5. Analysis of Volatile and Fixed solids
7. Optimum coagulant dose
8. Determination of Temporary and Permanent Hardness of water sample
9. Determination of Acidity & Alkalinity of water sample
10. Determination of Iron and Manganese
11. Determination of residual chlorine in the given water sample
12. Total Count of Bacteria Test.

6CE08 : FLUID MECHANICS – LAB

Suggested Fluid Practicals :
Minimum 8 practical out of the list given should be carried out. The practical examination shall consist of viva voce based on theory & practical. Graphs are to be drawn wherever necessary.

1. Verification of Bernoulliôs theorem.
2. Determination of coefficient of discharge for Venturimeter.
3. Verification of Reynoldôs Number with respect to type of flow.
4. Determination of metacentric height.
5. Determination of friction factor for GI pipe.
6. Determination of coefficient of discharge for rectangular notch.
7. Determination of coefficient of discharge for triangular notch.
8. Determination of Chezyôs coefficient.
9. Determination of coefficient of discharge of Venturiflume.
10. Verification of momentum equation.
11. Study of hydraulic jump, calculations of height of jump, length & energy loss.

6CE09: MINI PROJECT

Any one Group Project in details:
1) Irrigation Project
2) Rehabilitation of Village / Town
3) Water Supply Project
4) Sewerage System
5) Bridge on River
6) Flood Relief Structures
Students should conduct a detailed survey in a seven day camp.
Data Analysis, Design & Submit Report & Drawing sheets.

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SYLLABUS PRESCRIBED FOR SEMESTER V & VI OF B.E. (MECHANICAL ENGG.)

SEMESTER – V

5ME01 HEAT TRANSFER

Course Learning Objectives (CLOs):

1. To provide details of heat transfer involving conduction, convention and radiation mechanisms.
2. To carry out heat transfer analysis and to demonstrate different techniques used in solving a heat transfer problem.
3. To impart basics of designing heat transfer equipment.

Course Outcome (COs) :
At the end of Heat Transfer course the student will be able to:

1. Solve steady state heat transfer problems of 1-D heat conduction with and without internal heat generation.
2. Design and to analyze the performance of extended surfaces.
3. Apply Lumped heat capacity method for analysis of unsteady state heat transfer.
4. Explain the laws of radiation and its applications.
5. Predict heat transfer coefficients for forced and free convection heat transfer applied to internal and external flow conditions.
6. Design and analyze the performance of heat exchangers using NTU and LMTD methods.

UNIT - I : Introduction, heat transfer in engineering, modes of heat transfer, basic laws of heat transfer and their basic equations. Conduction-thermal conductivity and thermal diffusivity effect of phase &temperature on thermal conductivity, one dimensional steady state heat conduction through slab, cylinder & sphere-simple and composite. Combined conduction- convection, overall heattransfer coefficient. General heat conduction differential equation. One dimensional steady state conduction with internal heat generation for infinite slab, wire & cylinder. **(**8 Hrs**)**

UNIT II : Insulations, critical radius of insulation, Conduction through extended surfaces, analysis of a uniform C.S. fin, fin efficiency, fin effectiveness, Biot number. Introduction to unsteady state heat conduction, Newtonôs law of cooling, lumped heat capacityanalysis. **(8 Hrs)**

UNIT III : Radiation-general concepts and definitions, black body & greybody concept. Laws of radiation - Kirchoffôs Plankôs, Stefan- Boltzmanôs, Wienôs law. Concept of shape factor, emissivity factor and radiation heat transfer equation. (No numericals).Radiation errors in temperature, measurement, radiation shield. (7 Hrs)

UNIT IV: Forced convection- heat convection, forced and natural convection, boundary layer theory, hydrodynamic & thermal boundary layers, boundary layer thickness. Laminar & turbulent flow over flat plate and through pipes & tubes (only concept, no derivation & analytical treatment). Dimensionless number and their physical significance Reynold, Prandtl, Nusselt, Grashoff number, empirical correlations for forced convection for flow over flat plate, through pipes & tubes & their applications in problem solving. **(8 Hrs)**

UNIT V: Free convection- velocity and thermal boundary layers for vertical plate, free convection over vertical cylinder and horizontal plate/cylinder (only concept, no derivation & analytical treatment). Use of empirical correlations in problem solving. Condensation & Boiling - introduction to condensation heat transfer, film & drop condensation. Boiling heat transfer, pool boiling curves. **(7 Hrs)**

UNIT VI : Heat exchanger - applications, classification, overall heat transfer coefficient, fouling. L.M.T.D. & E.N.T.U. methods, temperature profiles, selection of heat exchangers. Introduction to working of heat pipe with and without wick. **(7 Hrs)**

Books Recommended:

Text Books:-

1. Heat and Mass Transfer; R.K Rajput; S. Chand, New Delhi.
2. Heat and Mass Transfer; V.M. Domkundwar; Dhanpat Rai & Co. Delhi.
3. Heat Transfer; A. F.Mills, V. Ganesan, Pearson Publication.

Reference Books:-

1. Heat Transfer; J.P. Holman; McGraw Hill
2. Heat Transfer; P.K. Nag; TMH.
3. Heat and Mass Transfer Data book, V.M. Domkundwar, Dhanpat Rai & Co.
4. Heat and Mass Transfer Data book; C.P. Kothandaraman; New age International.

5ME02 METROLOGY & QUALITY CONTROL

Course Learning Objectives:

1. To study generalized production technology, applications, general configuration and functional elements of inspection instruments.
2. To study about quality in production and services and quality management.
3. To study application of non destructive test for increasing productivity and efficiency of the work.
4. To study design and applications of various gauges and comparators used in inspection.
5. To study various techniques for the inspection of gears and threads.
6. To study various techniques for angular measurement, surface texture measurement, and geometric features measurement.
7. To study advance inspection techniques CMM, profile projector etc.

Course Outcomes:

1. Create & apply the concept of inspection, quality control and its importance to industry.
2. Demonstrate the skills of controlling various out of control processes using statistical quality control tools.
3. Understand the importance of improving production and productivity using work study approach.
4. Apply the knowledge of various measurement standards and techniques in the industry to measure various parameters related to metrology.

