufacturingò, Prentice Hall.
- 2) Robert E. Shannon; ñSystem Simulation: The Art and Scienceò; Prentice Hall.
- 3) J. Schwarzenbach and K.F. Gill Edward Arnold; ñSystem Modelling and Controlò
- 4) P. Radhakrishnan and Subramaniam: ñCAD/CAM/CIMò, wiley Eastern Ltd.

SEMESTER VII

7ME09 TECHNICAL SEMINAR AND PROJECT

Course Learning Objectives (CLOs):

1. To collect information on novel and latest development in core and allied area of the subject.
2. To encourage the process of independent thinking and working together in a group.
3. To implement innovative ideas for social benefit
4. To develop the ability to describe, interpret and analyze technical issues.

Course Outcomes (COs): After completion of course, student will be able to:

1. Prepare a well-organized report employing elements of technical writing and critical thinking.
2. Demonstrate the ability to describe, interpret and analyze technical issues.
3. Apply principles of ethics and standards, skill of presentation and communication techniques.
4. Work in a group to develop the leadership/interpersonal skills for finishing task within timeframe.

Brief Guidelines:

Student shall select a topic of seminar which is not covered in curriculum. Topics shall be approved by the concerned guide and Program in charge as per the department policy. Students should know the functional and technical details of selected topic after carrying out the conceptual study. Before the end of semester, student shall deliver a seminar and required to submit the seminar report in concerned with guide, Program in charge as per department policy. Student shall deliver a seminar based on submitted report. The presentation and oral examination on selected seminar topic shall be assessed by panel of examiners mentioned in syllabus scheme.

B.E. (MECHANICAL ENGINEERING SEMESTER - VIII (C.B.C.S.)

8ME07 PROJECT

Course Learning objectives (CLOs):

1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.

Course outcomes (COs):

1. Apply creative process techniques in synthesizing information, problem-solving and critical thinking to demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering project, use sustainable materials and manufacturing processes & Carry out cost and benefit analysis through various cost models.
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.

Brief Guideline: Earlier knowledge and experience of Research Skill-Lab (6ME09) and Technical seminar & Project (7ME09), the student should complete implementation of ideas as formulated in Project. It may involve coding, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, and sustainability. It may also include testing, results and report writing. Each student group should submit complete project report at the end of Semester-VIII in the form of Hard bound. The Internal Continuous assessment shall be done throughout the VII and VIII semester under the observance of supervisor/guide as per department policy. The Final External Assessment and evaluation for the project shall also include presentation and demonstration by the students as per the syllabus scheme.

Suggestive outline for the complete project report is as follows (depends on the topic, objectives and scope of the project) :-

ABSTRACT :

Chapter 1: Introduction Background • Motivation • Scope • Objective • Organization of Report • Summary •

Chapter 2: Literature Review, Critical literature Review analysis, Drawback and salient feature, Research Gap, Problem identification and Problem definition.

Chapter 3. Methodology : Design & development / Experimentation & observation / Survey & Data collection, Data arrangement, Data Analysis as per the scope and limitations of the study.

Chapter 4: Testing, Analysis & Validation, Data interpretation, optimization, etc.

Chapter 5: Result and Discussion

Chapter 5: Conclusion

- Scope for Future Work
- References/Bibliography
- Index
- Appendix/annexure, etc.
- Publications/copy right/patent, if any.
