SEMESTER III

MA209 SPECIAL FUNCTIONS AND PROBABILITY THEORY

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To make the student acquire knowledge of special functions
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using probability distribution and Testing of Hypothesis to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT-I

Special functions: Bessel functions: properties, Recurrence relations, Orthogonality. Legendre polynomials: Properties, Rodrigue's formula, Recurrence relations, Orthogonality.

UNIT-II

Complex Variables: Analytic functions, Cauchy Riemann equations, Harmonic functions, Conjugate functions. Complex integration: line integrals in complex plane, Cauchy's theorem (without proof), Cauchy's integral formula.

UNIT-III

Taylor's and Laurent's series expansions, zeros and singularities, Residues, residue theorem, evaluation of real integrals using residue theorem.

UNIT-IV

Probability and Statistics: Probability laws, Addition and Multiplication theorems on probability, Baye's theorem, Expectation, Moments and Moment generating function of Discrete and continuous distributions, Binomial, Poisson and Normal distributions, fitting these distributions to the given data.

UNIT-V

Testing of Hypothesis: Z-test for single mean and difference of means, single proportion and difference of proportions, t-test for single mean and difference of means, F-test for comparison of variances. Chi-square test for goodness of fit–Correlation, regression.

OUTCOMES:

- The subject helps the students to develop the fundamentals and basic concepts in Recurrence relations, Legendre polynomials, Probability and Statistics and complex functions.
- Students will be able to solve problems related to engineering applications by using these techniques.

TEXT BOOKS

1. R.V. Churchill, Complex variables and its applications, McGraw Hill, 1960.
2. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons.

REFERENCE BOOKS

1. M. K. Venkataraman, Higher Mathematics for Engineering and Science, National Publishing Company.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2013

ME201 Engineering Thermodynamics

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To familiarize the students to understand the fundamentals of thermodynamics and to perform thermal analysis on their behavior and performance.(Use of Standard and approved Steam Tables, Mollier Chart, Compressibility Chart is permitted)

UNIT-I

Basic concepts of thermodynamics, concept of continuum, macroscopic approach, thermodynamic systems – closed, open and isolated, property, state, path, process – quasi static process, work and modes of work, Zeroth law of thermodynamics, concept of temperature and heat – First law of thermodynamics, application to closed and open system. First law of thermodynamics steady flow process to various thermal equipments

UNIT-II

Second law statements – reversibility and irreversible processes, Carnot theorem, Carnot cycle, reversed Carnot cycle, efficiency, COP, Clausius Inequality – concept of entropy, entropy of ideal gas, principle of increase of entropy-Concept of availability.

UNIT-III

Properties of pure substances –thermodynamics properties of pure substances in solids, liquids and vapour phases – phase rule – p-V, p-T, T-V, T-s and h-s, thermodynamic properties of steam, Calculations of work done and heat transfer - Vapour power cycles - Rankine cycle - Effect of pressure and temperature on Rankine cycle -Reheat cycle - Regenerative cycle – Binary vapour cycles -

UNIT-IV

Air standard power cycles - Assumptions - Otto, Diesel, dual, Stirling and Brayton cycles. Thermodynamic relations: Partial derivatives - Maxwell relations – Tds relations, Clausius Clapeyron equation, Joule Thomson coefficient - entropy change of an ideal gas - equations of state, properties of ideal and real gases, Avagadro law, Vander waal's equation of state - compressibility- compressibility chart

UNIT-V

Mixture of non-reacting gases - Dalton's and Amalgam's model - calculation of Cp , Cv , Rand U , h and s changes for gas mixtures. Fuels and combustion - combustion chemistry –stoichiometric air required for complete combustion of fuels – excess air, products of combustion, calculation of air fuel ratio – determination of calorific value – Bomb and Junker's calorimeter, Orsat apparatus for flue gas analysis.

OUTCOMES:

- Understand the concepts of continuum, system, control volume, thermodynamic properties, thermodynamic equilibrium, work and heat.
- Apply the laws of thermodynamics to analyze boilers, heat pumps, refrigerators, heat engines, compressors and nozzles.
- Evaluate the performance of steam power cycles, the available energy and irreversibility and properties of pure substances and gas mixtures.
- Analyze air standard cycles applied in prime movers.

TEXT BOOKS:

1. Cengal, Y.A and Boles, M.A, Thermodynamics: An Engineering Approach, 5th ed.,McGraw-Hill, 2006.
2. Nag.P.K., "Engineering Thermodynamics", 4th Edition, Tata McGraw-Hill, New Delhi, 2008.

REFERENCE BOOKS:

1. Natarajan E., "Engineering Thermodynamics: Fundamentals and Applications", Anuragam Publications, 2012.
2. Holman.J.P., "Thermodynamics", 3rd Edition, McGraw-Hill, 1995.
3. Rathakrishnan. E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice-Hall of India Pvt. Ltd, 2006
4. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2010.
5. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
6. Van Wylen and Sonntag, "Classical Thermodynamics", Wiley Eastern, 1987
7. Venkatesh. A, "Basic Engineering Thermodynamics", Universities Press (India) Limited, 2007.

8.Kau-Fui Vincent Wong, "Thermodynamics for Engineers", CRC Press, 2010 Indian Reprint.
9. Sonntag, R.E., Borgnakke, C., and Van Wylen, G.J., Fundamentals of Thermodynamics, 6th ed., John Wiley, 2003.

ME203 Engineering Metallurgy

L-T-P-C: 3-0- 0-3

OBJECTIVES:

- To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

UNIT-I

Crystal structures - Solid Solutions – Types - Metallography – Metallurgical microscopes – specimen preparation- Cooling curves – Allotropy concept

UNIT-II

Construction and interpretation of binary phase diagrams – Types – Eutectic, Eutectoid, Petitectic and Peritectoid systems – Iron Carbon equilibrium diagrams – classification of steels and alloy steels – types, manufacture, properties and applications of cast irons.

UNIT-III

Heat treatment of steel: Critical temperature on heating and cooling, effects of residual stresses – Annealing, normalizing, hardening, Hardenability tests, tempering – construction and interpretation of TTT diagram – Martensitic transformation – Sub zero treatment - Surface hardening processes.

UNIT-IV

Non ferrous metals and alloys: Copper, Aluminium, Nickel, Zinc and Lead based alloys – concept and applications of metal matrix composites. Mechanical properties of materials – Testing of materials: Tensile, compression, torsion, hardness (micro & macro) and impact testing.

UNIT-V

Plastic deformation, Slip and twinning – Hot, cold and warm working – recovery and recrystallization concepts. Introduction to fracture mechanics – Types - ductile to brittle transition – Creep and Fatigue failures – Testing.

OUTCOMES:

- Upon completion of this course, the students can able to apply the different materials, their processing, heat treatments in suitable application in mechanical engineering fields.

TEXT BOOKS:

1. Dieter, G.E.,Mechanical Metallurgy, McGraw-Hill, 1988.

2. O.P.Khanna, Materials Science and Metallurgy, Dhanpat Rai Publishers

REFERENCE BOOKS:

1. Donald S.Clark, and Wilbur R. Varney, Physical Metallurgy for Engineers, East-West Press, 1999.

2.Suriyanarayana, A.V.K, Testing of metallic materials, Tata McGraw-Hill, 2001.

3.Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd., 1999.

4.Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint 2002.

5.Donald R. Askeland, The Science and Engineering of Materials, Chapman and Hall,1990.

6.Budinski and Budinski, Engineering Materials – Properties and Selection, Prentice Hall India Pvt. Ltd., 2005

7.Upadhyay. G.S. and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt.Ltd., New Delhi, 2006.

8. Avner, S.H., Introduction to Physical Metallurgy, 2nd ed., Tata McGraw-Hill, 1997.

9.Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition 2007.

10.Raghavan V, Physical Metallurgy – Principles and Practice, Prentice Hall India Pvt. Ltd., New Delhi, 2006

ME205 Production Technology

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.
- To learn about various unconventional machining processes and their applications.
- To understand the functions and design principles of Jigs, fixtures and press tools.

UNIT-I

Moulding sands - Types and Properties, patterns - types of patterns, selection of patterns -pattern allowances - Classifications of castings - according to mould materials and moulding methods. Special casting techniques - Fettling and finishing of castings - defects in castings.

UNIT-II

Classification of welding process: Principle of Gas welding, Arc welding, resistance welding, Solid State Welding, Thermochemical welding and radiant energy welding -Brazing and soldering - thermal cutting of metal/alloys.

UNIT-III

Forging: Classification of forging processes - forging processes - forging defects and inspection. Rolling: Classification of rolling processes - rolling mill - rolling of bars and shapes. Extrusion: Classification of extrusion processes - extrusion equipments - examples. Drawing: Drawing of rods, wires and tubes. Sheet metal forming methods: Shearing, Blanking, Bending, Stretch Forming, deep forming. Spinning: Spinning processes.

UNIT-IV

High Velocity Forming: Explosive forming, Electro hydraulic forming - magnetic pulse forming - pneumatic - mechanical high velocity forming. Plastics Working: Types of plastics - plastic moulding processes.

UNIT-V

Introduction to non –conventional machining– EDM, ECM, ECG, AJM and USM. Jigs and Fixtures – concepts of jigs and fixtures – advantages – elements of jigs and fixtures – 'v' locators – fixed stop locators – adjustable stop locators – clamping devices – strap clamp, screw clamp – cam action clamps – types of jigs – box drill jig – indexing drill jig – types of fixtures –keyway and string milling fixtures.

OUTCOMES:

Upon completion of this course, the students can able:

- To apply the different manufacturing process and use this in industry for component production.
- To demonstrate different unconventional machining processes and their applications.
- To design jigs, fixtures and press tools.

TEXT BOOKS:

1. Hajra Choudhry, Elements of Workshop Technology**,** Vol – II Media Promoters & Publishers, 1994.

2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2006

REFERENCE BOOKS:

1. Production Technology by HMT, Tata McGraw-Hill, 2002.

2. Chapman, W.A.J., Workshop Technology**,**Vol - II, Oxford & IBH Publishing Co. Ltd.,1986.

3. Gowri P. Hariharan, A.Suresh Babu, "Manufacturing Technology I", Pearson Education, 2008

4. Roy. A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2006

5. Paul Degarma E, Black J.T and Ronald A. Kosher, "Materials and Processes in Manufacturing" Eight Editions, Prentice – Hall of India, 1997.

6. Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2004.

7. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 2nd Edition, TMH-2003

8. Jain R.K., Production Technology, Khanna Publishers, 2001.

ME207 Strength of Materials

L-T-P-C: 3-0- 0-3

OBJECTIVES:

- Understand statically determinate and indeterminate problems.
- Determine the resistance and deformation in member's subjected to axial, flexural and torsional loads.
- Evaluate principal stresses, strains and apply the concept of failure theories for design.
- Analyze and design thin, thick cylinders and springs.

UNIT-I

Simple Stresses and Strain – Relation between three modulus and Poisson's ratio – Thermal Stress – Principal stress and Principal planes - Shear Force – Bending Moment – Cantilever and simply supported beams subjected to point loads and uniformly distributed loads.

UNIT-II

Theory of simple bending - stress variation in beam cross Section; Normal and Shear stress in Beams – Beam of uniform strength for bending, combined direct and bending stresses.

UNIT-III

Double integration method – moment area method – Introduction to strain energy method and Principle of virtual work. Truss analysis – method of joints, method of sections.

UNIT-IV

Torsion of circular solid and hollow shafts – Shafts in Series and parallel – Combined bending and torsion -Application of Torsion in helical springs: Open and closed coil springs, Leaf Springs.

UNIT-V

Euler's Equation – short and long column, Rankine empirical formulae, Johnson formula Introduction to thin cylinder – Thick cylinder – Lame's Equation – Compound Cylinders – Interference fit.

OUTCOMES:

- Upon completion of this course, the students can able to apply mathematical knowledge to calculate the deformation behavior of simple structures.
- Critically analyse problem and solve the problems related to mechanical elements and analyse the deformation behavior for different types of loads.

TEXT BOOKS:

1. Ramamurtham, S., Strength of Materials,,DhanpatRai Publications, 2005.
2. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2007

REFERENCE BOOKS:

1. Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2007.
2. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series,
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2007
4. Ferdinand P. Been, Russell Johnson, J.R. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.
5. Timoshenko, S.P., Gere, M.J., Mechanics of Materials, C.B.S., Publishers, 1980.
6. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007
7.R.K.Rajput, Strength of Materials, S.Chand Publication, New Delhi

ME209 Mechanical Drawing and Cost Estimation

L-T-P-C: 3-0-0-3

OBJECTIVES:

- Understand the representation of materials used in machine drawing
- Construct an assembly drawing using part drawings of machine components
- Introduce the process drawing concepts to make cost estimation for various products after process drawing.

UNIT-I

Conventional Representation of Machine elements - International Standards (ISD) and Indian Standards (IS). Limits and Fits - IT system of tolerances, deviations and fits. Geometric Dimensioning and Representation - Tolerancing, Tolerancing of form, orientation, location and run-outs, Datums and Datum Systems. Surface texture indication on drawing. Welds - Symbolic representing of drawings. Preparation of process - Chart for a given component.

UNIT-II

Screw thread, Threaded fasteners, Rivets and Riveted joints – Welded joints – Keys. Shaft Couplings: rigid, flexible: cotter joints, knuckle joints, Hook's joints. Bearings -Journal - Footstep, thrust or Collar bearing.

UNIT-III

Plummer block; Pulleys for flat belts, V-belt and rope. Engine parts - Stuffing box, Connecting rod, Atomizer, spark plug, fuel injection pump. Valves - stop valve - safety valve, relief valve and non-return valve.

UNIT-IV

Machine tool components - Drill jig, Tail stock, Toolpost, Tool head for shaping machine, machine vice, screw jack.

UNIT-V

Cost Estimation of setting time and machining time - estimation of material cost, labour cost and overhead cost based on supplied data. At least ten subassemblies/assemblies are to be completed on A4 sheets.

OUTCOMES:

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

- Mention the representation of machine elements.
- Represent tolerances and the levels of surface finish of machine elements
- Draw the different types of machine elements, tool elements and transmission system.
- Use the concepts of process planning and cost estimation for various products

TEXT BOOKS:

1.T.R.Banga and S.C.Sharma, Mechanical estimating and costing including contracting, Khanna Publishers,

2. Gopalakrishnan, K.R, "Machine Drawing", SUBHAS Publications, VIII edition, 2004

REFERENCE BOOKS:

1. Khan M.Y. & Jain P.K., Cost Management, TMH outline series, 2nd ed., 2000.

2. Engineering Drawing Practice for Schools and Colleges SP**:** 46- 1988.

3. Gupta, R.B, "Machine Drawing", Satya Prakasham, 1998

4. Sidheswar, "Machine Drawing" Tata Mc Graw Hill edition, 2006

5. Sadhu Singh and P.L. Sah, Fundamentals of Machine Drawing, PHI 2005

6. Dhawan, R.K., A Text Book of Machine Drawing, S. Chand & Company, 1996.

7. Ostrowsky, O., Engineering Drawing with CAD Applications, ELBS, 1995.

8. Bhatt, N.D "Machine Drawing", Charotar Publishing House.2008

ME211 Metallurgy Lab

L-T-P-C: 0-0-3-2

OBJECTIVES:

To gain practical knowledge in:

- ❖ Microstructure analysis of various steels, Cast Iron and Non ferrous Materials.
- ❖ Heat Treatment of steels and various Quenching mediums and tests.