UNIT I : Concept of quality and quality control, quality of design and quality of conformance, Quality characteristics, Cost of quality & Value of quality, Specification of quality, quality control & inspection.
Concept of TQM & Quality assurance, Concept of variation, variable and attribute data, Frequency distribution, Measures of Central tendency - Mean, mode & median, Measures of dispersion. -Range, std.deviation & variance. (8 **Hrs**)

UNIT II : Concept of universe and population, Normal distribution curve; Control charts for variables, process capability, Control charts for attributes; comparison between variable charts and attribute charts; precision & accuracy, Sampling plans,Operating Characteristic curve, Quality circle (7 **Hrs**)

UNIT III : Introduction to Non-Destructive testing, Ultrasonic testing, X-ray or Radiography Testing, Liquid Penetrant testing, Magnetic Particle Testing, Eddy current testing, itôs applications, Advantages & Disadvantages. (7 **Hrs**)

UNIT IV : Standards of measurements: line standards, end standard, wave length standard. Limits, fits and gauges: terminology of limits, Fits and gauges, concept of interchangeability, allowance tolerance, Indian Standard Specification for limits, fits and gauges, B.S. System. Limit gauging - design of Go, No Go gauges. (8 **Hrs**)

UNIT V : Linear measurement: various comparators such as mechanical, electrical, optical, pneumatic comparators, their principle, operations and applications.
Angular measurements: vernier, optical, bevel protractor universal bevel protector, Sine bar level clinometers, taper gauges. Thread measurement: screw thread limit and fit limits gauging of screw threads (8 **Hrs**)

UNIT VI : Gear measurement : alignment error, master gear, Parkinson tester. Study and use of optical dividing head, auto collimator, tool makers microscope. Interferometry, flatness testing, squareness testing. Surface texture testing. Coordinate measuring machine- types, role and application. **(7 Hrs**)

Books Recommended:

Text Books:

1. Engineering Metrology ï R.K.Jain - Khanna Publishers.
2. Statistical Quality Control- M. Mahajan ï Dhanpatrai & Co. Pvt.Ltd.
3. Non Destructive Testing techniques by Ravi Prakash, New Age Publications.

Reference Books:

1. Quality Control - By Juran - Mc. Graw Hill Pub. Company.
2. Statistical Quality Control- By Grant E.L. ï R.S.L.Leavgen Worth-.Mc. Graw Hill Pub. Company
3. Statistical Quality Control- By Gupta - Dhanpatrai & Com. Pvt. Ltd

5ME03 KINEMATICS OF MACHINES

Course Learning Objectives:

1. To get the basic Knowledge about the mechanism used in automobiles, industrial machines etc.
2. To study about the synthesis and analysis of the mechanism used in machines.
3. To get the operational knowledge about the power transmitting devices used in automobiles.
4. To study the designing and importance of cams in machines.
5. To study the most effective power transmission device used in automobiles, industrial equipment, toys, etc**.**

Course Outcomes:

Students will be able to-

1. Understand & apply the concept and its applications of link, mechanisms and machines.
2. Demonstrate the ability to analyze the mechanisms and machines on the basis of velocity and acceleration and they will show the ability to solve analytical methods.
3. Show the ability to use graphical and analytical methods for synthesis of mechanisms to develop mini projects in the course duration.
4. Understand the practical for study of brake, clutch, dynamometer, gear train etc.

Unit I: 1. Introduction to study of mechanisms, machines, different types of links, kinematic pairs. Grashofôs law-class-I and class ï II mechanisms. Grublerôs criterion, Kutzbachôs criterion for planer mechanism. Inversions of four bar, single slider, double slider mechanisms.

2. Transmission angle, Mechanical Advantage, Transmission angle and Mechanical Advantage of 4-bar mechanism. **(7 Hrs)**

Unit II: 1**. Velocity analysis**: - Relative velocity method, method of equivalent mechanisms, Instantaneous centre of rotation method for 4-bar mechanism, body and space centroids.

2**. Acceleration analysis**:- Relative acceleration method and analytical method. **(8 Hrs)**

Unit III: Synthesis of Mechanisms:- Introduction to type, number and dimensional synthesis, graphical method of two position, three position and four position synthesis for input output coordination, Freudenstienôs equation, Blochôs method. **(7 Hrs)**

Unit IV: Frictional torque in pivot and collar bearing. Clutches and Dynamometers: types, constructional details, operation. **(7 Hrs)**

Unit V: Special purpose mechanisms:- Steering mechanisms, Geneva wheel mechanism. **Cams**:- Introduction, types of cam & follower, different motions of followers, graphical layout of cam profiles, cam with specified contours. (8 Hrs)

Unit VI: 1. **Gear**: Introduction, terminology, gear tooth profiles, law of gearing, involumetry, interference of spur gears, minimum number of teeth to avoid interference.

2. **Gear Trains**:- Types of gear trains and its speed ratio applications. **(7 Hrs)**

Books Recommended:

Text Books:

1) Theory of Machines, P.L.Ballaney, Published by Dhanpat Rai and sons-N Delhi.
2) Theory of Machines, S.S.Ratan, Published by Tata Mc Graw Hill.
3) Theory of Machine, R.S.Khurmi and Gupta J.K., Published by Eurasia Publishing house-N Delhi.

Reference Books:

1) Theory of Machines and Mechanisms, J.E.Shigley, Uicker and Gordon, Published by Oxford University press-New York.
2) Theory of Machines, V.P.Singh, Published by Dhanpat Rai-N Delhi.
3) Theory of Machines and Mechanisms, Ghosh and Amitabh, Published Affiliated East West Press, N-Delhi.

5ME04 MEASUREMENT SYSTEMS

Course Learning Objectives:

1. To study the generalized measurement system and the general performance characteristics of measuring instruments, applications, general configuration and functional elements of measuring instruments.
2. To study the strain gauges, their types, strain gauge circuits for strain measurement and to study the pressure measurement methods and devices
3. To study the types, constructional details and working of force, torque and flow measuring devices.
4. To study the different types of temperature measuring devices, standards, construction details and their working and to study the different types of liquid level measuring devices.
5. To study the mechanical and electrical types of speed measuring devices, contact and contactless speed measuring devices and their applications.
6. To study the methods of vibrations measurement and methods of linear and angular displacements.

Course Outcomes:

At the end of Measurement System course, the student will be able to:

1. Analyze different measurement systems.
2. Calculate different types of errors in the measurement system.
3. Use strain gauges and pressure measurement devices for several applications.
4. Compare different methods of force, Power and flow measurement using different methods.
5. Select appropriate liquid level and temperature measurement devices for given applications.
6. Measure speed of motors and rotating shafts by using tachometers, stroboscope.

