Dr.M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
UNIVERSITY
(Decl. U/S 3 of UGC Act 1956)
DEPARTMENT OF MECHANICAL ENGINEERING

B.Tech - Mechanical Engineering (Full Time)
Curriculum and Syllabus
2013 Regulation

III SEMESTER						
S.No	**Sub. Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	BMA13005	Mathematics III for Mechanical & Civil Engineers	3	1	0	4
2	BME13004	Fluid Mechanics and Machinery	3	1	0	4
3	BME13005	Engineering Mechanics	3	1	0	4
4	BME13006	Engineering Thermodynamics	3	1	0	4
5	BME13007	Manufacturing Technology - I	3	0	0	3
6	BME13008	Computer Aided Machine Drawing	2	0	2	3
7	BME13L02	Manufacturing Technology Lab-I	0	0	3	1
8	BCS13L21	Programming in C &C++	2	0	2	2
		TOTAL	**19**	**4**	**7**	**25**

IV SEMESTER						
S.No	**Sub. Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	BMA13009	Numerical Methods for Mechanical and Civil Engineers	3	1	0	4
2	BME13010	Engineering Metallurgy	3	0	0	3
3	BME13011	Thermal Engineering - I	3	1	0	4
4	BME13012	Strength of Materials	3	1	0	4
5	BME13013	Mechanics of Machines - I	3	1	0	4
6	BEE13032	Electrical and Electronics Engineering.	3	0	0	3
7	BEN13L01	Career and Confidence Building (Soft Skills-I)	2	0	0	2
8	BME13L03	Fluid Mechanics and Machinery & Strength of Materials Lab	0	0	3	1
9	BEE13L21	Electrical and Electronics Lab	0	0	3	1
		TOTAL	**20**	**4**	**6**	**26**

V SEMESTER						
S.No	**Sub. Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	BME13014	Gas Dynamics and Jet Propulsion	3	1	0	4
2	BME13015	Engineering Metrology	3	0	0	3
3	BME13016	Design of Machine Elements –I	3	1	0	4
4	BME13017	Thermal Engineering - II	3	1	0	4
5	BME13018	Mechanics of Machines - II	3	1	0	4
6	BIC13031	Instrumentation & Control Engineering.	3	0	0	3
7	BEN13L02	Qualitative and Quantitative Skills(Soft Skills-II)	2	0	0	2
8	BME13L04	Thermal Engineering Lab –I	0	0	3	1
9	BME13L05	Metrology & Metallurgy Lab	0	0	3	1
		TOTAL	**20**	**4**	**6**	**26**

VI SEMESTER						
S.No	**Sub. Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	BMA13017	Optimization Techniques for Mechanical Engineers.	3	1	0	4
2	BEC13031	Microprocessor and Mechatronics	3	0	0	3
3	BME13019	Heat & Mass Transfer	3	1	0	4
4	BME13020	Design of Machine Elements-II	3	1	0	4
5	BME13021	Manufacturing Technology-II	3	0	0	3
6	BME13022	Hydraulics and Pneumatics	3	0	0	3
7	BME13L06	Thermal Engineering Lab-II	0	0	3	1
8	BME13L07	Manufacturing Technology Lab-II	0	0	3	1
9	BME13L08	Dynamics Lab	0	0	3	1
		TOTAL	**18**	**3**	**9**	**24**

VII SEMESTER						
S.No	**Sub. Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1.	BME13023	Statistical Quality Control & Reliability Engineering	3	0	0	3
2.	BME13024	Finite Element Method	3	1	0	4
3.	BME13025	CAD,CAM & CIM	3	0	0	3
4.	BME13EXX	Elective I	3	0	0	3
5.	BME13EXX	Elective II	3	0	0	3
6.	BME13L09	Automation Lab	0	0	3	1
7.	BME13L10	Design & Simulation Lab	0	0	3	1
8.	BME13L11	Industrial Training **/Mini Project	0	0	3	1
		TOTAL	**15**	**1**	**9**	**19**

** Students are expected to undergo industrial training for a minimum period of 15 days at the end of VI semester, during vacation period or can carry out a mini project in the university and submit a report on training / mini project and the department has to conduct a viva-voce exam with external and internal examiners to evaluate the students. The successful students will be awarded 1 credit. (50 mark for Internal Assessment + 50 mark for viva voce exam.)

VIII SEMESTER						
S.No	**Sub. Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	BME13026	Automobile Engineering	3	0	0	3
2	BME13027	Industrial Management & Entrepreneurship Development	3	0	0	3
3	BME13EXX	Elective III	3	0	0	3
4	BME13L12	Project work	0	0	20	10
		TOTAL	**9**	**0**	**20**	**19**

Number of Credits for I year : 45

Number of Credits from III semester to VIII semester : 139

TOTAL NO.OF CREDITS : 184

LIST OF ELECTIVES					
Subject Code	**Title of Subject**	**L**	**T**	**P**	**C**
BME13E01	Design of Heat Exchangers	3	0	0	3
BME13E02	Refrigeration & Air Conditioning	3	0	0	3
BME13E03	Advanced I.C Engines	3	0	0	3
BME13E04	Design of Production Tools	3	0	0	3
BME13E05	Process Planning and Cost Estimation	3	0	0	3
BME13E06	Computational Fluid Dynamics	3	0	0	3
BME13E07	Mechanical Vibrations	3	0	0	3
BME13E08	Turbo Machines	3	0	0	3
BME13E09	Design of Experiments	3	0	0	3
BME13E10	Industrial Robotics	3	0	0	3
BME13E11	Computer Integrated Manufacturing	3	0	0	3
BME13E12	Non Conventional Sources of Energy	3	0	0	3
BME13E13	Non Conventional Machining Techniques	3	0	0	3
BME13E14	Enterprise Resource Planning	3	0	0	3
BME13E15	Composite Materials	3	0	0	3
BME13E16	Engineering Ethics	3	0	0	3
BME13E17	Industrial Engineering	3	0	0	3
BME13E18	Total Quality Management	3	0	0	3
BME13E19	Industrial Safety Engineering	3	0	0	3
BME13E20	Ergonomics	3	0	0	3
BME13E21	Nanotechnology	3	0	0	3
BME13E22	Disaster management	3	0	0	3
BCS13E31	Artificial Intelligence and Expert System	3	0	0	3
BCS13E32	Visual Programming	3	0	0	3

BMA13005 MATHEMATICS III FOR MECHANICAL & CIVIL ENGINEERS 3 1 0 4

OBJECTIVES: The student will learn

- Basic mathematical tools and techniques which emphasize the development of rigorous logical thinking and analytical skills.
- Theory and applications of partial differential equation, its applications, fourier series, transforms and Laplace transformation.

UNIT I: PARTIAL DIFFERENTIAL EQUATIONS **12** Hrs

Formation of PDE by eliminating arbitrary constants and eliminating arbitrary functions – Solutions of standard types of first order equations – Lagrange's equation – Linear partial differential equations of second and higher order with constant coefficients.

UNIT II: FOURIER SERIES **12** Hrs

Dirichlet's conditions – General Fourier series – Half range Sine & Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

UNIT III: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12** Hrs

Classification of second order linear partial differential equations – Solutions of one dimensional wave equation, one-dimensional heat equation – Steady state solution of two dimensional heat equation (Cartesian coordinates only) – Fourier series solutions.

UNIT IV: LAPLACE TRANSFORMS **12** Hrs

Transforms of simple functions – Properties of Transforms – Inverse Transforms – Transforms of Derivatives and Integrals – Periodic functions – Initial and final value theorems – Convolution theorem – Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients and Linear simultaneous differential equations of first order with constant coefficients.

UNIT V: FOURIER TRANSFORMS **12** Hrs

Statement of Fourier integral theorem – Fourier transform pairs – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's theorem.

Total No. of Hrs : 60

TEXT BOOKS

1) Veerarajan T. (2007), *Engineering Mathematics (for first year)*, Tata McGrawHill Publishing Co.,
2) Veerarajan T. (2005), *Engineering Mathematics (for semester III)*, Tata McGraw Hill Publishing Co.,

REFERENCES

1) Singaravelu (2009), *Transforms and Partial Differential Equations*, Meenakshi Agency.
2) Kreyszig E. (2011), *Advanced Engineering Mathematics (9th ed.)*, John Wiley & Sons.
3) Grewal B.S. (2012), *Higher Engineering Mathematics*, Khanna Publishers.

BME 13004 **FLUID MECHANICS AND MACHINERY** **3 1 0 4**

OBJECTIVES: The student will learn
- The basic properties of fluids.
- Flow behaviour in various sections with basic equations
- Working principles of hydraulic pumps and turbines

UNIT I: PROPERTIES OF FLUIDS **11** Hrs

Units & Dimensions, Properties of fluids – density, specific Gravity, specific weight, viscosity. Surface tension and Capillarity, Compressibility & Bulk modulus, Vapour pressure, Measurement of pressure-Manometers, Mechanical gauges.

UNIT II: FLUID FLOW CONCEPTS AND BASIC EQUATIONS **11** Hrs

Flow Characteristics, Concepts of System and Control Volume, Continuity, Energy equation- Euler equation-Bernoulli equation, Impulse momentum equation-applications.

UNIT III: FLOW THROUGH CIRCULAR CONDUITS **12** Hrs

Laminar flow through circular tubes – Boundary layer thickness -Darcy equation on pipe roughness – Friction factor – Minor losses – Flow through pipes in series and in parallel, Equivalent pipes.

UNIT IV: HYDRAULIC TURBINES **13** Hrs

Impact of free jets-work done and efficiency calculation, Classification of hydraulic turbines, Elementary working principles of Pelton, Francis, Kaplan turbine, Work done, Governing of turbines, Draft tube, Specific Speed.

UNIT V: HYDRAULIC PUMPS **13** Hrs

Reciprocating pumps : Classification, Working, Single acting and Double acting, Slip, Indicator diagram, Air vessels. Centrifugal pumps :Classification, Components, Working, Velocity triangles, Losses & Efficiency of a centrifugal pump, Pumps in series & parallel, Specific speed, Separation, Cavitations, Priming.

Total No. of Hrs : 60

TEXT BOOKS
1) Bansal S.K. (2012) *"Fluid Mechanics and Hydraulic Machines"*, Laxmi Publications (P) Ltd., New Delhi.
2) R.K.Rajput. (1998) *"Fluid Mechanics and Hydraulic Machines"*, S.Chand & Company Ltd., New Delhi.

REFERENCES
1) L.Kumar. (2002), *"Engineering Fluid Mechanics"*, Eurasia Publishing House (P) Ltd., New Delhi.
2) Roberson J.A. & Crowe C.T. (2001), *"Engineering Fluid Mechanics"*, M/s Jaico Publishing Co., 9th edition
3) Streeter V.L. and Wylie E.B. (1983), *"Fluid Mechanics"*, McGraw Hill.
4) Ramamirtham S. (1988), *"Fluid Mechanics, Hydraulics and Fluid Machines"*, Dhanpat Rai & Sons, Delhi.
5) Yunus.A.Cengel, Robert H.Turner., *"Thermal-Fluid Sciences"*, Tata McGraw Hill.

BME 13005 **ENGINEERING MECHANICS** **3 1 0 4**

OBJECTIVES: The student will learn

- The vectorial and scalar representation of forces and moments.
- Static equilibrium of particles and rigid bodies both in two dimensions and in three dimensions.
- The principle of work and energy.
- The effects of friction on equilibriums, the laws of motion, the kinematics of motion and the inter-relationship.

