ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

R – 2008

B.E. MECHANICAL ENGINEERING

CURRICULUM FROM III TO VIII SEMESTERS FOR B.E. MECHANICAL ENGINEERING

SEMESTER – III

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
MA9211	Mathematics – III	3	1	0	4
ME9201	Manufacturing Technology – I	3	0	0	3
ME9202	Engineering Thermodynamics	3	0	0	3
CE9211	Fluid Mechanics and Machinery	3	1	0	4
ME9203	Kinematics of Machines	3	1	0	4
EE9211	Electrical Drives and Control	3	0	0	3
PRACTICAL					
ME9204	Manufacturing Technology Laboratory- I	0	0	3	2
EE9212	Electrical Engineering and `Measurements Laboratory	0	0	3	2
CE9212	Fluid Mechanics and Machinery Laboratory	0	0	3	2
	TOTAL	**18**	**3**	**9**	**27**

SEMESTER – IV

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
MA9262	Numerical Methods	3	1	0	4
CE9213	Strength of Materials	3	0	0	3
ME9251	Manufacturing Technology – II	3	0	0	3
ME9252	Engineering Materials and Metallurgy	3	0	0	3
ME9253	Dynamics of Machines	3	1	0	4
ME9254	Thermal Engineering – I	3	0	0	3
PRACTICAL					
ME9255	Computer Aided Machine Drawing	0	0	4	2
ME9256	Manufacturing Technology Laboratory – II	0	0	3	2
CE9214	Strength of Materials Laboratory	0	0	3	2
	TOTAL	**18**	**2**	**10**	**26**

SEMESTER – V

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
ME9301	Design of Jigs, Fixtures & Press Tools	3	0	0	3
ME9302	Thermal Engineering – II	3	0	0	3
ME9303	Hydraulics and Pneumatics	3	0	0	3
ME9304	Modern Machining Processes	3	0	0	3
ME9305	Design of Machine Elements	3	1	0	4
ME9306	Metrology & Measurements	3	0	0	3
PRACTICAL					
ME9307	Dynamics Laboratory	0	0	3	2
ME9308	Thermal Engineering Lab. – I	0	0	3	2
ME9309	Metrology & Measurements Laboratory	0	0	3	2
ME9310	Technical Seminar	0	0	2	1
	TOTAL	**18**	**1**	**11**	**25**

SEMESTER – VI

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
ME9351	Finite Element Analysis	3	0	0	3
ME9352	Microprocessor & Micro Controller	3	0	0	3
ME9353	Design of Transmission Systems	3	1	0	4
ME9354	Computer Aided Design & Manufacture	3	0	0	3
ME9355	Heat and Mass Transfer	3	0	0	3
	Elective – I	3	0	0	3
PRACTICAL					
ME9356	Thermal Engineering Lab. – II	0	0	3	2
ME9357	CAD / CAM Laboratory	0	0	3	2
ME9358	Microprocessor & Micro Controller Laboratory	0	0	4	2
GE9371	Communication skills and Soft Skills lab	0	0	2	1
	TOTAL	**18**	**1**	**12**	**26**

SEMESTER – VII

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
GE9022	Total Quality Management	3	0	0	3
ME9401	Power Plant Engineering	3	0	0	3
ME9402	Mechatronics	3	0	0	3
MG9362	Industrial Management	3	0	0	3
	Elective – II	3	0	0	3
	Elective – III	3	0	0	3
PRACTICAL					
ME9403	Computer Aided Simulation and Analysis Laboratory	0	0	3	2
ME9404	Mechatronics Laboratory	0	0	4	2
ME9405	Comprehension	0	0	2	1
ME9406	Design and Fabrication Project	0	0	4	2
	TOTAL	**18**	**0**	**13**	**25**

SEMESTER – VIII

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
	Elective – IV	3	0	0	3
	Elective – V	3	0	0	3
PRACTICAL					
ME9451	Project Work	0	0	12	6
	TOTAL	**6**	**0**	**12**	**12**

TOTAL CREDIT: 193

LIST OF ELECTIVES FOR B.E. MECHANICAL ENGINEERING

CODE NO.	COURSE TITLE	L	T	P	C
ME9021	Energy Conservation & Management	3	0	0	3
ME9022	New and Renewable Sources of Energy	3	0	0	3
ME9023	Advanced Welding and Casting Processes	3	0	0	3
ME9024	Mechanical Vibrations & Noise	3	0	0	3
ME9025	Design for Manufacturing	3	0	0	3
ME9026	Gas Dynamics and Jet Propulsion	3	0	0	3
ME9027	Management Sciences	3	0	0	3
ME9028	Composite Materials & Mechanics	3	0	0	3
ME9029	Automobile Engineering	3	0	0	3
ME9030	Industrial Tribology	3	0	0	3
ME9031	Turbo Machinery	3	0	0	3
ME9032	Computational Fluid Dynamics	3	0	0	3
ME9033	Micro Electro Mechanical Systems	3	0	0	3
MF9032	Artificial Intelligence	3	0	0	3
ME9034	Design of Pressure Vessels and Piping	3	0	0	3
MF9402	Flexible Manufacturing Systems	3	0	0	3
ME9035	Measurements and Controls	3	0	0	3
GE9021	Professional Ethics in Engineering	3	0	0	3
GE9023	Fundamentals of Nanoscience	3	0	0	3
MA9261	Probability & Statistics	3	0	0	3
ME9036	Advanced IC Engines	3	0	0	3
ME9037	Refrigeration and Air-conditioning	3	0	0	3
MF9023	Rapid Prototyping	3	0	0	3
MG9072	Entrepreneurship Development	3	0	0	3
MG9073	Marketing Management	3	0	0	3
ME9041	Theory of Metal Forming	3	0	0	3
ME9039	Design of Heat Exchangers	3	0	0	3
ML9402	Non Destructive Materials Evaluation	3	0	0	3
ME9040	Nuclear Engineering	3	0	0	3
MF9021	Product Design and Development	3	0	0	3

MA 9211 **MATHEMATICS III** **L T P C**
(Common to all branches of BE / B.Tech) **3 1 0 4**

AIM

To facilitate the understanding of the principles and to cultivate the art of formulating physical problems in the language of mathematics

OBJECTIVES:

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic
- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes
- To develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems

UNIT I FOURIER SERIES **9+3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Complex form of Fourier Series – Parseval's identity – Harmonic Analysis.

UNIT II PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Formation – Solutions of first order equations – Sandard types and Equations reducible to standard types – Singular solutions - Lagrange's Linear equation – Integral surface passing through a given curve – Solution of linear equations of higher order with constant coefficients.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Method of separation of Variables – Solutions of one dimensional wave equation, -One-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

UNIT IV FOURIER TRANSFORM **9+3**

Fourier integral theorem – Fourier transform pair-Sine and Consine transforms – Properties – Transform of simple function – Convolution theorem - Parseval's identity.

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATION **9+3**

Z-transform-Elementary properties-Inverse z transform – Convolution theorem-Formation of difference equation-Solution of difference equation using z transform.

T: 45 + 15, TOTAL : 60 PERIODS

TEXT BOOK

1. B.S.Grewal, "Higher Engineering Mathematics", Khanna Publications (2007)

REFERENCES

1. Glyn James, "Advanced Modern Engineering Mathematics, Pearson Education (2007)
2. B.V.Ramana, "Higher Engineering Mathematics" Tata McGraw Hill 2007.
3. N.P.Bali, and Manish Goyal, "A Text Book of Engineering 7th Edition (2007) Lakshmi Publications (P) Limited, New Delhi.

ME9201 **MANUFACTURING TECHNOLOGY – I** **L T P C**
3 0 0 3

AIM:

To gain comprehensive knowledge about different manufacturing processes

OBJECTIVES:

- To introduce the students on the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and plastics component manufacture.

UNIT I METAL CASTING PROCESSES 9

Sand casting – Sand moulds - Type of patterns – Pattern materials – Pattern allowances – Types of Moulding sand – Properties – Core making – Methods of Sand testing – Moulding machines – Types of moulding machines - Melting furnaces –Working principle of Special casting processes – Shell, investment casting – Ceramic mould – Lost Wax process – Pressure die casting – Centrifugal casting – CO2 process – Defects in Casting – Inspection methods

UNIT II JOINING PROCESSES 9

Fusion welding processes – Types of Gas welding – Equipments used – Flame characteristics – Filler and Flux materials - Arc welding equipments - Electrodes – Coating and specifications – Principles of Resistance welding – Spot/butt, seam welding – Percusion welding - Gas metal arc welding – Flux cored – Submerged arc welding – Electro slag welding – TIG welding – Principle and application of special welding processes - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding – Diffusion welding – Weld defects – Brazing and soldering process – Methods and process capabilities – Filler materials and fluxes – Types of Adhesive bonding.

UNIT III BULK DEFORMATION PROCESSES 9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – Characteristics of the process – Types of Forging Machines – Typical forging operations – Rolling of metals – Types of Rolling mills - Flat strip rolling – Shape rolling operations – Defects in rolled parts - Principle of rod and wire drawing -Tube drawing –– Principles of Extrusion – Types of Extrusion – Hot and Cold extrusion –– Equipments used.

UNIT IV SHEET METAL PROCESSES 9

Sheet metal characteristics - Typical shearing operations, bending and drawing operations – Stretch forming operations –– Formability of sheet metal – Test methods – Working principle and application of special forming processes - Hydro forming – Rubber pad forming – Metal spinning – Introduction to Explosive forming, Magnetic pulse forming, Peen forming, Super plastic forming.

UNIT V MANUFACTURING OF PLASTIC COMPONENTS 9

Types and characteristics of plastics -– Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines – Compression moulding, Transfer moulding - Typical industrial applications – Introduction to Blow moulding – Rotational moulding – Film blowing – Extrusion - Thermoforming - Bonding of Thermoplastics.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Kalpakjian, S., “Manufacturing Engineering and Technology”, Pearson Education India Edition, 2006.
2. S. Gowri, P. Hariharan, A. Suresh Babu, Manufacturing Technology I, Pearson Education, 2008

REFERENCES

1. Roy. A. Lindberg, Processes and Materials of Manufacture, PHI / Pearson Education, 2006
2. Hajra Choudhury S.K and Hajra Choudhury. A.K., Elements of Workshop Technology, Volume I and II, Media Promoters and Publishers Private Limited,Mumbai, 1997.
3. Paul Degarma E, Black J.T. and Ronald A. Kosher, Elighth Edition, Materials and Processes, in Manufacturing Prentice – Hall of India, 1997.
4. Sharma, P.C., A Text book of Production Technology, S. Chand and Co. Ltd.,2004.
5. P.N. Rao, Manufacturing Technology Foundry, Forming and Welding, TMH-2003; 2nd Edition, 2003

ME9202 ENGINEERING THERMODYNAMICS L T P C
3 0 0 3

AIM

To impart knowledge to the students on the basics of heat energy and its governing principles..

OBJECTIVE

- The student must acquire the knowledge capability of analyzing and solving any concept or problem associated with heat energy dynamics and utilization.

UNIT I BASIC CONCEPT AND FIRST LAW 9

Basic concepts - concept of continuum, macroscopic approach, thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics – concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipments.

UNIT II SECOND LAW AND ENTROPY 9

Second law of thermodynamics – Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Carnot theorem, Carnot cycle, reversed carnot cycle, efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy.

UNIT III THERMODYNAMIC AVAILABILITY 9

Basics – Energy in non-flow processes : Expressions for the Exergy of a closed system- Equivalence between mechanical energy forms and Exergy – Flow of energy associated with heat flow – Exergy consumption and entropy generation. Exergy in steady flow processes : Expressions for Exergy in steady flow processes – Exergy dissipation and entropy generation.

UNIT IV PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 9

Properties of pure substances – Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non-flow and flow processes. Standard Rankine cycle, Reheat and regenerative cycle.

UNIT V PSYCHROMETRY 9

Psychrometry and psychrometric charts, property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling, problems.

TOTAL: 45 PERIODS

(Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant property tables are permitted)

TEXT BOOKS :

1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 1998.
2. Lynn D Russell, George A, Adebiyi "Engineering Thermodynamics" Indian Edition, Oxford University Press, New Delhi, 2007.

REFERENCES :

1. Yunus A angel and Michael Boleo, Thermodynamics An Engineering Approach
2. E.Ratha Krishnan, Fundamentals of Engineering Thermodynamics, 2nd Edition, Prentice –Hallof India Pvt. Ltd, 2006.
3. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
4. Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.
5. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987
6. Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 1995.

CE9211 FLUID MECHANICS AND MACHINERY L T P C
3 1 0 4

AIM:

The student is introduced to the mechanics of fluids through a thorough understanding of the properties of the fluids. The dynamics of fluids is introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy.

OBJECTIVES:

- The applications of the conservation laws to flow though pipes and hydraulics machines are studied
- To understand the importance of dimensional analysis.
- To understand the importance of various types of flow in pumps and turbines

UNIT I INTRODUCTION 12

Units & Dimensions. Properties of fluids – Specific gravity, specific weight, viscosity, compressibility, vapour pressure and gas laws – capillarity and surface tension. Flow characteristics: concepts of system and control volume. Application of control volume to continuity equiation, energy equation, momentum equation and moment of momentum equation.

UNIT II FLOW THROUGH CIRCULAR CONDUITS 12

Laminar flow though circular conduits and circular annuli. Boundary layer concepts. Boundary layer thickness. Hydraulic and energy gradient. Darcy – Weisbach equaition. Friction factor and Moody diagram. Commercial pipes. Minor losses. Flow though pipes in series and in parallel.

UNIT III DIMENSIONAL ANALYSIS 9

Dimension and units: Buckingham's Π theorem. Discussion on dimensionless parameters. Models and similitude. Applications of dimensionless parameters.

UNIT IV ROTO DYNAMIC MACHINES 16

Homologus units. Specific speed. Elementary cascade theory. Theory of turbo machines. Euler's equation. Hydraulic efficiency. Velocity components at the entry and exit of the rotor. Velocity triangle for single stage radial flow and axial flow machines. Centrifugal pumps, turbines, performance curves for pumps and turbines.

UNIT V POSITIVE DISPLACEMENT MACHINES 11

Recriprocating pumps, Indicator diagrams, Work saved by air vessels. Rotory pumps. Classification. Working and performance curves.

T : 45 + 15 , TOTAL : 60 PERIODS

TEXT BOOKS:

1. Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 1983.
2. Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India (II Ed.), 2007.

REFERENCES:

1. Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, Dhanpat Rai & Sons, Delhi, 1988.
2. Kumar. K.L., Engineering Fluid Mechanics (VII Ed.) Eurasia Publishing House (P) Ltd., New Delhi, 1995.
3. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., New Delhi.

ME9203 KINEMATICS OF MACHINES L T P C
3 1 0 4

AIM:

To impart knowledge of motion characteristics of mechanisms and machine to make the students to develop new mechanisms.

OBJECTIVES:

- To understand the basic components and layout of linkages in the assembly of a system/machine.
- To understand the principles involved in 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.
- To understand and to design few linkage mechanisms and cam mechanisms for specified output motions
- To understand the basic concepts of toothed gearing and kinematics of gear trains.
- To understand the effects of friction in motion transmission and in machine components.

UNIT I BASICS OF MECHANISMS 12

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four-bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle – Description of some common mechanisms – Quick return mechanisms, Straight line generators, Dwell mechanisms, Ratchets and Escapements, Universal Joint – Basic structures of Robot Manipulators (serial & parallel) – Design of quick return crank-rocker mechanisms.

UNIT II KINEMATICS OF LINKAGE MECHANISMS 15

Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method – Velocity and acceleration polygons – Velocity analysis using instantaneous centres – Kinematic analysis by complex algebra methods – Vector approach – Computer applications in the kinematic analysis of simple mechanisms – Coincident points – Coriolis component of Acceleration.

UNIT III KINEMATICS OF CAM MECHANISMS 12

Classification of cams and followers – Terminology and definitions – Displacement diagrams – Uniform velocity, parabolic, simple harmonic, cycloidal and polynomial motions – Derivatives of follower motions – Layout of plate cam profiles – Specified contour cams – Circular arc and tangent cams – Pressure angle and undercutting – sizing of cams.

UNIT IV GEARS AND GEAR TRAINS 12

Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions –Gear tooth action – contact ratio – Interference and undercutting – Non-standard gear teeth – Helical, Bevel, Worm, Rack and Pinion gears [Basics only] – Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains – Differentials – Automobile gear box.

UNIT V FRICTION 9

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Friction aspects in brakes – Friction in vehicle propulsion and braking.

T : 45 + 15 , TOTAL : 60 PERIODS

TEXT BOOKS:

1. Ambekar A.G, "Mechanism and Machine Theory" Prentice Hall of India, New Delhi, 2007.
2. Shigley J.E. ,Pennock G.R.and Uicker.J.J., 'Theory of Machines and Mechanisms', Oxford University Press,2003.

REFERENCES:

1. Thomas Bevan, 'Theory of Machines', CBS Publishers and Distributors, 1984.
2. Ghosh.A, and A.K.Mallick, 'Theory of Mechanisms and Machines', Affiliated East-West Pvt. Ltd., New Delhi, 1988.
3. Rao.J.S. and Dukkipati.R.V. 'Mechanisms and Machine Theory', Wiley-Eastern Ltd., New Delhi, 1992.
4. John Hannah and Stephens R.C., 'Mechanics of Machines', Viva Low-Prices Student Edition, 1999.
5. V.Ramamurthi, Mechanics of Machines, Narosa Publishing House, 2002.
6. Robert L.Norton, Design of Machinery, McGraw-Hill, 2004.