UNIT I : 1. Generalized Measurement system: Significance of measurement, generalized systems. application of measuring instruments. Types of measuring instruments.
2. General configuration and functional elements of measuring instruments, types of inputs, various methods of correction for interfering and modifying inputs. (6 Hrs)

UNIT II : General performance Characteristics:-

1. Static characteristics, different types of errors, combination of component errors in overall systems.
2. Dynamic characteristics: General mathematical model of zero order, first order and second order instruments, response of first and second order instruments to following inputs step, ramp, impulse and frequency. (8 Hrs)

UNIT III : Strain Measurement :

1. Types of strain gauges, strain gauge circuits, calibration, Temperature compensation, use of strain gauges on rotating shafts, selection and installation of strain gauges.
2. Pressure Measurements:- Basic methods of pressure measurement: strain gauge pressure cell, High pressure measurement Bridgeman type, low pressure Measurement - Mcleod, Knudsen, ionisation, Thermal conductivity gauges. **(8 Hrs)**

UNIT IV : 1. Force Measurement: Various mechanical. Hydraulic, pneumatic and electrical methods.
2. Torque and Power Measurements: Various mechanical, hydraulic & electric methods.
3. Flow Measurements: Construction- orifice, Rota meter. Pressure probes- Pitot static tube, turbine meter, electro-magnetic flow meter. **(6 Hrs)**

UNIT V : 1. Temperature Measurements : Standards, Various temperature measuring devices, Bimetallic strip, pressure thermometers, thermo couples, electrical resistance thermometers, Thermistors, radiation Thermometers.
2. Liquid Level Measurements : Various methods such as- single float, displacement or force transducers. Pressure sensitivity, bubbler or Page system, capacitance variation type (for both conducting and non conducting type liquids) Resistance variation type. **(8 Hrs)**

UNIT VI: 1. Speed Measurements: Various mechanical type tachometers, electrical types tachometers, stroboscope etc.
2. Vibration Measurements : Seismic, Strain gauge and piezoelectric accelerometers.
3. Displacement measurements : Linear and angular displacement measurements, LVDT, LDR, Capacitive & inductive pick ups. **(8** Hrs)

BOOKS RECOMMENDED:

Text Books:-

1. Measurement Systems : - By Erenest O. Doebelins - MC Graw Hill.
2. Mechanical Measurement & Control: By D.S.Kumar.

References Books:-

1. Mechanical Measurements :- By T.G.Beckwith & N.L.Bulk - Addison Werllv.
2. Instrumental Measurement & Analysis : By Nakra Choudhari Tata Mc Graw Hill.
3. Mechanical Measurement & Instrumentation : By R.K.Rajput,Katsons Books Publications.

5ME05 OPEN ELECTIVE - I (1) PRODUCTION MANAGEMENT

Course Learning Objectives:

1. To study the new product design & manufacturing process technology.
2. To study the objectives of forecasting, factors affecting forecasting.
3. To study method study, work measurement.
4. To study objectives and functions of Production Planning and Control.
5. To study inventory control & inventory control application
6. To study quality management, quality related costs, quality function deployment & total quality management.

Course Outcomes:

1. Apply the knowledge of operations management and its applications in industrial environment.
2. Demonstrate the knowledge of advanced manufacturing technologies and philosophies.
3. Students will demonstrate the importance of inventory control, JIT in manufacturing.
4. Apply the basic concept of quality management, TQM etc.

UNIT I: Designing products, services and processes; Historical evolution of productions and operations management, newproduct designs, manufacturing process technology.
Flexible manufacturing systems (FMS) and computer integrated manufacturing (CIM). **(9 Hrs.)**

UNIT II: Sales Forecasting: Objectives, types of forecasting, factors affecting forecasting, process of sales forecasting, methods of sales forecasting. **(7 Hrs.)**

UNIT III : Work study: method study, recording techniques of method study, principles of motion economy. Work measurement techniques. **(7 Hrs.)**

UNIT IV: Production planning and control: Objectives and functions of PPC, types of production systems, principles of sound production control system. **(7 Hrs.)**

UNIT V: Inventory Control: Demand and control system characteristics, inventory concepts, costs Modeling, Deterministic inventory models, stochastic inventory models, inventory control application, just-in-time manufacturing. **(7 Hrs.)**

UNIT VI: Quality Management: Quality and quality related costs, quality function deployment(QFD), Taguchiôs off-line quality control methods, managerial responsibility in managing for quality products & services. TQM. Failure analysis, bath tub curve, Reliability of system. **(8 Hrs.)**

Books Recommended:

Text Books:

1. Production and operations management- concepts models and Behaviour by Everett E. Adam,Jr., & Ronald J. Ebert (Prentice- Hallof India)
2. Industrial engineering & production Management by M. Mahajan(Dhanpat Rai & Co.)

References Books:

1. Production and operations management ï Total Quality and responsiveness by Hamid Noori & Russell Radfort (Mc Graw Hill, Inc.)
2. Industrial engineering & management by O. P. Khanna (Dhanpat Rai& Co.)
3. Production and Operations Management; J.P. Saxena; McGraw Hill.

5ME05 OPEN ELECTIVE-I

(2) MANUFACTURING TECHNIQUES

Course Learning Objectives:

1. To study the fundamentals of different manufacturing processes and various activities in manufacturing.
2. To study the fundamentals of metals & alloys, properties of engineering materials like ferrous, non- ferrous metals and their alloys
3. To study different machine tools. cutting tools used in machine shop , various operations performed with working principles of these machine tools
4. To study the activities related to mechanical working of metals, various hot working & cold working operations fundamentals of metal forming ; sheet metal working processes with different tools and equipment
5. To study the necessary details regarding pattern making, moulding, core making and casting with foundry tools & equipment, also melting practice by cupola furnace.
6. To study different Joining processes, basic terms of welding processes tike arc welding, gas welding, resistance welding. friction welding , soldering ; brazing processes with tools & processes.
7. To study the methods of producing metal powders
8. To study plastic part manufacturing by different processes like extrusion. Injection, blow, compression, and transfer moulding processes.

Course Outcomes:

1. Apply the knowledge of various manufacturing techniques and its applications in engineering.
2. Understand the knowledge of machining operations, sheet metal working and processes.
3. Students will show the ability to apply various joining methods in practice.
4. Students will exhibit the knowledge of powder metallurgy.

Unit I : Overview of manufacturing: Classification of manufacturing processes, selection of manufacturing processes, types & properties of materials, selection of materials, Introduction to conventional and non-conventional machining processes. (6Hrs)

Unit II : Introduction to cutting type shaping processes, Basic concept of metal cutting, Types of cutting tools, Orthogonal & oblique cutting, General purpose machines Vs Special purpose machines. (8Hrs)

Unit III: Introduction & application of various metal cutting operations ï Turning, drilling, boring, milling, shaping, planning and grinding process. (8Hrs)

Unit IV: Introduction to metal forming and sheet metal process: Forming process- Forging, rolling, extrusion, wire drawing. Sheet metal processes- Forming, bending, drawing, coining, embossing. Cutting process: Punching, blanking, shearing, lancing. (7Hrs)

Unit V : Metal casting: Steps involved in casting, advantages of casting, pattern, difference between pattern and casting, pattern allowances, material used for patterns, molding sand, sand mould making core, types of cores, defects of castings, melting furnace(Cupola), casting process and its applications. (6Hrs)

Unit VI: Joining process with its types, advantages and disadvantages of riveting, soldering, brazing. Arc welding, gas welding, resistance welding, friction welding. (6Hrs)

Books Recommended:

Text Books:

1. Manufacturing processes ï Workshop practice, R.A. Khan, Ali Hassan, Scitech Pub.
2. Workshop Technology - Hajra Chaudhary, Dhanpat Rai and Sons.