List of Experiments

1. Study of microstructure in metals
2. Specimen preparation & microscopic study of ferrous/nonferrous metals
3. Effect of heat treatments viz., Annealing and hardening on ferrous/nonferrous metals
4. Study of various Quenching mediums
5. Jominy end quenching test

OUTCOMES:

- ❖ Ability to differentiate the microstructure of the various metals, and different quenching mediums.

ME213 Strength of Materials Lab

L-T-P-C: 0-0-3-2

OBJECTIVES:

- ❖ To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads.

List of Experiments

1. Deflection test on wooden beams.
2. Torsion test on different grades of steel.
3. Tensile and Compression test
4. Hardness test.
5. Impact test.
6. Ductility test

OUTCOMES:

- ❖ Ability to perform different destructive testing
- ❖ Ability to characterize the materials

SEMESTER IV

MA210 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

L-T-P-C: 3-0-0-3

OBJECTIVES:

- The course objective is to develop the skills of the students in the areas of Transforms and Partial Differential Equations.
- This will be necessary for their effective studies in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory.
- The course will also serve as a prerequisite for post graduate and specialized studies and research.

UNIT-I

Fourier series, Dirichlet's conditions, Half range Fourier cosine and sine series, Parseval's relation, Fourier series in complex form.

UNIT-II

Fourier transforms, Fourier cosine and sine transforms, inverse transforms, convolution theorem and Parseval's identity for Fourier transforms, Convolution, Finite cosine and sine transforms.

UNIT-III

Formation of PDE- Solution of standard types of first order equations, Lagrange's linear Equation, Charpit's method.

UNIT-IV

Classification of Partial Differential equations, One-dimensional wave equation and one-dimensional heat flow equation by the method of separation of variables.

UNIT-V

Fourier solution of one-dimensional heat flow equation, Laplace equation and wave equations.

OUTCOMES:

- The understanding of the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

TEXT BOOKS

1. B.S. GrewaL, Higher Engineering Mathematics, Khanna Publishers, 2013.

2. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand Sons, New-Delhi, 2008.

REFERENCE BOOKS

1. M.K. Venkataraman, Engineering Mathematics Vol.III, National Publishing Company.

2. Erwin Kreyszig, Advanced Engineering Mathematics, John- Wiley sons, New-York, 2005.

ME204 Conventional and CNC Machines

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching.
- To understand the basic concepts of Computer Numerical Control (CNC) of machine tools and CNC Programming

UNIT-I

Lathes, capstan & turret lathe, drilling and boring machine -Classification - principles of working components, work holding & tool holding devices.

UNIT-II

Shaper, Planer & Slotter machines - Classification - principles of working components,work holding & tool holding devices.

UNIT-III

Milling, hobbing, broaching & grinding machines - Classification - principles of working components, work holding & tool holding devices.

UNIT-IV

NC & CNC machine tools and manual part programming Machining centre, turning centre.NC part programming.

UNIT-V

Computer aided part programming - APP: Post processors. APT programming – motion statements, additional apt statements.

OUTCOMES:

- Upon completion of this course, the students can able to understand and compare the functions and applications of different metal cutting tools and also demonstrate the programming in CNC machining.

TEXT BOOKS:

1. Khanna, O.P., and Lal, M., A Text Book of Production Technology, Vol II, Dhanpat Rai & Sons, 1992.

2. Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters & Publishers, 1994

REFERENCE BOOKS:

1. Production Technology by HMT, Tata McGraw-Hill, 2002.

2.Kundra, T.K., Rao., P.N., and Tiwari, N.L.K., Numerical Control and Computer Aided Manufacturing, Tata McGraw-Hill, 2006.

3. Roy. A.Lindberg, “Process and Materials of Manufacture,” Fourth Edition, PHI/Pearson Education 2006

4. Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J.White “Machine Tool Practices”, Prentice Hall of India, 1998

5.YoramKoren, Computer Control of Manufacturing Systems, McGraw-Hill, 1986.
6. Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", Tata McGraw-Hill, New Delhi, 2003.

ME206 Heat and Mass Transfer

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To understand the mechanisms of heat transfer under steady and transient conditions.
- To understand the concepts of heat transfer through extended surfaces.
- To learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of mass transfer.
  (Use of standard HMT data book is permitted)

UNIT-I

Conduction - General 3-D equation - Heat generation problems - Fins - Unsteady state conduction.

UNIT-II

Radiation Laws - Black and Gray bodies - Radiation exchange between surfaces – Radiation shields- Gas radiation.

UNIT-III

Forced Convection - Boundary layer theory - External and internal flows - Free convection - Correlations.

UNIT-IV

Heat exchangers - Fouling factor, LMTD and NTU methods - Boiling and condensation -Boiling regimes and correlations, Nusselt's theory - Condensation over surfaces.

UNIT-V

Mass transfer - Fick's law - Similarities between heat and mass transfer.

OUTCOMES:

- Upon completion of this course, the students can able to understand and apply different heat and mass transfer principles of different applications.

TEXT BOOKS:

1.Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt, Fundamentals of Heat and Mass Transfer, 5th ed., JohnWiley,2002.

2. R.C.Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age Science Publishers

REFERENCE BOOKS:

1. Ozisik, M.N., Heat Transfer - A Basic Approach, McGraw-Hill, 1985.

2. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 2010

3. Yadav, R., "Heat and Mass Transfer", Central Publishing House, 1995.

4. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 1998.

5.M.Thirumaleshwar : Fundamentals of Heat and Mass Transfer, "Heat and Mass Transfer", First Edition, Dorling Kindersley, 2009

6. Holman, J.P., Heat Transfer, 9th ed., Tata McGraw-Hill, 2004.

7. Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2002

ME208 Mechanics of Machines

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To understand the basic components and layout of linkages in the assembly of a system /machine.
- To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
- To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains.

UNIT-I

Mechanisms - classification of mechanisms, Kinematic inversions - Grashoff's law -Inversions of slider crank mechanism, Coupler curves, spatial mechanisms - Straight-line generators.

UNIT-II

Slider crank mechanisms and four bar mechanism; Velocities of points on a rigid body -relative velocity - velocity polygon Acceleration of points on a rigid body – relative acceleration - acceleration polygon - Coriolis acceleration - analytical method .

UNIT-III

Chebyshcv spacing for precision positions - Structural error - Overlay method – Complex curve synthesis - Roberts Chebyshev theorem - Frudenstine's equation; Analytical synthesis using complex algebra; synthesis of dwell mechanism.

UNIT-IV

Classification of cam and follower - displacement diagrams - Graphical layouts of cam profiles. Derivatives of follower motion. High speed cams standard motions. Plate cams with flat face and roller followers.

UNIT-V

Terminology and definitions - law of gearing - profile for gears - Involute gearing - Interchangeability - Interference and undercutting. Contact ratio. Gear trains - types - Parallel axis gear trains. Epicyclic gear trains.

OUTCOMES:

- Upon completion of this course, the students can able to apply fundamentals of mechanism for the design of new mechanisms and analyze them for optimum design.

TEXT BOOKS:

1. Rattan, S.S, "Theory of Machines", 3rd Edition, Tata McGraw-Hill, 2009.

2. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.

REFERENCE BOOKS:

1. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2005

2. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.

3. Allen S. Hall Jr., “Kinematics and Linkage Design”, Prentice Hall, 1961

4. Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines", Affiliated East-West Pvt.Ltd., New Delhi, 1988.8.

5.Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 2002.

6. Khurmi, R.S.,”Theory of Machines”,14th Edition, S Chand Publications, 2005

7. Sadhu Singh: Theory of Machines, "Kinematics of Machine", Third Edition, Pearson Education,2012

8. Uicker, J. J., Jr., Pennock, G. R., and Shigley, J. E., Theory of Machines and Mechanisms, 3rd ed., Oxford University Press, 2003.

9.Rao, J.S. and Dukkipati, R.Y., Mechanism and Machine Theory, 2nd ed., Wiley Eastern Ltd., 1995.

ME210 Fluid Mechanics and Hydraulics

L-T-P-C: 3-0-0-3

OBJECTIVES:

- The applications of the conservation laws to flow through pipes and hydraulic machines will be studied.
- To understand the importance of dimensional analysis.
- To understand the importance of various types of flow in pumps and turbines.

UNIT-I

Basic concepts - Fluid properties - Basic hydrostatic equation - Manometry - Submerged and floating bodies. Pressure at a point - Hydrostatic equations for incompressible and compressible fluids -Manometers - Hydrostatic force on a submerged plane and curved surfaces - Buoyancy and equilibrium of floating bodies - Metacentre - Fluid in rigid motion bodies. Fluid dynamics; integral and differential formulations - Continuity equation - Navier-Stokes equations.

UNIT-II

Laminar and turbulent flows - Flow through pipes. Fluid rotation and deformation - Stream function - Condition of irrotationality -Governing equations of potential flow - Laplace equation.

Boundary layer concept -Prandtl's equation - Drag on flat plates - Buckingham π-theorem - Dimensionless numbers.

UNIT-III

Introduction - Classification - Dimensional analysis - Specific speed - Basic laws and equations.Hydraulic turbines - Pelton, Francis, and Kaplan turbines - Turbine efficiencies - Cavitation in turbines. Steam turbines; basic cycle, impulse and reaction turbines - Gas turbine; basic cycle and multi-staging - Power and efficiency calculations.

UNIT-IV

Centrifugal pumps; theory, components, and characteristics - Cavitation - Axial flow pumps - Pump system matching. Centrifugal and axial flow compressors; slip, surging and chocking. Basic concepts of fluid power system design - Hydraulic oils properties – Seals and Seal materials - Filters and Filtration. Hydraulic pumps, cylinders, and motors - Construction, sizing, and selection.

UNIT-V

Control valves; pressure, flow, and direction - Servo-valves. Basic hydraulic circuits, hydrostatic transmission - Cartridge valve circuits. Control of hydraulic circuits - Electrical, electronics, and PLC - Pneumatic components and basic circuits.

OUTCOMES:

- Upon completion of this course, the students can able to apply mathematical knowledge to predict the properties and characteristics of a fluid.
- Can critically analyse the performance of pumps and turbines.
- Compute drag and lift coefficients using the theory of boundary layer flows.

TEXT BOOKS:

1. Fox, R.W. and Mc Donald, A.T., Introduction to Fluid Mechanics, 6th ed., John Wiley, 2003.

2.R.K.Bensal, Fluid Mechanics and Hydraulic, Laxmi Publishers

REFERENCE BOOKS:

1. White, F.M., Fluid Mechanics, 5th ed., McGraw-Hill, 2003.

2. Lakshminarayana, B., Fluid Dynamics and Heat Transfer of Turbomachinery, Wiley-Interscience, 1995.

3, Industrial Hydraulics, Vickers - Sperry Manual, 2002.

4. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010

5. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2004

6. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011

7. Dixon, S.L., Fluid Mechanics and Thermodynamics of Turbomachines, 5th ed., Butterworth-Heinemann, 2005.

8.Sayers, A.T., Hydraulic and Compressible Flow Turbomachines,

9. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi2004.

10. Esposito. A., Fluid Power with Applications, 5th ed., Pearson Education, 2003.

ME212 Automobile Engineering

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To understand the construction and working principle of various parts of an automobile.

UNIT -I

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, resistances to vehicle motion and need for a gearbox, components of engine-their forms, functions and materials.

UNIT -II

Electronically controlled gasoline injection system for SI engines., Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system ,Turbo chargers, Engine emission control by three way catalytic converter system .

UNIT- III

Clutch-types and construction ,gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel –torque converter , propeller shaft, slip joints, universal joints ,Differential, and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT- IV

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems , Pneumatic and Hydraulic Braking Systems, Antilock Braking System and Traction Control, Electrical systems; construction, operation, and maintenance of batteries - Starter motors. Lighting and electrical accessories . Panel board instruments - Automobile air conditioning -Troubleshooting.

UNIT -V

Use of Natural Gas, Liquefied Petroleum Gas. Bio-diesel, Bio-ethanol , Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance ,Combustion and Emission Characteristics of SI and CI engines with these alternate fuels – Electric and Hybrid Vehicles, Fuel Cell

OUTCOMES:

- Upon completion of this course, the students can able to know the principle of various parts of an automobile

TEXT BOOKS:

1. Kirpal Singh, Automotive Engineering, Vol. I & II**,** Standard Publishers, New Delhi, 2002.

2. R.B.Gupta , Automobile Engineering, Satya Prakashan, New Delhi, 1997.

REFERENCE BOOKS:

1. Heitner, J. Automotive Mechanics Principle and Practice, 2nd ed., Affiliated East-West Press Ltd., 1974.Newton, K., Steeds, W., and Garrett, T.K., The Motor Vehicle, Butterworths, 1989.

2. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002

3. W.H.Crouse, Automotive Mechanics, Tata McGraw Hill Publishing Co., 1995.

4. V.L.Maleev, Internal Combustion Engines, McGraw Hill, 1987.

5. Joseph Heitner, Automotive Mechanics, CBS Publishers & Distributors, 1987.

6. R.B.Gupta., Auto Design, Satya Prakashan, New Delhi, 1995

ME214 Fluid Mechanics and Hydraulics Lab

L-T-P-C:0-0-3-2

OBJECTIVE:

- Upon Completion of this subject, the students can able to have hands on experience in flow measurements using different devices and also perform calculation related to losses in pipes and also perform characteristic study of pumps, turbines etc.

List of Experiments

1. Determination of Metacentric height of buoyancy
2. Determination of force due to impact of jets
3. Determination of co-efficient of discharge of venturi meter
4. Determination of co-efficient of discharge of orifice meter
5. Determination of major losses and minor losses in pipe flow
6. Study and performance test of the any five following hydraulic machines
   a. Centrifugal Pump
   b. Reciprocating Pump
   c. Jet – Pump
   d. Submersible Pump
   e. Parallel & Series Pump
   f. Gear Pump
   g. Pelton Wheel Turbine
   h. Francis Turbine

OUTCOMES:

- Ability to use the measurement equipments for flow measurement
- Ability to do performance trust on different fluid machinery

ME216 Conventional and CNC machines Lab

L-T-P-C: 0-0-3-2

OBJECTIVE:

- To study and acquire knowledge on various basic machining operations in special purpose machines and its applications in real life manufacture of components in the industry.

List of Experiments

1. Study of Lathe, Shaper, Milling Machines, CNC Lathe, CNC Milling, Grinding, Tool and Cutter
2. Plain turning, facing, step turning, Grooving & Chamfering
3. Taper turning by swiveling compound rest method
4. V – Thread cutting and Knurling
5. Cube and step shaping
6. Cube, Step and Key Way Milling
7. Programming in CNC Lathe – Simple Turning, Step Turning, Thread Turning
8. Programming in CNC milling
9. Cylindrical Grinding operation
10. Grinding of single point cutting tool

OUTCOMES:

- Ability to use different machine tools to manufacturing gears.
- Ability to use different machine tools for finishing operations
- Ability to manufacture tools using cutter grinder
- Develop CNC part programming

SEMESTER V

ME301 Engineering Measurements

L-T-P-C: 3-0-0-3

OBJETCTIVES:

- To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.
- To facilitate the understanding of Quality Management principles and process.

UNIT-I

Basic detector transducer elements, intermediate modifying systems, terminating devices and methods. Classification of instruments as indicators, recorders and integrators- their working principles, precision and accuracy, measurement of error and analysis, properties of errors.

UNIT-II

Pressure measurement: Gravitational, Bourdon, elastic transducers, strain gauge, pressure cells, measurement of high and low pressure, dynamic characteristics of pressure measuring devices. Strain measurement: Strain gauges, types, Wheatstone circuit, temperature compensation, Gauge rosettes, Calibration.