STANDARDS

1. IS 2458 : 2001, Vocabulary of Gear Terms – Definitions related to Geometry.
2. IS 3756 : 2002, Method of Gear Correction – Addendum modification for External cylindrical gears with parallel axes.
3. IS 5267 : 2002 Vocabulary of Gear Terms – Definitions Related to Worm Gear Geometry.
4. IS 12328 : Part 1: 1988 Bevel Gear Systems Part – 1 Straight Bevel Gears.
5. IS 12328 : 1988 Bevel Systems Part – 2 Spiral Bevel Gears.

EE 9211 ELECTRICAL DRIVES AND CONTROL L T P C
3 0 0 3

AIM

To provide knowledge in the area of electrical dives and their control techniques

OBJECTIVE

- To impart knowledge on
- Basics of electric drives
- Different speed control methods
- Various motor starters and controllers
- Applications of electrical drives

UNIT I INTROUDCTION 9

Fundamentals of electric drives – advances of electric drive-characteristics of loads – different types of mechanical loads – choice of an electric drive – control circuit components: Fuses, switches, circuit breakers, contactors. Relay – control transformers.

UNIT II SPEED CONTROL OF DC MACHINES 9

DCshunt motors – Speed Torque characteristics - Ward Leonard method, DC series motor – series parallel control – solid state DC drives – Thyristor bridge rectifier circuits- chopper circuits.

UNIT III SPEED CONTROL OF AC MACHINES 9

Induction motor – Speed torque Characteristics – pole changing, stator frequency variation - slip-ring induction motor – stator voltage variation - Rotor resistance variation, slip power recovery – basic inverter circuits- variable voltage frequency control.

UNIT IV MOTOR STARTERS AND CONTROLLERS 9

DC motor starters : using voltage sensing relays, current sensing relays and time delay relays - wound rotor induction motor starters – starters using frequency sensing relays - DOI -starter and auto transformers starter.

UNIT V HEATING AND POWER RATING OF DRIVE MOTORS 9

Load diagram, over load capacity, insulating materials, heating and cooling of motors, service condition of electric drive – continuous, intermittent and short time – industrial application.

TOTAL : 45 PERIODS

TEXT BOOKS

1. N.K De and P.K Sen 'Electric Drives' Prentice Hall of India Private Ltd,2002.
2. Vedam Subramaniam 'Electric Drives' Tata McGraw Hill ,New Delhi,2007
3. V.K Mehta and Rohit Mehta ' Principle of Electrical Engineering' S Chand & Company,2008

REFERENCES

1. S.K Bhattacharya Brinjinder Singh 'Control of Electrical Machines' New Age International Publishers,2002.
2. John Bird 'Electrical Circuit theory and technology' Elsevier, First Indian Edition, 2006.

ME 9204 MANUFACTURING TECHNOLOGY LAB- I L T P C
0 0 3 2

AIM:

To have knowledge on common basic machining operations

OBJECTIVES:

To study and practice the various operations that can be performed in lathe, shaping, drilling, milling etc. and equip with the practical knowledge required in the core industries.

LIST OF EXPERIMENTS

Measurement of the Machined Components and Machining time estimation of:

1. Taper Turning
2. External thread cutting
3. Internal thread cutting
4. Eccentric Turning
5. Knurling
6. Square Head Shaping
7. Hexagonal Head Shaping
8. Drilling and Tapping
9. Determination of Cutting forces in Turning and Milling Operations.

TOTAL : 45 PERIODS

EE9212 ELECTRICAL ENGINEERING AND MEASUREMENTS LABORATORY L T P C
0 0 3 2

OBJECTIVES:

1. Speed Control of DC Shunt Motor
2. Load Test on DC Shunt Motor
3. Study of DC Motors
4. Swinbuirne's Test
5. Load Test on DC Series Motor
6. Load Test on DC Compound Motor
7. Load Test on 3 Phase Induction Motor
8. Study of AC Motor Starters
9. No load and Blocked Rotor Test on 3 Phase Induction Motor

TOTAL: 45 PERIODS

CE 9212 FLUIDS MECHANICS AND MACHINERY LABORATORY L T P C
0 0 3 2

AIM:
To perform experiments on various types of pumps and turbines to understand their characteristics.

OBJECTIVES:
- To understand the concepts flow through different cross sections.
- To understand and draw characteristics of various pumps.
- To understand and draw performance characteristics of different turbines

UNIT I FLOW MEASUREMENT
Calibration of Flow Measuring instruments – venturimeter, orificemeter, rotometer, Calibration of flows in open channels – weirs and notches. Estimation of friction factor in flow through pipes.

UNIT II PUMPS
Determination of performance characteristics of pumps – centrifugal pumps, submersible pumps, turbine pumps and positive displacement pumps – reciprocating and gear pumps.

UNIT I II TURBINES
Determination of performance characteristics of turbines – reaction turbines and impulse turbines.

TOTAL : 30 PERIODS

REFERENCE
1. CWR, Hydraulics Laboratory Manual,2004

MA9262 NUMERICAL METHODS L T P C
3 1 0 4

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS (10 +3)
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton-Raphson method- Solution of linear system of equations - Gauss Elimination method – Pivoting - Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalues of a matrix by Power method and by Jacobi's method.

UNIT II INTERPOLATION AND APPROXIMATION (8 + 3)
Interpolation with unequal intervals - Lagrange interpolation – Newton's divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTATION AND INTEGRATION (9 + 3)
Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules – Romberg's method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS (9+ 3)
Single step-methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first and second order equations - Multi-step methods - Milne's and Adams-Bashforth predictor-corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS (9 + 3)

Finite difference methods for solving two-point linear boundary value problems. Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank Nicholson) methods - One dimensional wave equation by explicit method.

L = 45 T = 15 Total = 60

TEXT BOOKS

1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, 2004.
2. Sankara Rao, K. "Numerical methods for Scientists and Engineers', 3rd Edition Prentice Hall of India Private Ltd., New Delhi, 2007.

REFERENCE BOOKS

1. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 5th Edition, Tata McGraw-Hill, New Delhi, 2007.
2. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", 6th Edition, Pearson Education Asia, New Delhi, 2006.
3. Brian Bradie, "A friendly introduction to Numerical analysis", Pearson Education Asia, New Delhi, 2007.

CE9213 STRENGTH OF MATERIALS L T P C
3 0 0 3

AIM:

To understand the stresses and strains for different types of loads for various applications.

OBJECTIVES:

- To understand the stresses developed in beams under transverse load
- To understand the shear stress developed due to tensional load
- To understand the stresses induced in cylinders and spheres due to internal pressure.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 8

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic Constants – Volumetric strains – Stresses on inclined planes – Principal stresses and principal planes – Mohr's circle of stress.

UNIT II TRANSEVERSE LOADING ON BEAMS AND STRESSES IN BEAMS 13

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending - bending formula – bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

UNIT III TORSION 6

Torsion formulation Stresses and deformation in circular and hollows shafts – Stepped shafts – Shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs.

UNIT IV DEFLECTION OF BEAMS 10

Double Integration method – Macaulay's method – Area moment theorems for computation of slopes and deflections in beams – Conjugate beam and energy method – Maxwell's reciprocal theorems.

UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses – deformation in thin cylinders –spherical shells subjected to internal pressure – deformations in spherical shells - Lame's theory – application of theories of failure

TOTAL : 45 PERIODS

TEXTBOOKS

1. Rajput.R.K. “Strength of Materials” S.Chand & co Ltd. New Delhi 1996
2. Jindal U.C. “Strength of Materials” Asian Books Pvt Ltd, New Delhi 2007

REFERENCES

1. Egor.P.Popov “Engineering Mechanics of Solids” Prentice Hall of India, New Delhi 1997
2. Subramanian R. “Strength of Materials” Oxford University Press, Oxford Higher eucation series ,2007
3. Hibbeler , R.C, Mechanics of materials”, Pearson Education, Low price Edition,2007
4. Bansal, R.K, Strength of Materials , Lakshmi Publication (P) Ltd, New Delhi.
5. Ferdinand P Been, Russell Johnson,j.r. & John J Dewole mechanics of materials, Tata Mcgraw Hill publishing Co Ltd, NewDelhi,2006

ME9251 MANUFACTURING TECHNOLOGY – II L T P C
3 0 0 3

AIM:

To provide the concepts and working principal of special machineries and recent trends in manufacturing.

OBJECTIVE

- 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 (CNC) Computer Numerical Control of Machine tools and CNC Programming.

UNIT I THEORY OF METAL CUTTING 8

Mechanics of chip formation, single point cutting tool, forces in machining, thermal aspects of chip formation. orthogonal metal cutting, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

UNIT II CENTRE LATHE AND SPECIAL PURPOSE LATHES 10

Centre lathe, constructional features, specification, cutting tools, nomenclature various operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. capstan and turret lathes – tool layout, - automatic lathes: semi automatics – single spindle: swiss type, automatic screw type- multi spindle:

UNIT III RECIPROCATING MACHINES, MILLING MACHINES AND GEAR CUTTING 12

Reciprocating machine tools: shaper, planer, slotter: milling: types, milling cutter attachments, change gear calculations, machining time calculation, operations. hole making: drilling, reaming, boring, tapping, machining time calculations. gear cutting: forming, generations, shaping, planning and hobbing-tool and cutter grinders.

UNIT IV ABRASIVE PROCESS, BROACHING 8

Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding , surface grinding, centreless grinding, internal grinding- honing, lapping, super finishing, polishing and buffing, abrasive jet grindling.broaching machines: broach construction – push, pull, surface and continuous broaching machines.

UNIT V CNC MACHINE TOOLS AND PART PROGRAMMING 7

Numerical control (NC) machine tools – CNC types, constructional details, special features. machining centre, training centre.part programming fundamentals – manual programming.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Roy. A. Lindberg, “Process and Materials of Manufacture”, PHI / Pearson Education Fourth Edition 2006.
2. Rao. P.N “ Manufacturing Technology”, Metal Cutting and Machine Tools, Tata Mc Graw–Hill, New Delhi, 2003.

REFERENCES
1. Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J. White. “Machine Tool Practices”, Prentice Hall of India, 1998
2. HMT – Production Technology, Tata Mc Graw Hill, 1998.
3. Hajra Choudhury. Elements of Workshop Technology – Vol.II. Media Promoters.
4. Geofrey Boothroyd, Fundamentals of Metal Machining and Machine Tools, Mc Graw Hill, 1984.

ME9252 ENGINEERING MATERIALS AND METALLURGY L T P C
3 0 0 3

AIM:
To introduce the fundamentals of materials and metallurgical aspects involved in design materials and its processing**.**

OBJECTIVE
- 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 CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9
Constitution of alloys – Solid solutions, substitutional and interstitials – Phase diagrams and microstructure development: Isomorphous, eutectic, peritectic, eutectoid and peritectroid alloy systems. Iron-Iron carbide equilibrium diagram, peritecoid.

UNIT II HEAT TREATMENT 9
Full annealing-stress relief, Recrystalisation- Spheroidizing, Normalising, Hardening and tempering of steel. Isothermal transformation diagrams- TTT– CCT cooling curves - Hardenability, Jominy end quench test – Austempering, martempering – case hardening, carburizing, nitriding, cyaniding, carbonotriding –flame and induction hardening – vacuum and plasma hardening – current trends- thermo-mechanical treatments- elementary ideas on sintering.

UNIT III FERROUS AND NON FERROUS METALS 9
Effect of alloying additions on steel (Mn, Si, Cr, Mo, V, Ti & W)- classification of steels (tool steel, stainless)– cast irons – alloy cast irons- Copper and Copper alloys –Aluminum and its alloys- Magnesium and its alloys– Titanium and its alloys- Nickel and Cobalt alloys, properties and applications of these materials.

UNIT IV NON-METALLIC AND NEWER MATERIALS 9
Types, properties and applications: Polymers, Ceramics and Composites– Super conductors-nanomaterials and their properties.

UNIT V MECHANICAL PROPERTIES AND TESTING 9
Crystal imperfections- Dislocations- Strengthening mechanisms- Elastic, anelastic and viscoelastic behaviour – modulus of elasticity- plastic deformation- Mechancial tests- tension, compression, impact, hardness- effect of temperature, grain size , solutes and precipitates on dislocation dynamics – Mechancism of Fracture - mechanism of creep-creep resistant materials- creep tests- fracture toughness- ductile-brittle transition –deformation mechanism maps- fatigue fracture-fatigue test.

TOTAL: 45 PERIODS

TEXT BOOKS
1. Raghavan. V. Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd, 5th edition, 2007.
2. Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, Revised Indian edition 2007.

REFERENCES

1. George E. Dieter, Mechanical Metallurgy, McGraw Hill, 2007.
2. Syndney H Avner, "Introduction to Physical Metallurgy", 2/E Tata McGraw Hill Book Company, 2007.
3. Kenneth G. Budinski and Michael K. Budinski "Engineering Materials", PHI / Pearson Educations, 8th Edition, 2007.
4. G.S. Upadhay and Anish Upadhay, "Materials Science and Engineering", Viva Books Pvt. Ltd, 2006.
5. James F. Shackelford and Madanpalli K. Muralidhara, Introduction to Materials Science for Engineers, Pearson Education, 6th edition, 2007.
6. Donald R. Askeland and Pradeep P. Phulé, The Science and Engineering of Materials, Thomson 5th edition, 2007.

ME9253 DYNAMICS OF MACHINES L T P C
3 1 0 4

AIM:

To impart the knowledge about the effect of forces on the machines and the methods to control them

OBJECTIVE

- To understand the force-motion relationship in components subjected to external forces.
- To understand the force-motion 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 governing of machines.

UNIT I FORCE ANALYSIS 15

Applied and constraint forces – Free body diagrams – Static equilibrium conditions – Two, three & four members – Static force analysis of simple mechanisms – Dynamic force analysis – Inertia force and Inertia torque – D Alembert's principle – The principle of superposition – Dynamic Analysis in reciprocating engines – Gas forces – Equivalent masses – Bearing loads – Crank shaft torque – Turning moment diagrams – Fluctuation of energy – Fly Wheels – Engine shaking forces – Cam dynamics – Unbalance, Spring Surge and Windup.

UNIT II BALANCING 12

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing Multi-cylinder engines – Partial balancing in locomotive engines – Balancing of linkages – Balancing machines.

UNIT III FREE VIBRATION 12

Basic features of vibratory systems – Idealized models of basic elements and lumping of parameters – Degrees of freedom – single degree of freedom – Free vibration – Equations of motion – Natural frequency – Types of Damping – Damped vibration – Extending to multi degree freedom systems – Critical speeds of shafts – Torsional vibration – Torsionally equivalent shaft – Two and three rotor systems.

UNIT IV FORCED VIBRATION 6

Response to periodic forcing – Harmonic disturbances – Disturbance caused by unbalance – Support motion – force transmissibility and amplitude transmissibility – Vibration isolation.

UNIT V MECHANISM FOR CONTROL 15

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force – Other Governor mechanisms. Gyroscopes – Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.

T: 45 + 15, TOTAL : 60 PERIODS

TEXT BOOK

1. Ambekar A.G., "Mechanism and Machine Theory", Prentice Hall of India, New Delhi, 2007.
2. Shigley J.E., Pennock,G.R., Uicker J.J., "Theory of Machines and Mechanisms", Oxford University Press,2003..

REFERENCES

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Ghosh A. and Mallick A.K., "Theory of Mechanisms and Machines", affiliated East-West Press Pvt. Ltd., New Delhi, 1988.
3. Rao J.S. and Dukkipati R.V., "Mechanism and Machine Theory", Wiley- Eastern Limited, New Delhi, 1992.

ME9254 THERMAL ENGINEERING-I L T P C
3 0 0 3

AIM :

To impart the students with knowledge of Heat engine applications

OBJECTIVE

- To integrate the concepts, laws and methodologies from the first course in thermodynamics into the analysis of cyclic process.
- To apply the thermodynamic concepts into various thermal appliction like, IC engines Steam turbines, Gas Turbines

UNIT I GAS POWER CYCLES 9

Otto, Diesel, Dual, Brayton cycles - Calculation of mean effective pressure and air standard efficiency, Actual and theoretical PV diagram of Two stroke and Four stroke engines – Isentropic flow, Fanno flow and Rayleigh flow.

UNIT II AIR COMPRESSOR 9

Classification and working principle, work of compression with and without clearance. Volumetric efficiency, Isothermal efficiency and isentropic efficiency of reciprocating air compressors. Multistage air compressor and inter cooling – work of multistage air compressor., Problems in single and two stage air compressors. Various types of compressors.

UNIT III INTERNAL COMBUSTION ENGINES AND ITS SYSTEMS 9

Classification of IC engine - components and functions. Actual and theoretical Valve timing diagram, port timing diagram and p-V diagrams. Comparison of two stroke & four stroke engines and SI and CI engines.

UNIT IV INTERNAL COMBUSTION ENGINE FUELS, COMBUSTION AND PERFORMANCE 9

Comparison of petrol and diesel engine Fuels. Air-fuel ratio calculation, Knoecking and Detonation, Lubrication system and cooling system Performance calculation. Exhaust gas analysis, pollution control norms.

UNIT V GAS TURBINES 9

Open and closed Gas turbine cycles –Methods of Cycle improvement - Regeneration – Intercooling - Reheating and their combinations –Performance- Materials.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Rajput, R.K., Thermal Engineering, 6th Edition, Laxmi Publications, 2007
2. Ballaney, P.L., "Thermal Engineering" , Khanna Publishers, 24th Edition, 2003.