Reference Books :

1. Processes and materials of manufacture E.P. Degarmo, Prentice Hall of India (PHI)
2. Material and processes in manufacturing Lindberg, Tata McGraw Hill Pub.

5ME06 HEATTRANSFER - LAB.

Course learning objective: The lab work should clear the vision about all the modes of heat transfer. The practical knowledge should enhance the approach of student towards real life applications of the subject.

Course Outcomes:

Upon successful completion of lab Course, student will be able to:

i) Understand various modes of heat transfer
ii) evaluate various parameters of the heat transfer process

List of Practicals (Any six of the following):-

1. Determination of thermal conductivity of a metal bar.
2. Determination of thermal conductivity of insulating powder.
3. Study of heat transfer through composite wall.
4. Study of heat transfer through composite cylinders.
5. Determination of fin efficiency.
6. Verification of Stefan-Boltzmanôs law.
7. Determination of emissivity of grey body.
8. Determination of heat transfer coefficient for forced convection.
9. Determination of heat transfer coefficient for natural convection.
10. Study of pool & nucleate boiling.
11. Trial on double pipe heat exchanger.
12. Determination of efficiency of cross flow heat exchanger.
13. To write a computer program for conduction heat transfer problem.

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

5ME07 METROLOGY & QUALITY CONTROL - LAB.

Course learning objective:

The course aims at understanding the principles of metrology for precision measurement of various mechanical components using various measuring tools. Students shall also learn to use standard practices and standard data, learn to use statistical concept, control chart for variables, control chart for attributes.

Course Outcomes:

Upon successful completion of lab Course, students will be able to:

i) Explain the principles involved in measurement and inspection.
ii) Select and use appropriate measurement instrument for a given application
iii) Apply the basics of sampling in the context of manufacturing

Practicals : At least six from the below list.

1. Determination of Linear dimensions of a given specimen/part using Precision/Non-Precision Measuring instruments.
2. Determination of Angular Measurement using Precision/Non-Precision Measuring instruments.
3. Measurement of Gear Tooth Thickness by Gear Tooth VernierCaliper/Constant Chord/Span Micrometer.
4. Measurement of Circularity/Roundness of a given specimen.
5. Measurement of Screw Thread Element by Floating Carriage Micrometer.
6. Testing of Surfaces by using Optical Flat.
7. Measurements of various angles of single point cutting tool by usingProfile Projector and Tool Makerôs Microscope.
8. Preparation of Variable Control Charts for the given lot of sample.
9. Preparation of Attribute Control Charts for the given lot of sample.

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

5ME08 KINEMNATICS OF MACHINES - LAB.

Course Learning Objectives: Objectives of this lab are to impart practical knowledge on design and analysis of mechanisms for the specified type of motion in a machine. With the study of rigid bodies motions and forces for the transmission systems, machine kinematics can be well understood.

Course Outcome: On successful completion of the course students will be able to:

Design linkage, cam and gear mechanisms for a given motion or a given input/output motion or force relationship, identify the basic relations between velocity & acceleration and use graphical and analytic methods to study the motions of various mechanisms

Practicals: - *At least eight practicals from the below list shall beperformed.*

1. To Study, Analyse and drawing of inversions of four bar mechanism to identify the types and number of links, types of motion and its mode of fixing arrangement for the required application.
2. To Study and analyse of inversions of slider crank mechanism using working models and graphical representations to find type & number kinematic pair , type of joint and Degree of freedom.
3. To Study and analyse of inversions of double slider crank mechanism using working models and graphical representations to find type & number kinematic pair , type of joint and Degree of freedom.
4. To determine Velocity and acceleration of links in mechanism by relative velocity method. (2 Problem)
5. To determine Velocity and acceleration of Piston of a reciprocating engine by cleinôs construction method. (2 Problem)
6. To find braking force, braking toque of internal expanding and external expanding brake .

7. To study, understand and observe the actual working and function of each part of single plate clutch by dismantling and assembling.
8. To study, understand and observe the actual working and function of each part of centrifugal clutch by dismantling and assembling.
9. Study of dynamometers.
10. To draw Cam profile for a given follower type and follower motion. (2 Problem.)
11. To Study and find train value and speed ratio of various types of gear trains
12. To study and drawing of Simple four bar Mechanism using position synthesis.
13. To Study and drawing of four bar mechanism by input-output coordination methods using Blochôs Synthesis and Freudensteinôs equation.
14. To study interference and undercutting of spur gear pair using graphical layout.
15. To study and drawing of Generation of Involute and Cycloidal Spur Gear Tooth Profile.

The practical examination shall consist of viva-voce on the above syllabus & practical work.

5ME09 MEASUREMENT SYSTEMS -LAB.

Course Learning Objectives :

i)To study various sensers and measuring instruments required to measure various properties and quantities occurring in a typical engineering system.

ii)To understand general performance characteristics of measuring instruments, applications and general configuration of the measuring instruments.

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

i) Choose appropriate measuring device for measurement of various quantities
ii) Analyse the performance of various
iii) Analyse and execute the calibration process for measuring instruments

List of Practicals :

At least eight practicals from the following list:

1. Measurement of strain using strain gauges.
2. Calibration of pressure gauge with pressure gauge tester.
3. Measurement of linear displacement by LDR and inductive pick-uptransducers.
4. Performance of capacitance transducer as an angular displacementmeasuring device.
5. Performance of inductive Transducers.
6. Measurement of flow using optical flow meter and Rotameter.
7. Speed measurement by a stroboscope.
8. Speed measurement by magnetic pick up or photo electric pick up tachometer.
9. Pressure measurement by strains gauge type transducer.
10. Vibration measurement by using Seismic Transducer.
11. Measurement of Liquid level by using capacitive pickup transducer.
12. Temperature measurement using contact and non contact type instruments or various types of sensors.

*The practical examination shall consist of viva-voce on the above syllabus & practical work.

SEMESTER: SIXTH

6ME01 DESIGN OF MACHINE ELEMENTS

Course Learning Objectives (CLOs):

1. To study the concept of stresses and understand the design procedure of riveted and welded joints.
2. To study design procedure of knuckle joint, springs and power screw.
3. To analyze & select types of shafts, keys, couplings for various machines and industrial applications.

COURSE OUTCOMES (COs):

1. Understand the concept of various stresses and apply the design procedure to riveted joints and welded joints.
2. Understand design procedure of knuckle joint, springs and power screw.
3. Analyze & select types of shafts, keys, couplings for various machines and industrial applications.
4. Analyze the various types of bearings and understand the design procedure of IC Engine parts.