UNIT-III

Measurement of displacement-LVDT-Hall effect devices. Vibration-characteristics, analysis of vibration sensing devices, accelerometer-types-signal conditioner- voltage and charge amplifiers-vibration exciters-calibration. Speed Measurement – Stroboscope - Force measurement: scales and balance, elastic force meter, strain gauge, load cells, hydraulic and pneumatic load cells. Temperature measurement: Bimetallic, pressure and resistance thermometers, thermocouples, pyrometers and thermistors, calibration. Fourier transform analysis – FFT Analyser-concepts and techniques. Introduction to SCADA systems.

UNIT-IV

Standards-Errors in measurements-Calibration - Length measurements, Angle measurements, Limits and tolerances. Surface finish; terminology and measurements - Optical measuring

instruments. Measurement of screw thread and gear elements - Acceptance test for machines. Statistical Quality Control - Control charts - Sampling plans.

UNIT-V

Introduction TQM - Quality circle concepts – concepts, objectives and functions of quality circles – Benefits of the organization – Tools and Techniques – The seven management tools - Technique for analyzing a quality process – Statistical process Control – Introduction to S-S concepts – six sigma – Quality circles - Cost of quality – Taquchi's quality loss function – House keeping concepts for industries, tool room, production shop – processing industries. Quality based product and process Design – Design for reliability – Design for maintainability –QFD - Concepts and applications – case studies. KAIZEN Concepts – Kaizen by TQC – POKA YOKE ISO 9000 certification system – 9001 to 9004 systems – procedures, audits and reviews – case studies.

OUTCOMES:

- Upon completion of this course, the Students can demonstrate different measurement technologies and use of them in Industrial Components.
- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOKS:

1.Thomas G Beckwith, N Lewis Buck and Roy D Marargoni, "Mechanical Measurements", Narosa publishing house, 1989.

2.Gupta, I.C., Engineering Metrology, DhanpatRai & Sons, 2004.

3.S.M.Sundara Raja, Total Quality Management Tata McGraw Hill, 1998.

REFERENCE BOOKS:

1.Turner, J.D., "Instrumentation for Engineers", Springer – Verlag, New York Inc., 1988.

2. B.C.Nakra and Chaudhry, K.K.,"Instrumentation and Analysis",TMH, 1985.

3.Doeblin E.O., Measurement Systems, McGraw-Hill, 2004.

4.John Bank, The Essence of Total Quality Management, Prentice Hall of India, 1998.

5. James I Bossert, Quality Function Deployment, ASQC quality press, Wisconsin, 1994.
6. Harshavardhan, "Measurements – Principles and Practice", Macmillan India Limited, 1993
7. Grant, E.L., Statistical Quality Control, McGraw-Hill, 2004.
8. Patrick.J.Sweeney (editor), TQM for Engineering, Quality Resources, Newyork, 1993.

ME303 Computer Aided Design and Drafting

L-T-P-C: 3-0-0-3

OBJECTIVE:

- To provide an overview of how computers are being used in mechanical component design

UNIT-I

CAD hardware - Product cycle - CAD tools, CAD systems; system evaluation, CAD specific I/O devices.CAD software - Graphic standards .

UNIT-II

Modes of graphics operation, Software Modules.

UNIT-III

Geometric modeling – Types and mathematical representation and manipulation of curves and surfaces.

UNIT-IV

Solid modeling- fundamentals, feature based modeling manipulations of solid models.

UNIT-V

Transformation of Geometric models and visual realism - Animation.

OUTCOMES:

- Upon completion of this course, the students can able to use computer and CAD software's for modeling of mechanical components

TEXT BOOKS:

1. Ibrahim Zeid - CAD/CAM Theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2005

2. M.P.Groover and E.W.Zimmers - CAD/CAM; Computer Aided Design and Manufacturing, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2006.

REFERENCE BOOKS:

1. Rogers, D.E and Adams, J.A., Mathematical Elements for Computer Graphics, 2nd ed., McGraw-Hill, 1990.

2. P.Radhakrishnan et al - CAD/CAM/CIM, New Age International P Ltd., New Delhi, 2006.

3. Chris Mcmahon and Jimmie Browne - CAD/CAM – Principle Practice and Manufacturing Management, 2nd Edition, Addision Wesley England, 2000.

4. Sadhu Singh - Computer Aided Design and Manufacturing, II Edition, Khanna Publishers, New Delhi, 2008.

ME305 Dynamics of Machines

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- To understand the effect of Dynamics of undesirable vibrations.
- To understand the principles in mechanisms used for speed control and stability control.

UNIT-I

Static and dynamic force analysis of mechanisms - Flywheel function and design.

UNIT-II

Balancing of rotating masses in one and in several planes

UNIT-III

Balancing of reciprocating masses– Single and multi-cylinder engines.

UNIT-IV

Governors; gravity and spring controlled governors - Gyroscopic effect.

UNIT-V

Vibration; free and forced vibrations - Single degree and multi-degree freedom systems.
Vibration control - Passive and active control.

OUTCOMES:

- Upon completion of this course, the Students can able to predict the force analysis in mechanical system and related vibration issues and can able to solve the problem.

TEXT BOOKS:

1.Shigley, J.E., Uicker, J.J., Theory of Machines and Mechanisms, McGraw-Hill, 1995.
2.Rattan, S.S, "Theory of Machines", 3rd Edition, Tata McGraw-Hill, 2009

REFERENCE BOOKS:

1. Rao, J.S., and Dukkipati, R.Y., Mechanism and Machine Theory, 2nd ed., Wiley EasternLtd., 1995.
2. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2005
3. Benson H. Tongue, "Principles of Vibrations", Oxford University Press, 2nd Edition, 2007
4. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
5. Allen S. Hall Jr., "Kinematics and Linkage Design", Prentice Hall, 1961
6. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", Affiliated East-West Pvt.Ltd., New Delhi, 1988.
7. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low-Prices Student Edition, 1999.
8. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 1996
9. V.Ramamurthi, "Mechanics of Machines", Narosa Publishing House, 2002.
10. Khurmi, R.S.,"Theory of Machines", 14th Edition, S Chand Publications, 2005.

11. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms” ,3rd Edition, Oxford University Press, 2009.
12. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.

ME307 Analysis and Design of Machine Components

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components
  (Use of P S G Design Data Book is permitted)

UNIT-I
Mechanical engineering design - Design considerations

UNIT-II
Material selection - Modes of failure -Theories of failure - Endurance limit - Stress concentration - Factor of safety- Factors to be considered for material selection – application, life expectancy, risk factors etc.

UNIT-III
Design of shafts and couplings - Design of cotter and knuckle joints. Helical and leaf springs.

UNIT-IV
Fasteners and keys - Design of welded joints - Fillet and butt welds

UNIT-V
Design of riveted joints. Design of sliding contact bearings - Selection of rolling contact bearings. Seals and Selection of Seals for different applications

OUTCOMES:

- ❖ Upon completion of this course, the students can able to successfully design machine components

TEXT BOOKS:

1. Sundararajamoorthy, T.V. and Shanmugam, N., Machine Design, Anuradha Agencies, 2003.

REFERENCE BOOKS:

1. Shigley, J.E., Charles, R.M. and Richard, G.B., Mechanical Engineering Design, 7th ed., McGraw-Hill, 2004.

ME309 Measurements, Metrology and Dynamics Lab

L-T-P-C: 0-0-3-2

OBJECTIVE:

- ❖ To familiar with different measurement equipment's and use of this industry for quality inspection
- ❖ To supplement the principles learnt in kinematics and dynamics of machinery.
- ❖ To understand how certain measuring devices are used for dynamic testing.

List of Experiments

(Part A – Any Six Experiments)

1. Calibration of Micrometer.
2. Measurement of taper using Sine Bar.
3. Calibration of Plain Plug Gauge.
4. Straightness and Flatness Measurement using Autocollimator.
5. Surface Roughness Measurement (Talysurf method)
6. Inspection of Screw Threads (Effective Diameter).
7. Calibration of Inclined Tube Manometer.
8. Measurement of Pressure using Strain Gauges.
9. Determination of the Time Constant of Thermocouples.
10. Measurement of Force using Transducers.
11. Measurement of Strain using Strain Gauges.
12. Study of Displacement using LVDT and RVDT.
13. Vibration Measurement using Accelerometer.

14. Measurement of speed using stroboscope
15. Inspection of gear tooth profile using profile projectors
16. Tool Maker Microscope (inspection of screws)
17. Inspection of internal and external surfaces (C M M)
18. Statistical Quality Control charts.

(Part B – Any Six Experiments)

1. Natural frequency of single mass, single helical spring system.
2. Natural frequency of combination of springs – springs in parallel, springs in series
1. Natural frequency of undamped torsional single rotor, double rotor system. Effect of inertia (I) and stiffness (k_t).
2. Determination of radius of gyration of a given compound pendulum
3. Determination of radius of gyration, moment of inertia – bifilar suspension method – trifilar suspension method
4. Damping coefficient of torsional single rotor system – Effect of depth of immersion in oil and damping ratio Resonance frequency of equivalent spring mass system – undamped and damped condition. To plot amplitude Vs frequency graph for different damping.
5. Determination of characteristic curves of Watt, Porter, Proell and spring loaded governors.
6. Static and Dynamic balancing.
7. Journal bearing – pressure distribution of different loads at different Speeds.
8. Cam motion analysis.

OUTCOMES:

- Ability to handle different measurement tools and perform measurements in quality impulsion
- Ability to demonstrate the principles of kinematics and dynamics of machinery
- Ability to use the measuring devices for dynamic testing.

ME311 Computer Aided Design and Drafting Practice

L-T-P-C: 0-0-3-2

OBJECTIVES:

- To gain practical experience in handling 2D drafting and 3D modeling software systems.

Using Auto CAD Script file, draw the orthographic views for the given simple 3D blocks Preparation of Drawings for Parts and Assembly of the following by using AutoCAD.

Components drawing with dimensioning

1) Joints: Riveted Joints - Butt & Lap joints, Knuckle joint,
2) Couplings: flexible type flange coupling, Universal coupling.
3) Bearing: Pedestal bearing.
4) Screw jack
5) Connecting rod
6) Tail stock

OUTCOMES:

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

- To develop 2D and 3D models using modeling softwares.
- Draw complex geometries of machine components in sketcher mode.
- Write programs to generate script file components used in engineering practice.

TEXT BOOKS:

1. K.R. Gopalakrishnan - Machine Drawing, Subshas Publications, XII edition, 1988.
2. N.D. Bhatt - Machine Drawing, Charotar Publishing House.

REFERENCE BOOKS:

1. Sidheswar - Machine Drawing, Tata McGraw Hill edition, 1998
2. Auto CAD user Manual
3. R.B.Gupta - Machine Drawing, Satya Prakasham, 1988

SEMESTER V

ME302 Design of Mechanical Drives

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To gain knowledge on the principles and procedure for the design of mechanical power transmission components.
- To understand the standard procedure available for design of transmission of mechanical elements.
- To learn to use standard data and catalogues
  (Use of P S G Design Data Book is permitted)

UNIT-I

Introduction to transmission elements - Positive and friction based drives.

UNIT-II

Importance of friction based drives - Design of flat and V-belts - Design of rope and chain drives.

UNIT-III

Design of spur and helical gears based on contact and beam strength.

UNIT-IV

Design of bevel and worm gears.

UNIT-V

Design of multi-speed gearbox - Preparation of ray diagram and kinematic arrangement diagram for multi-speed gearbox.

OUTCOMES:

- Upon completion of this course, the students can able to successfully design transmission components used in Engine and machines

TEXT BOOKS:

1. Sundararajamoorthy, T.V. and Shanmugam, N., Machine Design, AnuradhaAgencies, 2003.

2. PSG Design Data Book, PSG Book Depot, 2010.

3. Bhandari V, "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill Book Co, 2010.

4. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.

REFERENCE BOOKS:

1.Shigley, J.E., Mechanical Engineering Design, 5th ed., McGraw-Hill, 1989.

2. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

3. Gitin Maitra, L. Prasad "Hand book of Mechanical Design", 2nd Edition, Tata McGraw-Hill, 2001.

4. C.S.Sharma, Kamlesh Purohit, "Design of Machine Elements", Prentice Hall of India, Pvt. Ltd.,2003.

5. Bernard Hamrock, Steven Schmid, Bo Jacobson, "Fundamentals of Machine Elements", 2nd Edition, Tata McGraw-Hill Book Co., 2006.

6. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4th Edition, Wiley,2005

7. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill Book Co.(Schaum's Outline), 2010

8. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.

9. Ansel Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2003.

10. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2003.

11. U.C.Jindal: Machine Design, "Design of Transmission System", Dorling Kindersley, 2010

12. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.

ME304 Thermal Engineering

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes.
- To apply the thermodynamic concepts into various thermal applications like IC engines, Steam Nozzles, Steam Turbines and Compressors systems.
- To understand the basic difference between incompressible and compressible flow.
- To understand the phenomenon of shock waves and its effect on flow.
- To gain some basic knowledge about jet propulsion and Rocket Propulsion.

(Use of standard Steam Tables, Mollier diagram, Gas Tables is permitted)

UNIT-I

Reciprocating air compressors - types - construction - work of compression without clearance - effect of clearance – Multistaging - optimum intermediate pressure for perfect intercooling - Compressor efficiencies and mean effective pressure.

UNIT-II

Working of two and four stroke engines - valve and port timing diagrams – I.C. engines fuels and rating -SI engine air fuel mixture requirements - Performance curve of an automobile carburetor - Diesel injection systems - types - Jerk type pump – Injection pump governors. Types of nozzles - Introduction to petrol injection.

UNIT-III

Battery Ignition - magneto ignition and transistorized coil ignition - Combustion in SI engines - Knock in SI engines - effect of engine variable on knock - Combustion in CI engines - knock in CI engines - combustion chambers for SI and CI engines.

UNIT - IV

Steam nozzles – flow through nozzles – nozzle efficiency – Effect of super heating – supersaturated (or) metastable expansion of steam in a nozzle – steam turbines – classification –

velocity diagrams – Compounding impulse turbine – Reaction turbine - Blade profiles of impulse and reaction turbines – Calculation of blade height, width – leakage prevention.

UNIT -V

Governing equations for inviscid-compressible flows - static and stagnation properties -speed of sound and Mach number. Isentropic flow through variable area passage ducts. Choking of flow. Normal and oblique shocks - Prandtl-Meyer flows. Fanno flow - Rayleigh flow. Fundamentals of jet propulsion - Propulsion cycle - Power and efficiency calculations. Turbojet, turbofan, and turboprop engines - Fundamentals of rocket propulsion.

OUTCOMES:

- Upon completion of this course, the students can able to apply the different gas power cycles and use of them in IC applications.
- Upon completion of this course, the students can able to successfully apply gas dynamics principles in the Jet and Space Propulsion

TEXT BOOKS:

1. Ganesan, V., Internal Combustion Engines, Tata McGraw-Hill, 2003.
2. Yahya, S.M., Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion, 3rd ed., New Age International Publishers, 2003.