REFERENCES

1. Holman, J.P." Thermodynamics", McGraw Hill, 1965.
2. Rudramoorthy, R., Thermal Engineering, 4th Edition, Tata McGraw Hill, New Delhi, 2006.
3. Domkundwar, Kothandaraman, and Domkundwar, A Course in Thermal Engineering, Dhanpat Raj & Sons, Fifth edition, 2002.

ME9255 COMPUTER AIDED MACHINE DRAWING L T P C
0 0 4 2

AIM:

To develop communication skills to represent machine components and their assemblies.

OBJECTIVE

- To make the students understand and interpret drawings of machine components so as to prepare assembly drawings either manually and using standard CAD packages.
- To familiarize the students with Indian Standards on drawing practices and standard components.

UNIT I DRAWING STANDARDS 4

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc.

UNIT II FITS AND TOLERANCES 5

Limits, Fits – Tolerancing of individual dimensions- Specification of Fits- Preparation of production drawings and reading of part and assembly drawings, basic principles of geometric dimensioning & tolerancing

UNIT III ASSEMBLY DRAWING 35

Preparation of assembled views, both manually and using software package, given part details for components such as Shaft couplings – Plummer block – Screw jack- Lathe Tailstock – Universal Joint –Machine Vice – Stuffing box- crosshead- safety Valves- Non-return valves- Connectingrod -Piston and crank shaft- Multi plate clutch- Preparation of Bill of materials and tolerance data sheet, software practice: Drawing, Editing, Dimensioning, Plotting Commands, Layering Concepts, Hatching, Detailing

T : 45 + 15 , TOTAL : 60 PERIODS

ME9256 MANUFACTURING TECHNOLOGY LAB – II L T P C
0 0 3 2

AIM:

To acquire skills on common basic machining operations and press working

OBJECTIVES:

- To study and practice the basic machining operations in the special purpose machines and acquire its applicability in the real time components manufacturing industries.

LIST OF EXPERIMENTS

1. Contour Milling using vertical milling machine
2. Gear Cutting using milling machine
3. Gear Hobbing
4. Gear Shaping
5. Hexagonal Machining using Horizontal Milling Machine
6. Gear Cutting – Gear Shaping
7. Spline Broaching
8. Exercise in Surface Grinding
9. Exercise in Cylindrical Grinding
10. Exercise in Tool and Cutter Grinder
11. Spur and helical gear cutting in Milling Machine
12. Determination of cutting forces in Milling Machine
13. Study of Turret and Capstan lathe
14. Forming of Simple Components in Press Working and simple Calculations of sheet metal work

TOTAL : 45 PERIODS

CE9214 STRENGTH OF MATERIALS LABORATORY L T P C
0 0 3 2

AIM:

To perform various types test like tension, compression impact tests in Laboratory.

OBJECTIVES:

- To understand the various mechanical properties by conducting tensile test.
- To understand the hardness value of different materials.

LIST OF EXPERIMENTS

1. Tension test on mild steel rod.
2. Double shear test on metals.
3. Torsion test on mild steel rod.
4. Impact test on metal specimen.
5. Hardness test on metals.
6. Compression test on helical spring.
7. Deflection test on carriage spring.

ME9301 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS L T P C
3 0 0 3

AIM:

To appreciate and understand the importance of tool design in the overall product cycle.

OBJECTIVES

- To understand the functions and design principles of Jigs, fixtures and press tools
- To gain proficiency in the development of required views of the final design.

UNIT I LOCATING AND CLAMPING PRINCIPLES 8

Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

UNIT II JIGS AND FIXTURES 10

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

UNIT III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 10

Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

UNIT IV BENDING FORMING AND DRAWING DIES 10

Difference between bending, forming and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design and development of bending, forming, drawing reverse re-drawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.

UNIT V MISCELLANEOUS TOPICS 7

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke - Course should be supplemented with visits to industries.
(Use of Approved design Data Book permitted).

TOTAL: 45 PERIODS

TEXT BOOKS

1. Joshi, P.H. “Jigs and Fixtures”, Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2004.
2. Donaldson, Lecain and Goold “Tool Design”, III rd Edition Tata McGraw Hill, 2000.

REFERENCES:

1. K. Venkataraman, “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi, 2005.Kempster, “Jigs and Fixture Design”, Hoddes and Stoughton – Third Edition 1974.
2. Joshi, P.H. “Press Tools” – Design and Construction”, Wheels publishing, 1996.
3. Hoffman “Jigs and Fixture Design” – Thomson Delmar Learning, Singapore, 2004.
4. ASTME Fundamentals of Tool Design Prentice Hall of India. Design Data Hand Book, PSG College of Technology, Coimbatore.

ME9302 THERMAL ENGINEERING – II L T P C
3 0 0 3

AIM :

To inculcate the students with Heat Energy applications

OBJECTIVE :

- To integrate the concepts, laws and methodologies from the first course in thermodynamics into the analysis of cyclic process.
- To apply the thermodynamic concepts into various thermal applications like boilers, Compressors and Refrigeration and Air conditioning Systems and waste heat recovery systems.

UNIT I BOILERS (9)

Types, Rankine cycle – Analysis – thermal calculations – Heat balance – Accessories – Types of boilers – Boiler code.

UNIT II STEAM NOZZLE (9)

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ration, supersaturated flow.

UNIT III STEAM TURBINES (9)

Types – Impulse and reaction principles, compounding, velocity diagrams for simple and multistage turbines, speed regulations – governors.

UNIT IV COGENERATION AND WASTE HEAT RECOVERY (9)

Cogeneration Principles – Cycle analysis – Applications – source and Utilization of waste heat systems – Heat exchangers – Economic analysis.

UNIT V REFRIGERATION AND AIR – CONDITIONING (9)

Vapour compression Refrigeration cycle – super heat, sub cooling, performance calcualtins. Working principle of vapour absorption, Air cycle, Ejector, Steam, Thermoelectric refrigeration systems, Psychrometry, Psychometric chart, Instrumentation, Cooling load calculations and air circulating systems, Concept of RSHF, GSHF, ESHF – Air conditioning systems.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Rajput, “Thermal Engineering”, S. chand Puclishers, 2000.
2. Rudramoorthy R, “Thermal Engineering”, Tata MC Graw Hill, New Delhi, 2003.

REFERENCES

1. Kothandaraman , C.P., Domkundwar .S and A.v. Domkundwar”, a course in thermal Engineering”, Dhanpal Rai & sons, fifth edition, 2002.
2. Holman .J.P., “Thermodynamics”, McGraw Hill, 1985.
3. Arora .C.P., “Refrigeration and Air Conditioning”, TMH, 1994.
4. Charles H Butler : Cogeneration” McGraw Hill, 1984.
5. Sydney Reiter “Industrial and commercial heat recovery systems “ Van Nostrand Reinhols, 1985.
6. David Gunn, Robert Horton, Industrial Boilers – Longman Scientific and Technical Publication, 1986.

ME9303 HYDRAULICS AND PNEUMATICS L T P C
3 0 0 3

AIM:

To understand the basis of fluid power and its application in Industrial automation

OBJECTIVE

- This course will give an appreciation of the fundamental principles, design and operation of hydraulic and pneumatic machines, components and systems and their application in recent automation revolution.

UNIT I FLUID POWER PRINCIPLES AND FUNDEMENTALS (REVIEW) 3

Introduction to Fluid power- Advantages and Applications- Fluid power systems – Types of fluids- Properties of fluids Basics of Hydraulics – Pascal’s Law- Principles of flow – Work, Power and Torque. Properties of air– Perfect Gas Laws.

UNIT II HYDRAULIC SYSTEM AND COMPONENTS 13

Sources of Hydraulic power: Pumping Theory – Pump Classification- Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criterion of Linear, Rotary- Fixed and Variable displacement pumps, Hydraulic Actuators: Cylinders – Types and construction, Hydraulic motors Control Components: Direction control, Flow control and Pressure control valves- Types, Construction and Operation- Applications – Types of actuation. Accessories: Reservoirs, Accumulators, Intensifiers, Pressure Switches- Applications- Fluid Power ANSI Symbol.

UNIT III HYDRAULIC CIRCUITS 9

Industrial hydraulic circuits- Regenerative, Pump Unloading, Double-pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-safe, Speed control, Hydrostatic transmission, Accumulators, Electro hydraulic circuits, Mechanical Hydraulic servo systems.

UNIT IV PNEUMATIC SYSTEM 8

Compressors- Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Servo systems. Introduction to Fluidics, Pneumatic logic circuits.

UNIT V DESIGN OF HYDRALIC AND PNEMATIC CIRCUITS 12

Designing the components of hydraulic system for Drilling, Planning, Shaping, Punching, Press. – Selection, fault finding and maintenance of hydraulic components- Sequential circuit design for simple application using cascade method, Electro pneumatic circuits. Selection criteria of pneumatic components – Installation fault finding and maintenance of pneumatic components. Microprocessor and PLC- Applications in Hydraulic and Pneumatics- Low cost Automation – Hydraulic and Pneumatic power packs- case studies.

TOTAL: 45 PERIODS

TEXT BOOK

1. Anthony Esposito," Fluid Power with Applications", PHI / Pearson Education, 2005.

REFERENCES

1. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006.
2. Majumdar, S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw Hill, 2001
3. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Tata McGraw Hill, 2007.
4. Micheal J, Pinches and Ashby, J.G., "Power Hydraulics", Prentice Hall, 1989.
5. Dudelyt, A Pease and John J Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

ME9304 MODERN MACHINING PROCESSES L T P C
3 0 0 3

AIM:

To provide knowledge on recent developments in unconventional machining process.

OBJECTIVES

- To understand how the material removal by using various Energy.
- To know how the new materials and complex parts are produced with high accuracy by using new technology.

UNIT I INTRODUCTION 7

Need of Newer Machining Processes – Classification Based on Energy, Mechanism, source of energy, transfer media and process - Process selection-Based on Physical Parameters, shapes to be machined, process capability and economics.

UNIT II MECHANICAL PROCESS 10

Ultrasonic Machining: Principle- Transducer types – Concentrators - Abrasive Slurry - Process Parameters – Tool Feed Mechanism – Advantages and Limitations – Applications. Abrasive Jet Machining: Process- Principle – Process Variables – Material Removal Rate - Advantages and Limitations – Applications. Water Jet Machining: Principle – Process Variables - Advantages and Limitations – Practical Applications

UNIT III ELECTRICAL DISCHARGE MACHINING AND ELECTRICAL DISCHARGE WIRE CUT 10

Electrical Discharge Machining: Mechanism of metal removal – Dielectric Fluid – Electrode Materials - Spark Erosion Generators – Electrode Feed System – Material Removal Rate – Process Parameters – Tool Electrode Design – Characteristics of Spark Eroded Surfaces-Advantages and Limitations – Practical Applications Electrical Discharge Wire Cut and Grinding: Principle – Wire Feed System - Advantages and Limitations – Practical Applications

UNIT IV CHEMICALS AND ELECTRO CHEMICAL MACHINING 10

Chemical Machining: fundamentals, Principle –classification and selection of Etchant -chemical milling, Engraving, Blanking, Drilling and Trepanning-Advantages and limitations – Applications. Electro Chemical Machining: Electro-chemistry of the process-Electrolytes - Electrolyte and their Properties – Material Removal Rate – Tool Material – Tool Feed System – Design For Electrolyte Flow – Process Variables - Advantages and Limitations – Applications - Electro Chemical Grinding: Honing, cutting off, Deburring and turning.

UNIT V ELECTRON BEAM, LASER BEAM, ION BEAM AND PLASMA ARC MACHINING 8

Electron Beam Machining: Principle –Generation and control of electron beam-Advantages and Limitations – Applications. Laser Beam Machining: Principle –Solid and Gas Laser Application – Thermal Features of LBM - Advantages and Limitations – Applications. Ion Beam Machining: Equipment – process characteristics - Advantages and Limitations – Applications. Plasma Arc Machining: Principle –Gas mixture– Types of Torches – Process Parameters - Advantages and Limitations – Applications.

TOTAL: 45 PERIODS

TEXT BOOK

1. P.C Pandey And H.S. Shan, “Modern Machining Process”, Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 2007
2. V.K. Jain, “ Advanced Machining Process”, Allied Publishers PVT Limited 2007

REFERENCES

1. Amitadha Bhattacharyya , “New Technology”, The Institution Of Engineers , (India) “Production Technology”, HMT Banglore, Tata Mc Graw–Hill Publishing Company Limited, New Delhi, 2006.

ME9305 DESIGN OF MACHINE ELEMENTS L T P C
3 0 0 3

AIM:

To impart knowledge on design principles of various components in mechanical engineering application.

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

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties -- Preferred numbers, fits and tolerances –Direct, Bending and torsional stress equations – Impact and shock loading – calculationof principle stresses for various load combinations, eccentric loading – Design of curved beams – crane hook and ‘C’ frame - Factor of safety - theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations

UNIT II DESIGN OF SHAFTS AND COUPLINGS 9

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys, key ways and splines - Design of crankshafts -- Design of rigid and flexible couplings.

UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS 9

Threaded fastners - Design of bolted joints including eccentric loading, Knuckle joints,Cotter joints – Design of welded joints, riveted joints for structures - theory of bonded joints.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS 9

Design of various types of springs, optimization of helical springs -- rubber springs -- Design of flywheels considering stresses in rims and arms for engines and punching machines.

UNIT V DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS 9

Sliding contact and rolling contact bearings -- Design of hydrodynamic journal bearings,McKee's Eqn., Sommerfield Number, Raimondi & Boyd graphs, -- Selection of Rolling Contact bearings -- Design of Seals and Gaskets -- Design of Connecting Rod.

TOTAL : 45 PERIODS

Note: (Use of P S G Design Data Book is permitted in the University examination)

TEXT BOOKS:

1. Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, Sixth Edition, Tata McGraw-Hill , 2003.
2. Bhandari V.B, “Design of Machine Elements”, Second Edition, Tata McGraw-Hill Book Co, 2007.

REFERENCES:

1. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha
2. Publications, Chennai, 2003.
3. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.
4. Ugural A.C, “Mechanical Design – An Integral Approach, McGraw-Hill Book Co,
5. 2004.
6. Spotts M.F., Shoup T.E “Design and Machine Elements” Pearson Education, 2004.

STANDARDS:

1. IS 10260 : Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 1 : Construction.
2. IS 10260 : Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 2 : Friction and Wear.
3. IS 10260 : Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 3 : Lubrication.

ME9306 METROLOGY AND MEASUREMENTS L T P C

3 0 0 3

AIM:

To understand the basics involved in the equipments meant engineering measurements.

OBJECTIVES:

- To provide knowledge on various Metrological equipments available to measure the
- dimension of the components.
- To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.
- Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy – Errors – Errors inMeasurements – Types – Control – Gauges and Comparator - Types of standards.

UNIT II LINEAR AND ANGULAR MEASUREMENTS 10

Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges –gauge design – terminology – procedure – concepts of interchangeability and selective assembly – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications.

UNIT III ADVANCES IN METROLOGY 12

Basic concept of lasers, advantages of lasers – laser interferometers – types – DC and AC lasers interferometer – Applications – Straightness – Alignment, Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications.

UNIT IV FORM MEASUREMENT 10

Principles and Methods of straightness – Flatness measurement – Thread measurement, Gear measurement, Surface finish measurement, Roundness measurement – Form and Surface measurement – Thread and Gear measurement - Applications.

UNIT V MEASUREMENT OF POWER, FLOW AND TEMPERATURE 8

Force, Torque, Pressure, Power – Mechanical, Pneumatic, Hydraulic and Electrical type.Flow measurement: Venturimeter, Orifice meter, Rotameter, Pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and calibration – Readability and Reliability

TOTAL : 45 PERIODS

TEXT BOOKS :

1. Jain R.K., “Engineering Metrology”, Khanna Publishers, 2005
2. Gupta.I.C., “Engineering Metrology”, Dhanpatrai Publications, 2005.

REFERENCES:

1. Shotbolt, “Metrology for Engineers, McGraw Hill, 1990.
2. Beckwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education,

ME9307 DYNAMICS LABORATORY L T P C
0 0 3 2

AIM:

To apply the knowledge gained in kinematics and dynamics of machines to real system.

OBJECTIVES:

- 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:

1. Study of gear parameters.
2. Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
3. Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms
4. Kinematics of single and double universal joints.
5. Determination of Mass moment of inertia of Fly wheel and Axle system.
6. Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
7. Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
8. Motorized gyroscope – Study of gyroscopic effect and couple.
9. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.

10. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
11. Single degree of freedom Spring Mass System – Determination of natural frequency and verification of Laws of springs – Damping coefficient determination.
12. Multi degree freedom suspension system – Determination of influence coefficient.
13. Determination of torsional natural frequency of single and Double Rotor systems.- Undamped and Damped Natural frequencies.
14. Vibration Absorber – Tuned vibration absorber.
15. Vibration of Equivalent Spring mass system – undamped and damped vibration.
16. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
17. Balancing of rotating masses.
18. Balancing of reciprocating masses.
19. a) Transverse vibration of Free-Free beam – with and without concentrated masses.
20. Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.
21. Determination of transmissibility ratio using vibrating table.

Students should be familiar with the use of the following device/equipments depending upon availability.

1. Tachometers – Contact and non contact
2. Dial gauge
3. Stroboscope
4. Accelerometers – Vibration pickups
5. Displacement meters.
6. Oscilloscope
7. Vibration Shaker
8. F.F.T. Analyzer and
9. Dynamic Balancing Machine.

TOTAL : 45 PERIODS

ME9308 THERMAL ENGINEERING LABORATOR Y – I

L	T	P	C
0	0	3	2

AIM:

To train the students with principle and operation of thermal Energy based systems.