Unit I : (A) Meaning of design, Phases of design, Simple stresses, Thermal stresses, Impact Stress, Torsional stress, bending stresses in straight & curved beams, itôs applications, Hooks, C-clamps.
(B) Rivetted Joints- Design, failures, strength & efficiency of riveted joint.
(C) Welded Joint- Strength, of transverse & parallel fillet welded section. **(11 hrs)**

Unit II : (A) Design of knuckle joint.
(B) Design of spiral & leaf spring.
(C) Design of power screw- Torque required to raise loads, efficiency & helix angle, overhauling & self locking of screw, ACME threads, stresses in power screws. **(11 hrs)**

Unit III : (A) Design of Shaft ï Subjected to twisting, bending & combined twisting & bending loads, based on rigidity.
(B) Design of coupling, rigid coupling, sleeve, muff coupling, flange coupling & flexible coupling. **(**11 hrs**)**

Unit IV : (A) Antifriction bearing: Types of bearing, construction, life of bearings, selection of bearings.
(B) Journal bearing: Lubrication, selection of lubrication, design procedure & numerical.
(C) Design of IC Engine parts: Connecting rod, design of flywheel based on TM diagram. **(11 hrs)**

Books Recommended :-

Text Books:

1. Machine Design by Dr. P.C. Sharma & dr. D. K. Agrawal, Katsons Publications Ltd.
2. Machine Design by R.K.Jain ,Khanna Publisherôs
3. Machine Design, R.S. Khurmi, J.K. gupta, Eurasia Publications, New Delhi.
4. Machine Design Data book by PSG, Coimbtore
5. Machine Design data book by Mahadevan.

Reference Books:-

1. Design of Machine Element by V.B. Bhandari, Tata McGraw Hill Publuication.
2. Machine Design ï Jindal, Pearson Publication.
3. Design of Machine Element ï C. S. Sharma & Kamlesh Purohit, PHI Publication.

6ME02 DYNAMICS OF MACHINES

Course Learning Objectives:

1. To study Static force analysis and Dynamic force analysis of plane mechanisms.
2. To demonstrate the use of gyroscopic effect on ship, aeroplane, four wheeler and two wheeler
3. To determine natural frequency vibrations.
4. To seek the knowledge of static and dynamic balancing.

Course Outcomes:

Students will be able to:

1. Apply basic concept of static force analysis and lubrication mechanism.
2. Understand the knowledge of dynamic force analysis analytically and graphically.
3. Apply the knowledge of space mechanism and vehicle dynamics.
4. Understand concept of free vibration and force vibration, concept of Torsional vibration.
5. Analyze the concept of balancing of machinery.

Unit I: 1. Static equilibrium, superstition principle, Static force analysis applied to plane motion mechanisms, virtual work method, static force analysis without and with friction.

2. Theory of hydrodynamic lubrication, boundary lubrication, film lubrication, rolling friction, performance of bearing. (8 Hrs)

Unit II: 1. DôAlemberts Principle. Engine force analysis-piston effort, thrust along connecting rod, side of cylinder, on the bearings, crank effort and turning moment on the crank shaft.

2. Dynamic equivalent system of connecting rod.

3.Turning moment diagrams for two stroke, four stroke and multi cylinder engines, fluctuations of speed & energy, Flywheel requirements. **(7 Hrs)**

Unit III: 1**. Space mechanism**:- Gyroscope, gyroscopic effect as applied to ship, aeroplane, four wheeler, two wheeler, universal joint.

2**. Vehicle dynamics**: - Coefficient of adhesion, resistance to vehicle motion, relative drive effectiveness, braking of vehicles. **(7 Hrs)**

Unit IV: Types of vibrations, elements of mechanical vibrating systems, degree of freedom in mechanical vibratory system.

1. **Longitudinal vibrations**- Natural frequency of free longitudinal vibrations by equilibrium, energy and Rayleigh method. Effect of inertia constraint in longitudinal vibrations. Damped vibrations with mass, spring and dash pot. Definitions of logarithmic decrement, magnification factor, transmissibility, vibration isolation.

2. **Torsional vibration**-single rotor systems, Two Rotor system, three rotor system, geared systems. **(**8 Hrs**)**

Unit V: 1.**Transverse vibrations**- Natural frequency of free transverse vibrations. Effect of inertia constraints in transverse vibrations. Natural frequency of free transverse vibrations due to point load and uniform distributed load acting over a simply supported shaft. Frequency of free transverse vibrations of a shaft subject to a number of point loads by energy and Dunkerleyôs method.

2.**Whirling or critical speed shaft**. (6 Hrs)

Unit VI: Balancing :- Balancing of rotating masses in same and different transverse planes, Partial balancing of reciprocating masses & Study of its effect. **(**8 Hrs**)**

Books Recommended:

Text Books:

1) Theory of Machines, P.L.Ballaney, Published by Dhanpat Rai andsons-N Delhi.
2) Theory of Machines, S.S.Ratan, Published by Tata Mc Graw Hill.
3) Theory of Machines, V.P.Singh, Published by Dhanpat Rai-N Delhi.
4) Theory of Machine, R.S.Khurmi and Gupta J.K., Published by EurasiaPublishing house-N Delhi.

Reference Books:

1) Theory of Machines and Mechanisms, J.E.Shigley, Uicker andGordon, Published by Oxford University press-New York.
2) Theory of Machines and Mechanisms, Ghosh and Amitabh, published affiliated East West Press N-Delhi.

6ME03 CONTROL SYSTEM ENGINEERING

Course Learning Objectives:

1. To study the basics of control systems and their mathematical modeling along with reduction methods.
2. Study the basic control actions and Industrial controllers.
3. To study the analysis of control systems with respect to transient time response and their errors.
4. To study the different pneumatic controllers and prime movers and their actions.
5. To understand stability analysis, frequency analysis by using bode plot for analytical problems.
6. Study of important automatic speed control systems.

Course Outcomes:

1. Understand the basic system concept and study different types of systems.
2. Understand the concept Transient- Response analysis and will apply in numerical methods, the knowledge of basic control action and industrial controllers.
3. Understand the concept of Stability and exhibit the knowledge of root locus concept.
4. Understand the concept of Frequency Response method and use bode diagram in solving analytical problems.

Unit I: Introduction system concept, open & closed loop systems, Mathematical models of physical systems, transfer functions. Block diagrams reduction and signal flow graphs. (8 Hrs)

Unit II : Basic control actions and Industrial controllers :-Classification of industrial automatic controllers, control actions, proportional controllers, obtaining derivative and integral control action, effects of integral and derivative control action on systems performance. (7 Hrs)

Unit III : Transient Response Analysis :- Introduction Std. Test signals, steady state response of first and second order systems for stop, ramp and impulse input, transient response specifications, steady state error & error constants. (7 Hrs)

Unit IV: Concept stability, necessary condition for stability, Rauths stability criterion, Root locus concept, construction of Root loci, systems with transporation lag. (8 Hrs)

Unit V : Frequency Response methods :-Introduction, concept of Bode diagrams. (7 Hrs)

Unit VI : Study of important automatic speed control systems in machine tools, Prime movers, system generators, etc. Analysis of performance characteristics. (7 Hrs)

BOOKS RECOMMENDED:-

TEXT BOOKS :

1. Automatic Control Engineering by F. H. Ravan Mc-Graw-Hill.
2. Modern Control Engg. - by Katsuhiko Ogata, PHI, .
3. Control System Engg. - by Nagrath & Gopal.