REFERENCE BOOKS:

1. Ballaney, P.L., Thermal Engineering, Khanna Publishers, 1996.
2. Sarkar, B.K,"Thermal Engineering" Tata McGraw-Hill Publishers, 2007
3. Rudramoorthy, R, "Thermal Engineering ",Tata McGraw-Hill, New Delhi,2003
4. Ramalingam. K.K., "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2009.
5. Heywood, J.B., Fundamentals of Internal Combustion Engines, McGraw-Hill, 1988.
6. Kothandaraman.C.P., Domkundwar. S,Domkundwar. A.V., "A course in thermal Engineering", Fifth Edition, "Dhanpat Rai & sons , 2002
7. Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2000

ME306 Thermal Engineering Lab

L-T-P-C: 0- 0-3-2

OBJECTIVES:

- To study the valve timing diagram and performance of IC Engines
- To study the characteristics of fuels/Lubricates used in IC Engines
- To study the heat transfer phenomena to predict the relevant coefficient
- To study the performance of refrigeration cycle and air conditioning components

List of Experiments (Part A and Part B)

Part A: Heat Transfer and Refrigeration & Air Conditioning (Any Six Experiments)

1. Study and performance tests on refrigeration.
2. Study and performance tests on air conditioning test rig.
3. Performance test on cooling tower.
4. Determination of dryness fraction of steam using calorimeter.
5. Determination of Thermal Resistance and Conductivity of a Composite wall
6. Heat Transfer from Cylindrical Surface by Natural Convection
7. Heat Transfer from Cylindrical Surface by Forced Convection
8. Heat Transfer from Pin Fin by Forced Convection
9. Performance of Parallel Flow/Counter Flow Heat Exchanger
10. Determination of Calorific value of Solid Fuel using Bomb Calorimeter
11. Determination of Calorific value of Gaseous Fuel using Junker's Gas Calorimeter

Part B: IC Engines (Any Six Experiments)

1. Valve and port timing diagrams of 4 stroke and 2 stroke IC engines respectively
2. Tests on single cylinder petrol engine: (a) Load test (b) finding air-fuel ratio
3. Tests on multi-cylinder petrol engine: (a) Load test (b) Morse test (c) heat balance test
4. Tests on single cylinder 4 stroke diesel engine: (a) Load test (b) Finding air-fuel ratio
5. Test on multi-cylinder diesel engine: (a) Load test (b) Heat balance test
6. Determination of Kinematic Viscosity using Redwood viscometer
7. Determination of Flash and Fire Points using Cleaveland Apparatus.
8. Performance test on Reciprocating Air Compressor
9. Performance test on Centrifugal Air Blower

10. Study on the composition of Exhaust gas of an IC engine using Orsat Apparatus under various loads.
11. Study and performance testing of IC engines & Emission measurements.

OUTCOMES:

- ❖ Ability to conduct experiment on IC engine to study the characteristic and performance of IC design/ steam turbines.
- ❖ Ability to demonstrate the fundamentals of heat and predict the coefficient used in that transfer applications and also design refrigeration cycle

SEMESTER VII

ME491 Project Phase-I

L-T-P-C: 0-0-0-2

OBJECTIVES:

- ❖ To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The objective of the project is to enable the students to work in groups of not more than four members in each group on a project involving analytical, experimental , design or combination of these in the area of Mechanical Engineering. Each project shall have a guide. The student is required to do literature survey, formulate the problem and form a methodology of arriving at the solution of the problem. At the end of the project phase-I work, project report /write up should be prepared and submitted to the department. The phase-I evaluation (100 marks) is based on continuous internal assessment by an internal assessment committee through oral presentation.

OUTCOMES:

- ❖ On completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

SEMESTER VIII

ME492 Project Phase-II

L-T-P-C: 0-0-15-4

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

Project work phase II will be an extension of the project work started in the seventh semester. The evaluation of project phase-II (100 marks) is based on continuous internal assessment by an internal assessment committee and final report evaluation and viva voce examination along with an institute appointed external expert. At the end of the project phase-II work, project report should be prepared and submitted to the department. After that, each group will make an oral presentation followed by a brief question and answer session. The project presentations and report for a total of 100 marks. Based on that, final report evaluation and viva voce examination (60 marks) will be conducted by a committee of one external examiner (appointed by the institution) and department faculties. The continuous internal assessment by an internal assessment committee will be evaluated for 40 marks. The method of evaluation will be as follows: 1^{st} Evaluation = 20 marks (Decided by conducting a review by the department faculties). 2^{nd} Evaluation = 20 marks (Decided by conducting a review by the department faculties). Final evaluation = 60 marks (Decided by conducting final review by the department faculties along with external expert appointed by the institution).

OUTCOMES:

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

LIST OF ELECTIVES FOR SEMESTER –V

ME501 Computational Fluid Dynamics

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To introduce Governing Equations of viscous fluid flows
- To introduce numerical modeling and its role in the field of fluid flow and heat transfer
- To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

UNIT-I

Classification of partial differential equations - Discretization methods.

UNIT-II

Finite difference and finite volume formulations.

UNIT-III

Numerical solution of elliptical equations - Linear system of algebraic equations.

UNIT-IV

Numerical solution of parabolic equations - Stability analysis.

UNIT-V

Numerical solution of hyperbolic equations - Burgers equation. Incompressible Navier-Stokes equations and algorithms - Basics of grid generation.

OUTCOMES:

Upon completion of this course, the students can able

- To create numerical modeling and its role in the field of fluid flow and heat transfer
- To use the various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems.

TEXT BOOKS:

1. Tannehill, J.E., Anderson, D.A., and Pletcher, R.H., Computational Fluid Mechanics and Heat Transfer, 2nd ed., Taylor & Francis, 1997.

2. Hoffmann, K.A. and Chiang, S.T., Computational Fluid Dynamics for Engineers, Engineering Education Systems, 2000.

REFERENCE BOOKS:

1. Versteeg, H.K. and Malalasekera, W., An Introduction to Computational Fluid Dynamics – The finite volume method, Longman Scientific & Technical, 1995.

2. Patankar, S.V., Numerical Heat Transfer & Fluid Flow, Hemisphere, 1980

3. Numerical method for Scientific & Engineering, Joe D HoffMan, Mc.Graw Hill

4. Numerical method for Scientific & Engineering, Peter A.Stark, Mc.Graw Hill

5. Anderson J.D., Computational Fluid Dynamics – The basics with applications, McGraw-Hill, 1995.

ME503 IT Applications in Manufacturing
L-T-P-C: 3-0-0-3

OBJECTIVES:

- Understand the decision phases and apply competitive & supply chain strategies.
- Understand drivers of supply chain performance.
- Understand the role of aggregate planning, inventory, IT and coordination in a supply chain

UNIT – I

Introduction to IT – Definition of IT – Application of IT in day to day design and manufacturing, Data base – Classification.

UNIT – II

Introduction to transaction processing – basics of a network – LAN, WAN, MAN – network topology – connecting devices – concepts of client – server computing.

UNIT – III

Multimedia – details on hardware, Software and its application, introduction to Internet-Internet Service providers – naming and addressing – Email and browsing - Intranet and extranet: introduction and applications.

UNIT – IV

Application of IT in – supply chain management, Inventory, Manufacturing resource Planning, Decision Support system and logistics.

UNIT – V

Enterprise Computing, Introduction to ERP, Activities under ERP, Benefits of ERP.

OUTCOMES:

- At the end of the course, the student will be able to:
- Analyze factors influencing network design.
- Analyze the influence of forecasting in a supply chain

TEXT BOOKS :

1. S.Jaiswal, Information Technology – Today, Galgotia Publications, 2000.

REFERENCE BOOKS

1. Dennis P.Curtin et al., Information Technology – The breaking wave, Tata McGraw Hill, 2001.

ME505 Theory of Metal Cutting

L-T-P-C: 3-0-0-3

OBJECTIVE:

- To understand the concept and basic mechanics of metal cutting, working of standard machine tools.
- To understand the concept of chip formation and its thermodynamics for heat transfer.

UNIT-I

Tool geometry – cutting tool geometry for turning, drilling and milling tools – tool signature – tool designation: ASM, DIN – their relationship.

UNIT-II

Mechanism of chip formation – continuous, discontinuous and built up edge chips – deformation of chips – single shear plane theory – chip formation in drilling and milling. Introduction to oblique and orthogonal cutting. Mechanics of metal cutting, force system, Merchant's Circle – velocity relationship, relationship between forces, cutting speed, feed and depth of cut – experimental determination of cutting forces – tool dynamometers.

UNIT-III

Thermodynamics of chip formation: Sources of Heat – Mathematical modeling of sources of heat in affecting the rise of temperature – The shear plane temperature – average chip-tool interface temperature – distribution of shear plane temperature – non-iterative method for determining chip-tool and tool-work interface temperature – experimental determination of chip-tool interface temperature – experimental observation of metal cutting temperature – hot machining – theoretical estimation of work-piece temperature

UNIT-IV

Machinability – mechanisms of tool wear – Taylor's tool life equation – tool failure criteria (direct and indirect) – effect of cutting variables on tool life, maintainability index.

UNIT-V

Cutting fluids – types, different methods of application, economics of machining – basic concepts, tool materials (HSS, carbide and coated tools, CBN and ceramics) – Chatter in machining.

OUTCOMES:

- Completion of this course, the students can able to understand and analyze the mechanics and thermodynamics of metal cutting.
- Knowledge of tool nomenclature and its heat transfer**.**

TEXT BOOKS:

1. A.Bhattacharya, Metal Cutting – Theory and Practice, Central Book Publishers, 1989.
2. B.L.Juneja & G.S.Sekhon, Fundamentals of Metal Cutting and Machine Tools, New Age International (p) Ltd., 1998.

REFERENCE BOOKS:

1. M.C.Shaw, Metal Cutting Principles, IBH Publishers, 1991.
2..G.Boothryd, Fundamentals of Metal Machining, Tata McGraw Hill, 1983.
3.G.Kuppusamy, Principle of Metal Cutting, University Press, 1992.

ME507 CONTROL SYSTEM ENGINEERING
L-T-P-C: 3-0-0-3

OBJECTIVES:

- To understand the basic concepts of control systems
- To understand the concept of different modes of controls, first and second order system and frequency response.
- To understand the principles of control system design.

UNIT- I

Basic Components of Control System – Open loop and Closed loop system – Automatic Control System. Mathematical Modeling, Analogous Models – Mathematical modeling of fluid system and thermal systems – Transfer Function – Block diagram reduction Techniques.

UNIT-II

Representation of Physical System – Linear approximation of non linear System – position Control system – Stepper motor – Hydraulic systems – pneumatic systems – Inertial navigation system – Applications. Modes of Controls: Proportional, Integral, Derivative – proportional plus integral – proportional plus Derivative– proportional plus integral plus derivative controls – examples from Mechanical system.

UNIT-III

Standard test signals and transient response of first and second order systems. Sources of errors, static and dynamic error constants.

UNIT-IV

Frequency Response – Bode Plot – Polar Plot. Stability Analysis – Relative stability – Routh Hurwitz Stability Criteria.

UNIT – V

Design Principles – an outline of Control System Design - Control of the A/F ratio in an Automotive Engine – Control of Read/Write Head Assembly of a Hard Disk. Introduction to Fuzzy logic – Fuzzy set – Fuzzy Control – PLC – micro controller.

OUTCOMES:

- On completion of this course, the students will be able to understand the basics of control system for designing mechanical operated control systems.

TEXT BOOKS:

1. F.H.Raven - Automatic Control Engineering, III Edition, McGraw Hill Students Edition.

2. Gene F.Franklin et al - Feedback control of Dynamic Systems, IV Edition, Pearson Education Asia, 2002.

REFERENCE BOOKS:

1. B.C.Kuo - Automatic Control System, VII edition, Prentice Hall of India, 2002.

2. I.J.Nagrath and M.Gopal - Control System Engineering, II edition, Wiley Eastern Ltd., 1992.
3. Timothy J.Ross - Fuzzy logic with Engineering Applications, McGraw Hill Inc., 1995.
3. Katsushiks Oguta - Modern Control Engineering, IV Edition, Prentice Hall of India, 2002.

ME509 Mechatronics

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To impart knowledge about the elements and techniques involved in mechatronics systems which are very much essential to understand the emerging field of automation.
- To explain the fundamentals of semiconductor and applications.
- To explain the principles of digital electronics

UNIT-I

Introduction: Introduction to Mechatronics - Systems-Measurement Systems-Control Systems-Mechatronics Approach.

UNIT-II

Sensors and Transducers: Introduction-Performance, Terminology-Displacement, Position and Proximity-Velocity and Motion- Fluid Pressure-Temperature Sensors-Light Sensors-Selection of Sensors-Signal Processing.

UNIT-III

8085 Microprocessor: Introduction-Architecture-Pin Configuration - Instruction set - Programming of Microprocessors using 8085 instructions-Interfacing input and output devices-Interfacing D/A converters and A/D converters-Applications- Temperature control-Stepper motor control-Traffic light controller.

UNIT-IV

Programmable Logic Controllers: Introduction-Basic structure-Input/output Processing-Programming-Mnemonics-Timers, Internal relays and counters-Data handling-Analog Input/Output-Selection of a PLC.

UNIT-V

Design and Mechatronics: Stages in Designing mechatronic systems - Traditional and Mechatronic design -Possible design solutions-Case studies of mechatronic systems - Pick and place robot - automatic car park system -engine management system.

OUTCOMES:

Upon completion of this course, the students can able to

- Model, analyze and control engineering systems.
- Identify sensors, transducers and actuators to monitor and control the behaviour of a process or product.
- Develop PLC programs for a given task.
- Evaluate the performance of mechatronic systems.
- Ability to identify electronics components and use of them to design circuits.

TEXT BOOKS:

1. W.Bolton, Mechatronics,Longman, Second Edition, 1999.

2. Michael B. Histand and David G.Alciatore, " Introduction to Mechatronics and Measurement Systems ", McGraw Hill International Editions, 1999.

REFERENCE BOOKS:

1. DanNecsulescu, "Mechatronics", Pearson Education Asia, 2002(Indian reprint).

2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 5th Edition, Prentice Hall, 2008.

3. Bradley D.A, Dawson D, Buru N.C and Loader A.J, “Mechatronics”, Chapman and Hall, 1993.

4. Smaili.A and Mrad.F ,“Mechatronics Integrated Technologies for Intelligent Machines”, Oxford University Press, 2007

5. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, PWS publishing company, 2007.

6. Krishna Kant, “Microprocessors & Microcontrollers”, Prentice Hall of India, 2007.

7. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013

8. David G.Alciatore and Mecheal.B.Histand, Introduction of Mechatronics and Measurement Systems, McGraw Hill International Edition, 1999.
9. Lawrence J.Kamm, Understanding Electro – Mechanical Engineering, An Introduction to Mechatronics, Prentice Hall, 20001

LIST OF ELECTIVES FOR SEMESTER –VI

ME502 Finite Element Methods

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems.

UNIT-I

Introduction - Illustration using spring systems and simple problems - Weighted residual methods Galerkin's method - Variational approach - Rayleigh-Ritz method.

UNIT-II

One-dimensional finite element analysis; bar element, beam element, frame element – Heat transfer problems.

UNIT-III

Two-dimensional finite element analysis; types of elements, shape functions, natural coordinate systems.

UNIT-IV

Applications to structural mechanics - Numerical integration - Solution of finite element equations.

UNIT-V

Fluid flow problems - Dynamic problems.

OUTCOMES:

- Upon completion of this course, the students can able to understand different mathematical techniques used in FEM analysis and use of them in Structural and thermal problem

TEXT BOOKS:

1.Seshu, P., Textbook of Finite Element Analysis, Prentice-Hall, India, 2003.

2. Frank L.Stasa, Applied Finite Element Analysis for Engineers, CBS International, Edition, 1985.

REFERENCE BOOKS:

1.Segerlind, L.J., Applied Finite Element Analysis, John Wiley, 1987.