LIST OF EXPERIMENTS

I.C. ENGINE LAB AND FUELS LAB (30)

1. Valve Timing and Port Timing diagrams.
2. Performance Test on 4 – stroke Diesel Engine.
3. Heat Balance test on 4 – stroke Diesel Engine.
4. Morse Test on Multicylinder Petrol Engine.
5. Retardation Test on a Diesel Engine.
6. Determination of Flash Point and Fire Point.

STEAM LAB (15)

1. Study of Steam Generators and Turbines.
2. Performance and Energy Balance Test on a Steam Generator.
3. Performance and Energy Balance Test on Steam Turbine.

TOTAL : 45 PERIODS

ME9309 METROLOGY AND MEASUREMENTS LABORATORY L T P C
0 0 3 2

AIM:
To understand the application of linear and angular measuring instruments

OBJECTIVES:
To equip students with knowledge on common metrological Instruments.

EXPERIMENTS
Sine bar & slip guage (Study)
Tool Makers Microscope
Rolling Gear tester – Study. (Study on parbinson gar rolling tester)
Comparator
Co-ordinate Measuring Machine (Study)
Surface Finish Measurement
Machine Vision System (Study)
Force Measurement
Torque Measurement
Bore diameter measurement using micrometer
Bore diameter measurement using telescope gauge
Gear tooth thickness and depth measurement
Taper angle measurement
Study of auto collimator
Mechanical Bevel protractor
Height vernier guage and depth micrometer. (Different height and depth measurements).

TOTAL : 45 PERIODS

ME9310 TECHNICAL SEMINAR L T P C
0 0 2 1

OBJECTIVE
During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for a duration of about 8 to 10 minutes. In a session of three periods per week, 15 students are expected to present the seminar. A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.

Students are encouraged to use various teaching aids such as over head projectors, power point presentation and demonstrative models. This will enable them to gain confidence in facing the placement interviews.

ME9351 FINITE ELEMENT ANALYSIS L T P C
3 0 0 3

AIM:
To appreciate the need for and applications of numerical techniques for solving problems in mechanical Engineering**.**

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 9

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems – Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT II ONE-DIMENSIONAL PROBLEMS 9

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors. Assembly of Matrices - solution of problems from solid mechanics and heat transfer- Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation – Transverse deflections and Natural frequencies of beams.

UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS 9

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation – Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts – Quadrilateral elements – Higher Order Elements.

UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 9

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.

UNIT V ISOPARAMETRIC FORMULATION AND MISCELLANEOUS TOPICS 9

Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems –

TOTAL : 45 PERIODS

TEXT BOOKS

1. J Seshu. P. “Textbook of Finite Element Analysis” Prentice Hall of India, 2003.
2. N. Reddy, “ Finite Element Method” Tata McGraw Hill, 2003.

REFERENCES

1. Chandrupatla and Belegundu, “Introduction to Finite Elements in Engineering” PHI / Pearson Education, 2003.
2. Logan. D.L. “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002.
3. Cook R.D., Malkus. D.S. Plesha, ME., “Concepts and Applications of Finite Element Analysis”, John – Wiley Sons 2003.
4. S.S. Rao, “The Finite Element Method in Engineering “Butter worth Heinemann, 2001.

ME9352 MICRO PROCESSOR AND MICRO CONTROLLER L T P C
3 0 0 3

AIM:

To know the architecture, programming aspects and applications of 8085 microprocessor and 8051 microcontroller.

OBJECTIVES:

- To impart knowledge on 8085 Microprocessor and 8051 Microcontroller and its applications, which are very much required to understand the emerging field of automation.

UNIT I 8085 MICROPROCESSOR 10

Introduction-Architecture of 8085-Pin Configuration-Addressing Modes-Instruction set.

UNIT II TIMING DIAGRAM AND PROGRAMMING 8

Instruction cycle-machine cycle-T states and Timing diagram of 8085- Calculation of instruction cycle timings- Assembly Language Programming using 8085 instructions.

UNIT III PERIPHERALS AND INTERFACING 12

keyboards- interfacing output display-interfacing memory-A/D and D/A Converters Interfacing.

UNIT IV 8051 MICROCONTROLLER 9

Introduction- Architecture of 8051- Pin configuration- Ports- External Memory- counters and Timers- Serial and Parallel Data I/O- Interrupts – Assembly language programming

UNIT V APPLICATIONS using Intel 8085 and 8051 6

Temperature Control - Stepper Motor Control- Traffic Light Controller. Measurement and speed control of DC motor.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Krishna Kant, Microprocessors & Microcontrollers", Prentice Hall of India, 2007.

REFERENCES:

1. M.A. Mazidi and J.C. Mazidi, "The 8051 Microcontroller and Embedded systems", PHI / Pearson Education, 2006.
2. P.K.Ghosh and P.R.Sridhar, "Introduction to Microprocessors for Engineers and Scientists", Prentice Hall of India, 2001
3. Kenneth J.Ayala, "The 8051 Microcontroller, Architecture, Programming and applications",Thomson Delmar Learning, Indian Edition, 2007.Douclas V.Hall, "Microprocessors and Interfacing, Programming and Hardware", Tata McGraw Hill, 1999.
4. L.A. Levental, Introduction to microprocessors Software and Hardware Programming", Prentice Hall Inc, 1978.
5. Aditya, P.Mathur, "Introduction to Microprocessors Software", Tata McGraw Hill, 1983
6. Ramesh Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085", Wiley Eastern, 1998

ME9353 DESIGN OF TRANSMISSION SYSTEMS L T P C
3 1 0 4

AIM:

To learn the design principles of various mechanical power transmission systems.

OBJECTIVES:

- To gain knowledge on the principles and procedure for the design of power Transmission components.
- To understand the standard procedure available for Design of Transmission systems
- To learn to use standard data and catalogues.

UNIT I DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS 9

Selection of V belts and pulleys – selection of Flat belts and pulleys – Wire ropes and pulleys – Selection of Transmission chains and Sprockets. Design of pulleys and sprockets.

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 9

Gear Terminology-Speed ratios and number of teeth-Force analysis – Tooth stresses – Dynamic effects – Fatigue strength – Factor of safety – Gear materials – Module and Face width-power rating calculations based on strength and wear considerations – Parallel axis Helical Gears – Pressure angle in the normal and transverse plane – Equivalent number of teeth-forces and stresses. Estimating the size of the helical gears.

UNIT III BEVEL, WORM GEARS AND CROSSED HELICAL GEARS 9

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits – Terminology. Thermal Capacity, Materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Crosseded -helical Terminology-helix angles – Estimating the size of the pair of Crossed-helical gears.

UNIT IV DESIGN OF GEAR BOXES 9

Geometric progression – Standard step ratio – Ray diagram, kinematic layout – Design of sliding mesh gear box- Constant mesh gearbox – Design of multi speed gear box.

UNIT V DESIGN OF CAM, CLUTCHES AND BRAKES 9

Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses.

Design of plate clutches – axial clutches-cone clutches-internal expanding rim clutches-internal and external shoe brakes.

T : 45 + 15 , TOTAL : 60PERIODS

Note: (*Usage of P.S.G Design Data Book is permitted in the University examination*

TEXT BOOKS:

1. Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, Sixth Edition, Tata McGraw-Hill , 2003.
2. Sundararajamoorthy T. V and Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

REFERENCES:

1. Maitra G.M. and Prasad L.V., “Hand book of Mechanical Design”, II Edition, Tata McGraw-Hill, 1985.
2. Bhandari, V.B., “Design of Machine Elements”, Tata McGraw-Hill Publishing Company Ltd., 1994.
3. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000,
4. Hamrock B.J., Jacobson B. and Schmid S.R., “Fundamentals of Machine Elements”, Tata McGraw-Hill Book Co., 1999.
5. Ugural A,C, "Mechanical Design, An Integrated Approach", Tata McGraw-Hill , 2003.

STANDARDS :

1. IS 4460 : Parts 1 to 3 : 1995, Gears – Spur and Helical Gears – Calculation of Load Capacity.
2. IS 7443 : 2002, Methods of Load Rating of Worm Gears
3. IS 15151: 2002, Belt Drives – Pulleys and V-Ribbed belts for Industrial applications – PH, PJ, PK, Pl and PM Profiles : Dimensions
4. IS 2122 : Part 1: 1973, Code of practice for selection, storage, installation and maintenance of belting for power transmission : Part 1 Flat Belt Drives.
5. IS 2122: Part 2: 1991, Code of practice for selection, storage, installation and maintenance of belting for power transmission : Part 2: V-Belt Drives.

ME9354 COMPUTER AIDED DESIGN AND MANUFACTURE L T P C
3 0 0 3

AIM:

To learn the importance and use of computer in design and manufacture

OBJECTIVES:

- To provide an overview of how computers are being used in design, development of manufacturing plans and manufacture
- To understand the need for integration of CAD and CAM

UNIT I COMPUTER AIDED DESIGN

Product cycle- The 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-visual realism

UNIT II GEOMETRIC MODELLING

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 – Introduction to model storage – Data structures for interactive modeling- integration of design analysis and CAD- customization and design automation

UNIT III CAD STANDARDS and CAD CAM INTERFACE

Graphics and computing standards- Data exchange standards- IGES-STEP – communication standards- current trends in manufacturing engineering- Group technology- design for manufacture and assembly – process planning techniques – Total approach to product development – techniques of quality engineering – QFD and FMEA – Taguchi methods – Rapid prototyping

UNIT IV MANUFACTURING ASPECTS

Fundamentals of Numerical control – CNC technology – CNC hardware basics- CNC Tooling and machine tools- Control systems – CNC Programming – Manual programming – Computer assisted part programming – APT language structure and commands-

UNIT V PRODUCTION PLANNING AND CONTROL

Introduction to production planning and control- Lean production- business process reengineering- just in time approach- setup reduction –Kanban- Product data management- Assembly and tolerance modeling Product life cycle management – use of world wide web in product development

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Chris McMahon and Jimmie Browne “CAD/CAM Principles, practice and manufacturing management “ Pearson Education Asia – 2001
2. P.N.Rao “CAD/CAM Principles and Applications” Tata McGraw-Hill Publishng Co. New Delhi – 2002

REFERENCE:

1. Ibrahim Zeid “CAD CAM Theory and Practice” Tata McGraw-Hill Publishng Co.1998

ME9355 HEAT AND MASS TRANSFER L T P C
3 1 0 4

AIM:

To make the student to understand the various modes of Heat transfer.

OBJECTIVES:

- To understand the mechanism of steady and unsteady conduction heat transfer and extended surfaces
- To understand the concepts of radiation heat transfer.
- To learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of mass transfer..

UNIT I CONDUCTION 11

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – General Differential equation of Heat Conduction – Fourier Law of Conduction – Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems – Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Infinite and Semi Infinite Solids

UNIT II CONVECTION 10

Basic Concepts – Convective Heat Transfer Coefficients – Boundary Layer Concept – Forced Convection – External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes – Internal Flow – Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9

Nusselt's theory of condensation- Regimes of pool boiling and flow boiling, correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors - Analysis – LMTD method, $\in$ - NTU method.

UNIT IV RADIATION 9

Concepts, Laws of Radiation – Wiens Displacement Law - Stefan Boltzman Law, Kirchoff Law – Black Body Radiation – Grey body radiation - Shape Factor – Electrical Analogy – Radiation Shields.

UNIT V MASS TRANSFER 6

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

L : 45 , T : 15, TOTAL : 60 PERIODS

TEXT BOOKS

1. Yunus A. Cengel, Heat Transfer A Practical Approach – Tata Mc Graw Hill - 2004

REFERENCES

1. Frank P. Incropera and David P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley & Sons, 1998.
2. S.P. Venkateshan, Heat Transfer, Ane Books, New Delhi, 2004.
3. Ghoshdastidar, P.S, Heat Transfer, Oxford, 2004,
4. Nag, P.K., Heat Transfer, Tata Mc Graw Hill, New Delhi, 2002
5. Holman, J.P., Heat and Mass Transfer, Tata Mc Graw Hill, 2000
   Ozisik, M.N., Heat Transfer, McGraw Hill Book Co., 1994.
6. Kothandaraman, C.P., Fundamentals of Heat and Mass Transfer, New Age International, New Delhi, 1998.
7. Yadav, R., Heat and Mass Transfer, Central Publishing House, 1995.

ME9356 THERMAL ENGINEERING LABORATORY – II L T P C
0 0 3 2

AIM

To train the students with principles and operation of thermal Engineering equipments

LIST OF EXPERIMENTS:

HEAT TRANSFER: 30

1. Thermal conductivity measurement using guarded plate apparatus.
2. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
3. Determination of heat transfer coefficient under natural convection from a vertical cylinder.

4. Determination of heat transfer coefficient under forced convection from a tube.
5. Natural convection heat transfer from a vertical cylinder.
6. Forced convection inside tube.
7. Heat transfer from pin-fin (natural & forced convection modes)
8. Determination of Stefan – Boltzmann constant
9. Determination of emissivity of a grey surface.
10. Effectiveness of Parallel / counter flow heat exchanger.

REFRIGERATION AND AIR CONDITIONING LAB **15**

1. Determination of COP of a refrigeration system
2. Experiments on Psychrometric processes
3. Performance test on single / two stage reciprocating air compressor
4. Performance test in a HC Refrigeration System
5. Performance test in a fluidized Bed Cooling Tower

TOTAL : 45 PERIODS

ME9357 CAD/CAM LAB **L T P C**
0 0 3 2

AIM:

To give the exposure to usage of software tools for design and manufacturing.

OBJECTIVES:

- To be able to understand and handle design problems in a systematic manner.
- To gain practical experience in handling 2D drafting and 3D modeling software systems.
- To be able to apply CAD in real life applications.
- To understand the concepts of G and M codes and manual part programming.
- To expose students to modern control systems (Fanuc, Siemens etc)
- To know the application of various CNC machines
- To expose students to modern CNC application machines EDM, EDM wire cut and Rapid Prototyping

UNIT I 3D GEOMETRIC MODELING

Creation of 3D Models - Wire Frame, Surface, Solid modeling Techniques Using CAD Packages – CSG, B-rep Approaches in Solid Modeling - Feature Based Modeling Technique – Assembly – Detailing - Exposure to Industrial Components – Application of GD&T

STL FILE GENERATION – REVERSE ENGINEERING

UNIT II MANUAL CNC PART PROGRAMMING

Manual CNC Part Programming Using Standard G and M Codes - Tool Path Simulation – Exposure to Various Standard Control Systems- Machining simple components by Using CNC machines.

UNIT III COMPUTER AIDED PART PROGRAMMING

CL Data Generation by Using CAM Software– Post Process Generation for Different Control System – Machining of Computer Generated Part Program by Using Machining Center and Turning Center.

UNIT IV STUDY OF EXPERIMENTS

Multi-axial Machining in CNC Machining Center –EDM – EDM Wire Cut - Rapid Prototyping.

TOTAL : 45 PERIODS

ME9358 MICROPROCESSOR AND MICRO CONTROLLER LABORATORY **L T P C 0 0 4 2**

AIM:

To impart knowledge about the assembly language programming of 8085 microprocessor and 8051 microcontroller methods of interfacing and real time applications.

OBJECTIVES:

- Study of 8085 Microprocessor and 8051 Microcontroller trainer kits and identifying the components.
- 8085 and 8051 Assembly language programs
  i)Arithmetic operation ii) Ascending/descending order and finding largest/ smallest number in an array.
- 8085 and 8051 Assembly Language Programs for code conversion
  BCD to binary ii)binary to BC
- 8051 Assembly Language Program for timer operations.
- Interfacing of 8 bit A/D and D/A converters using 8085 and 8051
- Stepper motor interface using 8085 and 8051
- Display unit interface with 8051 and 8051

TOTAL : 60 PERIODS

GE9371 COMMUNICATION SKILLS AND SOFT SKILLS LAB **L T P C 0 0 2 1**

AIM

To enhance the overall capability of students and to equip them with the necessary Communication Skills and Soft Skills that would help them excel in their profession.

OBJECTIVES:

- To equip students of engineering and technology with effective speaking and listening skills in English.
- To help them develop their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their job.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment exercises.

1. PC based session

A. Career Lab (15 periods) Viewing and discussing audio-visual materials

UNIT I Resume / Report Preparation / Letter Writing: (3)
Letter writing – Job application with Resume - Project report - Email etiquette.

UNIT II Presentation skills: (3)
Elements of effective presentation – Structure of presentation - Presentation tools – Body language.

UNIT III Soft Skills: (3)
Time management – Stress management – Assertiveness – Negotiation strategies, Psychometrics - Analytical and logical reasoning.

UNIT IV Group Discussion: (3)
Group discussion as part of selection process, Structure of group discussion – Strategies in group discussion – Mock group discussions.

UNIT V Interview Skills: (3)
Kinds of interviews – Interview techniques – Corporate culture – Mock interviews.