UNIT I: STATICS **12** Hrs

STATICS OF PARTICLE: Introduction – Units and Dimensions – Laws of mechanics – concurrent forces in a plane-resolution and Composition of forces – equilibrium of the particle-resultant force. Forces in space – Equilibrium of a particle in space
STATICS OF RIGID BODY **:** Free body diagram – Types of supports and their reactions – Moments and Couples – Moment of a force about a point and about an axis – Varignon's theorem – equilibrium of Rigid bodies in two dimensions –Equilibrium of Rigid bodies in three dimensions

UNIT II: PROPERTIES OF SURFACE AND SOLIDS **12** Hrs

Determination of Area and volume – Determination and derivation of First moment of area(Centroid), Second moment of area(Moment of Inertia) of Regular as well as irregular geometrical area – Centroid of line elements. Mass moment of inertia and polar moment of inertia. Principal moments of inertia of plane areas – Principal axes of inertia-Product of Inertia.

UNIT III: FRICTION **12** Hrs

Introduction – Laws of Dry Friction – Coefficient of friction – friction of a body lying on an inclined plane. Application of friction-Ladder friction-Wedge friction-Screw friction.

UNIT IV: DYNAMICS OF PARTICLES **12** Hrs

KINEMATICS**:** Displacement, Velocity-Constant and variable Acceleration, their relationship – linear and curvilinear motion- Projectile motion, relative motion.
KINETICS**:** Linear and Curvilinear motion-Work-Energy method, Impulse and Momentum, Impact-collision of Elastic bodies. Newton's law-D'Alemberts principle.

UNIT V: DYNAMICS OF RIGID BODIES **12** Hrs

KINEMATICS**:** Introduction-Rotation-Linear and Angular Velocity as well as acceleration. General plane motion-Absolute and Relative velocity in plane motion. Instantaneous centre of Rotation in plane motion-Location.
KINETICS**:** Relation between Translatory and Rotary motion of the body-Work energy equation of particles – D'Alemberts principle.

Total No. of Hrs : 60

TEXT BOOKS

1) R.S.Khurmi. (2008), "*A Textbook of Engineering Mechanics"*, S.Chand & co Ltd.
2) S.Rajasekaran et.al. (2009), "*Fundamentals of Engineering Mechanics"*,Vikas Publishing House Pvt Ltd., 3rd Edition.

REFERENCES

1) Arthur.P.Boresi,Richard.J.Schmidt, "*Engineering Mechanics : Statics &Dynamics"*, Thomson Brooks/Cole,Chennai.
2) Palanichamy M.S, Nagan.S, (2001), "*Engineering Mechanics – Statics and Dynamics*" Tata Mc Graw Hill.
3) Beer & Johnson et.al, (2010) *"Vector Mechanics for Engineers (Statics and Dynamics)"*, Tata Mc Graw Hill.

BME 13006 **ENGINEERING THERMODYNAMICS** **3 1 0 4**

OBJECTIVES: The student will learn
- Fundamentals concepts and laws of thermodynamics
- Various power cycles and their applications

UNIT I: BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS **11** Hrs

Thermodynamics systems, Concepts of continuum, Thermodynamic properties, Equilibrium, Process, Cycle, Work, Heat, Temperature, Zeroth law of thermo dynamics. First law of thermodynamics – Applications to closed and open systems, Internal energy, Specific heats, Enthalpy, Steady flow conditions.

UNIT II: SECOND LAW OF THERMODYNAMICS **12** Hrs

Statements, Reversibility, Causes of irreversibility, Carnot cycle, Reversed Carnot cycle, Heat engines, Refrigerators, Heat pumps. Clausius inequality, Concept of Entropy, Principles of increase of entropy, Carnot theorem, Available energy, Availability, Introduction to energy.

UNIT III: WORKING FLUIDS **12** Hrs

Thermodynamic properties of pure substance, Property diagrams. PVT surface of water and other substances, calculation of properties. First law and second law analysis using tables and charts.
Properties of ideal and real gases, Equation of state, Gas laws. Vanderwal's equation of state, Compressibility, Compressibility charts. Daltons law of partial pressures, Internal Energy, enthalpy, Specific heat and molecular weight of gas mixtures.

UNIT IV: POWER CYCLES **13** Hrs

Gas power cycles - Carnot, Otto, Diesel, Dual, Brayton Cycles. Vapour Power Cycles – Rankine, Modified Rankine, Reheat, Ideal Regenerative cycle.

UNIT V: THERMODYNAMIC RELATIONS **12** Hrs

Exact differentials, Maxwell relations, TdS relations, Difference and ratio of Heat Capacities, Energy Equation, Clausius Clapeyron equations, Joule-Thomson coefficient.

Total No. of Hrs : 60

***NOTE:** Use of Steam Table and Mollier Chart are permitted in Examination

TEXT BOOKS
1) P.K.Nag, (2012) *"Engineering Thermodynamics" (fourth Edition),* TataMcGraw Hill 5 Publishing Company Ltd., New Delhi.
2) Yunus A.Cengel, (2008) *"Thermodynamics-An Engg. Approach"*, Tata McGraw Hill, 6th edition.

REFERENCES
1) Spalding & Cole, "*Engineering Thermodynamics"*, ELBS, 6th edition.
2) J.P.Holman, (1988) "*Thermodynamics",* McGraw Hill 109095, 4th edition,
3) Van Wylen & Sonntag, (1998) "*Fundamentals of Classical Thermodynamics",* Wiley Eastern, 5th Edition.
4) Rogers & Mathew, (1992) *"Engineering Thermodynamics"*, Adison Wesley 1090909, 4th edition.
5) Michael Saad, (1966) *"Thermodynamics"*, Prentice Hall 109097.

BME 13007 **MANUFACTURING TECHNOLOGY – I** **3 0 0 3**

OBJECTIVES: The student will learn
- Various metal joining and forming processes.
- Powder metallurgy and Precision machining.
- Various methods of processing plastics.

UNIT I: METAL CASTING PROCESSES **9** Hrs

Introduction to Pattern making - Moulding sand - Melting furnaces - Special casting processes - Shell, Investment, Die casting, Full mould process - Defects in casting. Computers in casting processes.

UNIT II: METAL FORMING PROCESSES **9** Hrs

Cold and hot working - Forging, Rolling, Extrusion, Drawing. . Introduction to sheet metal forming processes. High energy rate forming - Explosive forming, Electro-hydraulic, Electro magnetic forming, dynapac machine, petro forge machines. Super plastic forming

UNIT III: METAL JOINING PROCESSES **10** Hrs

Classification - Arc Welding –Sheet metal arc welding , Gas metal welding- - Submerged Arc , TIG, MIG, - Resistance welding -Electrode types – Specification- Special Types - Laser, Electron beam, Plasma Arc, Ultrasonic, Electro slag, Explosive welding and Friction welding - Thermit welding –inspection of welding- Defects in weld- Brazing and soldering

UNIT IV: METAL CUTTING PROCESSES- INTRODUCTION **9** Hrs

Lathe: Specification - Types - Mechanisms - Operations - Calculations - Capstan and turret lathe - Tooling with examples - Copy turning lathe. Drilling: Specification - Types - Feed Mechanism - Operations - Drill tool nomenclature - Mounting – Reamer and tap tools - Calculations.

UNIT V: PROCESSING OF PLASTIC MATERIALS **8** Hrs

Types of Plastics - Types of moulding - Compression moulding - Transfer molding - Injection molding - Blow Moulding – Rota moulding - Film and sheet forming - Thermo forming - Reinforced plastic - Laminated plastics.

Total No. of Hrs : 45

TEXT BOOKS
1) Sharma P.C. (2008), *"A Text Book of Production Technology"*, S.Chand & Company Ltd., New Delhi.
2) Serope Kalpakjian (2013), *"Manufacturing Engineering and Technology"*, Addison-wesley Pub.Co ,7th edition.

REFERENCES
1) Rao P.N. (2007), *"Manufacturing Technology - Foundry Forging & Welding"*, Tata McGraw Hill Publishing Co., New Delhi, 2nd edition.
2) R.K. Jain, (2001) *"Production Technology"*, Khanna publisher.
3) O.P. Khanna, (1993), *"Welding Technology"*, Dhanpat Rai & sons.
4) S. K. Hajra Choudry, S. K. Bose, (2010) *"Elements of Workshop Technology -Volume I & II"*. Media promoters.

BME 13008 **COMPUTER AIDED MACHINE DRAWING** **2 0 2 3**

OBJECTIVES: The student will learn
- To impart the knowledge in Machine Drawing fundamentals.
- To impart the knowledge to read, draw and to understand various machine elements and industrial drawing.
- To draw the component and assembly drawing using CAD software.

(Units I, II and III should be practiced by drafting equipment- UNIT IV to be practiced by CAD software)

UNIT I: I.S CODE OF PRACTICE FOR ENGINEERING DRAWING **6** Hrs

Use of scales – Selection and designation of sizes – types of lines – termination of leader line, hatching of sections – revolved and removed sections.
Limits, Fits and Tolerances: Tolerances of forms and position - Geometrical dimensioning and tolerance (GD and T) - Symbols - MMC, Virtual size and Least material size - Methods of surface texture on drawing. Surface roughness - Symbols on drawing, direction of lay - Roughness grade numbers and symbols-RFS symbols.

UNIT II: MACHINE COMPONENTS **10** Hrs

Screws and Threads: True projection of screw thread – ISO metric thread, different types of threads – single and multi start threads – Right and Left hand threads – Conventional representation of threads - Internal and external types.
Bolts and Nuts: Machine and cap screws, set screws, Grub screws, studs. Types of nuts - cap, castle, wile's , lock nuts - Locking by set screw, grooved nut, plate and spring washer. Hexagonal square bolt and nut assembly.
Keys: Hollow, saddle, Sunk, Parallel sunk, Feather, Wood ruff, Round, key with gib head, and Splined shaft.

UNIT III: COMPONENTS AND ASSEMBLY DRAWING **14** Hrs

Orthographic views of the following components: Engine piston,Connecting rod,crank,Drill jig bush,strap clamp,flange.
Assembly drawing: Screw jack-Swivel bearing-Tail stock-Milling fixture-Drilling Jig.

UNIT IV: COMPUTER AIDED DRAWING (to be practiced using CAD software) **30** Hrs

Drafting: 2-D drafting of machine elements like bolt, nut,keys,springs, spline shaft.
Assembly Modeling: 1. Screw Jack. 2. Tail stock. 3. Cotter Joint. 4. Knuckle Joint. 5. Couplings

Total No. of Hrs : 60

***NOTE:** Use of approved Design Data Book permitted

TEXT BOOKS
1) K.R. Gopalakrishna, (2004) *"Machine Drawing"*, Subhas publications, Bangalore, Eighteenth edition.
2) N.D.Bhatt, (2004) *"Machine Drawing"*, Charotar publishing house, Thirty nine edition.
3) K.L.Narayana, P.Kannaiah and K.Venkata Reddy, (2003) *"Machine Drawing"*, 3rd reprint, New Age International Ltd., New Delhi.
4) *"Design Data Hand Book"*, PSG College of Technology, Coimbatore.

REFERENCES
1) Warren Hammer, (2003) *"Blueprint Reading Basics"*, III Edition, Industrial Press Inc, New York.
2) Dhawan, *"Machine Drawing"*, First Edition, Sultan Chand and Sons, New Delhi, 109096.
3) P.S. Gill, (2004) *"A TEXT BOOK of Machine Drawing"* Seventh Edition Reprint. S. K. Kataria & Sons.New Delhi.
4) Narayana, P.Kannaiah and K.Venkata Reddy, *"Production Drawing"*, Ist Edition, New Age International Ltd., New Delhi, 109097.