2. S.S.Rao, Finite Element Method in Engineering, Pergamon Press, 1989.

3. Cook Robert Devis et al, Concepts and Application of finite Element Analysis, Wiley John & Sons, 1999.

4. G.Buchaman, Schaum's Outline of finite Element Analysis, McGraw Hill,

5. J.N.Reddy, An Introduction to Finite Element Method, McGraw Hill International Edition, 1993.

ME504 Advanced IC Engines

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To understand the underlying principles of operation of different IC Engines and components.
- To provide knowledge on pollutant formation, control, alternate fuel etc.

UNIT-I

Engine design parameters, properties of working fluids.

UNIT-II

Analysis of engine cycles, fuel intake systems.

UNIT-III

Combustion in SI and CI engines.

UNIT-IV

Pollutant formation and control in IC engines.

UNIT-V

Engine performance and modeling.

OUTCOMES:

- Upon completion of this course, the students can able to compare the operations of different IC Engine and components and can evaluate the pollutant formation, control, alternate fuel

TEXT BOOKS:

1. Ramalingam. K.K., "Internal Combustion Engine Fundamentals", Scitech Publications, 2002.
2. Ganesan, "Internal Combustion Engines", II Edition, TMH, 2002.

REFERENCE BOOKS:

1. Ganesan, V., Internal Combustion Engines, 2nd ed., Tata McGraw-Hill, 2003.
2. Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines", Dhanpat Rai & Sons2007.
3. Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987.
4. Eric Chowenitz, "Automobile Electronics", SAE Publications, 1995
5. Heywood, J.B., Internal Combustion Engine Fundamentals, McGraw-Hill, 1988.
6. Taylor, C.P., The Internal Combustion Engines in Theory and Practice, Vol. II, MIT

ME506 Advanced Heat and Mass Transfer

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To develop the ability to use the heat transfer concepts for various applications like finned systems, turbulence flows, high speed flows.
- To analyze the thermal analysis and sizing of heat exchangers and to learn the heat transfer coefficient for compact heat exchanges.
- To achieve an understanding of the basic concepts of phase change processes and mass transfer.

UNIT-I

Factors affecting thermal conductivity of solids, liquids & gases. General three dimensional heat conduction equation in Cartesian, cylindrical & spherical coordinates. Initial condition and various boundary conditions. Heat sources systems, Critical thickness of insulation. Different types of fins & their analysis. Two dimensional steady state conduction. Transient heat conduction.

UNIT-II

Free & forced convection, Similarity & simulation of convection heat transfer, Boundary layer theory, Turbulent flow heat transfer. Analogy between momentum & heat transfer. Heat transfer with liquid metals. Recent developments in the theory of turbulent heat transfer. Natural convection under different situations. Empirical relations in convection heat transfer.

UNIT-III

Boiling- Introduction to boiling heat transfer, regimes of boiling heat transfer, pool boiling, flow boiling. Condensation- Heat transfer in condensation, Drop wise & film wise condensation. Empirical equations.Laws of thermal radiation. Shape factors. Radiation heat transfer between black, diffuse & gray surface.

UNIT-IV

LMTD Methods, importance of fouling factor, Overall heat transfer co-efficient, NTU effectiveness method, Analysis of compact heat exchanger—plate-fin heat exchangers,

regenerative type heat exchanger. Optimization & simulation of heat exchangers. Basic aspects of heat transfer in porous media.

UNIT-V

Modes of mass transfer, comparison between heat & mass transfer, Frick's law of diffusion, general mass diffusion equation, diffusion through stagnant gas, convective mass transfer, dimensionless parameters & dimensional analysis of convective mass transfer, Evaporation of water in air.

OUTCOME:

- On successful completion of this course the student will be able to apply the different mode of heat transfer to various thermal equipment.

TEXT BOOKS:

1.J.P. Holman, "Heat Transfer", McGraw Hill Book Co. 9th edition, 2008.

2.Incropera& Hewitt, "Fundamentals of Heat & Mass Transfer", John Willey, 2005.

REFERENCE BOOKS:

1.L S Tong and Y S Tang. Boiling Heat Transfer and Two-Phase Flow. Taylor and Francis,1997.

2.P.BWhalley. Boiling, Condensation and Gas-Liquid Flow. Oxford University Press, 1987.

3.Louis C Burmeister, Convective Heat Transfer, John Wiley and Sons, 1993.

4.AdrianBejan, Convective Heat Transfer, John Wiley and Sons, 1995.

5. R.C. Sachdeva, Fundamentals of Heat and Mass Transfer, New Age International Ltd., 2000.

6. Eckert and Drag, Analysis of Heat and Mass Transfer, McGraw Hill, New York, 1975.

7.Collier, J.B. and Thome, J.R., Convective boiling and condensation, Oxford Science Publications, 1994.

ME508 Design of Gears and Cams

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To familiarize the various steps involved in the process of gear design
- To understand the principals involved in evaluating the shape and dimensions of a gear component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data of gear design
- To learn the design of cams and its applications

UNIT-I

Gear drives - Advantage of Gear drives over other drives, Nomenclature, failures of gear tooth, Design of gears - spur, helical, bevel and worm & worm wheel.- based on bending and wear criteria - based on Lewis and Buckingham equation.

UNIT – II

Bevel Gears – Nomenclature - Design of bevel gears-based on bending and wear criteria- based on Lewis and Buckingham equation, Worm and Worm Wheel – Nomenclature – Design procedure

UNIT – III

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box -Constant mesh gear box. – Design of multi speed gear box. Speed reducer – Design of Speed reducer using spur and helical gears

UNIT-IV

BIS standards for gear design and its Force analysis.

UNIT-V

Design of cams - Tangential and Polynomial cams.

OUTCOMES:

- Upon completion of this course, the students can able to successfully design various types of gears and cams

TEXT BOOKS:

1. Maitra, G.L., Hand Book of Gear Design, 2nd ed., Tata McGraw-Hill, 2005.

REFERENCE BOOKS:

1. Merritt, H.E., Gear Engineering, A. H. Wheeler & Co. Pvt. Ltd., 1984.

LIST OF ELECTIVES FOR SEMESTER –VII

ME511 Design of Heat Exchangers

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To learn the thermal and stress analysis on various parts of the heat exchangers.
- To analyze the sizing and rating of the heat exchangers for various applications

UNIT – I

Definition – Classification – Application – Parallel Flow, Counter Flow – Single Pass and Multi Pass – Overall Heat Transfer Coefficient – Fouling Factor – Temperature Distribution – LMTD – LMTD Method and LMTD Correction Factor – Effectiveness – NTU Method – Methodology of Heat Exchanger & Calculation.

UNIT – II

Double Pipe Heat Exchanger – Application and Design Parameters – Film Coefficient for Fluids in Pipes and Tubes – Caloric Temperature and wall Temperature – Series and Parallel Arrangement – Design Procedure – Pressure Drop Calculation.

UNIT – III

Shell and Tube Heat Exchanger – Tubes, Shells, Baffles – Types and Application – Exchanger using Water, Oil Solutions, Steam as Heating Medium – Design Procedure – Flow Arrangement for increased Heat Recovery.

UNIT – IV

Types of Condenser and their selection – Design Procedure – types of Evaporators – Shell and Tube Re-Boilers – Types and Thermal Design.

UNIT – V

Energy Recovery - Definition of HEN – Pinch point – Pinch Technology – Cascade Diagram – Pinch and its implication - Minimum number of Heat Exchangers – Design – above and below the Pinch – Synthesis of HEN.

OUTCOMES:

- Upon completion of this course, the students can able to apply the mathematical knowledge for thermal and stress analysis on various parts of the heat exchangers components.

TEXT BOOKS:

1. D.Q.Kern, Process Heat Transfer, McGraw Hill Book Co., New York, 1957.

2. W.M.Kays and A.L.Londown, Compact Heat Exchangers, III Edition, McGraw Hill, New York, 1984.

REFERENCE BOOKS:

1.E.U.Schlunder, (Editor-in-chief) Heat Exchanger Design Hand Book,
Vols.1-5, Hemisphere Publishing Corporation, NewYork, 1983

2. T. Taborek, G.F. Hewitt and N.Afgan, Heat Exchangers, Theory and Practice, McGraw Hill Book Co., 1980

3.Walker, Industrial Heat Exchangers - A Basic Guide, McGraw Hill Book Co., 1980

4. Nicholas Cheremisioff, Cooling Tower, Ann Arbor Science Pub 1981

5.Arthur P.Fraas, Heat Exchanger Design, John Wiley & Sons, 1988

ME513 Industrial Work Study
L-T-P-C: 3-0-0-3

OBJECTIVES:

- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT-I

Work study – Introduction to work study – objectives – factors for selection of work study job – uses of work study in industry- elements of work study- Qualities of a workman.

UNIT-II

Methods study – objectives of method study – techniques of method study - elements of method study. Motion study – Benefits of motion study – tools of motion study. Time study – aims and objectives – benefits of time study - procedure of time study – time study equipments – standard elements of time

UNIT-III

Use of standard data- advantages - methods – work sampling – confidence level – sample size determination – determination of accuracy for a given number of observation - determination of time standards by work sampling – over time study – errors in work sample study - types of standardization – benefits of standardization- standard of forms and sizes- standard tools, conditions, materials

UNIT-IV

Job classification and job evaluation - advantages of job evaluation - Methods of job evaluation. Introduction to production – types of production – importance of production control –routing in industries – types of schedules – function of dispatching- forms used in dispatching- flow process chart.

UNIT-V

Labour and industrial laws – Wages and incentives – control and record keeping of men, materials and machines – Regulations – HSE – Factory act- mines act- EPA- water and air act.

OUTCOMES:

- Upon completion of this course, the students can able to prepare production planning and control activities such as work study, product planning, production scheduling, Inventory Control.
- They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

TEXT BOOKS

1.G.B.S.Narang& V.Kumar - Production and Costing, Khanna Publishers Delhi

2.Vijay Shantilal Sheth, Industrial Engineering Methods and Practice, 2005, Penram International Publishing (India)

REFERENCES BOOKS

1.T.R.Banga and S.C.Sharma - Industrial organisation and Engineering Economics, Khanna Publishers, Delhi

ME515 MEMS Devices - Design and Fabrication

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To provide knowledge of micro electro mechanical devices.
- To educate the students on the rudiments of micro fabrication techniques.
- To introduce different materials used for MEMS and its properties
- To introduce the lumped modeling of the systems and transducer

UNIT-I

An overview of microelectromechanical devices and technologies, and an introduction to design and modeling, Standard microelectronic fabrication technologies.

UNIT-II

Bulk micromachining, surface micromachining, bonding technologies, related fabrication methods, and creating process flows.

UNIT-III

Mechanical, thermal, electrical, magnetic, optical, and chemical properties of materials.

UNIT-IV

Introduction to lumped modeling of systems and transducers; an overview of system Dynamics

UNIT-V

MEMS examples, energy methods, the thermal energy domain; modeling dissipative processes, Fluids and Transport

OUTCOMES

- Ability to understand and analyze the micro electro mechanical devices and its fabrication techniques

TEXT BOOKS:

1. Tai – Ran Hsu, "MEMS& Microsystems Design and Manufacturing", Tata McGrawhill Edition, 2006

2. Mohamed Gad-el-Hak , "MEMS: Design and Fabrication (Mechanical Engineering)", CRC; 1 edition, 2005.

REFERENCE BOOKS:

1. Sami Franssila , "Introduction to Microfabrication", John Wiley; 1 edition, 2004.

2. John A. Pelesko, David H. Bernstein, "Modeling MEMS and NEMS", CRC; First edition, 2002

3. Marc J. Madou, "Fundamentals of Microfabrication, the science of Miniaturization", CRC Press Second Edition, 2002.

ME517 Refrigeration and Air Conditioning

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
- To provide knowledge on design aspects of Refrigeration & Air conditioning systems (Use of refrigeration tables, Psychrometry charts is permitted)

UNIT-I

Introduction about Refrigeration – Definitions of various terms. Methods of refrigeration.Air refrigeration system. Bell – Coleman cycle. Introduction about Air craft Air-Conditioning.

UNIT-II

Analysis of Vapour compression cycle, Modifications to basic cycle. Multipressure systems. Multi-evaporator system and Cascade systems.Properties of refrigerants.Selectionof refrigerants.

UNIT-III

Discussion of components of V.C system, Servicing.Vacuumizing and charging of refrigerant. Introduction to cryogenics.

UNIT-IV

Psychrometry – Definitions for properties. Introduction to cooling load calculations. Comfort conditions. Effective temperature concept.

UNIT- V

Air-conditioning systems – discussion about the central plant with direct evaporator and chiller applications, Ice plant, refrigerators. Food preservation, IQF technique and freeze drying etc. Cold storage and thermal insulation.

OUTCOMES:

- Upon completion of this course, the students can able to demonstrate the operations in different Refrigeration & Air conditioning systems and also able to design Refrigeration & Air conditioning systems

TEXT BOOKS:

1. Manohar Prasad, Refrigeration and Air Conditioning, New Age International, 2004.

2. Dossat R.D., Principle of Refrigeration, 4th ed., Prentice-Hall, 1997.

3**.** Arora, C.P., Refrigeration and Air Conditioning, 2nd ed., Tata McGraw-Hill, 2000.

REFERENCE BOOKS:

1**.** Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.

2. Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986.

3. ASHRAE Hand book, Fundamentals, 2010

4. Jones W.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2001

ME519 Welding Engineering

L-T-P-C: 3-0-0-3

OBJECTIVE:

- To understand the basics of welding and to know about the various types of welding processes

UNIT-I

Welding Processes - Gas welding, manual, submerged arc, TIG, MIG welding, plasma arc. Electroslag, electro-gas welding, pressure welding processes - cold and hot pressure welding. resistance, friction and explosive welding. Plastic and ceramic welding.

UNIT-II

Welding Processes - Radiant energy and solid phase welding processes and equipment - Beam power control. Laser beam cutting, under water welding.Diffusion welding.

UNIT-III

Allied Processes Brazing, Soldering, Cutting, Surfacing Methods - Need, Flame Spraying. Plasma Spraying.

UNIT-IV

Welding metallurgy - weld thermal cycles and their effects - structural changes in different materials, effect of pre and post heat treatment, Weldability.

UNIT-V

Testing And Design of Weldment- Design and quality control of welds. Edge preparation types of joints, weld symbols. Stresses in butt and fillet welds - weld size calculations. Design for fatigue. Testing - tensile, bend hardness. Impact, notch and fatigue tests. Visual examination - liquid penetration test, magnetic particle examination. Radio graphs, ultrasonic testing. Life assessment of elements.

OUTCOMES:

- Upon completion of this course, the students can able to compare different types of Welding process for effective Welding of Structural components.

TEXT BOOKS:

1. Jackson, M.D., Welding Methods and Metallurgy, Charles Griffin & Company, London, 1967.
2. AWS, American Welding Society, Volume I to V, Miami, 1982.

REFERENCE BOOKS:

1. George E. Linnert, Welding Metallurgy, GML Publications, South Carolina, U.S.A.,1994.
2. Little LR, Welding and Welding Technology. Tata McGraw-Hill, New Delhi, 1980.

ME521 Pressure Vessel Design

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To understand the Mathematical knowledge to design pressure vessels and piping.
- To understand the ability to carry of stress analysis in pressure vessels and piping

UNIT - I

Pressure vessels - introduction – functional requirements, size and shape, fluid contained, method of support, location of attachment and penetrations, operational requirements and limitations, loading, severity of duty, principal design codes, safety devices, pressure testing.