II. Class Room Session

1. **Resume / Report Preparation / Letter writing**: Students prepare their own resume and report. (9)
2. **Presentation Skills:** Students make presentations on given topics. (12)
3. **Group Discussion**: Students participate in group discussions. (12)
4. **Interview Skills**: Students participate in Mock Interviews (12)

TOTAL : 45 periods

REFERENCES:

1. Prakash P, **Verbal and Non-Verbal Reasoning**, Macmillan India Ltd., 2nd Edition, New Delhi, 2004.
2. John Seely, **The Oxford Guide to Writing and Speaking**, Oxford University Press, New Delhi 2004.
3. Paul V Anderson, **Technical Communication**, Thomson Wadsworth , 6th Edition, New Delhi, 2007.
4. Edgar Thorpe and Showick Thorpe, **Objective English**, Pearson Education, 2nd Edition, New Delhi 2007.
5. David Evans, **Decision maker**, CUP, 1997

Lab Requirement:

1. Teacher console and systems for students.
2. English Language Lab Software
3. Tape recorders

GE9022 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

AIM

To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

OBJECTIVES

- To understand the various principles, practices of TQM to achieve quality.
- To learn the various statistical approaches for Quality control.
- To understand the TQM tools for continuous process improvement.
- To learn the importance of ISO and Quality systems

UNIT I INTRODUCTION 9

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 TQM PRINCIPLES 9

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 TQM TOOLS & TECHNIQUES I 9

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 TQM TOOLS & TECHNIQUES II 9

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

UNIT V QUALITY SYSTEMS 9

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.

TOTAL : 45 PERIODS

TEXT BOOK

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.

ME9401 POWER PLANT ENGINEERING L T P C
3 0 0 3

AIM:

Impartation of the basic knowledge on Power Plant Engineering underscoring the development trends.

OBJECTIVE:

To provide a general perspective of Power Plant Engineering indicating the role of mechanical engineers in their operation and maintenance.

PREREQUISITE:

The course is specific to Mechanical Engineering stream students only.

UNIT I LAYOUT OF POWER PLANTS 8

Schematics of various power plant systems – steam, hydel, piston engine, MHD, Gas turbine, Combined Cycle, Fuel cell, Cogeneration, Solar, Wind mill, OTEC, Comparisons, Selection.

UNIT II STEAM AND NUCLEAR POWER PLANTS 10

Steam generators including FBC, cycle analyses, subsystems of thermal analyses power plants, coal gasification technologies, Types of Nuclear Reactor plants – Indian Scenario, Environmental aspects of thermal and nuclear plants, Development trends.

UNIT III HYDEL AND OTHER POWER PLANTS 10

Essential elements of hydel power plants, selection of turbines, microhydel plant developments, pumped storage plants, Wind mill developments, specialities of fuel cell power plants – PAFC, MCFC, SOFC and PEM systems, Hybrid power plants, advanced piston engine and gas turbine power plants, geothermal power plants.

UNIT IV INSTRUMENTATION AND CONTROLS 8

Modern Control system of power plants, instrumentation for vital parameters like temperature, pressure, flow of steam, gas, water, flue gas etc.,flue/exhaust gas analyses, automatic controls.

UNIT V ECONOMICS, RENOVATION AND MODERNISATION OF POWER PLANTS 9

Load duration curves, costing of electrical energy, tariff types, load sharing economics, Renovation and modernisation of aged power plants, Development pathways for power plants – national and global scenario.

TOTAL : 45 PERIODS

TEXT BOOK

1. Power Plant Engineering, P.K. Nag, Tata McGraw – Hill Publishing Company Ltd., Third Edition, 2007.

REFERENCES

1. Standard Handbook of Powerplant Engineering, Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, McGraw – Hill, 1998, Second Edition.
2. Power Plant Engineering, Frederick T. Morse, Affiliated East-West-Press Private Ltd., New Delhi 1953.

ME9402 MECHATRONICS L T P C
3 0 0 3

AIM:

To understand the principles, techniques & components of Mechatronics system and its design

OBJECTIVE:

- This syllabus is formed to create knowledge for the students about the source of concepts and techniques involved in mechatronic systems which are widely used in various industries.

UNIT I INTRODUCTION 5

Introduction to Mechatronics- Systems- Concepts of Mechatronics approach-Need for Mechatronics- Emerging area of Mechatronics- Classification of Mechatronics.

UNIT II SENSORS AND TRANSDUCERS 12

Introduction – Performance Terminology- Potentiometers-LVDT-Capacitance sensors-Strain gauges- Eddy current sensor-Hall effect sensor- Temperature sensors- Light sensors-Selection of sensors- Signal processing

UNIT III MOTION CONTROL AND MEASUREMENT SYSTEM 12

Control system- Open Loop and Feedback Control-Measurement system-Drives and actuators-Control devices- Servo systems- Motion converters.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 8

Introduction- Basic structure- Input and output processing- Programming- Mnemonics- Timers, counters and internal relays- Data handling-Selection of PLC.

UNIT V DESIGN AND MECHATRONICS 8

Design process-stages of design process-Traditional and Mechatronics design concepts- Case studies of Mechatronics systems- Pick and place Robot- Autonomous mobile robot-Wireless suriviellance balloon- Engine Management system- Automatic car park barrier.

TOTAL: 45

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

REFERENCES

1. Godfrey C. Onwubolu, "Mechatronics Principles and Applications", Elsevier, 2006
2. Devadas Shetty and Richard A.Kolk, “Mechatronics systems design”, PWS Publishing company 2007.
3. Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts and Applicatlions” Tata McGraw-Hill Publishing company Limited, 2003.
4. Michael B.Histand and Davis G.Alciatore,” Introduction to Mechatronics and Measurement systems”. McGraw Hill International edition,1999.
5. Bradley D.A, Dawson.D, Buru N.C and Loader A.J, “Mechatronics” Chapman an Hall, 1993.
6. Lawrence J.Kamm, “Understanding Electro-Mechanical Engineering – An Introduction to Mechatronics”, Prentice Hall of India Pvt Ltd, 2000.
7. Dan Necsulescu, “Mechatronics”, Pearson education,2002.
8. Newton C.Braga, “Mechatronics Sourcebook”, Thomson Delmar Learning, Eswar Press, 2003.

MG9362 INDUSTRIAL MANAGEMENT L T P C
3 0 0 3

AIM:

To provide a clear understanding of basic management principles that leads to corporate building.

OBJECTIVE:

- To develop modern concepts of Industrial Management

UNIT I INTRODUCTION 9

Technology Management - Definition – Functions – Evolution of Modern Management – Scientific Management Development of Management Thought. Approaches to the studyof Management, Forms of Organization – Individual Ownership – Partnership – Joint Stock Companies – Co-operative Enterprises – Public Sector Undertakings, Corporate Frame Work – Share Holders – Board of Directors – Committees – Chief Executive –Line and Functional Managers, Constraints – Environmental – Financial – Legal – Trade Union

UNIT II FUNCTIONS OF MANAGEMENT 9

Planning – Nature and Purpose – Objectives – Strategies – Policies and Planning Premises – Decision Making – Organizing – Nature and Process – Premises –Departmentalization – Line and staff – Decentralization – Organizational culture, Staffing- selection and training – Placement – Performance appraisal – Career Strategy –Organizational Development. Leading – Managing human factor – Leadership –Communication, Controlling - Process of Controlling – Controlling techniques,productivity and operations management – Preventive control, Industrial Safety.

UNIT III ORGANIZATIONAL BEHAVIOUR 9

Definition – Organization – Managerial Role and functions – Organizational approaches,Individual behaviour – causes – Environmental Effect – Behaviour and Performance,Perception – Organizational Implications. Personality – Contributing factors – Dimension – Need Theories – Process Theories – Job Satisfaction, Learning and Behaviour – Learning Curves, Work Design and approaches.

UNIT IV GROUP DYNAMICS 9

Group Behaviour – Groups – Contributing factors – Group Norms, Communication –Process – Barriers to communication – Effective communication, leadership – formal and informal characteristics – Managerial Grid – Leadership styles – Group DecisionMaking – Leadership Role in Group Decision, Group Conflicts – Types –Causes – Conflict Resolution – Inter group relations and conflict, Organization centralization and decentralization – Formal and informal – Organizational Structures – Organizational Change and Development – Change Process – Resistance to Change – Culture and Ethics.

UNIT V MODERN CONCEPTS 9

Management by Objectives (MBO) –, Management by Exception (MBE), Strategic Management - Planning for Future direction – SWOT Analysis – Evolving developmentstrategies, information technology in management – Decisions support system – Management Games – Business Process Re-engineering(BPR) – Enterprises ResourcePlanning (ERP) – Supply Chain Management (SCM) – Activity Based Management (ABM) – Global Perspective - Principles and Steps – Advantages and disadvantages

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Herald Koontz and Heinz Weihrich, 'Essentials of Management', McGraw Hill Publishing Company, Singapore International Edition, 1980.

REFERENCE BOOKS:

1. S.Chandran, Organizational Behaviours, Vikas Publishing House Pvt.. Ltd, 1994
2. Ties, AF, Stoner and R.Edward Freeman, 'Management' Prentice Hall of India Pvt.Ltd. New Delhi 110011, 1992
3. Joseph J, Massie, 'Essentials of Management' Prentice Hall of India Pvt. Ltd. 1985
4. M. Govindarajan and S. Natarajan, Principles of Management, Prentice Hall of India Pvt. Ltd. New Delhi 2007

ME9403 COMPUTER AIDED SIMULATION AND ANALYSIS LABORATORY

L	T	P	C
0	0	3	2

AIM:

To acquire the skills needed to analyze and simulate engineering systems.

OBJECTIVES:

- To give exposure to software tools needed to analyse engineering systems.
- To expose the students to different applications of simulation and analysis tools.

A. SIMULATION

1. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables
2. Use of Matlab to solve simple problems in vibration and Laplace Transforms

B. ANALYSIS

1. Stress analysis of a plate with a circular hole.
2. Stress analysis of rectangular L bracket
3. Stress analysis of plane strain problems
4. Stress analysis of an axi-symmetric components
5. Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
6. Mode frequency analysis of a 2 D component
7. Mode frequency analysis of beams (Cantilever, Simply supported, Fixed ends)
8. Harmonic analysis of a 2D component
9. Transient analysis of spring mass system
10. Spectrum analysis of spring mass system
11. Thermal stress analysis of a axisymmetric component
12. Conductive heat transfer analysis of a 2D component
13. Convective heat transfer analysis of a 2D component

TOTAL : 45

ME9404 **MECHATRONICS LABORATORY** **L T P C**
0 0 4 2

AIM:
To know the design, modeling & analysis of basic electrical, hydraulic & pneumatic systems using software and trainer kits**.**

OBJECTIVES:
- Simulation of basic hydraulic, pneumatic and electrical circuits.
- Study of Electro pneumatic circuits.
- Simulation of electro- pneumatic circuits using microprocessor.
- Modeling and analysis of basic hydraulic, pneumatic and electrical circuits using
- 'AUTOMATION STUDIO' Software.
- Study of various types of transducers.
- Study of various signal conditioning circuits.
- Open and closed loop control of AC and DC drives.
- Study of PLC and its applications.

TOTAL : 60 PERIODS

ME9405 **COMPREHENSION** **L T P C**
0 0 2 1

AIM:
To give a comprehensive knowledge and understanding in the various fields of mechanical engineering.

OBJECTIVES:
- The objective of this comprehension is to achieve an understanding of the fundamentalsof contemporary manufacturing systems including materials, manufacturing process,product and process control, computer integrated manufacture and quality. Thestudents work in groups and solve a variety of problems given to them. The problemsgiven to the students should be of real like industrial problems selected by a group offaculty members of the concerned department. A minimum of three small problemshave to be solved by each group of students. The evaluation is based on continuousassessment by a group of Faculty Members constituted by the professor in-charge of the course.

TOTAL : 30 PERIODS

ME9406 **DESIGN AND FABRICATION PROJECT** **L T P C**
0 0 4 2

AIM:
To impart the knowledge involved in conceptual design, preparation of route / schedule sheets and the fabrication.

OBJECTIVES:
- The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by

them. The students may be grouped into 2 to 4 and work under a project supervisor. The device/system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group, which will be evaluated by a Committee which will be constituted by the Head of the Department.

TOTAL : 60 PERIODS

ME9451	**PROJECT WORK**	**L T P C**
		0 0 12 6

AIM:

To apply the knowledge gained from theoretical and practical courses in solving a problem so as to encourage students' creativity, planning, coordination etc.

OBJECTIVES:

- A Project topic may be selected either from published lists or from the creative ideas of the students themselves in consultation with their guides. The aim of the project work is to deepen the comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department

ME9021	**ENERGY CONSERVATION AND MANAGEMENT**	**L T P C**
		3 0 0 3

AIM :

To instruct the importance of energy conservation in both thermal and electrical energy and its management for the better utilization of resources.

OBJECTIVE :

At the end of the course, the student expected to do

- Understand and analyse the plant energy data
- Carryout Energy audit and suggest methodologies for energy savings
- Energy accounting and balancing
- Utilise the available resources in optimal way

UNIT I IMPORTANCE OF ENERGY CONSERVATION AND MANAGEMENT 8

World, national Energy consumption – environmental aspects – Energy prices, policies – Energy auditing : methodology, analysis, energy accounting – Measurements – Thermal and Electrical.

UNIT II ELECTRICAL SYSTEMS 12

AC / DC current systems, Demand control, power factor correction, load management, Motor drives : motor efficiency testing, energy efficient motors, motor speed control – Lighting : lighting levels, efficient options, daylighting, timers, Energy efficient windows – electrical distribution systems – Transformers – Power quality – harmonic distortion.

UNIT III THERMAL SYSTEMS 10

Boiler – efficiency testing, excess air control, Steam distribution & use – steam traps, condensate recovery, flash steam utilization, Thermal Insulation. Heat exchanger networking – concept of pinch, target settling, problem table approach.

UNIT IV ENERGY CONSERVATION 8

Energy conservation in Pumps, Fans (flow control) and blowers, Compressed Air Systems, Refrigeration and air conditioning systems – Waste heat recovery recuperators, heat sheets, heat pipes, heat pumps.

UNIT V ENERGY MANAGEMENT, ECONOMICS 7

Energy resource management – Energy Management information systems – Computerized energy management – Energy economics – discount rate, payback period, internal rate of Return, life cycle costing – Financing energy conservation Projects.

TOTAL 45

TEXT BOOK

1. L.C. Witte, P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.

REFERENCES

1. I.G.C. Dryden, "The Efficient Use of Energy" Butterworths, London, 1982
2. W.C. turner, "Energy Management Hand book" Wiley, New York, 1982.
3. W.R. Murphy and G. Mc KAY "Energy Management" Butterworths, London 1987.

ME9022 NEW AND RENEWABLE ENERGY SOURCES L T P C
3 0 0 3

AIM :

To instruct the importance of renewable energy and its utilization for the thermal and electrical energy needs and also the environmental aspects of theses resources.

OBJECTIVE :

At the end of the course, the student expected to do
Understand and analyze the pattern of renewable energy resources
Suggest methodologies / technologies for its utilization
Economics of the utilization and study its environmental merits

UNIT I SOLAR ENERGY 9

Solar Radiation – Measurements of solar Radiation and sunshine – Solar Thermal Collectors – Flat Plate and Concentrating Collectors – Solar Applications – fundamentals of photo Voltaic Conversion – solar Cells – PV Systems – PV Applications.

UNIT II WIND ENERGY 9

Wind Data and Energy Estimation – wind Energy Conversion Systems – Wind Energy generators and its performance – Wind Energy Storage – Applications – Hybrid systems.

UNIT III BIO - ENERGY 9

Biomass, Biogas, Source, Composition, Technology for utilization – Biomass direct combustion – Biomass gasifier – Biogas plant – Digesters – Ethanol production – Bio diesel production and economics.

UNIT IV OTEC, TIDAL, GEOTHERMAL AND HYDEL ENERGY 9

Tidal energy – Wave energy – Data, Technology options – Open and closed OTEC Cycles – Small hydro, turbines – Geothermal energy sources, power plant and environmental issues.

UNIT V NEW ENERGY SOURCES 9

Hydrogen, generation, storage, transport and utilisation, Applications: power generation, transport – Fuel cells – technologies, types – economics and the power generation

TOTAL: 45

TEXT BOOK

1. G.D. Rai, Non Conventional Energy Sources, Khanna Publishers, New Delhi, 1999.
2. S.P. Sukhatme, Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.

REFERENCES

1. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 1996.
2. Twidell, J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 1986.
3. G.N. Tiwari, solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002
4. L.L. Freris, Wind Energy Conversion systems, Prentice Hall, UK, 1990.

ME9023 ADVANCED WELDING AND CASTING PROCESSES L T P C
3 0 0 3

AIM:

To provide students knowledge on advanced welding and design aspects of casting**.**

OBJECTIVES:

- To provide knowledge on Newer developments in Metal Casting, Planning and management of foundry,Foundry Mechanization, design of gating and risering for casting.
- To provide knowledge on Welding Metallurgy and Welding of dissimilar metals.

UNIT I WELDING OF DISSIMILAR METALS 8

Friction Welding Process – effect of speed and pressure – explosive welding – plasma arc welding – Electon beam welding – High frequency induction welding - Laser beam weding.

UNIT II WELDING METALLURGY 8

Weld thermal cycles – Heat Affected Zone(HAZ) – Weldability of steels – Cast Iron –Stainless steel,aluminium – Copper and Titanium alloys – Hydrogen embrittlement – Pro and post weld heat Treatments – weld defects – Testing of Welds.

UNIT III DESIGN OF GATING SYSTEM 11

Soldification,gating,risering and casting design solidification process – Gating System design pouring Time – Choke Area – Sprue – Other gating elements – Risering design - Caines – modulus – Naval research Laboratory method – feeding distances – Chills feeding Aids – design of Castings.

UNIT IV FERROUS AND NON FERROUS CASTINGS 10

Steel Casting – The family of cast iron – melting of steels and cast irons – Grey iron foundry practice – Ductile iron – Malleable Iron casting design – Considerations Aluminium ,Magnesium,Copper,Zinc and Titanium alloys foundry practice.

UNIT V FOUNDRY MECHANISM 8

Mechanical equipments in foundry – plant site location, layout – Plant Engineering – Maintenance – Services – Practical aspects .