BME 13L02 MANUFACTURING TECHNOLOGY LAB – I 0 0 3 1

OBJECTIVES: The student will learn

- Practical skill in foundry and welding operations
- Metal cutting skill in lathe and drilling.

FOUNDRY

Study of tools and equipments.

1) Preparation of Green sand moulds for Flange, Gear, V-grooved pulley etc

WELDING

Study of tools and equipments.

1) Electric arc welding exercises – lap joint – Butt joint – Fillet joint – Tee joint.
2) Gas welding and gas cutting – Template cutting.

LATHE PRACTICE

1) Step turning
2) Taper turning
3) Thread cutting
4) Eccentric turning

DRILLING PRACTICE

1) Drilling
2) Reaming
3) Tapping.

Total No. of Hrs : 45

BCS 13L21 **PROGRAMMING IN C AND C++** **2 0 2 2**

OBJECTIVES: The student will learn

- Various features of C and C++ such as classes, functions, constructors, destructors, inheritance, overloading in both theory and lab sessions.
- Programming exposure to solve real time problems.

THEORY COMPONENT

I. C- LANGUAGE

Fundamentals- data types -operators –expressions-statements-control flow-Conditional statements –storage devices-preprocessor statements –Arrays – Pointers- Input output functions - String- Recursive functions.

II. INTRODUCTION TO C++

Programming methodologies-Comparison-Object Oriented concepts-Basics of C++ environment.

III. CLASSES

Definition-Data members-Function members-Access specifiers-Constructors-Default constructors-Copy constructors-Destructors-Static members -This pointer-Constant members-Free store operators-Control statement.

IV. INHERITANCE AND POLYMORPHISM

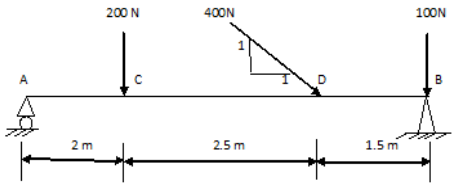
Overloading operators-Functions-Friends-Class derivation-Virtual functions-Abstract base classes-Multiple inheritance. Microsoft Foundation Class Libraries

V. TEMPLATES

Class templates-Function templates-Exception handling-Streams.

LAB COMPONENT

Simple C programs, Simple C++ Programs, Implementation of class and object, Implementation of Inheritance, Implementation of Templates, Implementation of Operator Overloading & Fundamentals, Implementation of , File Handling and Exception.



Fig(i)

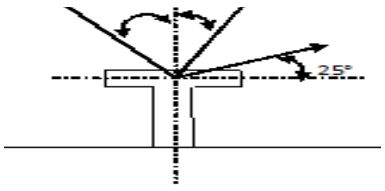


Fig (ii)

Write program in C and C++ to solve the following problems from Mechanical Engineering domain.

1. Write a computer program for finding reactions for the beam as shown in Fig i) which is pinned at B and supported on a roller at A
2. Write a computer program to find the magnitude and direction of the resultant of the forces acting on the bolt as shown in fig (ii).
3. A ladder AB of length L slides along a corner of a wall making an angel θ with vertical. Write a computer program to execute the velocity of the top end of the ladder and the angular velocity of the ladder if the bottom end of the ladder is moving to the right with a constant speed v, also execute a sample program for L=3 m, θ=30° and v=2m/s.
4. Write a computer program for finding the greatest elevation reached by a projectile which is fired from a cliff of height (h) with initial velocity(vo) and an angel θ. Also perform a sample execution for h=120m, vo=150m/s and θ varying from 0° to 60° at 5° interval.

Total No. of Hrs : 60

TEXT BOOKS

1) Stanley B.Lippman, (2000) "*The C++ Primer"* Pearson Education,3rd edition.
2) H.M.Deitel and P.E.Deitel, (2003) *"Java How to Program"*, Pearson Education, 5th edition.

REFERENCES

1) Deitel and Deitel, (2000) *"C++ How to Program"* Pearson Education, 4th edition.
2) N.Barkakati, "*Object Oriented Programming in C++"*, Prentice Hall of India Pvt.Ltd, 109097.
3) Ken Arnold and James Gosling, (2000) *"The Java Programming Language with updated 1.3"*, Pearson Education.

BMA 13009 NUMERICAL METHODS FOR MECHANICAL AND CIVIL ENGINEERS 3 1 0 4

(Common to II yr. / IV Sem. - Mechanical, Civil - B.Tech (Full Time))
(I yr. / II Sem. - Mechanical, II yr. / III Sem. - Civil - B.Tech (Part Time))

OBJECTIVES: The student will learn

- Methods of solution of algebraic equations
- Basic principles of numerical interpolation methods.
- Solution methods for ordinary and partial differential equations.

UNIT I: SOLUTION OF EQUATIONS **12** Hrs

Solution of Algebraic and Transcendental equations – Method of false position – Iteration method – Newton-Raphson method – Solution of Linear system of equations – Gauss Elimination method – Gauss-Jordan method – Iterative methods – Gauss-Jacobi method – Gauss-Seidel method – Matrix Inversion by Gauss-Jordan method.

UNIT II: INTERPOLATION **12** Hrs

Newton forward and backward differences – Central differences – Stirling's and Bessel's formulae – Interpolation with Newton's divided differences – Lagrange's method.

UNIT III: NUMERICAL DIFFERENTIATION AND INTEGRATION **12** Hrs

Numerical Differentiation with interpolation polynomials – Numerical Integration by Trapezoidal and Simpson's (both 1/3 rd & 3/8 th) rules – Two and three point Gaussian Quadrature formulae – Double integrals using Trapezoidal and Simpson's rules.

UNIT IV: NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS **12** Hrs

Taylor's series – Euler's & Modified Euler's method – Runge Kutta method of fourth order for first & second order differential equations – Milne's predictor-corrector method – Adam-Bashforth's predictor-corrector method.

UNIT V: NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12** Hrs

Finite difference solutions for one dimensional heat equation (both implicit & explicit) – Bender-Schmidt method – Crank-Nicolson method – One dimensional wave equation – Two dimensional Laplace and Poisson equations – Liebmann's method.

Total No. of Hrs : 60

TEXT BOOK

1) Veerarajan T. (2005), *"Numerical Methods*", Tata McGraw Hill Publishing Co.

REFERENCES

1) Sastry S.S. (2003), *"Introductory Methods of Numerical Analysis*", Prentice Hall of India.
2) Kandasamy P., Thilagavathy, Gunavathy K. (2008), *"Numerical Methods" (Vol.IV)*, S.Chand & Co.,
3) Grewal B.S. (2012), *"Higher Engineering Mathematics*", Khanna Publishers.

BME 13010 **ENGINEERING METALLURGY** **3 0 0 3**

OBJECTIVES: The student will learn
- Fundamental of metal structures,
- Properties of ferrous, non-ferrous and polymers.
- Heat treatment and testing of materials.

UNIT I: CRYSTALLOGRAPHY AND STRENGTHENING MECHANISMS **9** Hrs

Crystalline and amorphous solids - Unit cell and primitive cell - Miller indices BCC, FCC and HCP crystal structures and their packing factors –Crystalisation- Crystal defects - Effect of crystal imperfections in mechanical properties-Dislocations- strengthening mechanisms for the improvement of mechanical properties.

UNIT II: FERROUS AND NON FERROUS METALS **9** Hrs

Significance of Phase diagram-(Eutectic and Eutectoid alloy system)-Equilibrium and Non- Equilibrium cooling-Allotrophy of Iron-iron carbon phase diagram.
Classification of Steels and Cast Iron-Microstructure of Iron and Steel- Cast Irons - Grey, White malleable, spheroidal –Effect of alloying elements on steel - stainless and tool steels. Copper and Copper alloys - Brass, Bronze and Cupronickel –Aluminum and Al-Cu alloy

UNIT III: HEAT TREATMENT AND TESTING **9** Hrs

Definition - Classification of heat treatment process - Purpose of heat treatment -Principles (fundamentals) of heat treatment - Annealing –Re-crystallization- Normalizing - Hardening-TTT-CCT Cooling curves- Tempering - Interrupted quenching - Testing of materials - Destructive testing - Tensile, Compression, Hardness, Impact, Torsion, Fatigue. Non-destructive testing - Visual inspection, Hammer test, Radiography, Ultrasonic inspection.

UNIT IV: FAILURE MODES AND ITS PREVENTIONS **9** Hrs

Plastic deformation-Fracture - Mechanism of brittle fracture (Griffith's theory) and ductile fracture -Difference between brittle and ductile fractures - Fatigue failure and its prevention - Creep - different stages in creep curve - Factors affecting creep resistant materials -Mechanism of creep fracture.

UNIT V: NON METALLIC AND NEWER MATERIALS **9** Hrs

Types, Properties and Application: Polymers, Ceramics and Metal matrix Composites –Super alloys, Nano-materials- carbon and metal based materials, Smart materials and their properties

Total No. of Hrs : 45

TEXT BOOKS

1) Avner, (1997) *"Introduction to Physical Metallurgy"*, McGraw Hill International Book., second edition.
2) Williams D Callister, (2007) *"Material Science and Engineering"*, Wiley India Pvt Ltd, Revised Indian Edition.

REFERENCES

1) Raghavan, V., (2006) *"Materials Science and Engineering"*, Prentice Hall of India Pvt., Ltd.," 5 th edition.
2) Muralidhara. M.K. (1998) *"Material science and Process"*, Danpat Rai Publishing.
3) Nayak, S.P., (1985) *"Engineering Metallurgy and Material Science"*, Character Publishing House, Anand, India.
4) Van Vlack, (1970) *"Material Science for Engineers"*, Addison Wesley, 10985,
5) Arumugam, M., (1997) *"Material Science"*, Anuradha Publishers.
6) O.P. Kanna (1999) *"Material Science and Metallurgy"*, Prentice Hall of India Pvt., Ltd.

BME 13011 **THERMAL ENGINEERING – I** **3 1 0 4**

OBJECTIVES: The student will learn

- 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, IC engines Steam turbines, Gas Turbines.

UNIT I: STEAM GENERATORS **12** Hrs

Types and Classifications, Low pressure, high pressure, fire and water tube boilers –Cochran-Locomotive– Lancashire boilers - Babcock-Wilcox boilers - Benson, Lamont. Boiler mountings and Accessories – Criteria for selection of a boiler.

UNIT II: STEAM CONDENSERS AND NOZZLES **12** Hrs

Steam condensers – introduction – classification –jet and surface condensers-vacuum efficiency- condenser efficiency- simple problems. Steam nozzles–isentropic flow through nozzles-convergent, convergent divergent nozzles-critical pressure ratio- effect of friction.

UNIT III: STEAM TURBINES **12** Hrs

Impulse and Reaction Principles – Compounding-velocity and pressure compounding- Velocity diagrams for single stage turbines, Speed regulations – Governing.

UNIT IV: INTERNAL COMBUSTION ENGINES **12** Hrs

Actual cycles, Valve and port timing diagrams, Engine types and applications, Fuel supply, Ignition, Cooling and Lubrication System for S.I and C.I engines.

UNIT V: COMBUSTION AND TESTING OF I. C. ENGINES **12** Hrs

Cetane and Octane numbers of fuels – Combustion, Knocking and Detonation, Scavenging and Supercharging – Performance & Testing of I. C. Engines – Determination of frictional power and determination of various efficiencies – Heat balance calculations.