UNIT - II

Stresses in pressure vessels – stresses in a circular ring, cylinder and sphere – Dilation of pressure vessels – Intersecting spheres – Membrane stresses in vessels under internal pressures – stresses in thick cylinders and spheres - Built up cylinders – Auto frettage of thick cylinders – Thermal stresses due to thermal gradients – Ultra-high pressure vessel design principles.

UNIT - III

Design codes and usage – design preliminaries – design loads – failure criteria – factor of safety. Selection and design of heads and enclosures – opening and compensation – Non standard flanges – Supports – Welded, bolted and gasketed joints - Long life design philosophy – vessel construction codes and usage.

UNIT - IV

Fatigue and crack growth – causes – dynamic loading, stress concentration, surface effects and material properties – creep effects at elevated temperatures – thermal stress fatigue – embrittlement – fracture control.

UNIT - V

Buckling of pressure vessels under external pressure (cylinders and spheres) – Effect of supports and imperfections on buckling – economics of pressure vessel fabrication – modern trends in pressure vessel construction - use of codes.

OUTCOMES:

- Upon completion of this course, the students can able to apply the mathematical fundamental for the design of pressure vessels and pipes. Further they can able to analyze and design of pressure vessels and piping.

TEXT BOOKS:

1. J.F.Harvey, Theory and Design of Pressure Vessels, CBS Publishers & Distributors, 1987.

2.B.C.Bhattacharya, Introduction to Chemical Equipment Design – Mechanical Aspects, CBS Publishers & Distributors, New Delhi, 1991.

REFERENCE BOOKS:

1. Henry H.Bednar - Pressure Vessel Design Hand Book, CBS Publishers & Distributors, 1987.

2. L.E.Brownell and E.H.Young - Process Equipment Design, Wiley Eastern Ltd., 1986

3. IS: 2825 – 1969 - Code for Unfired Pressure Vessels, Bureau of Indian Standards,

4. Henry H.Bednar - Pressure Vessel Design Hand Book, CBS Publishers & Distributors, 1987.

5. L.E.Brownell and - Process Equipment Design, Wiley Eastern Ltd., 1986

6. IS: 2825 – 1969 - Code for Unfired Pressure Vessels, Bureau of Indian Standards,

ME523 Solar Power Engineering

L-T-P-C: 3-0-0-3

OBJECTIVE:

- At the end of the course, the students are expected to identify the new methodologies / technologies for effective utilization of solar energy.

UNIT-I

Solar radiation - radiation at the earth's surface – measurement of solar radiation - solar radiation data geometry – solar radiation on tilted surfaces – relationship among absorption and emittance and reflectance – Selective surfaces.

UNIT-II

Flat plate collectors – transmissivity of cover system – collector efficiency – liquid plate collector – performance of flat Plate collector. Concentrating collectors Types of Collectors - Solar heating – air heating system – solar energy heat pump system – solar water heating system: forced and natural circulation system – passive solar heating system – green house effect.

UNIT-III

Solar cooling – absorption cooling – vapour absorption refrigeration – solar desiccant Cooling- Solar drier and dehumidifier – solar pond – domestic, commercial and industrial applications of solar heating / cooling systems.

UNIT-IV

Photovoltaic Principle –materials for photovoltaic cells – design and fabrication of photovoltaic cells – performance analysis of photovoltaic cells – Thermoelectric generator solar cell – photochemical solar cells – solar cells in terrestrial and space applications.

UNIT-V

Solar power systems – electrical power generation – solar thermal power plants – low, medium and high temperature power generation systems: using flat plate collectors or solar ponds, concentrating collectors, central receiver and solar chimneys – solar energy process economics.

OUTCOMES:

- Upon completion of this course, the students can able to identify the new methodologies /technologies for effective utilization of solar energy.

TEXT BOOKS:

1.S.P.Sukhatme, Solar Energy – Principles of Thermal Collection and storage, Tata McGraw Hill Publishing Co., New Delhi, 1996.

2. J.A.Duffie &W.Beckmann, Solar Engineering of Thermal Processes, John Wiley, 1991.

REFERENCE BOOKS:

1.N.K.Bansal et al, Renewable Energy Sources and Conversion Technology, Tata McGraw Hill Publishing Co., New Delhi, 1990.

2.Jiu Sheng Hsieh, Solar Energy Engineering, Prentice Hall, 1991

3. L.L.Freris, Wind Energy Conversion Systems, Prentice Hall, 1990.

4. D.A.Spera, Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering, ASME Press.

5. J.F.Kreider and F.Kreith-Solar Energy Handbook McGraw-Hill (1981

ME525 Industrial Engineering and Management

L-T-P-C: 3-0-0-3

OBJECTIVE:

- At the end of the course, the students are expected to identify the methods for industrial plant establishment

UNIT-I

Plant Location: influencing factors – rural and urban locations – evaluation of location alternatives for Single facility location problems – solving simple problems. Plant Layout: classification of production systems – principles of layout – basic types of layout – line balancing – simple problems in line balancing using Ranking Positional Weight Method. Material Handling: functions – principles – classification of material handling equipments (only classification and no description) - factors to be considered in selection of material handling equipment.

UNIT -II

Method Study: objectives - basic procedure - various recording techniques – process charts, multiple activity charts, SIMO chart, Flow diagram, string diagram, cyclegraph and chronocyclegraph - principles of motion economy – Therbligs - micromotion study & memomotion study.

UNIT -III

Work Measurement: purpose - basic procedure – various techniques of work measurement – stop watch time study – time study equipments – different systems of performance rating – time allowances – PMTS - work sampling – simple problems involving the determination of standard time and compensation.

UNIT-V

Production Planning and Control : functions – qualitative and quantitative techniques of forecasting – simple problems in forecasting using moving average, weighted moving average, simple exponential smoothing and regression methods - routing – loading and scheduling – different methods of scheduling – expediting – dispatching – functions and objectives of materials management – Introduction to inventory control and ABC analysis.

UNIT-V

Management: Basic Concepts – Scientific management – Fayol's principles - functions of management. Financial Management : fixed and working capital - sources of finance - evaluation of investment alternatives using present worth / future worth / annuity / rate of return methods – different methods of determining depreciation - Elements of cost & cost ladder - break-even analysis – simple problems. Marketing Management: Concepts of Marketing - products and markets – pricing - channels of distribution - sales promotion - advertising - basics of market research. Human Resources Management: individual and group behaviour – Maslow's hierarchy of needs – motivation and morale – fatigue: causes & remedy – accidents: causes and prevention -manpower planning – job analysis – job evaluation and merit rating - management by objectives (MBO).

OUTCOMES:

- Upon completion of this course, the students can able to identify the methods for industrial plant establishment

TEXT BOOKS:

1. R .Panneerselvam - Production and Operations Management, Prentice Hall of India Pvt. Ltd., 2003.

2. O.P.Khanna - Industrial Engineering and Management, Dhanpat Rai Sons (P) Ltd., 1999.

REFERENCE BOOKS:

1. Joseph Monks - Operations Management, McGraw Hill, New York, 1986.
2. R.M.Barnes - Motion and Time Study, John Wiley Eastern, New York, 1985.
3. Roger G.Schroeder - Operations Management, III Edition, McGraw Hill, New York, 1989.
4. Martand Telsang - Industrial and Business Management, S.Chand & Co., 2001.

ME527 Metal Forming Processes

L-T-P-C: 3-0-0-3

OBJECTIVE:

- At the end of the course, the students are expected to identify the various aspects of metal forming

UNIT-I

Classification of forming processes – flow curves and their significance in forming – Effect of temperature, speed and metallurgical structure on forming processes – Effect of friction on forming processes. Basic concepts of yield criteria – types.

UNIT-II

Classifications of forging processes - Forging equipment – forging die design procedure for simple products – forging defects – determination of forging load – concept of P/M forging – Applications.

UNIT-III

Rolling mills – Estimation of rolling load and power – rolling defects – Applications. Direct extrusion equipment - hydrostatic extrusion - extrusion of tubes – determination of extrusion stress - extrusion defects – Applications.

UNIT-IV

Drawing of rods, wires and tubes-Determination of drawing loads through conical dies, sheet metal forming: Shearing, blanking, bending, punching, piercing, stretch forming, deep drawing, rubber pad forming –Applications.

UNIT-V

High rate energy forming processes: Introduction - Effect on mechanical properties and microstructures – Explosive forming, Electro hydraulic forming – Electro magnetic forming, Water hammer forming.

OUTCOMES:

- Upon completion of this course, the students can able to identify the various aspects of metal forming

TEXT BOOKS:

1. Dieter, Mechanical Metallurgy, McGraw-Publishing Co., New York, 1998.
2. P.C.Sharma, Production Engineering, S.Chand & Co., New Delhi, 1995.
3. G.R.Nagpal, Metal Forming Processes, Khanna Publishers, New Delhi,2014

REFERENCE BOOKS:

1.G.W.Rowe, An Introduction to the Principles of Metal Working", Edward, Arnold Publications, 1973.
2. Gyril Donaldson, Tool Design, Tata McGraw Hill Publishing Co. Ltd., 1989.
3. ASTME, Hand Book – Fundamental of Tool Design, Prentice Hall of India, Pvt. Ltd., New Delhi, 1976

LIST OF ELECTIVES FOR SEMESTER -VIII

ME5510 Industrial Robotics

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

UNIT-I

Introduction of Robot - Classification and characteristics, Advantages and Disadvantages of Robots –Robot selection - work cell – Vision –Accidents – Safety – Maintenance- Installation

UNIT-II

Introduction of Robotic sensors – Types of Sensors, - Robot with sensors

UNIT-III

Robot end effectors – Classification of end effectors,

UNIT-IV

Robot Programming

UNIT-V

Applications of Robots – Manufacturing Applications – Material handling applications – Cleanroom robots

OUTCOMES:

- Upon completion of this course, the students can able to apply the basic engineering knowledge for the design of robotics

TEXT BOOKS:

1. Mair, G.M., Industrial Robotics, Prentice-Hall, 1988.

2.A.K.Gupta and S.K.Gupta, Industrial Automation and Robotics, University Science Press, New Delhi.

REFERENCE BOOKS:

1. Groover, M.P., Weiss, M., Nagel, R.N., and Odrey, N.G., Industrial Robotics,Technology, Programming, and Applications, McGraw-Hill, 1995.

2. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.

3. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 1994.

4. Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co., 1992.

5. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.

6. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.

7. Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company, 2008.

8. Surender Kumar, "Industrial Robots and Computer Integrated Manufacturing", Oxford and IBH

9. Considine, D.M. and Considine, G.D., Standard Hand Book of industrial Automation, Chapman and Hall, 1986.

ME512 Combustion Engineering

L-T-P-C: 3-0-0-3

OBJECTIVES:

- Understand combustion in spark ignition and diesel engines.
- To identify the nature and extent of the problem of pollutant formation and control in internal combustion engines.

UNIT-I

Combustion of fuels - Combustion equations and air-fuel ratio calculations.

UNIT-II

Thermodynamics of combustion - Thermochemistry - Kinetics of combustion.

UNIT-III

Laminar and turbulent flames - Quenching, flammability, ignition and flame stabilization.

UNIT-IV

Combustion in SI and CI engines.

UNIT-V

Emission and control methods.

OUTCOME:

- On successful completion of this course the student will be able to understand the concept of the combustion in engines

TEXT BOOKS:

1. Turns, S.R., An Introduction to Combustion, 2nd ed., McGraw-Hill, 2000.
2. Glassman, I**.,** Combustion, 3rd ed., Academic Press, 1996.

REFERENCE BOOKS:

1. Heywood, J.B., Internal Combustion Engine Fundamentals, McGraw-Hill, 1988.
2. Mukunda, H.S., Understanding Combustion, Macmillan, 1992.
3. Samir Sarkar, Fuels & Combustion, 2nd Edition, Orient Longman, 1990
4. Bhatt, and Vora Stoichiometry, 2nd Edition, Tata Mcgraw Hill, 1984
5. Blokh AG, Heat Transfer in Steam Boiler Furnace, Hemisphere Publishing Corpn, 1988
6. Civil Davies, Calculations in Furnace Technology, Pergamon Press, Oxford, 1966
7. Sharma SP, Mohan Chander, Fuels & Combustion, Tata Mcgraw Hill, 1984 EIA

ME514 Industrial Safety and Maintenance Engineering

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.

- To explain the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
- To illustrate some of the simple instruments used for condition monitoring in industry.

UNIT – I

Safety and productivity - causes of accidents in industries – accident reporting and investigation - measuring safety performance - Safety organizations and functions - Factories act and rules.

UNIT – II

Safety Codes and Standards - General Safety considerations in Material Handling equipments - Machine Shop machineries-pressure vessels and pressurized pipelines – welding equipments – operation and inspection of extinguishers – prevention and spread of fire – emergency exit facilities.

UNIT – III

Objectives of maintenance - types of maintenance – Breakdown, preventive and predictive maintenance - Repair cycle - Repair Complexity, Lubrication and Lubricants.Maintenance of Mechanical transmission systems and process plants.

UNIT – IV

Predictive Maintenance - vibration and noise as maintenance tool - wear debris analysis - Condition monitoring concepts applied to industries - Total Productive Maintenance (TPM) - Economics of Maintenance- Computer aided maintenance.

UNIT – V

Reliability: Definition, concept of reliability based design, failure analysis - failure rate, MTTF, MTBF, failure pattern, failure prediction, system reliability: Series, Parallel and Mixed configurations - Availability and Maintainability concepts- Applications. Non Destructive Examination – Base line data- residual life prediction.

OUTCOMES:

- Upon completion of the programme, the students can able to implement the maintenance function and different practices in industries for the successful management of maintenance activities.
- To identify the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.

TEXT BOOKS:

1.P.Gopalakrishnan - Maintenance and Spare parts Management, Prentice Hall of India Pvt. Ltd., New Delhi, 1990.

2. L.S.Srinath - Reliability Engineering, Affiliated East West press, 2003 3. Rolland P.Blake - Industrial Safety, Prentice Hall of India Pvt. Ltd., New Delhi, 1973.

3.Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey, 1973

4.Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980.

REFERENCE BOOKS:

1.H.P.Garg, Industrial Maintenance, S.Chand & Co Ltd., New Delhi, 1990.

2. E.Balagurusamy, Reliability Engineering, Prentice Hall of India P Ltd., New Delhi, 2003.

3.Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, Bombay, 1997.

4. John Ridley, "Safety at Work", Butterworth & Co., London, 1983.

ME516 Renewable Energy

L-T-P-C: 3-0-0-3

OBJECTIVES :

- Identify renewable energy sources and their utilization.
- Understand the basic concepts of solar radiation and analyze the working of solar PV and thermal systems.
- Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, biogas and hydrogen.
- Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.
- Identify methods of energy storage for specific applications.

UNIT-I

Solar energy - Solar radiation - Heat transfer equations.

UNIT-II

Solar thermal energy conversion - Efficiencies - Solar photo voltaic energy.

UNIT-III

Bio energy - Conversion - bio degradation - Biogas generation - Fuel properties – Biomass gasifier.

UNIT-IV

Wind energy - Data and energy estimation, Conversion - Wind mill - Performance, applications- Geothermal.

UNIT-V

Tidal energy - Magneto hydrodynamic - Thermionic - Fuel cell.

OUTCOMES:

- Upon completion of this course, the students can able to identify the new methodologies / technologies for effective utilization of renewable energy sources.

TEXT BOOKS:

1. Sukhatme, S.P., Solar Energy: Principle of Thermal Collection and Storage, 2nd ed., Tata McGraw Hill, 2000.

2. Rao, S. and Parulekar, R.B., Energy Technology - Nonconventional, Renewable and Conventional, Khanna Publishers, 1995.