TOTAL : 45 PERIODS

TEXT BOOKS:

1. P.N.Rao , Manufacturing Technology , Tat McGraw Hill, 2001

REFERENCES:

1. Heine , Loper and Rosenthal, Principles of Metal Casting ,Tata McGraw Hill,1994
2. A.K.Chakrabarti, Casting Technology and Cast Alloys, Prentice –Hall Of India Ltd, 2005
3. T.V.Rama Rao, Metal casting Principles and Practice, New Age International, 2007
4. Parmar, Welding Engineering and Technology, Khanna Publishers,2002
5. Little R.L.Welding and Welding Technology, McGraw Hill, NewYork 1973

ME9024 MECHANICAL VIBRATIONS AND NOISE L T P C
3 0 0 3

AIM:

To impart the knowledge of effects of vibrations and noise and the methods to control them in engineering applications.

OBJECTIVES:

- To understand the Fundamentals of Vibration and Noise and its practical
- applications.
- To understand the working principle and operations of various vibrations and noise
- measuring instruments
- To understand the various Vibration and Noise control strategies

UNIT I FUNDAMENTALS OF VIBRATION 9

Introduction -Sources of vibration-Mathematical models-Types of vibration. Review of Single degree freedom systems with and without damping –Types of Damping- Dynamics of rotating and reciprocating engines– Critical speed of industrial rotors with specific reference to rigid and flexible rotors – Influence of type of bearings – Vibration isolation – Nonmetallic isolators.

UNIT II TWO DEGREE FREEDOM SYSTEM 8

Introduction- Free vibration of Undamped and damped system. Torsional system-Spring coupled system – mass coupled system – Vibration of two degree freedom system – Forced vibration with harmonic Excitation – Dynamic Vibration Absorber – Torsional Vibration Absorber-Vibration control.

UNIT III MULTI-DEGREE FREEDOM SYSTEM 8

Longitudinal, Transverse, Torsional systems, Geared systems Complexities – Normal mode of vibration – Flexibility Matrix and Stiffness matrix – Eigen values and eigen vectors – Orthogonal properties – Energy methods of Rayleigh, Ritz and Dunkerley

UNIT IV EXPERIMENTAL VIBRATION ANALYSIS 10

Need for the experimental methods in Vibration analysis. Vibration Measuring Devices: seismometer, accelerometer and velometers-Vibration exciters: mechanical, hydraulic, electromagnetic and electrodynamic –Frequency measuring instruments: single reed,multi reed and stroboscope. Vibration meters and sound level meter. Signal conditioning devices: Filters, Amplifiers, Modulators/Demodulators, ADC/DAC. Signal analysis devices. Vibration recording and display devices. Experimental modal analysis. System Identification from frequency response

UNIT V ENGINEERING NOISE AND ITS CONTROL 10

Introduction-Sound Power, Sound Intensity and Sound pressure level. Sound spectra.The decibel scale-Decibel addition, subtraction and averaging- Loudness, Weighting networks, Equivalent sound level. Noise: Effects, Ratings and Regulations. Noise: Sources, Isolation and control-Industrial noise sources-Industrial noise control strategies-Noise control at the source, along the path and at the receiver.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ambekar.A.G. "Mechanical Vibrations and Noise Engineering", Prentice Hall of India, New Delhi,2006
2. Rao, S.S.," Mechanical Vibrations," Addison Wesley Longman, 1995.

REFERENCES:

1. Thomson, W.T. – "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990.
2. Den Hartog, J.P, "Mechanical Vibrations," Dover Publications, 1990.
3. Ramamurti. V, "Mechanical Vibration Practice with Basic Theory", Narosa, New Delhi, 2000.

ME9025 DESIGN FOR MANUFACTURING L T P C
3 0 0 3

AIM:

To give exposure to interrelation between design and manufacture.

OBJECTIVES:

- To understand the principles of design such that the manufacturing of the product is possible.
- To educate students on Various design aspects to be considered for manufacturing the products using different processes.

UNIT I DESIGN FOR MANUFACTURING APPROACH AND PROCESS 9

Methodologies and tools, design axioms, design for assembly and evaluation, minimum part assessment. Taguchi method, robustness assessment, manufacturing process rules, designer's tool kit, Computer Aided group Technology, failure mode effects analysis, Value Analysis. Design for minimum number of parts, development of modular design, minimizing part variations, design of parts to be multi-functional, multi-use, ease of fabrication, Poka Yoke principles.

UNIT II GEOMETRIC ANALYSIS 9

Surface finish, review of relationship between attainable tolerance grades and different machining processes. Analysis of tapers, screw threads, applying probability to tolerances.

UNIT III FORM DESIGN OF CASTINGS AND WELDMENTS 9

Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, use of welding symbols.

UNIT IV MECHANICAL ASSEMBLY 9

Selective assembly, deciding the number of groups, control of axial play, examples, grouped datum systems - different types, geometric analysis and applications – design features to facilitate automated assembly.

UNIT V TRUE POSITION THEORY 9

Virtual size concept, floating and fixed fasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, examples. Operation sequence for typical shaft type of components. Preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples.

TOTAL : 45 PERIODS

TEXT BOOKS :

1. Harry Peck, "Designing for Manufacture", Pitman Publications, 1983.
2. Matousek, Engineering Design, - A Systematic Approach" - Blackie & Son Ltd., London, 1974.

REFERENCE BOOKS :

1. Spotts M.F., "Dimensioning and Tolerance for Quantity Production, Prentice Hall Inc., 1983.
2. Oliver R. Wade, "Tolerance Control in Design and Manufacturing", Industrial Press Inc. New York Publications, 1967.
3. James G. Bralla, "Hand Book of Product Design for Manufacturing" McGraw Hill Publications, 1983.
4. Trucks H.E., "Design for Economic Production", Society of Manufacturing Engineers, michigan, 2nd edition, 1987.

ME9026 GAS DYNAMICS AND SPACE PROPULSION L T P C
3 0 0 3

AIM :

To impart knowledge to the students on compressible flow through ducts, jet propulsion and space propulsion.

OBJECTIVE

- 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.

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS (6)

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers – Use of Gas tables.

UNIT II FLOW THROUGH DUCTS (9)

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties – Use of tables and charts – Generalised gas dynamics.

UNIT III NORMAL AND OBLIQUE SHOCKS (10)

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Use of table and charts – Applications.

UNIT IV JET PROPULSION (10)

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT V SPACE PROPULSION (10)

Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

TOTAL : 45 PERIODS

TEXT BOOKS :

1. Anderson, J.D., Modern Compressible flow, McGraw Hill, 3rd Edition, 2003.
2. H. Cohen, G.E.C. Rogers & Saravanamutto, Gas Turbine Theory, Longman Group Ltd., 1980.
3. S.M. Yahya, fundamentals of Compressible Flow, New Age International (P) Limited, New Delhi, 1996.

REFERENCES :
1. P. Hill and C. Peterson, Mechanics and Thermodynamics of Propulsion, Addison – Wesley Publishing company, 1992.
2. N.J. Zucrow, Aircraft and Missile Propulsion, vol.1 & II, John Wiley, 1975.
3. N.J. Zucrow, Principles of Jet Propulsion and Gas Turbines, John Wiley, New York, 1970
4. G.P. Sutton, Rocket Propulsion Elements, John wiley, 1986, New York. A.H. Shapiro, Dynamics and Thermodynamics of Compressible fluid Flow, , John wiley, 1953, New York.
5. V. Ganesan, Gas Turbines, Tata McGraw Hill Publishing Co., New Delhi, 1999.
6. PR.S.L. Somasundaram, Gas Dynamics and Jet Propulsions, New Age International Publishers, 1996.
7. V. Babu, Fundamentals of Gas Dynamics, ANE Books India, 2008.

ME9027 MANAGEMENT SCIENCES L T P C
3 0 0 3

AIM:
To introduce the concepts in optimization of resources for industries

OBJECTIVES:
- To create awareness about the optimization of resources.
- To understand and apply the operations research techniques in industrial operations.

UNIT I LINEAR PROGRAMMING PROBLEMS 9
OR-Definition - Phases - models, LP model - formulation - solutions: Graphical- simplex method, Duality in LP - Dual simplex method - Revised simplex method - Sensitivity analysis.

UNIT II TRANSPORTATION AND NETWORK MODELS 10
Transportation problems- Assignment problems - Traveling salesman problems, Project management: Network logic - Fulkerson's rule - AON diagram - CPM and PERT techniques, se quencing models.

UNIT III INVENTORY CONTROL 8
Types of inventory- Inventory cost - EOQ - Deterministic inventory problems - EOQ with price breaks - Stochastic inventory problems - Multi product problems - Systems of inventory control - Selective inventory control techniques.

UNIT IV QUEUING THEORY 9
Queuing system - Characteristics - symbols - Poisson process and exponential distribution - Single server queuing models - Multiserver queuing models, Simulation Monte Carlo technique - Inventory & Queuing problems.

UNIT V DECISION MODELS 9
Theory of Games - Two person zero sum games - pure strategies - Mixed strategies Principle of dominance - Graphical solutions - Algebraic solutions - LP solutions. Replacement models - types of failures - replacement of items: Efficiency deteriorates with time, sudden failures.

TOTAL : 45 PERIODS

TEXT BOOKS:
1. Wayne.L.Winston, Operations research applications and algorithms, 4th edition 2007, Thomson learning.
2. HamdyATaha, Operations research an introduction, 8th edition 2007, PHil Pearson education.

REFERENCES:
1. G.Srinivasan, Operations research principles and applications, EEE 2007, PHI.
2. R.Pannerselvam, Operations research, 2hd edition 2007, PHI
3. Frederick. S. Hiller and Gerald.J.Lieberman, Operations research concepts and cases, 8th edition (SIE),TMH.
4. Ravindran, Phillips and Solberg, Operations research principles and practice, 2nd edition 2007, Wiley India.
5. J.K.Sharma, Operations research theory and aplications, 3rd edition 2007, Macmillan India.
6. Prem kumar Gupta and D.S.Hira, Problems in Operations research, S.Chand.

ME9028 COMPOSITE MATERIALS AND MECHANICS L T P C
3 0 0 3

AIM:

To understand the fundamentals of mechanics and manufacturing methods of composites for its strength and design.

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 INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS & MANUFACTURING 12

Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding – Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes

UNIT II FLAT PLATE LAMINATE CONSTITUTE EQUATIONS 10

Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

UNIT III LAMINA STRENGTH ANALYSIS 5

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure

UNIT IV THERMAL ANALYSIS 8

Assumption of Constant C.T.E's. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates

UNIT V ANALYSIS OF LAMINATED FLAT PLATES 10

Equilibrium Equations. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Gibson, R.F., Principles of Composite Material Mechanics, McGraw-Hill, 1994, Second Edition - CRC press in progress.
2. Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill, 1998

REFERENCES:

1. Issac M. Daniel and Ori Ishai, “Engineering Mechanics of Composite Materials”, Oxford University Press-2006, First Indian Edition - 2007
2. Mallick, P.K., Fiber –”Reinforced Composites: Materials, Manufacturing and Design”, Maneel Dekker Inc, 1993.
3. Halpin, J.C., “Primer on Composite Materials, Analysis”, Techomic Publishing Co.,1984.
4. Agarwal, B.D., and Broutman L.J., “Analysis and Performance of Fiber Composites” John Wiley and Sons, New York, 1990.
5. Mallick, P.K. and Newman, S., (edition), “Composite Materials Technology: Processes and Properties”, Hansen Publisher, Munish, 1990.

ME9029 AUTOMOBILE ENGINEERING L T P C
3 0 0 3

AIM:

Impartation of basic principles of Automotive Vehicular systems with suitable illustrations and numerical problems ; also enlightenment of development trends.

OBJECTIVE :

- To provide a comprehensive view of automobile engineering to the students.

PREREQUISITE:

Other branch students may be offered this course without any preconditions. However, a orientation programme lasting a duration of 10 hours may be offered on selected topics like thermodynamics and vehicle mechanics.

UNIT I INTRODUCTION 5

Basic layouts of automotive vehicles including electric and hybrid electric systems,specifications and performance parameters of vehicles. Types of vehicle bodies & chasses.

UNIT II ENGINE SYSTEMS 10

Reciprocating engine systems, Rotary engine systems, Electric motors, Hybrid systems, Gas turbine systems. Development trends like GDI and HCCI engine systems, complex hybrid electric systems, closed loop controls in piston engine systems, Alternate Fuel systems for propulsion engines. Vehicular pollutants emission and their controls. Three Way Catalytic converter features. Electronic Engine Management systems.

UNIT III TRANSMISSION SYSTEM 10

Types of Clutch, gear box (manual and automatic), propeller shafting, differential and types of rear axle.

UNIT IV AUTOMOTIVE SAFETY, HANDLING AND COMFORT SYSTEMS 10

Braking System, Steering System, Suspension system, Electrical system, Safety systems and HVAC system.

UNIT V TESTING AND SERVICING OF AUTOMOBILE ENGINES AND VEHICLES 10

1. A brief discussion on the following :
2. Engine Tunning
3. Chassis Dynamometer
4. Tests for emissions of pollutants like HC, CO, CO2, NOx and particulates
5. Wind tunnel Testing of vehicles

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Automotive Mechanics, William H Crouse and Donald L. Anglin, Tata McGraw-Hill Publishing Company Ltd., 2004, Tenth Edition.

REFERENCES:

1. Automotive Handbook, Bosch, Robert Bosch GmbH, Germany, 2004, Sixth Edition.
2. Automotive Technology – A Systems Approach, Jack Erjavek, Thomson Learning, 3rd Edition, 1999.

ME9030 **INDUSTRIAL TRIBOLOGY** **L T P C**
3 0 0 3

AIM:
To expose the students in the area of friction, wear and lubrication.

OBJECTIVES:
- To teach the basics of friction mechanisms and materials selection based on friction behavior.
- To teach the design principles involved in the design of various types of bearings.

UNIT 1 SURFACES AND FRICTION **9**
Topography of Engineering surfaces- Contact between surfaces - Sources of sliding Friction – dhesion-Ploughing- Energy dissipation mechanisms Friction Characteristics of metals - Friction of non metals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction - Source of Rolling Friction – Stick slip motion - Measurement of Friction.

UNIT II WEAR **9**
Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear – Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture - wear - Wear of Ceramics and Polymers - Wear Measurements.

UNIT III LUBRICANTS AND LUBRICATION TYPES **9**
Types and properties of Lubricants - Testing methods - Hydrodynamic Lubrication – Elasto-hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication- Hydrostatic Lubrication.

UNIT IV FILM LUBRICATION THEORY **9**
Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings – Reaction torque on the bearings - Virtual Co-efficient of friction - The Sommerfield diagram.

UNIT V SURFACE ENGINEERING AND MATERIALS FOR BEARINGS **9**
Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes – Surface coatings - Plating and anodizing - Fusion Processes - Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

TOTAL : 45 PERIODS

TEXT BOOK:
1. A.Harnoy “ Bearing Design in Machinery “Marcel Dekker Inc,NewYork,2003

REFERENCES:
1. M.M.Khonsari & E.R.Booser, “ Applied Tribology”,John Willey &Sons,New York,2001
2. E.P.Bowden and Tabor.D., " Friction and Lubrication ", Heinemann EducationalBooks Ltd., 1974.
3. A.Cameron, " Basic Lubrication theory ", Longman, U.K.., 1981.
4. M.J.Neale (Editor), " Tribology Handbook ", Newnes. Butter worth, Heinemann, U.K., 1995.

ME9031 TURBO MACHINERY L T P C
3 0 0 3

AIM :
To teach and train the students in the filed of Turbo machinery and its applications.

OBJECTIVE :
- To understand the various systems, principles, operations and applications of different types of turbo machinery components.

UNIT I PRINCIPLES 9
Energy transfer between fluid and rotor-classification of fluid machinery,-dimensionless parameters-specific speed-applications-stage velocity triangles-work and efficiency.

UNIT II CENTRIFUGAL FANS AND BLOWERS 9
Types- stage and design parameters-flow analysis in impeller blades-volute and diffusers, losses, characteristic curves and selection, fan drives and fan noise.

UNIT III CENTRIFUGAL COMPRESSOR 9
Construction details, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

UNIT IV AXIAL FLOW COMPRESSOR 9
Stage velocity diagrams, enthalpy-entropy diagrams, stage losses and efficiency, work done simple stage design problems and performance characteristics.

UNIT V AXIAL AND RADIAL FLOW TURBINES 9
Stage velocity diagrams, reaction stages, losses and coefficients, blade design principles, testing and performance characteristics.

TOTAL: 45 PERIODS

TEXT BOOK
1. Yahya, S.H., Turbines, Compressor and Fans, Tata McGraw Hill Publishing Company, 1996.

REFERENCES

1. Bruneck, Fans, Pergamom Press, 1973.
2. Earl Logan, Jr., Hand book of Turbomachinery, Marcel Dekker Inc., 1992.
3. Dixon, S.I., Fluid Mechanics and Thermodynamics of Turbomachinery, Pergamon Press, 1990.
4. Shepherd, D.G., Principles of Turbomachinery, Macmillan, 1969.
5. Stepanpff, A.J., Blowers and Pumps, John Wiley and Sons Inc. 1965.
6. Ganesan, V., Gas Turbines, Tata McGraw Hill Pub. Co., 1999.
7. Gopalakrishnan .G and Prithvi Raj .D, A Treatise on Turbomachines, Scifech Publications (India) Pvt. Ltd., 2002.