Total No. of Hrs : 60

***NOTE:** Use of approved thermodynamic property Tables and Charts are permitted in Examination

TEXT BOOKS

1) Rajput R. K., (2012) *"Thermal Engineering"*, Laxmi Publications (P) Ltd.
2) C. P. Kothandaraman and S. Domkundwar, (2004) *"Thermodynamics and Thermal Engineering"* Dhanpat Rai & Co. (P) Ltd.

REFERENCES

1) P. L. Ballaney, (1994) *"Thermal Engineering"*, Khanna Publishers, New Delhi.
2) W.P.Stoecker and J. W. Jones, *"Refrigeration and Air Conditioning*", Tata McGraw Hill Co. Ltd.,
3) Ganesan V., (2012) "*Internal Combustion Engines"*, Tata McGraw Hill New Delhi, 4th edition.

BME 13012 **STRENGTH OF MATERIALS** **3 1 0 4**

OBJECTIVES: The student will learn

- Basic principles of stress, strain and elastic constants.
- To draw shear force and bending moment diagrams .
- To find deflection of beams.

UNIT I: STRESS, STRAIN DEFORMATION OF SOLIDS **12** Hrs

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants and their relationship – strain energy due to axial load – stress due to suddenly applied load and impact load.

UNIT II: BEAMS - LOADS AND STRESSES **12** Hrs

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported beams and Overhanging beams Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stress distribution in beams of different sections.

UNIT III: TORSION OF SHAFTS AND SPRINGS **12** Hrs

Theory of pure torsion- Torsion of circular and hollow shafts –Stepped shafts – Composite shaft – Stress due to combined bending and torsion. Type of springs - Stiffness- Springs in series-Springs in parallel - Stresses and deflections in helical springs and leaf springs – Design of helical springs- design of buffer Springs - leaf springs.

UNIT IV: DEFLECTION OF BEAMS **12** Hrs

Double integration method- Macaulay's Method- Area Moment Theorems for Computations of slope and deflection in Beams. Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns.

UNIT V: ANALYSIS OF STRESSES IN TWO DIMENSIONS **12** Hrs

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point-Stress as Tension. Stresses on inclined plane – Principal planes and Principal stresses – Mohr's circle for biaxial stresses – Maximum shear stress - Strain energy and Strain Energy Density.

Total No. of Hrs : 60

TEXT BOOKS

1. Egor P. Popov, *"Engineering Mechanics of Solids"*, Prentice Hall of India, New Delhi, 109097 .
2. S.Ramamruthum and R. Narayan, *"Strength of Materials"*, Dhanpat Rai & Sons, 109096.
3. Beer F. P. and Johnston R, (2002) "*Mechanics of Materials"*, McGraw-Hill Book Co, Third Edition.

REFERENCES

1.Egor P. Popov, *"Engineering Mechanics of Solids"*, Prentice Hall of India, New Delhi, 109097 .
2.Beer F. P. and Johnston R, (2002) "Mechanics of Materials", McGraw-Hill Book Co, Third Edition

BME 13013 **MECHANICS OF MACHINES – I** **3 1 0 4**

OBJECTIVES: The students will learn

- Fundamental concepts of mechanisms and kinematics analysis of simple mechanisms.
- Application of friction in transmission drives.
- fundamental concepts of gears and gear trains

UNIT I: KINEMATICS OF MECHANISMS **14** Hrs

Definition of kinematic link, pair, chain, structure, machine,mechanism,inversion,types of constraints in motion, degree of freedom-mobility – kutzbach criterion –Grubler's criterion.Velocity and Acceleration in simple mechanisms by relative velocity method– Klien's construction, definition of Coriolis component of acceleration

UNIT II: BELT DRIVE **11** Hrs

Belt drives-types-flat and V-belt drive-slip and creep-power transmitted-length of the belt-ratio of belt tension-centrifugal tension-initial tension-maximum tension-condition for maximum power transmission, power transmitted by rope drives.

UNIT III: FRICTION IN BEARINGS, BRAKES AND CLUTCHES **11** Hrs

Frictional power loss in pivot and collar bearing. Torque transmitted in single and multiple plate clutches. Brakes-calculation of braking torque in block brake, simple and differential band brake.

UNIT IV: CAM **11** Hrs

Cams-Definition and terminology and applications. Classification of cam and follower – profile of cam with Simple harmonic motion and uniform acceleration and retardation of reciprocating knife edge and roller followers.

UNIT V: GEARS **13** Hrs

Gear terminology-Classification - law of gearing –forms of gear teeth –Length of path of contact - arc of contact-contact ratio- Gear trains –types-velocities in simple Epicyclic gear trains.

Total No. of Hrs : 60

TEXT BOOK

1) Khurmi R. S, (2001-2012) *"Theory of Machines"*, S.Chand,.

REFERENCES

1) Thomas Bevan, (2005) "*Theory of Machines"*,CBS Publishers and Distributors ,5th Edition.
2) Shigley J.E and Uicker J.J., (1995) *"Theory of Machines and Mechanisms"*, McGraw Hill Inc.
3) Rattan S.S., (2009) "*Theory of Machines"*, Tata McGraw Hill Publishing Company Ltd., New Delhi.
4) Dr.V.P.Singh. (2005) "*Theory of Machines"*, Dhanpat Rai and Co Private Limited.

BEE 13032 ELECTRICAL AND ELECTRONICS ENGINEERING 3 0 0 3

OBJECTIVES: The student will learn

- Working principle of Electrical Machines
- Electronic engineering principles and digital electronics fundamentals.

UNIT I: DC MACHINES **9** Hrs

Construction details of DC machines – principle of operation of DC generator – EMF equation – Characteristics of DC generators – Principle of DC motor –Back EMF – Torque equation – Characteristics shunt, series and compound motors - Losses and efficiency – Starters – Speed control – applications.

UNIT II: TRANSFORMERS **9** Hrs

Principle of ideal transformer – constructional details – EMF equation – Equivalent circuit – Voltage regulation – losses and efficiency – OC and SC tests on transformer – Autotransformer – Power supplies - basic principle of SMPS and UPS.

UNIT III: SYNCHRONOUS MACHINES AND INDUCTION MOTORS **9** Hrs

Construction details – principle of alternator – EMF equation – Voltage regulation – Starting of synchronous motor – effect of field excitation – Induction motor – principle of operation – torque equation – torque-slip characteristics – Starting methods and speed control – principle of single -phase induction motor - applications. (Qualitative Treatment only)

UNIT IV: DIGITAL ELECTRONICS **9** Hrs

Number systems-Binary, Octal, hexadecimal, Binary arithmetic-complement arithmetic-Binary coded decimal-Boolean Algebra-De Morgan's Laws-Logic gates-AND, OR, NOT, NAND, NOR, XOR-half & full adders-Multiplexers-De-multiplexers-Encoder-Decoder.

UNIT V: FLIP FLOPS **9** Hrs

Flip Flops-RS-JK-D&T-Asynchronous & Synchronous counters-shift registers (brief explanation only)

Total No. of Hrs : 45

TEXT BOOKS

1) S.K Bhattacharya, (2008) *"Electrical Machines"*, Tata Mc Graw Hill Publications, 2nd Edition, 109098.
2) B.L.Theraja., (2012) *"Electrical Techonology"*,S.Chandhan Publication, 23rd edition.
3) M.Morris mano., (2008) *"Digital Design"*, Prentice-Hall of India,4th edition.

REFERENCES

1) I.J. Nagrath & D.P. Kothari, (2010) *"Electrical Machines"*, TMH Publications, 4th edition.
2) I Mckenzie Smith , (2012) *"Hughes Electrical Technology*", Revised, Low price Edition, Pearson Education, eleventh edition.

BEN13L01 CAREER AND CONFIDENCE BUILDING (SOFT SKILLS-I) 2 0 0 2

COURSE OBJECTIVES:

- To develop an independent personality
- To be sure of presenting one-self
- To acquire knowledge in specialized sectors

To Improve:

1. Behavioural Pattern and Basic Etiquette
2. Value System
3. Inter Personal Skills
4. Behaving in Corporate Culture
5. Self Awareness / Confidence
6. Managing Self and Personality Styles including Body Language
7. International Culture / Cross Cultural Etiquette
8. Communication Skill

UNIT – 1 **6 Hrs**

Creation of awareness of the top companies / different verticals / courses for improving skill set matrix, Industry expectations to enable them to prepare for their career – Development of positive frame of mind – Avoiding inhibitions – Creation of self awareness – Overcoming of inferiority / superiority complex.

UNIT – II **6 Hrs**

Selection of appropriate field vis-à-vis personality / interest to create awareness of existing industries, Preparation of Curriculum Vitae – OBJECTIVESs, Profiles vis-à-vis companies.

UNIT – III **6 Hrs**

Group discussions: Do's and Don'ts – handling of group discussions – What evaluators look for! Interpersonal relationships – with colleagues – clients – understanding one's own behaviour – perception by others, How to work with persons whose background, culture, language / work style different from one's, behaviour pattern in multi-national offices.

UNIT – IV **6 Hrs**

Interview – awareness of facing questions – Do's and Don'ts of personal interview / group interview, Enabling students prepare for different Procedures / levels to enter into any company – books / websites to help for further preparation, Technical interview – how to prepare to face it. Undergoing employability skills test.

UNIT – V **6 Hrs**

Entrepreneurship development – preparation for tests prior to the interview – Qualities and pre-requisites for launching a firm.

References

1. Agarwal, R.S. Chand, S. (1989) *Quantitative Aptitude*. Publication.
2. ShaliniVerma,(2009) *Soft Skills*. Publication Pearson.
3. Shaliniverma,(2012) *Enhancing employability @ SOFT SKILLS*. Publication Pearson.
4. Kiranmai Dutt, P. Geetha Rajeevan, C.L. Prakash, N.(2010) *A Course in Communication Skills.* Publication Foundation Books.
5. Nirakonar,(2011) *English Language Laboratories*.PHI Learning.
6. Anandamurugan, S.(2011) *Placement Interviews*. Publication Tata McGraw Hill Education.

Total No. of Hrs : 30

BME 13L03 **FLUID MECHANICS AND MACHINERY & STRENGTH OF MATERIALS LAB** **0 0 3 1**

FLUID MECHANICS AND MACHINERY LAB

OBJECTIVES: The student will learn
- Methods of flow measurements
- To check the characteristics of hydraulic pumps and turbines.

1. EXPERIMENTS ON FLOW MEASUREMENTS
Venturimeter, Orifice Meter, Mouthpiece.

2. EXPERIMENT TO DETERMINE FRICTION FACTOR IN PIPES

3. EXPERIMENTS TO DRAW THE CHARACTERISTIC CURVES OF PUMPS
Centrifugal pump, Reciprocating pump and Gear pump.

4. EXPERIMENTS TO DRAW THE CHARACTERISTIC CURVES OF TURBINES
Pelton Wheel, Francis Turbine.

STRENGTH OF MATERIALS LAB

OBJECTIVES: The student will learn
- Experimental methods of finding Mechanical properties of materials.

1. Evaluation of Engineering Stress/strain diagram on steel rod.
2. Compression test on Bricks, Concrete blocks
3. Deflection test on beams– Verification of Maxwell Theorem
4. Hardness testing of Steel , Copper and Aluminium using Brinell hardness machines
5. Hardness testing of Steel ,Copper and Aluminium using Rockwell machine
6. Estimation of Spring constant ,under Tension and Compression
7. Estimation of notch toughness of steel using Charpy impact testing machine
8. Double shear test of mild steel and aluminum.
9. Fatigue test on steel shaft

Total No. of Hrs : 45

BEE 13L21 ELECTRICAL AND ELECTRONICS LAB 0 0 3 1

OBJECTIVES: The student will learn

- To conduct tests to find performance of electric motors and generators
- To draw characteristic curves of electron devices
- To verify logic gates.