REFERENCE BOOKS:

1. Rai, G.D., Nonconventional Energy Sources, Khanna Publishers, 1999.

2. Le Gourieres, D., Wind Power Plant - Theory and Design, Pergaman Press, 1982.

3. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press,U.K., 1996.

4. Tiwari. G.N., Solar Energy – "Fundamentals Design, Modelling & Applications", Narosa Publishing House, New Delhi, 2002.
5. Freris. L.L., "Wind Energy Conversion Systems", Prentice Hall, UK, 1990.
6. Johnson Gary, L. "Wind Energy Systems", Prentice Hall, New York, 1985
7. David M. Mousdale – "Introduction to Biofuels", CRC Press, Taylor & Francis Group, USA2010
8. Chetan Singh Solanki, Solar Photovoltaics, "Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2009.
9. Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 2006.

ME518 Mechanical Vibrations

L-T-P-C: 3-0-0-3

OBJECTIVES:

- The student will be able to understand the sources of vibration in the system and make design modifications to reduce the vibration and improve the life of the components,

UNIT-I

Single degree of freedom systems - Periodic excitations - Impulse response - Virtual work.

UNIT-II

Forced vibrations.

UNIT-III

Two degree of freedom systems - coupled vibrations.

UNIT-IV

Vibration of continuous systems.

UNIT-V

Wave and Euler equations - Vibration of plates.

OUTCOMES:

- Understand the causes and effects of vibration in mechanical systems.
- Develop schematic models for physical systems and formulate governing equations of motion.
- Understand the role of damping, stiffness and inertia in mechanical systems
- Analyze rotating and reciprocating systems and compute critical speeds.
- Analyze and design machine supporting structures, vibration isolators and absorbers.

TEXT BOOKS:

1. Rao, J.S. and Gupta, K., Introductory Course on Theory and Practice of Mechanical Vibration, New Age International Pvt. Ltd., 2004.

3. Rattan - Theory of Machines, Tata McGraw Hill, 2009.

REFERENCE BOOKS:

1. Thomson, W.T., Theory of Vibration with Applications, CBS Publishers, New Delhi, 1990.1. J.S.Rao and R.V.Dukkipati - Mechanism and Machine Theory, New Age International, 2004.

2. P.L.Ballaney - Mechanics of Machines, Khanna Publishers, 2005.

3. Robert F.Steidel Jr. - An introduction to Mechanical Vibrations, 3.John Wiley & Sons Inc.,New York, 2003

4. J.E.Shigley and J.J.Uicker - Theory of Machines & Mechanisms, McGraw Hill International Edition, 2006.

5 Thomas Bevan - Theory of Machines, CBS Publishers & Distributors, 2004.

ME520 Petroleum Engineering

L-T-P-C: 3-0-0-3

OBJECTIVES:

- The student will be able to understand the methods involved in the petroleum process,

UNIT-I

Overview and history of the petroleum industry and petroleum engineering, including nature of oil and gas reservoirs, petroleum exploration and drilling, well completions and production,

surface facilities, - Importance of ethical, societal, and environmental considerations and current events on activities in the petroleum industry.

UNIT-II

Introduction to petroleum drilling systems, drilling rig components, drilling fluids, casing, well cementing, and directional drilling. Thermodynamic behavior of naturally occurring hydrocarbon mixtures; physical properties of petroleum reservoir fluids. Flow of non-Newtonian fluids; multi-phase flow; flow in porous media, non-Darcy flow.

UNIT-III

Physical properties of petroleum reservoir rocks; lithology, porosity, elastic properties, strength, acoustic properties, electrical properties, relative and effective permeability, fluid saturations, capillary characteristics, and rock-fluid interaction.Introduction to well logging methods & evaluation of well logs for formation evaluation. Basic logging principles, theory of tool operation

UNIT-IV

Steady-state, pseudo steady-state, and transient well testing methods to determine well and reservoir parameters used in formation evaluation; applications to wells that produce gas and liquid petroleum; rate forecasting; deliverability testing. Determination of reserves; displacement, pattern, and vertical sweep efficiencies in water floods; enhanced oil recovery processes; design of optimal recovery processes.

UNIT-V

Introduction to production operations and oil field equipment, multiphase flow in pipes, bottom hole pressure prediction, inflow/outflow performance, production systems and backpressure analysis, hydraulic fracturing fluids and equipment; downhole and artificial lift equipment, tubular, work over/completion nomenclature and procedures; produced fluids, fluid separation and metering, safety systems, pressure boosting and monitoring. Well control; offshore drilling; horizontal, extended reach.

OUTCOMES:

- Upon completion of this course, the students can able to identify the new methods of petroleum process.

TEXT BOOKS:

1.The Properties of Petroleum Fluids, 2nd ed., McCain, W. D., Penn Well Publishing Co., Tulsa, Oklahoma, 1990.

2.Tiab, D., Donaldson, E.C: Petrophysics: Theory and Practice of Measuring Reservoir Rock and Fluid Transport Properties, 2nd edition, Elsevier, New York, NY, 2004.

3.Fundamentals of Reservoir Engineering, L. P. Dake, Elsevier Scientific Publishing Co, New York, 1978.

REFERENCE BOOKS:

1.Reservoir Engineering Handbook, T. Ahmed, Gulf Professional Publishing, 2001.

2.Petroleum Production Systems, M. J. Economides, A. D. Hill, and C. Ehlig-Economides, Prentice Hall, Englewood Cliffs, NJ, 1994.

3.Petroleum Engineering Handbook, edited by H.B. Bradley, Society of Petroleum Engineers, 1987.

4.Drilling Fluid Engineering Manual. Textbook prepared by M-I Drilling Fluids Co., 1998;

5.Nontechnical Guide to Petroleum Geology, Exploration, Drilling and Production, 2nd Edition, Hyne, Norman J., Penn Well Books, 2001.

ME522 Composite Materials

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To understand the fundamentals of composite material strength and its mechanical behavior

  Understanding the analysis of fiber reinforced Laminate design for different.
- combinations of plies with different orientations of the fiber.
- Thermo-mechanical behavior and study of residual stresses in Laminates during processing.

Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.

UNIT-I

Definition of Composite materials – Classification of composites, Need and General characteristics – advantages and limitations.

UNIT-II

Matrices – Polymers – thermo set – thermo plastics, metal matrix – types, ceramics, reinforcement – Types, continuous, whiskers and particles – reinforcing materials.

UNIT-III

Primary processing – Bag moulding, compression moulding – Pultrusion and Filament winding, Solid state processing, Liquid state processing, In situ methods. Secondary processing and heat treatment of MMCs

UNIT-IV

Introduction to Physical Properties, mechanical properties, fatigue, creep and damping properties – Effects of environment on the properties.

UNIT-V

Selection of constituents for end application, Design considerations, Applications – case studies.

OUTCOMES:

- Upon completion of this course, the students can able to analyse the fiber reinforced laminate for optimum design.
- Apply classical laminate theory to study and analyse the residual stresses in Laminate.

TEXT BOOKS:

1. S.C.Sharma - Composite Materials, Narosa Publishing House, 2000.

2. P.K.Mallick & S.Newsman, Composite Materials Technology – Processes and Properties, Hansen Publisher, Munich, 1990.

REFERENCE BOOKS:

1. KrishanK.Chawla, Composite Materials – Engineering and Science, Springer Verlag, UK, 1998.

2. Sanjay K.Mazumdar, Composites Manufacturing, CRC Press, UK, 2002

3. P.K.Mallick - Fiber reinforced Composites, Marcel Decker Inc., USA, 1993.

ME524 Operations Research

L-T-P-C: 3-0-0-3

OBJECTIVES:

- Understand the concepts of operations research modeling approaches.
- Formulate and solve engineering and managerial situations as LPP.
- Formulate and solve engineering and managerial situations as Transportation and Assignment problems.
- Formulate multi-stage applications into a dynamic programming framework.
- Solve Integer programming problems.

UNIT-I

Linear Programming: Formulation and graphical solution of LPP's. Reduction of a LPP to the standard form.Simplex method, Big-M method, Two-phase method.Dual linear programming problem.Solution of the primal problem from the solution of the dual problems. Transportation Problems: Initial basic feasible solution using N-W corner rule, row minimum, column minimum, least cost entry and Vogel's approximation method. Optimal solutions.Degeneracy in Transportation problems.Assignment Problem.

UNIT-II

CPM and PERT: Network diagram - Events and activities - Project planning - reducing critical events and activities - critical path calculations - example - sequencing problems - 2machines and n jobs, n machines and 2 jobs, m machines and n jobs problem.

UNIT-III

Dynamic Programming: Formulation - Invest problem - General allocation problem - Stage coach problem - Production scheduling.

UNIT-IV

Decision Theory: Two person Zero Sum game, saddle point determination, algebraic method, graphical method-replacement analysis.

UNIT-V

Introduction to Markov Process - M/M/1, M/M/C Queues with finite and infinite waiting space.

OUTCOMES:

- Upon completion of this course, the students can able to use the optimization techniques for use engineering and Business problems

TEXT BOOKS

1. J.C. Pant: Introduction to Operations Research, (Jain Brothers, New Delhi)

2. Taha H.A., "Operations Research", Sixth Edition, Prentice Hall of India, 2003.

REFERENCE BOOKS:

1.Hillier& Lieberman: Operations Research, TMH

2.Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern,1994.

3.Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley,1990.

4. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992.

5. Hillier and Libeberman, "Operations Research", Holden Day, 1986

6. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.

7.Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002.

8.KantiSwarup, Man Mohan & P. K. Gupta: Introduction to Operations Research by (Sultan Chand & Sons)

ME526 Automotive Fuels, Pollution and Control

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To impart knowledge on various alternative fuels for I.C. Engines
- To create an awareness on the various environmental pollution aspects and issues.
- To give a comprehensive insight into the pollution in engine and gas turbines.
- To impart knowledge on pollutant formation and control.
- To impart knowledge on various emission instruments and techniques.

UNIT – I

Liquid Fuels: Gasoline and Diesel - Physical and chemical properties. Fuel rating – octane rating and cetane rating - Fuel additives. Gaseourfuels: LPG and CNG – Alternative Fuels: sources – Liquid fuels – vegetable oil and its derivatives – methanol and ethanol Gaseous fuels: methane and producer gas – physical and chemical properties.

UNIT – II

Pollutants from automobiles - carbon, nitrogen and sulfur compounds – aldehydes – particulate matter and smoke – odour – Influence of fuel constituents on pollutant emissions. Impact of pollutants on health and environment – Norms – ambient emission norms – noise level norms – waste disposal norms,

UNIT – III

Formation of hydrocarbons, oxides of nitrogen, sulphur and carbon monoxide in SI and CI engines.Formation of particulate emission from CI engine – Formation of aldehydes – Effect of operating parameters on the formation of pollutants.

UNIT – IV

Chassis Dynamometer tests – CVS methods – Sampling techniques – Emission measurement – Chemiluminescence and NDIR Analyzers – Flame ionization detector – smoke measurement : Comparison and obscuration’s methods – Bosch smoke meter-measurement of particulate matter.

UNIT – V

Influence of operating parameters in the control of pollutants – changes in the design of combustion chamber – Fuel modification – Exhaust gas recirculation - Catalytic convertors for spark ignition engines - NO_x reduction methods – Fuel additives to control emission - particulate traps.

OUTCOMES:

On successful completion of this course the student will be able to

- Understand about the emission formation and its control in engines.
- Understand the various alternative fuel options available for conventional fuels and their performance and emission characteristics.

TEXT BOOKS:

1.JohnB.Heywood, Internal Combustion Engine Fundamentals, McGraw Hill International Edition, 1988.

2. V.Ganesan, Internal Combustion Engines, Tata McGraw Hill, New Delhi, 1995.

REFERENCE BOOKS:

1. Paul Degobert, Automobiles & Pollution, Society of Automotive Engineers, 1995.

2. Obert, Edward, Internal Combustion Engines and Air Pollution, Harper and Row

3. Crouse William, Automotive emission control, Gregg Division, McGraw Hill, New York, 1971.

4. George, Springer and Donald J Patterson, Engine emissions, pollutant formation and measurement,Plenum press, 1973.

5. Osamu Hirao, Present and future Automotive fuels, John Wiley and sons, New York, 1975.

ME528 Advanced Machining Processes

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications

UNIT-I

Non-traditional machining processes – classification.

UNIT-II

Chemical and electrochemical processes - material removal - maskants and etchants – types of chemical material removal - application and limitations - Electrochemical material removal.

UNIT-III

Thermoelectrial processes - types - electrical discharging machining, electron beam machining, ion beam machining and plasma arc machining.

UNIT-IV

Mechanical processes - ultrasonic machining abrasive jet machining - abrasive flow machining - water jet cutting.

UNIT-V

Special Machining Processes - polygonal turning and drilling deep hole drilling and trepanning - shaped tube electrolytic machining - thread rolling - roller burnishing – electrical discharge wire cutting - thermal deburring - orbital grinding micromachining – Numerical control and automated processes.

OUTCOMES:

- Upon completion of this course, the students can able to demonstrate different unconventional machining processes and know the influence of difference process parameters on the performance and their applications.

TEXT BOOKS:

1. Production Technology by HMT, Tata McGraw Hill, 2002.
2. Wellar, P.C., Non-Traditional Machining Processes, SME, Michigan, 1984.

REFERENCE BOOKS:

1. Pandey, P.C., Modern Machining Processes, Tata McGraw Hill Company, 2004.

2. SeropeKalpakjian, Manufacturing Processes for Engineering Materials, 3rd ed..,
Addison Wesicy Publishing Company, 1997.

ME530 Direct Energy Conversion Systems

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To explain the concept of various forms of non - renewable and renewable energy.
- To outline division aspects and utilization of renewable energy sources for both domestics and industrial applications
- To explain the concept of Quantum Physics and Plasma Physics.

UNIT-I

Energy: Types and classification – Energy sources – Energy conversion processes. Direct and Indirect energy conversion-Fuels for Energy conversion-Introduction to irreversible thermodynamics.

UNIT-II

Basic ideas of quantum physics – Pauli Exclusion Principle – Shell structure of electrons – Fermi Energy – Energy levels – Bonding in crystals – Energy bands –Intrinsic and Extrinsic semiconductors – junctions – types.

UNIT-III

Photovoltaic conversion – solar cell configurations – characteristics of solar cells- performance of solar cells - Thermoelectric converters – Thermoelectric refrigerators – Thermionic converters and other thermal – electric conversion systems.

UNIT-IV

Introduction to plasma physics – Temperature and ionization– confinement of plasma: Magnetic confinement and inertial confinement – Principles of Magneto hydrodynamic conversion-Ideal and practical MHD generators performance – MHD technology.

UNIT-V

Fuel cells and Batteries – Principles of EMF generation – Description of fuel cells – Applications of fuel cells – Description of batteries: Primary, Secondary, Reserve and advanced battery system – Types – Characteristics – applications.

OUTCOMES:

- Understanding of commercial energy and renewable energy sources
- Knowledge in working principle of various working systems
- Capacity to do basic design of direct energy systems.