ME9032 COMPUTATIONAL FLUID DYNAMICS L T P C
3 0 0 3

AIM:
To impart the knowledge of numerical techniques to the solution of fluid dynamics and heat transfer problems.

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

PREREQUISITE : Fundamental Knowledge of partial differential equations, Heat Transfer and Fluid Mechanics

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS (8)

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momemtum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT II FINITE DIFFERENCE METHOD (9)

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – solution methods for finite difference equations – Elliptic equations – Iterative solution Methods – Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations.

UNIT III FINITE VOLUME METHOD (FVM) FOR DIFFUSION (9)

Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank – Nicolson and fully implicit schemes.

UNIT IV FINITE VOLUME METHOD FOR CONVECTION DIFFUSION (10)

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes-properties of discretization schemes – Conservativeness, Boundedness, Trasnportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT V CALCULATION FLOW FIELD BY FVM (9)

Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants. Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models

TOTAL : 45 PERIODS

TEXT BOOKS :

1. T.J. Chung, Computational Fluid Dynamics, Cambridge University, Press, 2002.
2. Versteeg, H.K., and Malalasekera, W., An Introduction to Computational Fluid Dynamics: The finite volume Method, Longman, 1998.
3. Ghoshdastidar , P.S., computer Simulation of flow and heat transfer, Tata McGraw Hill Publishing Company Ltd., 1998.

REFERENCES :

1. Patankar, S.V. Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation, 2004.
2. Muralidhar, K., and Sundararajan, T., computationsl Fluid Flow and Heat Transfer, Narosa Publishing House, NewDelhi, 1995.
3. Ghoshdastidar P.S., Heat Transfer, Oxford Unversity Press, 2005.
4. Prodip Niyogi, Chakrabarty .S.K., Laha .M.K. Introduction to Computational Fluid Dynamics, Pearson Education, 2005.
5. Introduction to Computational Fluid Dynamics Anil W. Date Cambridge University Press, 2005.

ME 9033 MICRO ELECTRO MECHANICAL SYSTEMS L T P C
3 0 0 3

AIM:
To impart knowledge to the students about the design and fabrication of Micro Electro Mechanical Systems (MEMS).

OBJECTIVES:
On completion of the course, the students will be able to select the suitable manufacturing processes and strategies for the production of MEMS.

UNIT I INTRODUCTION TO MICROSYSTEMS 9
Overview of Microsystems technology, Multi disciplinary nature of MEMS. Survey of materials central to micro engineering. Applications of MEMS in various industries.

UNIT II MICRO MANUFACTURING TECHNIQUES 9
Photolithography, Film deposition, Etching processes, Bulk micro machining, silicon surface micro machining, L1GA process, Rapid micro product development.

UNIT III MICRO SENSORS AND MICRO ACTUATORS 9
Transducer principles, various types of displacement force, vibration and temperature micro sensors, signal detection and processing. Energy conversion and force generation, Electromagnetic Actuators, Reluctance motors, piezoelectric actuators, bimetal-actuator Friction and wear.

UNIT IV INTRODUCTION TO MICRO / NANO FLUIDS 9
Fundamentals of micro fluidics, Micro pump - introduction - Types - Mechanical Micro pump - Non Mechanical micro pumps, Actuating Principles, Design rules for micro pump - modeling and simulation, Verification and testing - Applications.

UNIT V MICROSYSTEMS DESIGN AND PACKAGING 9

Design considerations, Mechanical Design, Process design, Realisation of MEMS components using intellisuite. Micro system packaging, Packing Technologies, Assembly of Microsystems, Reliability in MEMS.

TOTAL : 45 PERIODS

TEXTBOOK:
1. "MEMS Handbook:" Edited by Mohamed Gad - el - Hak CRC Press 2002

REFERENCES:
1. "Sensors Handbook "Sabrie Solomon, Mc Graw Hill 1998
2. "Fundamentals of micro fabrication" Marc F Madou CRC Press 2002 2nd Edition
3. "Micro fluidics and bio mems application" Francis E.H. Tay and W.O.Choong
4. "Micromachanics and MEMS" Trimmer William S., Ed., IEEE Press New York 1997
5. "An introduction to Micro electro mechanical Systems Engineering" Maluf, Nadim AR Tech house, Boston 2000.

MF9032 ARTIFICIAL INTELLIGENCE L T P C
3 0 0 3

UNIT I INTRODUCTION 10
Definition - Pattern recognition - Criteria of Success - Production Systems - Control Strategies - Heuristic Search - Problem Characteristics - Production System Characteristics - Forward and backward reasoning – Matching Indexing - Heuristic Functions - Search Algorithms.

UNIT II GAME PLAYING 8
Overview - Minimax search procedure - Adding Alpha - Beta cutoffs - Waiting for Quiescence – Secondary search - Using book moves.

UNIT III KNOWLEDGE REPRESENTATION 10
Use of Predicate logic - Introduction to representation - representing simple facts in logic - augmenting the representation - resolution - Conversion to clause from - The basis of resolution-Unification of algorithm - Question answering - Natural Deduction.

UNIT IV KNOWLEDGE REPRESENTATION USING OTHER LOGICS 8

Non-monotonic reasoning - Statistical and Probabilistic reasoning - Techniques for dealing with a random world and deterministic world - rule based system.

UNIT V STRUCTURAL REPRESENTATIONS OF KNOWLEDGE 9

Common knowledge structures-Level of representation - Right structures - Declarative representations - Semantic nets - Conceptual dependency - Frames - Scripts - Procedural representation - Natural language understanding - Perception - learning - Implementation A.I. Systems

TOTAL : 45 PERIODS

TEXT BOOK :

1. Elaine Rich, “Artificial Intelligence”, McGraw Hill Book Company, 1998.

REFERENCES :

1. M.W.Richaugh, “Artificial Intelligence, A.Knowledge Based Apprach”, PWS Rent Publishing, Boston.
2. Charniac, E And M.C.Dermott, “Introduction to Artificial Intelligence”, Addison Wesley Publishing Company.

ME9034 DESIGN OF PRESSURE VESSELS AND PIPING L T P C
3 0 0 3

AIM:

To give exposure to various types of process equipments and their design.

OBJECTIVES:

To understand the different types of stresses and their effects in pressure vessel.
To understand the piping layout and the stresses acting on it.

UNIT I CYLINDRICAL SHELL AND VARIOUS CLOSURES 9

Membrane theory for thin shells, stresses in cylindrical, spherical and conical shells,dilation of above shells, general theory of membrane stresses in vessel under internal pressure and its application to ellipsoidal and torispherical end closures. Bending of circular plates and determination of stresses in simply supported and clamped circular plate. Introduction to ASME code and formulae

UNIT II JUNCTION STRESSES, OPENING AND REINFORCEMENTS 9

Discontinuity stresses. Stress concentration in plate having circular hole due to bi-axial loading. Theory of reinforced opening and reinforcement limits.

UNIT III SUPPORT DESIGN 9

Supports for vertical & horizontal vessels. Design of base plate and support lugs. Types of anchor bolt, its material and allowable stresses. Design of saddle supports.

UNIT IV BUCKLING IN VESSELS 9

Buckling of vessels under external pressure. Elastic buckling of long cylinders, buckling modes, Collapse under external pressure. Design for stiffening rings. Buckling under, combined external pressure and axial loading.

UNIT V PIPING STRESS ANALYSIS 9

Flow diagram, Piping layout and piping stress analysis. Flexibility factor and stress intensification factor. Design of piping system as per B31.1 piping code. Piping components – bends, tees, bellows and valves. Types of piping supports and their behaviour.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Harvey J F , 'Pressure vessel design' CBS publication
2. Brownell. L. E & Young. E. D , 'Process equipment design', Wiley Eastern Ltd., India

REFERENCES:

1. ASME Pressure Vessel and Boiler code, Section VIII Div 1 & 2, 2003
2. American standard code for pressure piping , B 31.1
3. Henry H Bednar, Pressure vessel Design Hand book,CBS publishers and distributors
4. Stanley M Wales, Chemical Process equipment, selection and design, Butterworths, series in Chemical Engineering,1988
5. William.j.,Bees,"Approximate methods in the Design and Analysis of pressure vessels and piping", ASME Pressure vessels and piping conference,1997

MF9402 FLEXIBLE MANUFACTURING SYSTEMS L T P C
3 0 0 3

UNIT I PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS 9

Introduction – Single product, N-product, single batch, N-Batch scheduling problem – Modeling of N operations in M machines – Knowledge based scheduling system.

UNIT II COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS 10

Introduction – Composition of FMS – Hierarchy of computer control – Computer control of work center and assembly lines – FMS supervising computer control. Types of software – specification and selection – trends.

UNIT III FMS SIMULATION AND DATA BASE 10

Application of simulation – Model of an FMS – Simulation software – limitation. Manufacturing data systems – Data flow – CAD/CAM considerations in planning the FMS data base – FMS database systems – Planning for FMS database.

UNIT IV GROUP TECHNOLOGY AND FMS 9

Introduction – matrix formulation – Mathematical Programming formulation – Graph Formulation – Knowledge based system for group technology. Application of possibility distributions in FMS systems justification.

UNIT V FACTORY OF THE FUTURE 7

FMS application in aerospace machining, sheet metal fabrication and prismatic component production. FMS development towards factories of the future – Artificial intelligence and Expert systems in FMS – Design Philosophy and Characteristics for Future.

TOTAL : 45 PERIODS

TEXT BOOK

1. MIKELL P.GROOVER, automation, Production Systems and Computer Integrated Manufacturing, Prentice Hall of India Pvt. Ltd., 1989.

REFERENCES

1. NAND JHA.K., Handbook of Flexible Manufacturing Systems, Academic Press Inc., 1991.

ME 9035 MEASUREMENTS AND CONTROL L T P C
3 0 0 3

AIM:

To educate student on measurement and control systems which are the essential components of manufacturing system.

OBJECTIVES:

To understand the principle and use of sensors for measurement of different parameters.
To understand the concept of feedback control systems and their applications.

UNIT I MEASUREMENTS 9

General concepts - Units and standards - Measuring instruments - sensitivity, readability, range accuracy, precision - static and dynamic response - repeatability hysteresis - systematic and random errors - correction - calibration.

UNIT II INSTRUMENTS 9

Transducer, Modifying (intermediate) and Terminal stages - Mechanical and electrical transducers - preamplifiers - charge amplifiers - filters - attenuaters - D' Arsonval CRO - Oscillographs - records - micro processor based data logging, processing and output.

UNIT III PARAMETERS FOR MEASUREMENT 9

Dimension, displacement velocity, acceleration, impact - Force, torque, power - strainpressure - humidity- temperature - flow-Time, frequency and phase angle - noise and sound level. Radio tracer techniques - Flow visualization - shadow-graph interferometer, Schlieren, Laser doppler anemometer.

UNIT IV AUTOMATIC CONTROL SYSTEMS 9

Basic elements - feedback principle implication of measurements - Error detectors final actuating elements - Two position, multi position, floating, pro-portional controlsrelays - *seNO* amplifiers - *seNO* motors - mechanical, Electrical, magnetic, electronic, hydraulic, pneumatic systems.

UNIT V APPLICATION OF CONTROL SYSTEMS 9

Governing of speed kinetic and process control- pressure, temperature, fluid level, flowthrust and flight control - photo electric controls.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. E.O.Doeblin, "Measurement Systems, Application and Design", Mc Graw Hillint. Edition, 4th Ed., 1990.
2. I.J.Nagarath and M.Gopal, "Control Systems Engineering", John wiley & Sons, 2nd Ed., Ch.1-4, 1982.

REFERENCES:

1. J.P. Holman and N.J.Gajda Jr., "Experimental Methods for Engineers", Mc Graw Hill Int. Edition, 5th Ed., 1989.
2. T.G.Beckwith and N.L.Buck, "Mechanical Measurements", Addision Wesley Pub, Co., 1969.
3. W.H.Bureau, "What the printer should know about paper", GATF, 1983.
4. J.P.Casey, "Ed. Pulp and Paper, Chemistry & Chemical Technology", Vol. Wiley-Interscience Publication, 1981.

GE 9021 PROFESSIONAL ETHICS IN ENGINEERING L T P C
3 0 0 3

AIM:

To sensitize the engineering students on blending both technical and ethical responsibilities.

OBJECTIVES:

- Identify the core values that shape the ethical behavior of an engineer.
- Utilize opportunities to explore one's own values in ethical issues.
- Become aware of ethical concerns and conflicts.
- Enhance familiarity with codes of conduct.
- Increase the ability to recognize and resolve ethical dilemmas.

UNIT I ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal

UNIT IV RESPONSIBILITIES AND RIGHTS 9

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES 9

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

TOTAL : 45 PERIODS

TEXT BOOKS :

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York (2005).
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Thompson Learning, (2000).

REFERENCES :

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, (1999).
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, (2003)
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, (2001)
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, (2004)
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003)

GE9023 FUNDAMENTALS OF NANOSCIENCE L T P C
3 0 0 3

AIM:
To make the students understand the importance ,relevance and potentialities of this emerging field of study.

OBJECTIVES:
- Study the basic nano technology and nano science.
- Understand interdisciplinary nature of this field.
- Understand the important role of physics, chemistry ,biology.
- Recognize that the rules of nano science are fundamentally different than those we experience.
- Study the basic fabrication strategies of nano science.

UNIT I INTRODUCTION 10
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II PREPARATION METHODS 10
Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 5
Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

UNIT IV PREPARATION ENVIRONMENTS 10
Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

UNIT V CHARECTERISATION TECHNIQUES 10
X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

TOTAL :45 Periods

TEXT BOOKS

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale charecterisation of surfaces & Interfaces”, 2nd Edition,
3. Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES

1. G Timp (Editor), “Nanotechnology”, AIP press/Springer, 1999
2. Akhlesh Lakhtakia (Editor), “The Hand Book of Nano Technology,Nanometer Structure”, Theory, Modeling and Simulations”, Prentice-Hall of India (P) Ltd, New Delhi, 2007.

MA9261 PROBABILITY AND STATISTICS L T P C
3 0 0 3

UNIT I RANDOM VARIABLES 9 + 3

Discrete and Continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions - Functions of random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 9 + 3

Joint distributions – Marginal and Conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables-Linberg Levy central limit theorem

UNIT III TESTING OF HYPOTHESIS 9 + 3

Tests for single mean – Proportion – Difference of means – Tests for single variance and equality of variances – χ^2-test for goodness of fit – Independence of attributes.

UNIT IV DESIGN OF EXPERIMENTS 9 + 3

Completely randomized design – Randomized block design – Latin square design - 2^2 - factorial design.

UNIT V STATISTICAL QUALITY CONTROL 9 + 3

Control charts for measurements ($\bar{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8th edition, 2007.
2. R.A. Johnson, C.B. Gupta, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th edition, 2006, / R.A. Johnson, "Miller and Freund's Probability and Statistics for Engineers', Prentice Hall of India, 7th edition, 2007.

BOOKS FOR REFERENCE:

1. J.L. Devore, "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/Cole, International Student Edition, 7th edition, 2008.
2. J. S. Milton, J.C. Arnold, " Introduction to Probability and Statistics", Tata McGraw Hill, 4th edition, 2007.
3. S.M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists, 3rd edition, Academic Press, (An imprint of Elsevier), 2004

ME9036 ADVANCED I.C. ENGINES L T P C
3 0 0 3

AIM :

To impart the knowledge of advancements in the field of Internal Combustion Engines.

OBJECTIVE :

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

UNIT I SPARK IGNITION ENGINES (9)

Spark ignition Engine mixture requirements – Fuel and injection systems – Monopoint, Multipoint injection, Direct injection – Stages of combustion – Normal and Abnormal combustion – Factors affecting knock – combustion chambers.

UNIT II COMPRESSION IGNITION ENGINES (9)

Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel spray behaviour – spray structure and spray penetration – Air motion - introduction to Turbocharging.

UNIT III POLLUTANT FORMATION AND CONTROL (9)

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, NOx, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters and Particulate Traps – Methods of measurement – Emission norms and Driving cycles.

UNIT IV ALTERNATIVE FUELS (9)

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits as fuels - Engine Modifications.

UNIT V RECENT TRENDS (9)

Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – common Rail direct Injection Systems – Hybrid Electric vehicles – fuel Cells.

TOTAL : 45 PERIODS

TEXT BOOK

1. K.K. Ramalingam, Internal Combustion Engine Fundamentals, Scitech Publications, 2002.

REFERENCES

1. R.B. Mathur and R.P. Sharma, Internal Combustion Engines.
2. V. Ganesan, Internal Combustion Engines, II Edition, TMH, 2002.
3. Duffy Smith, Auto Fuel Systems, The Good Heart Willox Company, Inc., 1987.

ME9037 REFRIGERATION AND AIR CONDITIONING L T P C
3 0 0 3

AIM:

To inculcate the students with the knowledge of Refrigeration and aid conditioning.

OBJECTIVES:

To understand the underlying principles of operation in different Refrigeration & Air conditioning systems and components.
To provide knowledge on design aspects of Refrigeration & Air conditioning Systems

UNIT I REFRIGERATION CYCLE 7

Review of thermodynamic principles of refrigeration. Concept or TS diagram Air refrigeration system. Vapour compression refrigeration cycle - use of P.H charts - multistage and multiple evaporator systems - cascade system - COP comparison.

UNIT II REFRIGERANTS, SYSTEM COMPONENTS AND BALANCING 10

Compressors - reciprocating & rotary (elementary treatment) - condensers – evaporators cooling towers. Refrigerants - properties - selection of refrigerants, Alternate Refrigerants, Cycling controls.