ELECTRICAL LAB

LIST OF EXPERIMENTS

1. Open Circuit and Load Test on DC Shunt Generator
2. Load Test on DC Shunt Motor.
3. Load Test on DC Series Motor.
4. Swine Burne's Test
5. Speed Control on DC Shunt Motor
6. O.C. and S.C. test on 1-phase Transformer
7. Load Test on Transformer
8. Load Test on Alternator.
9. Load Test on 3-phase Squirrel cage Induction Motor.
10. Load Test on 1-phase Induction Motor.

ELECTRONICS LAB

LIST OF EXPERIMENTS

1. P-N junction & Zener Diode characteristics.
2. BJT characteristics in CE configuration
3. Operation amplifier Application-Adder, Interfacer, Differentiator, Integrator.
4. Verification of Logic Gates.
5. Design of Multiplexer and Demultiplexer.
6. Design of Half –Adder & Full Adder Circuits

Total No. of Hrs : 45

BME 13014 GAS DYNAMICS AND JET PROPULSION 3 1 0 4

OBJECTIVES: The student will learn

- The basic difference between incompressible and compressible flow.
- The phenomenon of shock waves and its effect on flow.
- Basic knowledge about jet propulsion and Rocket Propulsion.

UNIT I: COMPRESSIBLE FLOW – FUNDAMENTALS **12** Hrs

Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states. Mach number, Critical Mach number, types of waves. Mach cone, Mach angle.

UNIT II: FLOW THROUGH VARIABLE AREA DUCTS **12** Hrs

Isentropic flow through variable area ducts. T-s and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles.

UNIT III: FLOW THROUGH CONSTANT AREA DUCTS **12** Hrs

Flow in constant area ducts with friction (Fanno flow) – Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length. Isothermal flow with friction in constant area ducts. Flow in constant area ducts with heat transfer (Rayleigh flow), Rayleigh line and Rayleigh flow equation, variation of flow properties, Maximum heat transfer.

UNIT IV: NORMAL SHOCK **12** Hrs

Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across the normal shocks. Prandtl Meyer equation, impossibility of shock in subsonic flows, flow in convergent and divergent nozzle with shock, normal shock in fanno and Rayleigh flows, flow with oblique shock (elementary treatment only).

UNIT V: PROPULSION **12** Hrs

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. Types of rocket engines – Propellants-feeding systems – Ignition and Combustion-Theory of rocket propulsion – Effective jet velocity-specific impulse – rocket engine performance.

Total No. of Hrs : 60

***NOTE:** Use of approved Gas tables permitted in Examination

TEXT BOOK

1) Yahya S.M., (2005) "*Fundamental of Compressible flow"*, New Age International (P) Ltd., New Delhi. Third edition reprint.

REFERENCES

1) Patrick & William, (1997) *"Fundamentals Of Compressible Flow*", Mcgraw Hill-Inc.
2) Ganesan.V, (2010) "*Gas Turbines"* , Tata McGraw Hill Publishing Company, New Delhi.
3) Sutton, G.P. "*Rocket Propulsion Elements"*, John Wiley, Newyork, 10986.
4) Cohen H., R.E.C., Rogers And Sravanamutoo, *"Gas Turbine Theory*", Addison Wesley Ltd., 10987.

BME 13015 **ENGINEERING METROLOGY** **3 0 0 3**

OBJECTIVES: The student will learn
- To understand and apply the various measuring and inspection methods in metrology.
- Recent advances in metrology

UNIT I: BASIC CONCEPTS OF MEASUREMENTS **7** Hrs

Need for measurement - Precision and Accuracy - Reliability - Errors in Measurements – Types – Causes.

UNIT II: LINEAR AND ANGULAR MEASUREMENTS **9** Hrs

Measurement of Engineering Components: Comparators (Mechanical, Optical, Electrical) - Slip Gauges - Limit Gauges -Auto Collimator - Angle Decker - Alignment Telescope - Sine Bar - Bevel Protractor**.**

UNIT III: FORM MEASUREMENTS **10** Hrs

Measurement of: Screw Thread - Gears - Radius - Surface Finish – Straightness - Flatness – Roundness.

UNIT IV: LASER METROLOGY **10** Hrs

Precision instrument based on Laser: Use of Lasers - Principle - Laser Interferometer - Application in Linear and Angular measurements - Testing of machine tools using Laser Interferometer**.**

UNIT V: ADVANCES IN METROLOGY **9** Hrs

Co-ordinate Measuring Machine (CMM) - Constructional features - Types - Applications of CMM – CNC applications - Computer Aided Inspection (CAI) - Machine Vision - Applications in Metrology.

Total No. of Hrs : 45

***NOTE:** Problems not included

TEXT BOOK
1) R.K. Jain, (1994) *"Engineering Metrology"*, Khanna publishers, 109094.

REFERENCES
1) I.C. Gupta, *"A TEXT BOOK of Engineering Metrology"*, Dhanpat Rai & sons, 109096.
2) G.N. Galyer and C.R. Shotbolt, *"Metrology for Engineers"*, ELBS edition, 109090.
3) Thomas *"Engineering Metrology"*, Butthinson & co, 10984.

BME 13016 **DESIGN OF MACHINE ELEMENTS – I** **3 1 0 4**

OBJECTIVES: The student will learn

- Design principles of various components in mechanical engineering application.
- To familiarize the various steps involved in the Design Process to satisfy functional and strength requirements.
- To learn to use standard practices and standard data.

UNIT I: FUNDAMENTALS OF DESIGN **15** Hrs

Introduction to the design Process – Computer aided design – Mechanical Properties of Materials – Selection of material based on its physical properties. Types of Loads and Stresses – Static and Varying - Factor of Safety – Theories of Failure – Stress Concentration Factors.

UNIT II: DESIGN OF TEMPORARY AND PERMANENT JOINTS **12** Hrs

Threaded fasteners - Design of bolted joints including eccentric loading, Knuckle joints, Cotter Joints – Design of welded joints, riveted joints for structures.

UNIT III: DESIGN OF SHAFTS AND COUPLINGS **12** Hrs

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

UNIT IV: DESIGN OF IC ENGINE COMPONENTS **9** Hrs

Design of Connecting Rod – Piston – Flywheel.

UNIT V: DESIGN OF SPRINGS **12** Hrs

Design of Helical Springs – Compression and Tension – Leaf Springs.

Total No. of Hrs : 60

TEXT BOOKS

1) Shigley J.E and Mischke C. R., (2008) *"Mechanical Engineering Design"*, Sixth Edition, Tata McGraw Hill.
2) Bhandari V.B, (2010) *"Design of Machine Elements"*, Second Edition, Tata McGraw-Hill Book Co.

REFERENCES

1) Sundararajamoorthy T. V, Shanmugam .N, (2003) *"Machine Design"*, Anuradha Publications, Chennai.
2) Orthwein W, (2005) *"Machine Component Design"*, Jaico Publishing Co.
3) Ugural A.C, (2004) *"Mechanical Design – An Integral Approach"*, McGraw-Hill Book Co.
4) Spotts M.F., Shoup T.E (2004) *"Design and Machine Elements"*, Pearson Education.

BME 13017 **THERMAL ENGINEERING – II** **3 1 0 4**

OBJECTIVES: The student will learn

- 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: AIR COMPRESSORS **12** Hrs

Reciprocating Compressor – Single Stage and Multi-stage operations, Effect of clearance, Volumetric efficiency. Rotary Compressor –Construction & Working of vane type blower, roots blower, screw compressor, centrifugal compressor.

UNIT II: GAS TURBINES **12** Hrs

Classifications, Constant pressure Open cycle Gas turbines - Methods for improvement of Thermal efficiency – Inter-cooling, Reheating, Regeneration, Effect of operating variables on thermal efficiency. Constant pressure closed cycle gas turbines, Gas turbine fuels.

UNIT III: REFRIGERATION **12** Hrs

Reversed Carnot cycle, Bell Coleman Cycle, Vapour Compression refrigeration cycle – Components, Working, P-H & T-S diagrams, Calculation of COP, effect of subcooling and superheating, Properties of refrigerants, Important refrigerants, Vapour absorption refrigeration cycles.

UNIT IV: AIR-CONDITIONING **12** Hrs

Introduction to Psychrometry – Psychrometric charts – Psychrometric processes - Principles of air-conditioning – Types of a/c systems – Summer, Winter comfort and Year round air-conditioning – Design of air-conditioners – Heat load calculations.

UNIT V: LAYOUT OF POWER PLANT **12** Hrs

Layout of Steam, hydel, diesel, MHD, nuclear and Gas-turbine power plants – Combined power cycles – Comparison and selection.

Total No. of Hrs : 60

***NOTE:** Use of approved Refrigeration Tables and Psychrometric charts are Permitted

TEXT BOOK

1) R.K.Rajput, (2012) *"Thermal Engineering"*, Laxmi Publications (P) Ltd, New Delhi.

REFERENCES

1) B.K.Sarkar, *"Thermal Engineering"*, Tata McGraw-Hill publishing company Ltd.
2) W.P.Stoecker and J.W.Jones, (2009) *"Refrigeration and air-conditioning"*, Tata McGraw Hill, New Delhi.
3) P.L.Ballaney, (1994) *"Thermal engineering"*, Khanna Publishers.

BME 13018 **MECHANICS OF MACHINES – II** **3 1 0 4**

OBJECTIVES: The students will learn

- Static and dynamic analysis of forces
- Fundamental concepts of different vibratory systems.
- Working principles of Speed controlling governors
- Gyroscopic principle and its effects.

UNIT I: FORCE ANALYSIS **12** Hrs

Dynamic force analysis – Inertia force and Inertia torque – D'Alemberts principle - Dynamic analysis in Reciprocating Engines – Gas forces – Equivalent masses – Bearing loads – Crank shaft Torque - Turning moment diagrams – Fly wheels.

UNIT II: BALANCING **12** Hrs

Static and dynamic balancing – Balancing of rotating masses in same plane and in different planes. Balancing of reciprocating masses-partial balancing of locomotives– tractive force, swaying couple and hammer blow.

UNIT III: LONGITUDINAL VIBRATION **12** Hrs

Basic features of vibratory systems –types of vibration – Degrees of freedom – free longitudinal vibration of Single degree of freedom – damping – logarithmic decrement –forced damped vibration- magnification factor-vibration isolation- transmissibility.

UNIT IV: TRANSVERSE AND TORSIONAL VIBRATION. **12** Hrs

Transverse vibration- single concentrated load, Uniformly loaded shaft , shaft carrying several loads and whirling of shafts-Torsional vibration-single, two and three rotor systems –Torsionally Equivalent shaft-geared system.

UNIT V: MECHANISM FOR CONTROL **12** Hrs

Governors – Types – Centrifugal governors –Watt, Porter , Proell and Hartnel Governors – Equilibrium conditions, Iso-chronous , Sensitivity , Hunting, Stability, Effort and Power of Governor- Controlling Force Diagram— Gyroscopic Stabilization – Gyroscopic effects in Automobiles, ships and airplanes .

Total No. of Hrs : 60

TEXT BOOK

1) Khurmi R. S, (2011 – 2012) *"Theory of Machines"*, S.Chand and Co.