REFERENCE BOOKS:

1) Automatic Control Engg. - by Kuo B.C. & F. Golnaraghi,
2) Modern Control System by Richard C. Dorf, Robert H. Bishop,

6ME04 PROFESSIONAL ELECTIVE-I (1) TOOL ENGINEERING

Course Learning Objectives (CLOs):

1) To study the basic geometries of different cutting tools, chip formation mechanism, tool force analysis etc. in metal cutting.
2) To understand the steps in designing and drawing of single and multipoint cutting tools and form tools.
3) To study the basic principles of workpiece positioning and clamping. To get acquainted with designs of locators, clamps, drill bushes and methods of location.
4) To understand the design and operation of various types of Jigs and Fixtures.
5) To develop a graphical design of a jig or fixture suitable to the requirements of a workpiece.
6)To understand the theory of metal cutting and how to estimate the required force and clearance amount in sheet metal cutting and forming operations.
7)To study construction and working of various types of dies used for different press working operations.
8) To study the steps in designing and drawing of different cutting, drawing and forming dies in press working.

Course Outcomes:

1. Create the design of single and multi-point cutting tools.
2. Apply the knowledge related to machining in order to estimate tool life and selection of cutting fluids.
3. Create the design of multipoint tools like twist drills, reamers, broach and milling cutters & press working dies like punching, blanking and drawing.
4. Analyze the real time problems of work holding by designing jigs and fixtures.

Unit I: Single Point cutting Tool: Shear angle, shear strain, velocity relations, un-deformed chip thickness, Merchant's circle, energy relations, nomenclature, single point cutting tool design, recommended speed, feed and depth of cut Form tools. Graphical approach of circular form tool design. (08 Hours)

Unit II: Jig & Fixture Design: Economics, principles of locations, types of locations, prevention of jamming, problems of chip & dust in location, use of dowels. Redundant location, Principles of clamping, types of clamps, power clamping, Tool guiding & tool setting, types of drill Jigs & fixtures, (07 Hours)

Unit III: Jig & Fixture Design: Design of Plate, Channel, Box, Turnover and Post type Drill Jigs. Design of Turning, Milling, Fixture, Broaching, Assembly & Welding Fixtures. (07 Hours)

Unit IV: Multi-point Cutting Tools: Types, Geometric elements and forces in various tools like Twist drills & Reamers, Circular Broaches, Milling Cutters, Taps and Dies, Gear shaper cutter & Gear Hobs. (07 Hours)

Unit V: Press tools: Classification of presses, Theory of sheet metal cutting, clearance, cutting force calculations, Methods of reducing cutting forces, Centre of pressure & its significance, Classification of press working operations, Theory of bending, spring back action in metals, drawing fundamentals, calculation of drawing & bending forces, planning for cupping operation, Stock layout. (07 Hours)

Unit VI : Design of Press working Tools: Types of die construction, function & nomenclature of die components, Cutting Dies- Blanking & Punching, Forming Dies-Forming, Drawing and Bending etc. Design of Compound, Combination and progressive dies miscellaneous dies- Horn die, Cam-action die, Rubber & Building die, Suppress die. (08 Hours)

Text Books:

1. Tool Design - Cyril Donaldson (Tata Mc-graw Hill)
2. Jigs & Fixtures - P.H.Joshi (Tata Mc-graw Hill)
3. Fundamentals of Metal Cutting & M/c Tools - Juneja (New Age International).
4. Fundamentals of Tool Design - A.Kumar (Dhanpatrai & Sons).
5. A Text book of Production Engineering- P.C.sharma (S.Chand Publication).

Reference Books :

1. Metal Cutting Theory & Cutting Tool Design- Arshinov (Mir Publications)
2. Tool Design - ASTME (ASTME)
3. Jigs and Fixture- Grantt.

6ME04 Professional Elective – I (2) 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 utilisation 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):

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.

UNIT I :

1. Introduction:- Global and Indian energy scenario, Need of Renewable energy, need, Renewable and non renewable energy sources, energy and environment,

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. (7 hrs)

UNIT II :

1.Solar thermal systems : Low temperature applications: solar water heating, space heating, drying. High temperature applications, dish and parabolic collectors. Central tower solar thermal power plants. Solar energy storage and utilization: Methods of storage- mechanical, thermal, electrical storage systems.

2. Solar Photovoltaic Systems: Basic principle of power generation in a PV cell ; Types of photovoltaic cell, Application of PV; Brief outline of solar PV stand-alone system; Storage battery and Balance of system.(8 Hrs)

Unit III :

Wind Energy Systems: Potential of wind electricity generation in India and current scenario. Wind pattern and wind speed data, Types of turbines, Coefficient of Power, Betz limit. Wind electric generators, Power curve; wind characteristics and site selection; Windfarms for bulk power supply to grid. Application for pumping (7 Hrs.)

Unit IV :

Biomass Energy: Biomass: Sources and Characteristics; Wet biogas plants; Biomass gasifiers: Classification and Operating characteristics; Updraft and Downdraft gasifiers; Gasifier based electricity generating systems.

Biogas-Types of bio gas plants, factors affecting production rates. Introduction to biodiesel and ethanol as alternative fuels, (7 Hrs.)

Unit V : **Energy from Ocean:** Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy.

Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Wave energy and power from wave, wave energy conversion devices, advantages and dis-advantages of wave energy (7 Hrs.)

UNIT VI : Fuel Cells: Introduction, working principle of fuel cell, Types of fuel cells, conversion efficiency of fuel cell, application of fuel cells.

Hydrogen Energy: Hydrogen as alternative fuel, Production methods, Hydrogen storage, **Geothermal Energy Resources:** Hot Dry Rock system, Vapor dominated, liquid dominated, flash steam, binary fluid and total flow concept of power generation. **(8Hrs)**

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 Sorenson; Elsevier Publication
3. Renewalle Energy; GodfreyBoyle, Oxford University Press, Mumbai.

6ME04 PROFESSIONAL ELECTIVE-I
(3) COMPUTER AIDED DESIGN & SIMULATION

Course Learning Objectives (CLOs):

1. To study product cycle & fundamentals of CAD/CAM.
2. To understand the concept of representations of curves and surfaces.
3. To study the solid modeling techniques.
4. To study the geometric transformation techniques.
5. To study basic probability & statistics and physical modeling.
6. To study Simulation of Mechanical Systems & Simulation of manufacturing systems.