UNIT III PSYCHROMETRY 10

Psychrometric processes use of psychrometric charts - Grand and Room Sensible Heat Factors - bypass factor - air washers, requirements of comfort air conditioning, Summer and Winter Air conditioning.

UNIT IV AIR CONDITIONING SYSTEMS 9

Cooling load calculation. Working principles of Centralised Air conditioning systems, Split, Ductable split, Packaged Air conditioning, VAV & VRV Systems. Duct Design by equal friction method, Indoor Air quality concepts.

UNIT V UNCONVENTIONAL REFRIGERATION CYCLES 9

Vapor Absorption system –Ejector jet , Steam jet refrigeration, Thermo electric refrigeration. Applications - ice plant - food storage plants - milk - chilling plants.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Manohar Prasad, " Refrigeration and Air Conditioning", Wiley Eastern Ltd., 1983
2. Arora C.P., " Refrigeration and Air Conditioning", Tata McGraw Hill, New Delhi, 1988.

REFERENCE BOOKS:

1. Roy. J. Dossat, " Principles of Refrigeration", Pearson Education 1997
2. Jordon and Priester, " Refrigeration and Air Conditioning", Prentice Hall of India PVT Ltd., New Delhi, 1985.
3. Stoecker N.F and Jones, " Refrigeration and Air Conditioning", TMH, New Delhi, 1981.

MF9023 RAPID PROTOTYPING L T P C
3 0 0 3

OBJECTIVES:

Generating a good understanding of RP history, its development and applications.
To impart knowledge on different types of RP systems, i.e., the process, advantages, limitations and applications.
To expose the students to different types of materials used in RP systems to make best use of various RP machines.
To impart knowledge on various new techniques in RP and reverse engineering.

UNIT I INTRODUCTION 8

History – Development of RP systems – Applications in Product Development,Reverse Engineering, Rapid Tooling, Rapid Manufacturing- Principle –Fundamental – File format – Other translators – medical applications of RP – On demand manufacturing – Direct material deposition - Shape Deposition Manufacturing.

UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS 10

Classification – Liquid based system - Stereolithography Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses. Solid based system - Fused Deposition Modeling, principle, process, products, advantages, applications and uses - Laminated Object Manufacturing

UNIT III POWDER BASED RAPID PROTOTYPING SYSTEMS 10

Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses. Three Dimensional Printing – process, major applications, research and development. Direct shell

production casting – key strengths, process, applications and uses, case studies, research and development. Laser Sintering System, emanufacturing using Laser sintering, customized plastic parts, customized metal parts, e-manufacturing - Laser Engineered Net Shaping (LENS).

UNIT IV MATERIALS FOR RAPID PROTOTYPING SYSTEMS 10

Nature of material – type of material – polymers, metals, ceramics and compositesliquid based materials, photo polymer development – solid based materials, powder based materials - case study.

UNIT V REVERSE ENGINEERING AND NEW TECHNOLOGIES 7

Introduction, measuring device- contact type and non-contact type, CAD model creation from point clouds-preprocessing, point clouds to surface model creation, medical data processing - types of medical imaging, software for making medical models, medical materials, other applications - Case study.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Rafiq I. Noorani, Rapid Prototyping – Principles and Applications, Wiley & Sons, 2006.
2. Chua C.K, Leong K.F and Lim C.S, Rapid Prototyping: Principles and Applications, second edition, World Scientific, 2003.

REFERENCE BOOKS:

1. N.hopkinson, r.j.m, hauge, p m, dickens, “Rapid Manufacturing – An Industrial revolution for the digital age”, Wiley, 2006
2. IAN GIBSON, “Advanced Manufacturing Technology for Medical applications:Reverse Engineering, Software conversion and Rapid Prototying”, Wiley, 2006
3. Paul F.Jacobs, Rapid Prototyping and Manufacturing, “Fundamentals of Stereolithography”, McGraw Hill 1993.
4. D.t.Pham and S.S.Dimov, “Rapid Manufacturing”, Springer Verlog 2001

MG9072 ENTREPRENEURSHIP DEVELOPMENT L T P C
3 0 0 3

AIM:

To initiate the entrepreneurship skills among the student community.

OBJECTIVES:

To develop confidence on financial assistance by the institutions, methods of taxation and tax benefits, etc.

UNIT I ENTREPRENEURSHIP 9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur. Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT II MOTIVATION 9

Major Motives Influencing an Entrepreneur – Achievement Motivation Training,Entrepreneurial skills - Self Rating, Business Game, Thematic Appreciation Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT III BUSINESS 9

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT IV FINANCING AND ACCOUNTING 9

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Network Analysis Techniques of PERT / CPM – Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V SUPPORT TO ENTREPRENEURS 9

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Govindarajan. M, “Marketing management – concepts, cases, challenges and trends”, Prentice hall of India, second edition 2007.
2. Philip Kolter & Keller, “Marketing Management”, Prentice Hall of India, XII edition,2006.

REFERENCES:

1. Donald S. Tull and Hawkins, “Marketing Reasearch”, Prentice Hall of Inida-1997.
2. Philip Kotler and Gary Armstrong “Principles of Marketing” Prentice Hall of India, XII Edn, 2000.
3. Ramasamy and Nama kumari, “Marketing Environment: Planning, implementation and control the Indian context”, 1990.
4. Czinkota&Kotabe, “Marketing management”, Thomson learning, Indian edition 2007
5. Adrain palmer, “ Introduction to marketing theory and practice”, Oxford university
6. press IE 2004.
7. Steven J.Skinner, “Marketing”, All India Publishers and Distributes Ltd. 1998.

MG9073 MARKETING MANAGEMENT L T P C

3 0 0 3

OBJECTIVE

Marketing Management deals with newer concepts of marketing principles like strategic marketing concepts, segmentation, pricing, advertisement and strategic formulation. This will enable a student to take up marketing as a professional career.

UNIT I CONCEPTS IN MARKETING 9

Definition, Marketing Process, Dynamics, Needs, Wants and Demands, Marketing Concepts, Environemnt, Mix, Types, Philosophies, Selling vs Marketing, Consumer Goods, Industrial Goods, Product, Hierarchy.

UNIT II BUYING BEHAVIOUR AND MARKET SEGMENTATION 9

Cultural, Demographic factors, Motives, Types, Buying Decisions, Segmentation factors, Demographic, Psycho graphic and Geographic Segmentation, Process, Patterns.

UNIT III PRODUCT PRICING AND MARKETING RESEARCH 9

Objectives, Pricing, Decisions and Pricing Methods, Pricing Management, Introduction, Uses, Process of Marketing Research.

UNIT IV MARKETING PLANNING AND STRATEGY FORMULATION 9

Components of a Marketing Plan, Strategy Formulation and the Marketing Process, Implementation, Portfolio Analysis, BCG, GEC Grids.

UNIT V ADVERTISING, SALES PROMOTION & DISTRIBUTION 9

Characteristics, Impact, Goals, Types, Sales Promotion – Point of purchase, Unique Selling Propositions, Characteristics, Wholesaling, Retailing, Channel Design, Logistics, Modern Trends in Retailing, Modern Trends, e-Marketing.

Total : 45

TEXT BOOKS

1. Govindarajan. M, "Marketing management – concepts, cases, challenges and trends", Prentice hall of India, second edition 2007.
2. Philip Kolter & Keller, "Marketing Management", Prentice Hall of India, XII edition, 2006.

REFERENCES

1. Donald S. Tull and Hawkins, "Marketing Reasearch", Prentice Hall of Inida-1997.
2. Philip Kotler and Gary Armstrong "Principles of Marketing" Prentice Hall of India, XII Edn, 2000.
3. Ramasamy and Nama kumari, "Marketing Environment: Planning, implementation and control the Indian context", 1990.
4. Czinkota&Kotabe, "Marketing management", Thomson learning, Indian edition 2007
5. Adrain palmer, " Introduction to marketing theory and practice", Oxford university press IE 2004.
6. Steven J.Skinner, "Marketing", All India Publishers and Distributes Ltd. 1998.

ME9041 THEORY OF METAL FORMING

L	T	P	C
3	0	0	3

AIM:

To learn the basics involved in the mechanism of plastic deformation during metal forming process.

OBJECTIVES:

This course aims to impart the knowledge about various metal forming processes.
It deals with metal forming concepts like theory of plasticity and special metal forming techniques. After this course a student will have a good exposure about this subject. This also gives the recent trends in the metal forming processes.

UNIT I THEORY OF PLASTICITY 9

Theory of plastic deformation – Engineering stress and strain relationship – Strees tensor – Strain tensor – Yield criteria – Plastic stress strain relationship – Plastic work.

UNIT II CONSTITUTIVE RELATIONSHIPS AND INSTABILITY 7

Uniaxial tension test – Mechanical properties – Work hardening, Compression test, bulge test, plane strain compression stress, plastic instability in uniaxial tension stress, plastic instability in biaxial tension stress

UNIT III ANALYSIS OF METAL FORMING 12

Slab analysis – Slip line method, upper bound solutions, numerical methods, contact problems, effect of friction, thermo elastic- Elasto plasticity, elasto visco plasticity – analysis of forging, rolling, extrusion and wire drawing processes- Cold and Hot Forging

UNIT IV SHEET METAL FORMING 8

Sheet Metal Forming methods – Bending – Drawing – Deep Drawing – Stretch Forming – Tooling and applications – Analysis of Sheet Metal Forming – HERF Techniques – Principles and Process Parameters – Superplastic Forming.

UNIT V SPECIAL METAL FORMING PROCESSES 9

Orbital forging, Isothermal forging, Warm forging, Hot and Cold isotrophical pressing, high speed extrusion, rubber pad forming, micro blanking – Overview of Powder Metal Techniques – Powder rolling.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Dieter G.E , " Mechanical Metallurgy" Mc Graw – Hill Co. S1. Edition 1995
2. Nagpal G.R "Metal Forming Process", Kanna Pub, New Delhi – 2000.

REFFERENCES:

1. Wagoner, R.H and Chenot, JJ Metal Forming Analysis, Cambridge University Press, 2002.
2. Slater, R.A.C., Engineering Plasticity – Theory and Applications to Metal Forming, John Wiely and Sons, 1987.
3. Shiro Kobayshi, Altan. T, Metal Forming and Finite Element Method, Oxford University Press, 1989.
4. Hosford, W.F and Caddell, R.M., Metal Forming Mechanics and Metallurgy, Prentice Hall Eaglewood Cliffs, 1993.
5. Narayanaswamy. R, Theory of Metal Forming and Plasticity Narosa Publishers,1999.

ME 9039 DESIGN OF HEAT EXCHANGERS L T P C
3 0 0 3

A IM:

To build up necessary background for the design of various types of heat exchangers.

OBJECTIVES:

To learn the sizing of heat exchangers, thermal and mechanical stress analysis for various heat exchange applications.

UNIT I DIFFERENT CLASSIFICATION OF HEAT EXCHANGERS 9

Parallel flow, counter flow and cross flow; shell and tube and plate type; single pass and multipass; once through steam generators etc;

UNIT II PROCESS DESIGN OF HEAT EXCHANGERS 9

Heat transfer correlations, Overall heat transfer coefficient, LMTD, sizing of finned tube heat exchangers, U tube heat exchangers, fouling factors, pressure drop calculations.

UNIT III MECHANICAL DESIGN OF SHELL AND TUBE TYPE 9

Thickness calculation, Tubesheet design using TEMA formula, concept of equivalent plate for analysing perforated analysis, flow induced vibration risks including acoustic issues and remedies, tube to tubesheet joint design, buckling of tubes, thermal stresses

UNIT IV COMPACT AND PLATE HEAT EXCHANGER 9

Types – Merits and Demerits – Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations

UNIT V CONDENSORS AND COOLING TOWERS 9

Design of surface and evaporative condensers – cooling tower –performance characteristics

TOTAL : 45 PERIODS

TEXT BOOKS / REFERENCES:

1. T.Taborek, G.F.Hewitt and N.Afgan, Heat Exchangers, Theory and Practice, McGraw-Hill Book Co.1980.
2. Walker, Industrial Heat Exchangers- A Basic Guide, Mc Graw Hill Book Co. 1980
3. Nicholas Cheremistoff, Cooling Tower, Ann Arbor Science Pub 1981
4. Arthur, P. Frass, Heat Exchanger Design, John Wiley and Sons, 1988
5. J.P. Gupta, Fundamentals of heat exchangers and pressure vessel technology, Hemisphere publishing corporation, Springer-Verlag (outside NA), 1986
6. Donald Q. Kern and Alban D. Kraus, “Extended surface hear transfer” Mc Graw Hill Book Co., 1972
7. E.A.D. Sanders, Heat Exchangers, Selection Design and Construction Layman Scientific & Technical; co published with John Wiley & sons, 1988

ML 9402 NON DESTRUCTIVE MATERIALS EVALUATION L T P C
3 0 0 3

OBJECTIVES:

Study the most important Non Destructive Evaluation and Testing methods, theory and their industrial application.

UNIT I INTRODUCTION TO NON DESTRUCTIVE TESTING 7

Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Comparison of advantages and limitations of different NDT methods. Visual inspection.

UNIT II SURFACE NDT, LIQUID PENETRANT (PT), MAGNETIC PARTICLE TESTING (MT) 8

PT: Physical Principles, Penetrant Systems, Applications.
MT: Magnetisation methods, evaluation of results.

UNIT III THERMOGRAPHY AND EDDY CURRENT TESTING (ET) 10

Active and Passive Thermography, Application in flaw detection. ET: Principles, permeability and conductivity, Testing for defects, material characterisation and sorting

UNIT IV ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE) 10

Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A-scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction.

UNIT V RADIOGRAPHY (RT) 10

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, Computed Radiography, Computed Tomography.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. Prakash Ravi," Nondestructive Testing Techniques", New Age International Publishers, 1st edition, 2007
2. Paul E Mix," Introduction to nondestructive testing: a training gUide", Wiley, 2nd edition New Jersey, 2005

REFERENCES :

1. Baldev Raj, B. Venkataraman, O. J. Varde, Nerulikar, "Practical Magnetic Particle Testingv", Narosa Publishing House, 2007
2. Charles, J. Hellier," Handbook of nondestructive evaluation", McGraw Hill, New York 2001.
3. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NOT Handbook, Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing

ME9040 NUCLEAR ENGINEERING L T P C

3 0 0 3

UNIT I NUCLEAR PHYSICS 7

Nuclear model of the atom – Equivalence of mass and energy – Binding – Radio activity – Half Life – Neutron interactions – Cross sections.

UNIT II NUCLEAR REACTIONS AND REACTOR MATERIALS 7

Mechanism of nuclear fission and fusion – radio activity – Chain Reactions- Critical mass and composition – Nuclear fuel cycles and its characteristics – Uranium production and purification – Zirconium, thorium, beryllium.

UNIT III REPROCESSING 9

Reprocessing: nuclear fuel cycles-spent fuel characteristics-role of solvent extraction in reprocessing-solvent extraction equipment.

UNIT IV NUCLEAR REACTOR 9

Nuclear reactors: types of fast breeding reactors-design and construction of fast breeding reactors-heat transfer techniques in nuclear reactors- reactor shielding. Fusion reactors.

UNIT V SAFETY AND DISPOSAL 9

Safety and disposal: Nuclear plant safety-safety systems-changes and consequences of accident-criteria for safety-nuclear waste-types of waste and its disposal-radiation hazards and their prevention-weapons proliferation.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. S. Glasstone and A. Sesonske, “Nuclear Reactor Engineering: Reactor Design Basics”, Vol. 1, Ed. 4, Chapman and Hall, London, 1994.
2. S. Glasstone and A. Sesonske, “Nuclear Reactor Engineering: Reactor Systems Engineering”, Vol. 2, Ed. 4, Chapman and Hall, New York, 1994.
3. Thomas J. Cannoly, “Fundamentals of Nuclear Engineering”, John Wiley, 1978.

REFERENCES:

1. A. E. Walter and A. B. Reynolds, “Fast Breeder Reactors”, Pergamon Press, 1981.
2. M. Benedict, T.H. Pigford and H. Lewi, “Nuclear Chemical Engineering”, McGraw-Hill, 2nd ed. 1981.
3. J.G. Collier and G.F. Hewitt, “Introduction to Nuclear power”, Hemisphere publishing, New York. 1987.
4. M.M. El. Wakil, “Power Plant Technology”, McGraw-Hill International, 1984.

MF9021 PRODUCT DESIGN AND DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES:
To impart knowledge on principles and practices of product design considering the customer wants and needs.

UNIT I **9**
Product Development process – Product development organizations, Gather raw data – Interpret raw data- organize the needs into a hierarchy – Relative importance of the needs.

UNIT II **9**
Establishing the product specifications,– Target specifications – Refining specification Concept generation-Clarify the problem – Search internally – Search externally – Explore systematically.

UNIT III **9**
Concept selection- Screening – scoring, Product architecture – Implication of architecture – Establishing the architecture – Related system level design issues.

UNIT IV **9**
Need for industrial design – Impact of industrial design – Industrial design process – Management of industrial design process – Assessing the quality of industrial design,design for manufacturing- cost considerations, Impact of DFM decisions on other factors.

UNIT V **9**
Principles of prototyping – Planning for prototypes, economics of product development projects, Elements of economic analysis – Base – Case financial model – Sensitivity analysis – Influence of the quantitative factors.

TOTAL : 45 PERIODS

TEXT BOOKS:
1. Karal, T.Ulrich steven D.Eppinger, Product Design and Development, McGraw Hill, International Editions, 2003.

REFERENCES:
1. S.Rosenthal, Effective Product Design and Development, Irwin, 1992.
2. Charles Gevirtz Developing New products with TQM, McGraw Hill International Editions, 1994.