REFERENCES

1) Rattan S.S., (2009) "*Theory of Machines"*, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2) Dr.V.P.Singh., (2005) *"Theory of Machines"*, Dhanpat Rai and Co Private Limited.
3) Thomas Bevan, (2005) *"Theory of Machines"*,CBS Publishers and Distributors.
4) Shigley J.E and Uicker J.J., (1995) *"Theory of Machines and Mechanisms"*, Tata McGraw Hill Inc.

BIC 13031 INSTRUMENTATION AND CONTROL ENGINEERING 3 0 0 3

OBJECTIVES: The student will learn

- To understand the fundamental concepts and applications of various mechanical measurement techniques
- Various control system approaches and their applications

UNIT I: MEASUREMENTS **6** Hrs

General concepts - Units and Standards – Measuring Instruments – Sensitivity, Readability, Range of Accuracy, Precision – Static and Dynamic Response – Repeatability, Hysteresis – Systematic and Random Errors – Correction Calibration.

UNIT II: INSTRUMENTS **12** Hrs

Transducer, Modifying (Intermediate) and Terminal Stages – Mechanical and Electrical Transducers – Pre-amplifiers – Charge Amplifiers – Filters – Attenuators – D'arsonval – CRO - Oscillographs – Recorders – Microprocessor based logging, Processing and Output.

UNIT III: PARAMETERS FOR MEASUREMENTS **15** Hrs

Dimensions, Displacements, Velocity, Acceleration, Impact – Force, Torque, Power – Strain – Pressure – 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 **6** Hrs

Basic Elements – Feedback Principle, Implication of Measurements – Error Detectors – Final Actuating Elements – Two Position, Multi-position, Floating Proportional Controls – Relays – Servo Amplifiers – Servo Motors – Mechanical, Electrical, Magnetic, Hydraulic and Pneumatic Systems.

UNIT V: APPLICATION OF CONTROL SYSTEMS **6** Hrs

Governing of Speed – Kinetic and Process Control – Pressure, Temperature, Fluid Level, Flow – Thrust and Flight Control – Photo-electric Controls.

Total No. of Hrs : 45

TEXT BOOKS

1) K Ghosh, (2005) *"Introduction to Instrumentation and Control"*, Prentice – Hall of India, New Delhi, revised edition.
2) R. S. Sirohi, H. C. Radha Krishna, (1991) *"Mechanical Measurements"*, New Age International (P) Limited, 3rd edition.

REFERENCES

1) J. P. Holman, (2011) *"Experimental Methods for Engineers"*, McGraw Hill Book Company, 10971, 8th edition.
2) L. F. Adams, (1983) *"Measurements and Instrumentation"*, the English Language Book Society, 10975.

BEN13L02 QUALITATIVE AND QUANTITATIVE SKILLS (SOFT SKILLS-II) 2 0 0 2

COURSE OBJECTIVES:

- Ability to work out mentally any problem.
- Ability to choose the correct approaches.
- Ability to tackle all interviews and competitive exams.

The purpose of this course is to build confidence, inculcate various Soft skills and also helps the students to identify in achieving their personal potential.

At the end of this training program the participant will be able to,
Explain the concept problem solving

- Outline the basic steps in problem solving.
- List out the key elements
- Explain the use of tools and techniques in problem solving.
- Discuss the personality types and problem solving techniques.
- By adapting different thinking styles in group and learn environment.
- Recognizing and removing barriers to thinking in challenging situations.
- Make better decision through critical thinking and creative problem solving.

METHODOLOGY

The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talent of the students which they will be employing during various levels in their real life.

1. Group activities + individual activities
2. Collaborative learning
3. Interactive sessions
4. Ensure Participation
5. Empirical Learning

UNIT 1:

Self Introduction – Narration-Current News Update – Numbers – Height & Distance – Square & Cube Roots

UNIT II:

Current Technology Update – Verbal Aptitude Test I – GD-I – Odd man out series – Permutation & Combination – Problems on ages

UNIT III:

GD-II – Resume Writing – Mock Interview I / reading comprehension

UNIT IV:

Mock Interview II / reading comprehension – Mock Interview III / reading comprehension – GD – III – Ratio & Proportion – Clocks – H.C.F. & L.C.M

UNIT V:

GD – IV – Verbal Aptitude Test II – Review – Partnership – Puzzles - Test

References

1 Pushpalata and Sanjay Kumar, *(2007) Communicate or Collapse: A Handbook of Effective Public Speaking, Group Discussions and Interviews*. Delhi: Prentice-Hall.
2 Thorpe, Edgar, (2003) *Course in Mental Ability and Quantitative Aptitude*. Tata McGraw-Hill.
3 Thorpe, Edgar, (2003) *Test of Reasoning*. Tata McGraw-Hill.
4 Prasad, H.M. (2001) *How to prepare for Group Discussion and Interview*. Tata McGraw-Hill.

Total no. of Hrs : 30

BME 13L04 **THERMAL ENGINEERING LAB – I** **0 0 3 1**

OBJECTIVES: The student will learn

- To evaluate the performance of steam turbines and IC engines.

STEAM LAB

1. Study of steam generators and turbines.
2. Performance and energy balance test on a steam generator.
3. Performance and energy balance test on a steam turbine.
4. Performance test on a steam condenser.
5. Analysis of flue gas using Orsat apparatus.

IC ENGINES LAB

1. Study of IC engines components and loading devices.
2. Valve timing and port timing diagrams.
3. Performance test on 4-stroke twin cylinder diesel engine.
4. Heat balance test on 4-stroke single cylinder diesel engine.
5. Performance test on single cylinder 4-stroke petrol engine.
6. Morse test on multi cylinder petrol engine.
7. Retardation test to find frictional power of a diesel engine.

Total No. of Hrs : 45

BME 13L05 METROLOGY & METALLURGY LAB 0 0 3 1

METROLOGY LABORATORY

OBJECTIVES: The student will learn

- Application of Instruments and Gauges for the measurement of products' characteristics to assess their quality, in manufacturing industries;
- In particular, they will have hands-on exposure to:

1. Linear measurements, **2.** Angular measurements, **3.** Form Measurements

LIST OF EXPERIMENTS

1. Measurement of Dimensions using Vernier Height Gauge
2. Measurement of Dimensions using Vernier Depth Micrometer
3. Measurement of Gear Nomenclature using Gear Tooth Vernier
4. Angular Measurement using Vernier Height Gauge and Sine Bar
5. Angular Measurement using Sine Bar, Slip Gauge and Dial Gauge
6. Thread Measurement using Profile Projector
7. Measurement of Dimensions using Tool Makers Microscope
8. Angular measurement for Bevel Protractor
9. Calibration of Dial Gauge using Slip Gauge
10. Flatness of given work piece using Autocollimator

METALLURGY LABORATORY

OBJECTIVES: Students will learn

- Micro structures of various ferrous and non ferrous materials using microscopes.
- Heat treatment processes of materials.

STUDY EXPERIMENTS

1. Introduction to metallurgy
2. Specimen preparation
3. Metallurgical microscope
4. Iron carbon system
5. Time temperature transformation diagram (TTT)

MICROSTRUCTURE ANALYSIS

1. Brass
2. Copper
3. Gray cast-iron
4. Malleable cast-iron
5. Nodular iron
6. Mild-steel, Stainless-steel and High speed steel

HEAT TREATMENT PROCESS

1. Jominey quench test
2. Hardness of steel
3. Creep test

Total No. of Hrs : 45

BMA 13017 OPTIMIZATION TECHNIQUES FOR MECHANICAL ENGINEERS 3 1 0 4

OBJECTIVES: The student will learn
- Mathematical formulation of a real time problem
- Algorithms for optimal use of resources

UNIT I: LINEAR PROGRAMMING **12** Hrs

Formulation of LPP – Standard form of LPP – Graphical method – Simplex method – Big M method – Two phase method.

UNIT II: TRANSPORTATION AND ASSIGNMENT **12** Hrs

Formulation of Transportation problem – North West corner method – Least cost method – Vogel's approximation method – Optimality test – MODI method – Degeneracy – Assignment problem: Hungarian method – Travelling salesman problem.

UNIT III: CPM, PERT AND SEQUENCING MODELS **12** Hrs

Network representation – Fulkerson's rule – Critical path method – Scheduling of activities – Earliest and Latest times – Float and Slack times – PERT – Probability for project duration – Sequencing Models: Introduction – Basic Terminologies – Processing n jobs on 2, 3, and machines – Johnson's method.

UNIT IV: QUEUING MODELS **12** Hrs

Elementary concepts – Pure Birth and Death process – Single server Markovian models with infinite and finite capacity – Multi server Markovian models with infinite and finite capacity.

UNIT V: SIMULATION AND REPLACEMENT MODELS **12** Hrs

Simulation: Introduction – Monte-Carlo Technique – Generation of Random numbers – Applications to Queuing models – Replacement Models: Introduction – Individual Replacement policy – Money value (not considered and considered) – Group Replacement policy – Comparison of Individual and Group Replacement policies.

Total No. of Hrs : 60

TEXT BOOKS
1) Sundaresan V. et.al. (2009), *"Resource Management Techniques*", A.R. Publications.

REFERENCES
1) Panneerselvam R. (2011), "*Operations Research"* (2nd ed.), Prentice Hall of India.
2) Hamdy A. Taha (2010), "*Operations Research: An Introduction" (09th ed.)*, Pearson.
3) Hillier, Lieberman (2005), *"Introduction to Operations Research"* (8th ed.) (IAE), Tata McGraw Hill Publishing Co.
4) Hira D.S., Gupta P.K., (2007) *"Operations Research"*, S.Chand & Co.

BEC 13031 MICROPROCESSOR AND MECHATRONICS 3 0 0 3

OBJECTIVES: The student will learn
- Basic architecture of a microprocessor
- Basics and design of a Mechatronic system
- Structure of PLCs.

UNIT I: MICROPROCESSOR **9** Hrs

Simple Block Diagram-CPU-control unit-ALU-Registers-Architecture of 8085-Addressing modes-Direct-Indirect, Implicit-Basic concepts of microprocessor programming –Assembly language programming – Instruction sets of 8085-simple programs.

UNIT II: ELECTRONICS AND MICROPROCESSOR APPLICATIONS **9** Hrs

Basic interfacing concepts -Peripheral interfacing – 8255 & 82509 – RAM –ROM – EPROM-Hierarchy of memory- DMA controller- A/D & D/A conversion

UNIT III: MECHATRONICS **9** Hrs

Introduction to Mechatronics Systems – Measurement Systems – Control Systems – Continuous and discrete process Controllers – Control Mode – Two Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Digital Controllers.

UNIT IV: PROGRAMMABLE LOGIC CONTROLLERS **9** Hrs

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

UNIT V: DESIGN OF MECHATRONICS SYSTEMS & APPLICATIONS **9** Hrs

Traditional and Mechatronic Design - Possible Design Solutions Case Studies of Mechatronics Systems, Pick and place robot – automatic Car Park Systems – Engine Management Systems- simple control applications – Traffic light-stepper motor control.

Total No. of Hrs : 45

TEXT BOOKS
1) W. Bolton, (2011) *"Mechatronics"*, Pearson Education, 1090909, 5th revised edition.
2) Gaonkar R.S., (2011) "*Microprocessor Architecture, Programming & Application"*, Wiley Eastern, 5th edition.
3) A.Nagoor kani., (1998) *"Control system"*, R.B.A. Publications.