TEXT BOOKS:

1. S.W.Angrist, Direct Energy Conversion, Allyn and Bacon, Boston, 1982

2 W.Culp Archie, Principles of energy conversion, Tata McGraw Hill Publishing Co.Ltd., New Delhi-2000.

REFERENCE BOOKS:

1. D.Lindon, Handbook of Batteries and Fuel Cells, McGraw Hill Book Co., 1984.

2. M.A.Greem, Solar Cells, Prentice Hall Inc, Englewood Cliffs, 1982.

3. Rakosh Das Begamudre, Energy Conversion System, New Age International (P) Ltd., New Delhi, 2000.

4. M.A.Greem, Solar Cells, Prentice Hall Inc, Englewood Cliffs, 1982.

5. K.Messerle Hugo Magneto hydrodynamic Electric Power Generator,JohnWiley&Sons, 1995.

ME532 Fundamental and Principles of Fuel Cells

L-T-P-C: 3-0-0-3

OBJECTIVES:

- Student will be able to acquire the fundamental concept of hydrogen and fuel cell and relevant engineering and technologies

UNIT-I

Hydrogen – Fundamentals: Hydrogen as a source of energy, physical and chemical properties, salient characteristics, relevant issues and concerns, Fuel Cells- Types: Brief history, principle,

working, types of fuel cells; Low and high temperature fuel cells; AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits, performance evaluation of fuel cell, comparison of battery Vs fuel cell,

UNIT-II

Fuel cell thermodynamics - heat, work potentials, prediction of reversible voltage, fuel cell efficiency. Fuel cell reaction kinetics - electrode kinetics, overvoltages, Tafel equation, charge transfer reaction, exchange currents, electrocatalyses - design, activation kinetics, Fuel cell charge and mass transport - flow field, transport in electrode and electrolyte.

UNIT-III

Fuel cell characterization:- in-situ and ex-situ characterization techniques, i-V curve, frequency response analyses; Fuel cell modeling and system integration: - 1D model - analytical solution and CFD models.

UNIT-IV

Hydrogen Storage and Applications: Production of hydrogen, steam reforming, water electrolysis, gasification and woody biomass conversion, biological hydrogen production, photo dissociation, direct thermal or catalytic splitting of water, hydrogen storage options, compressed gas, liquid hydrogen, hydride, chemical storage, safety and management of hydrogen, applications of hydrogen

UNIT-V

Fuel Cells -Application And Economics: Fuel cell usage for domestic power systems, large scale power generation, automobile, space applications, economic and environmental analysis on usage of fuel cell, safety issues, cost expectation and life cycle analysis of fuel cells, future trends of fuel cells

OUTCOMES:

- Upon completion of this course, the students can able to understand fundamental concept and working of various fuel cells, their relative advantages / disadvantages and hydrogen generation/storage technologies

TEXT BOOKS:

1. Viswanathan, B and M Aulice Scibioh, Fuel Cells – Principles and Applications, Universities Press
2. Bent Sorensen (Sorensen), Hydrogen and Fuel Cells: Emerging Technologies and Applications, Elsevier Academic Press, UK
3. Ryan O'Hayre, Suk-Won Cha, Whitney Colella, Fritz B. Prinz, Fuel Cell Fundamentals (Second Edition), ISBN: 978-0-470-25843-9, Wiley

REFERENCE BOOKS

1. M. Hashem Nehrir, Caisheng Wang , Modeling and Control of Fuel Cells, , Wiley, ISBN: 978-0-470-23328-3, 2009.
2. Kordesch, K and G.Simader, Fuel Cell and Their Applications, Wiley-Vch, Germany. 8.
3. Hart, A.B and G.J.Womack, Fuel Cells: Theory and Application, Prentice Hall, NewYork Ltd., London
4. Jeremy Rifkin, The Hydrogen Economy, Penguin Group, USA.
5. Bard,A. J. L. R., Faulkner, Electrochemical Methods, Wiley, N.Y.(2004) .
6. Basu,S. Fuel Cell Science and Technology, Springer, N.Y.(2007).
7. Liu, H.,Principles of fuel cells, Taylor & Francis, N.Y. (2006).
8. Rebecca L. and Busby, Hydrogen and Fuel Cells: A Comprehensive Guide, Penn Well Corporation, Oklahoma
9. James Larminie and Andrew Dicks,Fuel Cell Systems Explained (Second Edition), Wiley, ISBN: 978-0470848579, 2003

ME534 Nuclear Power Engineering

L-T-P-C: 3-0-0-3

OBJECTIVES:

- Student will be able to understand the various concepts in the nuclear reactors, nuclear fuels, and biological effects of nuclear power plants

UNIT-I

Nuclear fuels-occurrence and extraction, fissile characteristics, enrichment, fission process - thermal and fast fission - energy released from fission - chain reaction - reaction control. Neutron balance - fast fission - resonance capture – thermalisation - geometric effects - burn-up – introduction to reactor kinetics.

UNIT-II

General components of nuclear reactor - Fuel cladding - fuel assembly – moderators – coolants - control rods -Different types of reactors - Pressurized Water Reactor - Boiling Water Reactor - Heavy Water cooled Reactor -Gas cooled Reactor - Liquid metal cooled reactor - Organic moderated and cooled reactors - Fast Breeder Reactors - Reactor safety - Neutron Population growth - assurance of safety -emergency core cooling and containment.

UNIT-III

Nuclear fuel cycle - Waste classification - Spent fuel storage – Transportation – Reprocessing - High-Level waste disposal - low-level waste generation and treatment - Low-level waste disposal - Nuclear power plant decommissioning.

UNIT-IV

Biological effects of radiation - radiation dose - Basic for limits and exposure - Sources of radiation dosage -Gas counters - Neutron detectors - Scintillation counters - Solid state detectors - Statistics of counting - Pulse height analysis - Protective measures - calculation of dose - effects of distance and shielding - Internal exposure - The Radon problem - Environmental radiological impact - radiation standards.

UNIT-V

Reactors for naval propulsion - Space reactors - Space isotopic power generator - Energy economics -Components of electrical power – cost forecast versus Reality - Challenges and opportunities - Technical and institutional improvements – Developments in nuclear reactor.

OUTCOMES:

- Upon completion of this course, the students can able to identify the various concepts in the nuclear reactors, nuclear fuels, and biological effects of nuclear power plants

TEXT BOOKS:

1. W.Marshall, Nuclear Power Technology, Vol. I &II, Clarendon press, Oxford, 1985.

2. Samual Glasstone, Principle of Nuclear Reactor Engineering, Van Nostrand ReinholdCo. Inc., New York, 1963.

REFERENCE BOOKS:

1. Margulova, Nuclear Power Station, Mir Publishers, Moscow, 1978.

2. Archie W.Culp, Principle of Energy Conversion, McGraw Hill Kogakusha Ltd., 1984.

3. Domkundwar, A Course in Power Plant Technology, Dhanpat Rai Sons, 1993

GLOBAL ELECTIVES OFFERED BY

DEPARTMENT OF MECHANICAL ENGINEERING

ME1001 Applied Thermodynamics

L-T-P-C: 3-0-0-3

OBJECTIVES:

Student will be able to understand the concepts of

- First and second law of thermodynamics, Analysis of Air, vapor and gas power cycles,
- Modes of heat transfer and liquid cooling, Reciprocating Air Compressors.

UNIT-I

Definitions of system - system boundary, property, process, cycle, state, Thermal equilibrium, temperature, Zeroth law of thermodynamics, heat, work, reversible and quasistatic processes - Heat and work transfer during different types of processes.

UNIT-II

First law of Thermodynamics - Closed system application - internal energy - heat transfer calculations - open system applications - non flow and flow System applications - Second Law of Thermodynamics - Heat engine, Refrigerators, Kelvin – Planck statement – Clausius statement – their equivalence – Carnot cycle – Clausius Inequality – Entropy. Air standard cycles: Air standard Carnot cycle - Air standard Otto cycle, diesel cycle, dual cycle and Brayton cycles and their efficiencies.

UNIT-III

Modes of heat transfer – conduction, convection, radiation – Thermal and electrical insulation and its critical thickness - design of fins for cooling of electrical and electronics components – Known fin width, Known fin thickness, Natural convection cooling, forced convection cooling - Liquid cooling, cooling of heat generating board inside a parallel – plate channel.

UNIT-IV

Gas power cycle - Vapour power cycle - Rankine cycle - reheat cycle - regenerative cycle - calculations for efficiency and power output using steam tables and mollier chart.

UNIT-V

Reciprocating air compressors – optimum pressure ratio in multistage compression - inter cooling - effect of clearance volume - Performance and testing of IC engines.

TEXT BOOKS:

1. Nag.P.K , "Engineering Thermodynamics", Tata McGraw Hill, 5th Edition, 2013.
2. Cengel.Y.A. and Boles.M.A., "Thermodynamics - An Engineering Approach", 5th Edition, Tata McGraw Hill, 2006.

REFERENCE BOOKS:

1. Gordan Van Wylen and Richard Sonntag., "Fundamentals of Classical Thermodynamics", John Wiley and Sons,4th Edition, 1994.
2. Kothandaraman.C.P, "A Course in Thermodynamics and Heat Engines", Dhanpat, Rai and Sons, 1992.
3. Huang.F.F, "Engineering Thermodynamics", 2nd Edition , Macmillan Publishing Co. Ltd., New York, 1988.
3. Arora.C.P, "Thermodynamics", Tata McGraw Hill Publishing Co. Limited., New Delhi, twelfth reprint, 2007.
4. Wark.K, "Thermodynamics", 4th Edition , Tata McGraw Hill, New York,1985.

OUTCOMES:

- Upon completion of this course, the students can able to understand the concepts of thermodynamics, used in the electric power generation

ME1002 Introduction to Mechatronics

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To understand the interdisciplinary applications of Electronics, Electrical, Mechanical and ComputerSystems for the Control of Mechanical and Electronic Systems.

UNIT-I

Introduction to Mechatronics Systems – Measurement Systems – Control Systems – Microprocessor based Controllers. Sensors and Transducers – Performance Terminology – Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors – Selection of Sensors

UNIT-II

Pneumatic and Hydraulic Systems – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and pawl – Belt and Chain Drives – Bearings. Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – Construction and working principle of DC and AC Motors – speed control of AC and DC drives, Stepper Motors-switching circuitries for stepper motor – AC & DC Servo motors

UNIT- III

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational – Transnational Systems, Electromechanical Systems – Hydraulic – Mechanical Systems. Continuous and discrete process Controllers – Control Mode – Two – Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Digital Controllers – Velocity Control – Adaptive Control – Digital Logic Control – Micro Processors Control.

UNIT-IV

Programmable Logic Controllers – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls - Data Handling – Analogs Input / Output – Selection of a PLC.

UNIT-V

Stages in designing Mechatronics Systems – Traditional and Mechatronic Design - Possible Design Solutions. Case studies of Mechatronics systems- Pick and place Robot- Autonomous mobile robot-Wireless suriviellance balloon- Engine Management system- Automatic car park barrier.

OUTCOMES:

Upon completion of this course, the students can able to

- ❖ Model, analyze and control engineering systems. Identify sensors, transducers and actuators to monitor and control the behaviour of a process or product.
- ❖ Develop PLC programs for a given task and also evaluate the performance of mechatronic systems.
- ❖ Ability to identify electronics components and use of them to design circuits.

TEXT BOOKS:

1. Bolton,W, "Mechatronics" , Pearson education, second edition, fifth Indian Reprint, 2003

2. Smaili.A and Mrad.F, "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008

REFERENCE BOOKS:

1. Rajput. R.K, A textbook of mechatronics, S. Chand & Co, 2007 68

2. Michael B. Histand and David G. Alciatore, " Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2000.

3. Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, "Mechatronics", Chapman and Hall, 1993.

4. Dan Necsulesu, "Mechatronics", Pearson Education Asia, 2002 (Indian Reprint).

5. Lawrence J. Kamm, "Understanding Electro – Mechanical Engineering", An Introduction to Mechatronics, Prentice – Hall of India Pvt., Ltd., 2000.

6. Nitaigour Premchand Mahadik, "Mechatronics", Tata McGraw-Hill publishing Company Ltd, 2003

ME1003 Computer Aided Design

L-T-P-C: 3-0-0-3

OBJECTIVES:

- To provide an overview of how computers are being used in mechanical component design

UNIT-I

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D - transformations- homogeneous coordinates – Line drawing -Clipping- viewing transformation

UNIT-II

Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves- Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep

UNIT-III

Hidden – Line-Surface-Solid removal algorithms – shading – colouring – computer animation.

UNIT-IV

Assembly modelling – interferences of positions and orientation – tolerance analysis-mass property calculations – mechanism simulation and interference checking.

UNIT-V

Standards for computer graphics- Graphical Kernel System (GKS) – standards for exchange images- Open Graphics Library (OpenGL) – Data exchange standards – IGES, STEP, CALS etc. – communication standards.

- **OUTCOMES:**

  Upon completion of this course, the students can able to use computer and CAD software's for modeling of mechanical components

TEXT BOOKS:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007

REFERENCE BOOKS:

1. Chris McMahon and Jimmie Browne "CAD/CAM Principles", "Practice and Manufacturing management " Second Edition, Pearson Education, 1999.
2. William M Neumann and Robert F.Sproul "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.
3. Donald Hearn and M. Pauline Baker "Computer Graphics"". Prentice Hall, Inc, 1992.
4. Foley, Wan Dam, Feiner and Hughes – "Computer graphics principles & practice" Pearson Education – 2003.

ME1004 Total Quality Management

L-T-P-C: 3-0-0-3

OBJECTIVES

- To provide the principles, tools, techniques and quality of the Management

UNIT-I

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT-II

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT- III

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT-IV

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

UNIT-V

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

OUTCOMES:

- Upon completion of this course, the students can able to identify the principles, tools, techniques and quality of management

TEXT BOOKS:

1. Dale H.Besterfiled, et at., "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint (2006).

REFERENCE BOOKS:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2005.

2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2003.

3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,2006.

4. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

ME1005 Utilization of Solar Energy

L-T-P-C: 3-0-0-3

OBJECTIVE:

- To provide deep introduction about solar energy basics, principles, materials, theories about solar radiation, solar devices and storage of solar energy and its applications.

UNIT-I

History of solar energy utilization - Solar radiation and modeling - Empirical equations for predicting the availability of solar radiation – Measurement of global, direct and diffuse radiation – Radiation computations on inclined surfaces – Angstrom's turbidity - Solar chart - Standard radiation scale.

UNIT-II

Measurement of solar radiation - Solar energy measuring instruments – Pyranometer – Pyrheliometer – Sunshine recorder - Estimation of average solar radiation - Ratio of beam and total radiation on tilted surface of that on horizontal surface.

UNIT-III

Flat plate collector - Materials for flat plate collector and their properties - Thermal Analysis of Flat- plate Collector and Useful Heat Gained by the fluid - fin efficiency - collector efficiency factor - Heat Removal Factor - Focusing collectors - Types and applications of focusing collectors

UNIT-IV

Introduction and principle of operation of solar cooker - solar air heater - solar water heater - solar distillation - solar pond - solar thermal power generation – Greenhouse - Solar PV system.

UNIT-V

Types of Energy Storage - Thermal Storage - Electrical Storage - Chemical Storage - hydro-storage

OUTCOMES:

- Upon completion of this course, the students can able to identify the utilization solar energy in our day today life

TEXT BOOKS:

1. Rai, G.D., Solar Energy Utilization, Khanna Publishers, N. Delhi, 2010.

3. Duffie, J.A., and Beckman, W.A. Solar Energy Thermal Process, John Wiley and Sons, New York, 2006.

REFERENCE BOOKS:

1. Jui Sheng Hsieh, Solar Energy Engineering, Prentice- Hall, 2007.

2. Garg, H.P.,Treatise on Solar Energy, John Willey & Sons, 2006.

3. Anna Mani, S Rangarajan: Handbook of Solar Radiation Data for India, Allied Publishers, 2006.

4. Sukhatme S.P., Solar Energy, Tata McGraw Hills P Co.,3rd Edition, 2008.

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