Course Outcomes (COs):

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

Unit I: Fundamentals of CAD/CAM:
Product cycle and scope of CAD/CAM/CIM in product cycle, CAD/CAM, Hardware and software, selection of software, CAD workstation configurations. (6 Hrs)

Unit II: Representations of curves and surfaces:
Introduction to analytical curves, synthetic curves: Hermite cubic Spline, Bezier Curve, B- Spline curve. Surface Representation : Synthetic Surfaces, Applications of surface modeling. (6 Hrs)

Unit III: Solid Modeling :
2D Vs 3D modeling, Comparison of Wireframe, surface and solid modeling techniques, Geometry Vs Topology, Requirements of Solid Modeling Methods: Constructive Solid Geometry (CSG), Boundary Representation (B-rep), etc. (6 Hrs)

Unit IV: Geometric transformation
2D geometric transformations, Homogeneous co-ordinate representation, Composite Transformations, 3D transformations, Inverse transformations, geometric mapping. (8 Hrs)

Unit V: Introduction to statistics and physical modeling: A review of basic probability and statistics, random variables and their properties , Estimation of means variances and correlation. Physical Modeling- Concept of System and environment, Principles of modeling, types of models. (8Hrs)

Unit VI: Simulation of Mechanical Systems: Basic Simulation modeling, Role of simulation in model evaluation and studies, advantages of simulation Simulation of manufacturing Systems: Introduction to Flexible manufacturing systems, Simulation software for manufacturing. (8 Hrs)

Books Recommended :

Text Books:

1) P. N. Rao; CAD/CAM Principles and Applications; McGraw 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: Automation, Production systems & Computer Integraded manufacturing, Prentice Hall.
2) Robert E. Shannon; System Simulation: The Art and Science ; Prentice Hall
3) J. Schwarzenbach and K.F. Gill Edward Arnold; System Modelling and Control
4) P. Radhakrishnan and Subramaniam: CAD/CAM/CIM, wiley Eastern Ltd.

6ME05 OPEN ELECTIVE -II
(1) 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 utilisation 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):

1. Understand concept of renewable and non-renewable sources.
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.

UNIT I :

1. **Introduction:-** Global and Indian energy scenario, Need of Renewable energy, need, Renewable and non renewable energy sources, energy and environment,
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. (7 hrs)

UNIT II: Solar thermal systems. Low temperature applications: solar water heating, space heating, drying. High temperature applications, dish and parabolic collectors. Central tower solar thermal power plants.

Solar Photovoltaic Systems: Basic principle of power generation in a PV cell ; Types of photovoltaic cell, Application of PV ; Brief outline of solar PV stand-alone system ; Storage battery and Balance of system. (8 Hrs)

Unit III : Wind Energy Systems: Potential of wind electricity generation in India and current scenario. Types of turbines, Coefficient of Power, Wind electric generators, Power curve; wind characteristics and site selection; Windfarms for bulk power supply to grid. (7 Hrs.)

Unit IV : Biomass Energy: Biomass: Sources and Characteristics; Wet biogas plants ; Biomass gasifiers: Classification and Operating characteristics; Updraft and Downdraft gasifiers; Gasifier based electricity generating systems. Introduction to biodiesel and ethanol as alternative fuels, (7 Hrs.)

Unit V : **Energy from Ocean:** Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. **Ocean Thermal Electric Conversion** (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India.

Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy. (7 Hrs.)

UNIT VI:

1. **Fuel Cells :** working principle, types of fuel cells, applications.
2. **Geothermal Energy Resources:** Hot Dry Rock system, Vapor dominated, liquid dominated, flash steam, binary fluid and total flow concept of power generation. (8Hrs)

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; BentSorensen; 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 (2) AUTOMOBILE ENGINEERING

Course Learning Objectives:

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 Ignition system.
4. To study the basics of transmission system, clutches, gear boxes and to understand the principle of differential.
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 suspension system, shock absorbers and to study the types of lubricants and lubrication system, crankcase ventilation.

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.

UNIT I : Introduction, Classification of automobiles, chassis layout, basic working of SI and CI engines, engine parts, engine types, 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 liquid cooling system, radiator, by pass recirculation system, antifreeze mixtures. (7 Hrs)

UNIT III : The electrical system. Battery Capacity, standard capacity ratings, starter motor drive-Bendix drive. Ignition system:- Battery coil ignition system, Electronic ignition system. (7 Hrs)

UNIT IV: Transmission system:- Layout, Working principle of clutch, single plate friction clutch and multiplate clutch, Gear Boxes:- Sliding mesh, constant mesh gear box, Propeller shaft, Hotchkiss drive, torque tube drive, differential. (8 Hrs)

UNIT V: Braking system: Mechanical, hydraulic brakes, power brakes and vacuum brakes. Steering system:- Function, types of linkages, steering gears, wheel balancing, wheel alignment, camber, castor, king pin inclination, toe-in& toe-out & their effects, Introduction to power steering. (7 Hrs)

UNIT VI: Suspensions : shock absorbers, Rigid axle and independent suspension system, Auto lubrication :- Types of lubricants, their ratings, multi viscosity oils. Engine lubrication:- types of lubricating systems, full pressure system, dry sump system, crankcase ventilation. (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

Reference Books:

1. Automotive Mechanics; Crouse & Anglin; TMH.
2. Automotive Mechanics; J. Heitner; East West Press
3. Automotive Mechanics; S. Srinivasan; TMH.

6ME06 DESIGN OF MACHINE ELEMENTS - LAB.

Course learning objectives:

1. To study the basic design principles
2. To familiarize with use of design data books & various codes of practice
3. To make conversant with preparation of working drawings based on designs

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

1. Design various machine elements like joints, springs, couplings etc, under various conditions
2. Convert design dimensions into working/manufacturing drawing
3. Use design data book/standard codes to standardize the designed dimensions

Practical Term Work: At least Six exercises based on the following:

1. Design of Cotter or Knuckle joint.
2. Design & drawing of screw jack.
3. Design & drawing of Riveted joints.
4. Design & drawing of leaf spring.
5. Design of shaft on the basis of various loading.
6. Design and drawing of Coupling (any one type).
7. Design and drawing of Journal Bearing Plumber Block Type).
8. Design and drawing of connecting rod in IC Engine.
9. Design and drawing of Flywheel.
10. Determine Hydrodynamic lubrication profile using Journal Bearing Apparatus.

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

6ME07 DYNAMICS OF MACHINES - LAB.

Course Learning Objectives:

1. To understand Static force analysis and Dynamic force analysis of plane mechanisms.
2. To demonstrate the use of gyroscopic couple and its effect.
3. To understand the phenomenon of vibrations.
4. To demonstrate the effect of static and dynamic balancing.

Course Outcomes:

Students will be able to :

1. Apply basic concept of force analysis and lubrication mechanism.
2. Understand the knowledge of dynamic force analysis analytically and graphically.
3. Apply the knowledge of space mechanism and vehicle dynamics.
4. Understand concept of vibrations.
5. Analyze the concept of balancing of machinery.