REFERENCES
1) Michael B. Histand and David G. Alciatore, (2012) *"Introduction to Mechatronics and Measurement Systems"*, McGraw-Hill International Editions, 4th edition.
2) Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, *"Mechatronics"*, Chapman and Hall, 109093.
3) Nitaigour Premchand Mahadik, (2003) *"Mechatronics"*, Tata McGraw-Hill publishing Company Ltd.

BME 13019 **HEAT AND MASS TRANSFER** **3 1 0 4**

OBJECTIVES: The student will learn

- Concept and modes of heat and mass transfer.
- Application of various experimental heat transfer correlations in engineering calculations
- To learn the thermal analysis and sizing of heat exchanger.

UNIT I: CONDUCTION **12** Hrs

Introduction of heat transfer – Mode of Heat Transfer: Conduction, Convection and Radiation. Fourier' Law of Conduction - General Differential equation of Heat Conduction - Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – through Plane Wall, Cylinders and Spherical systems – Composite Systems - Thermal contact resistance- Overall heat transfer coefficient - Critical thickness of insulation - Extended surfaces (Fins) - Transient heat conduction: lumped heat capacity system.

UNIT II: CONVECTION **12** Hrs

Basic Concepts –Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection–Dimensional Analysis–External Flow–Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar and Turbulent Flow–Combined Laminar and Turbulent – Flow over Bank of tubes – Free Convection – Flow over Vertical Plate, Horizontal Plate and long horizontal cylinder.

UNIT III: RADIATION **11** Hrs

Basic Laws of Radiation, Radiation shape factor, shape factor algebra for radiant heat exchange between black and gray bodies, Radiosity, Irradiation, and Radiation shield-Introduction to gas radiation.

UNIT IV: PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGER **15** Hrs

Boiling heat transfer phenomenon – modes of boiling, pool boiling regime-flow boiling thro horizontal pipes-boiling empirical correlations. Condensation-film and drop wise condensation-Nusselt theory of condensation over vertical surface -governing equations-empirical correlations. Heat exchangers- types- derivation of LMTD & NTU effectiveness equation- fouling factor-Simple design problems.

UNIT V: MASS TRANSFER **10** Hrs

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.

Total No. of Hrs : 60

***NOTE:** Use of approved HMT data book is permitted in the University Examination

TEXT BOOKS

1) C.P.Kothandaraman, (2005) "*Fundamentals of Heat and Mass Transfer"*, New age International (p) Ltd-109098.
2) R.C.Sachdeva (2010) "*Fundamentals of Heat and Mass Transfer"*, New age International (p) Ltd -109098, 4th edition.

REFERENCES

1) J.P.Holman (2001) *"Heat transfer"*, McGraw Hill Book Company, 9th edition.
2) Ozisik.N.M. (1998) "*Heat transfer"*, McGraw Hill Book Company.
3) R.Yadav (2004) *"Heat and Mass transfer"*, Central publishing house-Allahabad-109095.
4) R.K.Rajput (2007) "*Heat and Mass transfer"*, Chand Publishers.

BME 13020 **DESIGN OF MACHINE ELEMENTS – II** **3 1 0 4**

OBJECTIVES: The student will learn
- Design principles and design procedure of various mechanical power transmission systems.
- Use of standard design data books and catalogues.

UNIT I: DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS **12** Hrs

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

UNIT II: DESIGN OF SIMPLE GEARS **12** Hrs

Design of gears – Spur gear, Helical gear and Herringbone gears.

UNIT III: DESIGN OF SPECIAL GEARS **12** Hrs

Design of Bevel gears – Straight and Spiral Bevel types. Design of Worm gears .

UNIT IV: DESIGN OF SPEED REDUCERS **12** Hrs

Design of speed reducers –Geometric Progression – Standard Step ratio- Ray diagram – Kinematic arrangement of Gears -Number of teeth on gears.

UNIT V: DESIGN OF SIMPLE MECHANISMS AND BEARINGS **12** Hrs

Design of Ratchet and pawl mechanism, Geneva mechanism and Selection of Bearings.

Total No. of Hrs : 60

***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., (2003) *"Mechanical Engineering Design"*, Sixth Edition, Tata McGraw Hill.
2) Sundararajamoorthy T. V and Shanmugam .N, (2003) *"Machine Design"*, Anuradha Publications, Chennai.

REFERENCES
1) Maitra G.M. and Prasad L.V., *"Hand book of Mechanical Design"*, II Edition, Tata McGraw Hill 10985.
2) Bhandari, V.B., *"Design of Machine Elements"*, Tata McGraw Hill Publishing Company Ltd., 109094.
3) Prabhu. T.J., (2000) *"Design of Transmission Elements"*, Mani Offset, Chennai.
4) Hamrock B.J., Jacobson B. and Schmid S.R., *"Fundamentals of Machine Elements"*, Tata McGraw-Hill Book Co., 1090909.
5) Ugural A,C, (2003) *"Mechanical Design, An Integrated Approach"*, Tata McGraw-Hill.

BME 13021 MANUFACTURING TECHNOLOGY – II 3 0 0 3

OBJECTIVES: The student will learn
- Basic concept of metal cutting.
- Various types of machine tools for metal cutting.

UNIT I: THEORY OF METAL CUTTING **9** Hrs

Metal cutting types - Mechanism of metal cutting - Cutting forces - Chip formation - Merchant's circle diagram - Calculations – Tool geometry - Machinability - Tool wear - Tool life - Cutting tool materials - Cutting fluids.

UNIT II: SPECIAL PURPOSE MACHINES-I **10** Hrs

Automats – Classification, cam controlled automats, single and multi spindle automats.
Shaper, Planer, slotter: Specification - Types - Mechanism – Calculations
Milling: Specification - Types - Cutter nomenclature - Types of cutter - Milling processes - Indexing - Cam and thread milling

UNIT III: SPECIAL PURPOSE MACHINES-II **10** Hrs

Broaching: Specification - Types - Tool nomenclature - Broaching process.
Boring: Specification - Types - Operations - Boring tool - Jig Boring machine.
Grinding: Types of grinding machine - Designation and selection of grinding wheel - Bonds - Reconditioning of grinding wheel – Lapping, honing and super finishing.

UNIT IV: GEAR CUTTING MACHINES **8** Hrs

Kinematics of gear shaping and gear hobbing - Gear generation principles specifications - Cutters - Bevel gear generator - Gear finishing methods.

UNIT V: POWDER METALLURGY AND PRECISION ENGINEERING **8** Hrs

Powder metallurgy – production of metal powders, compaction, sintering,selective laser sintering, finishing of sintered parts. Precision machining and micro machining – diamond turning of parts to nanometer accuracy, stereo microlithography, machining of microzied components

Total No. of Hrs : 45

TEXT BOOKS
1) C. Elanchezian, M. Vijayan, (2004) *"Machine Tools"* Anuradha Publications.
2) S. K. Hajra Choudry, S. K. Bose, (2010) *"Elements of Workshop Technology -Volume I & II"*. Media promoters.

REFERENCES
1) H.M.T, (1990) *"Production Technology – Handbook"*, TMH.
2) Richara R. Kibbe, John E. Neely, Roland O. Meyer and Warrent T. White, (2009) *"Machine Tool Practices"*, VI Edition, Prentice Hall of India.
3) N. K. Mehta, (2012) *"Machine Tool Design and NC"*, Tata McGraw Hill Publishing Co. Ltd.
4) P. C. Sharma, (2008) *"A text book of Production Engineering"*, S. Chand and Co. Ltd., IV Edition.
5) Jaeger R.C, (1988) *"Introduction to microelectronics fabrication"*, Addison Wesley pub. Co.,

BME 13022 **HYDRAULICS AND PNEUMATICS** **3 0 0 3**

OBJECTIVES: The student will learn
- Pneumatic and hydraulic components and functions
- Design of Pneumatic and hydraulic circuits for automation.

UNIT I: BASIC PRINCIPLES **9** Hrs

Hydraulic principles – Hydraulic pumps – Characteristics – pump selection – pumping circuits - Hydraulic actuators – Linear and rotary selection – Characteristics – Hydraulic valves –Pressure – Flow – Direction controls – Applications – Hydraulic Fluids – Symbols.

UNIT II: HYDRAULIC CIRCUITS **9** Hrs

Hydraulic circuits – Reciprocating – Quick-return – sequencing – synchronizing –Accumulators circuits – Safety circuits – Industrial circuits – Press, milling machine, Planner, forklift etc.

UNIT III: DESIGN AND SELECTION **9** Hrs

Design of Hydraulic circuits – selection of components – Installation and maintenance of Hydraulic power packs.

UNIT IV: PNEUMATIC SYSTEMS **9** Hrs

Fundamentals – Control elements – logic circuits – position – pressure sensing – switching – Electro-pneumatic – Electro-hydraulic circuits.

UNIT V: DESIGN AND SELECTION **9** Hrs

Design of Pneumatic circuits – classic – cascade – step counter – combination methods – Selection criteria – for pneumatic components – Installation and Maintenance of Hydraulic and Pneumatic power packs.

Total No. of Hrs : 45

TEXT BOOKS
1) Anthony Esposito, (2008) *"Fluid power with applications"*, Pearson education Pvt. Ltd, 7th edition.
2) W.Bolton, (2012) *"Pneumatic and Hydraulic Systems"*, Butterworth, 3rd edition.

REFERENCES
1) Anthony Esposito, (2008) *"Fluid power with applications"*, Pearson education Pvt. Ltd, 7th edition.
2) W.Bolton, (2012) *"Pneumatic and Hydraulic Systems"*, Butterworth, 3rd edition.

BME 13L06 **THERMAL ENGINEERING LAB – II** **0 0 3 1**

OBJECTIVES: The student will learn

- To evaluate the performance of air compressor, air blower and refrigeration and air conditioning systems.
- To determine the properties of lubricating oil.
- To determine the heat transfer characteristics.

LIST OF EXPERIMENTS:

1. Performance test on reciprocating air compressor.
2. Performance test on a constant speed air blower.
3. Viscosity measurement using Redwood apparatus.
4. Viscosity measurement using Say bolt apparatus.
5. Determination of COP of a refrigeration system.
6. Determination of COP of air conditioning system.
7. Determination of flash point and fire point of the given lubricating oil sample**.**
8. Determination of thermal conductivity of an insulating material.
9. Determination of efficiency of a pin fin using natural and forced convection methods.
10. Determination of emissivity of a gray body using emissivity apparatus.
11. Determination of Stefan Boltzman Constant.
12. Determination of effectiveness of a parallel flow and counter flow heat exchanger.
13. Determination of Heat Transfer in Drop and Film wise Condensation
14. Overall Heat Transfer Coefficient of Composite wall..

Total No. of Hrs : 45

BME 13L07 MANUFACTURING TECHNOLOGY LAB – II 0 0 3 1

OBJECTIVES: The student will learn

- Practical skill in various manufacturing processes in special purpose machines.

MILLING PRACTICE

1. Hexagonal milling
2. Contour milling
3. Gear milling

SHAPING, PLANING AND SLOTTING PRACTICE

1. Cutting key ways
2. Dove tail hexagonal machining.
3. Machining of large components using planer
4. Internal keyway using slotter

GRINDING PRACTICE

1. Cylindrical grinding
2. Surface grinding.
3. Tool and cutter grinding

HOBBING PRACTICE

Gear hobbing.

Study on Mechanical press and hand operated injection moulding machine

Machining time has to be calculated for all the machining operations. Also the students are expected to check the dimensions of the finished job with the drawing.