Practicals:- At least eight practical from the following list:

1. Study of static force analysis of mechanism. (any 2 problem)
2. Determining the inertia forces of connecting rod
3. Determination of gyroscopic couple using motorized gyroscope .
4. Study of vehicle dynamics.
5. To study the longitudinal vibration of helical spring and to determine the frequency and time period of oscillation theoretically and experimentally.
6. Experiment on free and damped vibration of systems with one degree of freedom.
7. Experiment on forced damped vibration of systems with one degree of freedom.
8. Experiment on free damped torsional vibration.
9. To verify the Dunkerleyôs rule.
10. To determine the natural frequency of free torsional vibration of single rotor system.
11. To determine the natural frequency of free torsional vibration of two rotor system.
12. Experiment on whirling speed of shaft.
13. Experiment on static balancing of rotating masses.
14. Experiment on dynamic balancing of rotating masses.

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

6ME08 PROFESSIONAL ELECTIVE -I - LAB (i) TOOL ENGINEERING –LAB.

Course learning objectives:

1. To study the basic geometries of different cutting tools
2. To study cutting forces involved in machining operation using tool dynamometer.
3. To understand the steps involved in designing and drawing of various tools.
4. To understand the design and operation of various types of Jigs and Fixtures.

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

1. Create the design of single and multi-point cutting tools.
2. Create the design of multipoint tools like twist drills, reamers, broach and milling cutters & press working dies like punching, blanking and drawing.
3. Analyze the real time problems of work holding by designing jigs and fixtures.

TERM WORK: (Any Six of the following)

1. Design & Drawing of single point cutting tool.
2. Design & Drawing of Form Tools (Using Graphical Method).
3. Measurement of forces in Orthogonal cutting by Lathe Tool Dynamometer.
4. Measurement of forces & Torque in Drilling by Drill Tool Dynamometer.
5. Study of geometric Elements & Forces in Multi-Point Cutting Tool. 6. Design & drawing of Post Drill Jig.
7. Design & Drawing of Turnover Drill Jig.
8. Design & Drawing of Milling Fixture.
9. Design & Drawing of Turning Fixture.
10. Design & Drawing of Compound Die.
11. Design & Drawing of Progressive Die.
12. Design & Drawing of Drawing die.

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

6ME08 PROFESSIONAL ELECTIVE -I – LAB
(2) NON-CONVENTIONAL ENERGY SOURCES– LAB.

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 utilisation 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):

1. Understand concept of renewable and non-renewable sources.
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.

List of practicals : Any six practicals will be based on the following topics :-

1. Study of Pyrheliometer and measurement of direct radiation.
2. Study of pyranometer and measurement of global and diffuse radiation.
3. Study of sunshine recorder and measurement of sunshine hours.
4. Study and testing of a flat plate recorder.
5. Study of biogas plant.
6. Study of photovoltaic system,
7. Study of various types of Wind mill.
8. Study of various solar equipment.

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

6ME08 PROFESSIONAL ELECTIVE -I – LAB
(1) COMPUTER AIDED DESIGN & SIMULATION

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

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.

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

6ME09 RESEARCH SKILLS – LAB

Course learning objectives:

1. Apply fundamental and disciplinary concepts and methods in ways appropriate to their principal areas of study.
2. Demonstrate skill and knowledge of current information and technological tools and techniques specific to the professional field of study.
3. Use effectively oral, written and visual communication.
4. Identify, analyze, and solve problems creatively through sustained critical investigation.
5. Integrate information from multiple sources.
6. Demonstrate an awareness and application of appropriate personal, societal, and professional ethical standards.
7. Practice the skills, diligence, and commitment to excellence needed to engage in lifelong learning.

Course Outcomes:

1. Demonstrate a sound technical knowledge of their selected research topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering research.
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.

Students will have to perform any one task and prepare a report on it; from the following list:

1. A mini project involving mechanisms/ electromechanical systems/
2. CAD modeling/ simulation of any thermal, hydraulic or mechanical system.
3. IoT based system for any domestic/ rural/ agricultural/ industrial application
4. A system using non- conventional energy source
5. Market research for launching a new product.
6. Study of any Small Scale Industry.
7. Any other innovative concept for promoting research and innovation among students.

***Practical Examination:-** The practical examination shall consist of oral basedon the task and the report.

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SEMESTER V & VI B.E. ELECTRICAL, ELECTRICAL (ELECTRONICS & POWER) AND ELECTRICAL & ELECTRONICS

B.E. (ELECTRICAL ENGG.) SEMESTER - V

5EE01 CONTROL SYSTEMS

Course Outcomes:

After completing this course, the students will be able to:

1. Demonstrate the fundamental concepts of automatic Control and mathematical modeling of the Systems.
2. Determine the transfer function of control system components.
3. Analyze the time response of various systems and performance of controllers.
4. Evaluate the stability of linear systems using various methods.

Unit I: Introduction to automatic control : Open loop and closed loop system, servo-mechanisms, mathematical modeling of physical systems, transfer functions, block diagrams and signal flow graphs. Effect of feedback on sensitivity to parameter variation and reduction of the noise.

Unit II : Control System Components:

Electrical / Electro-mechanical components such as A.C./D.C. servomotors, stepper motors, synchros, potentiometers, tacho-generators, encoders, their functional analysis and operating characteristics and their application.

Unit III: Time response analysis:

Time response of first and second order systems to standard inputs. Time response specifications, types of system, error analysis, error coefficients, steady state errors, dynamic error series. Approximate methods for higher order system, proportional, derivative and integral control.

Unit IV: Stability:

Stability of control systems, characteristics equation, impulse response, Routh-Hurwitz stability criterion, relative stability. Root Locus: construction of root locus, determination of roots from root locus conditions on variable parameter for stability, effect of addition of poles and zeros.

Unit V: Frequency response methods

Frequency response of linear system, specification, Logarithmic frequency response (Bode) plots from transfer function for various systems. Polar plots for various systems. Estimation of approximate transfer functions from the frequency response.

Unit VI: Stability analysis from frequency response

Gain margin and Phase margin; Stability analysis from Bode plots. Nyquist criterion, Nyquist plots and stability analysis.

Books Recommended:

Text Book: Nagrath I.J., Gopal M.: Control System Engineering, Wiley Eastern.

Reference Books:

1. Control Engineering, D.Ganesh Rao, k. Chennavenkatesh, 2010, PEARSON
2. Ogata K.: Modern Control Systems, Prentice Hall of India.
3. Control Systems by K.R.Varmah TMH edition 2010
4. Linear Control Systems, Ashfaq Hussain, Haroon Ashfaq, Dhanpat Rai &Co.

5EE02 MICROPROCESSOR & MICROCONTROLLER

Course Outcomes:

After completing the course the students will be able to:

1. Recite Fundamentals and Architecture of Microprocessor 8085, Microcontroller 8051
2. Interpret Assembly Language Programming of Microprocessor 8085, Microcontroller 8051
3. Illustrate interfacing with Microprocessor 8085, Microcontroller 8051
4. Develop applications of Microprocessor 8085, Microcontroller 8051.