Total No. of Hrs : 45

BME 13L08 **DYNAMICS LAB** **0 0 3 1**

OBJECTIVES: The student will learn

- Working of simple mechanisms.
- Dynamic analysis of machine elements
- To find natural frequency of vibrating system at different modes.

KINEMATICS (Demonstration only)

1. Kinematics of four bar mechanisms - Slider Crank, Crank Rocker Mechanism.
2. Kinematics of Gears - Spur, Helical, Bevel, Worm.
3. Kinematics of Gear trains - Simple, Compound, Epicyclic & differential gear trains.

1. DYNAMICS

a. Motorized Gyroscope - Verification of Laws.
b. Connecting Rod and Flywheel - Determination of M.I. by oscillation.
c. Governors - Watts, Porter, Proell and Hartnell – Study of characteristics and determination of Sensitivity, effort etc.
d. Cam-profile of the cam-study of Jump phenomenon - Determination of Critical Speeds.

2. VIBRATING SYSTEMS

a. Helical Spring – Determination of natural frequency
b. Compound Pendulum - Determination of natural frequencies - moment of inertia.
c. Torsional vibration - Determination of natural frequencies – Single rotor system – Two rotor system
d. Flywheel - Determination of torsional natural frequencies – moment of inertia.
e. Whirling of shaft - Determination of critical speed of shaft.

3. BALANCING

Static and dynamic balancing of rotating masses

Total No. of Hrs : 45

BME 13023 **STATISTICAL QUALITY CONTROL AND RELIABILITY ENGINEERING** **3 0 0 3**

OBJECTIVES: The student will learn

- Concepts, principles, techniques and implementation of quality control and reliability.

UNIT I: STATISTICAL QUALITY CONTROL **9** Hrs

Quality, quality control, factors affecting quality, methods of control, chance causes, assignable causes. Quality control and quality assurance, economics of quality, organization for quality, statistical tools for quality control, quality circles**.**

UNIT II: CONTROL CHARTS **9** Hrs

Control charts, control charts for variables X bar and R charts , standard deviation Charts, process and machine capabilities, control charts for attributes, fraction defective and number of defectives charts, control charts for non-conformities, special control charts, statistical process control.

UNIT III: ACCEPTANCE SAMPLING **9** Hrs

Types of sampling, sampling inspection, inspection by Attributes and Variables, role of acceptance sampling, procedure for sampling, single, double, multiple sequential sampling plans, O.C.curves, quality indices for acceptance sampling plans, Dodge-Roaming sampling for lot by lot, acceptance sampling by attributes, AQL, LTPD, AOQL- sampling plans, numerical problems on the above**.**

UNIT IV: RELIABILITY **9** Hrs

Definition, mean fracture rate, mean time to failure, mean time between failure, hazard rate ,hazard models. Weibull model, system reliability, series , parallel and mixed configuration , simple problems.

UNIT V: RELIABILITY IMPROVEMENT **9** Hrs

Reliability improvement, redundancy, element , unit and stand by redundancy , reliability allocation for a series system , maintainability and availability. System down time , reliability and maintainability trade off , simple problems.

Total No. of Hrs : 45

TEXT BOOKS

1) Grantt, "*Statistical Quality Control"*, Tata McGraw Hill.
2) L.S.Srinath, *"Reliability Engineering*", Affiliated East West Press, New Delhi, 10975.

REFERENCES

1) Jerry Banks, "*Principles of Quality Control"*, John Willey, 109090
2) Dr. E. Balagurusamy, *"Reliability Engineering"*

BME 13024 **FINITE ELEMENT METHOD** **3 1 0 4**

OBJECTIVES: The student will learn

- Fundamentals of finite element analysis and their applications.ifc

UNIT I: INTRODUCTION **12** Hrs

Relevance of finite element analysis in design – Modeling and discretization Interpolation, elements, nodes and degrees-of-freedom-applications of FEA. One-Dimensional elements and computational procedures- Bar element – beam element – bar and beam elements of arbitrary orientation – assembly of elements – properties of stiffness matrices-boundary conditions-solution of equations-mechanical loads and stresses-thermal loads and stresses.

UNIT II: BASIC ELEMENTS **12** Hrs

Interpolation and shape functions - element matrices-linear triangular elements (CST)-quadratic triangular elements – bilinear rectangular elements-quadratic rectangular elements-solid elements-higher order elements-nodal loads-stress calculations.

UNIT III: ISOPERIMETRIC ELEMENTS **12** Hrs

Introduction-bilinear quadrilateral elements – quadratic quadrilaterals – hexahedral elements – Numerical Integration – quadrature - static condensation – load considerations – stress calculations – 2D and 3D applications.

UNIT IV: FINITE ELEMENTS IN STRUCTURAL ELEMENTS IN STRUCTURAL DYNAMICS APPLICATIONS **12** Hrs

Dynamic equations – mass and damping matrices – natural frequencies and modes – damping – reduction of number of degrees-of-freedom-response history – model methods – Ritz vectors – component mode synthesis – harmonic response – direct integration techniques – explicit and implicit methods – analysis by response spectra.

UNIT V: HEAT TRANSFER AND FLUID MECHANICS APPLICATIONS **12** Hrs

Heat transfer – element formulation – reduction-nonlinear problems-transient thermal analysis-acoustic frequencies and modes-fluid structure interaction problems-plane incompressible and rotational flows.

Total No. of Hrs : 60

TEXT BOOKS

1) Singiresu S.Rao, (2004) *"The Finite Element Method in Engineering"*, Third Edition, Butterwoth Heinemann Publications.
2) Tirupathu R.Chandrupatla and Ashok D. Belagundu, (2002) *"Introduction to Finite Elements in Engineering"*, Third edition, Pearson education Pvt Limited.

REFERENCES

1) Cook, Robert Davisetal, (2007) *"Concepts and Applications of Finite Element Analysis"*, John Wiley and Sons.
2) Reddy, J.N., (2006) *"An Introduction to the Finite Element Method"*, McGraw Hill, International Edition.
3) Segerlind L.J., (1984) *"Applied Finite Element Analysis"*, John Wiley.
4) George R Buchaman, (2008) *"Schaum's Outline of Finite Element Analysis"*, McGraw Hill Company.

WEB REFERENCES

1) http://www.vector-space.com
2) http://www.mech.port.ac.uk/sdalby/mbm/CTFRProg.htm

BME 13025 **CAD, CAM & CIM** **3 0 0 3**

OBJECTIVES: The student will learn

- 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: INTRODUCTION TO CAD **9** Hrs

Product cycle- The design process- sequential and concurrent engineering- Computer aided Design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3DTransformations-scaling, rotation, homogeneous coordinates-Line drawing -Clipping- viewing transformation visual realism(parametric equation only)- Graphics standards – Data exchange format, evolution- features of various interfaces GKS, IGES, DXF, PDES, STEP.

UNIT II: GEOMETRIC MODELLING TECHNIQUES **9** Hrs

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: COMPUTER AIDED MANUFACTURING **9** Hrs

Introduction to manufacturing systems –components of manufacturing systems-classification of manufacturing systems-overview of classification scheme-manufacturing progress functions. Group Technology-Single station manufacturing cell-single station manned work stations, single station automation cells-Applications-Analysis of single station cells. Flexible manufacturing system (FMS) introduction and components.

UNIT IV: CNC & PROGRAMMING **9** Hrs

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-Structure of CNC program, Coordinate system, G & M codes, cutter radius compensation, tool nose radius compensation, tool wear compensation, canned cycles, sub routines, do loop, mirroring features, Manual part programming for CNC turning and machining centre, Generation of CNC program using any CAM software. Exercise programs

UNIT V: COMPUTER INTEGRATED MANUFACTURING **9** Hrs

Introduction about CIM, elements of CIM, Process planning –computer aided process planning. Concurrent engineering and design for manufacturing. Advanced manufacturing planning. Production planning and control system. Aggregate production plans and master production schedule .materials requirement planning (MRP).capacity planning, shopfloor control, inventory control. Manufacturing resource planning (MRPII). Introduction to Just in time production systems, Lean production and agile manufacturing.

Total No. of Hrs : 45

TEXT BOOKS

1) Chris McMohan and Jimmie Browne, *"CAD/CAM"*, Addison Wesley Publications, 2nd Ed.
2) HMT, (2000) *"Mechatronics"*, Tata McGraw –Hill Ed.
3) Mikkel. P.Groover, (2007) *"Automation, Production and Computer Integrated Manufacturing"*, PHI., Pvt Ltd.

REFERENCES

1) Ibrahim Zeid, (2007) *"Mastering CAD/CAM"*, Tata McGraw –Hill Ed.
2) David F.Rogers and Alan Adams.J, (1999) *"Mathematical Elements for Computer Graphics"*, McGraw – Hill Publishing Company International Edition.
3) Warren S Seames, (2008) "*Computer Numerical Control Concepts and Programming"*, Thomson Delmar, 4th Edition.
4) P.Radhakrishnan, S.Subramanyan, V.raju *"CAD/CAM/CIM"* New Age International Publications.
5) P.N.Rao, (2004) *"CAD/CAM"*, Tata McGraw Hill Publications.

BME 13L09 **AUTOMATION LAB** **0 0 3 1**

OBJECTIVES: The student will learn

- To get practical knowledge through intensive practice on CNC Machines and related software.
- To practice simple programs on microprocessors and micro controllers.
- To design and implement pneumatic and hydraulic circuits with automation studio software and with kits.

1. Exercises in CNC lathe.
2. Exercises in CNC milling machine.
3. Exercises in PLC Trainer Kit.
4. Exercises in Pneumatic / Hydraulic Trainer Kit.
5. Exercises in Industrial Robot.
6. Exercises in microprocessors and micro controllers.
7. Design of pneumatic and hydraulic circuits using Automation Studio software.
8. Programming in CAM software.

Total No. of Hrs : 45

BME 13L10 **DESIGN AND SIMULATION LAB** **0 0 3 1**

OBJECTIVES:

- To get practical knowledge in computer aided design and visualizing the real time working conditions.

Design the following machine elements using C, C++, model using CAD software, analyse and simulate using FEA/simulation software.

1. Shafts subjected to Bending Moment and Twisting Moment
2. Shafts with Axial Load, Bending Moment and Twisting Moment
3. Open and Closed coiled helical springs
4. Leaf Springs
5. Power Screws
6. Wire ropes for various loads
7. Connecting rod
8. Crank shaft

Design and simulation of linkages.

1. Simulation of Single Slider Crank chain Mechanism for I.C. Engines.
2. Simulation of 4 bar mechanism.
3. Simulation of crank and slotted lever mechanism.

Total No. of Hrs : 45

BME 13L11 INDUSTRIAL TRAINING / MINI PROJECT 0 0 3 1

INDUSTRIAL TRAINING:

Students will have exposure to industrial environment and will have knowledge of industrial practices. Also students acquire technical information regarding the industrial processes.

OBJECTIVES:

Students are supposed to undergo industrial training in Mechanical related Industries for a minimum period of 15 days during the VI semester summer holidays. They have to prepare a report on the Industrial visit with a certificate in proof of the Industrial visit from competent authority in the industry.

MINI PROJECT:

OBJECTIVES:

Students will have an opportunity to expose their knowledge and talent to make an innovative project. Students are supposed to do innovative projects useful to industries/society in the area of Mechanical Engineering and related areas, under the guidance of a staff member and with their acquired knowledge in seven semesters of their study. They have to prepare a project report and submit to the department.

At the end of VII semester Viva-Voce examination will be conducted by the internal Examiner duly appointed by the Head of the department and the students will be evaluated.

BME 13026 **AUTOMOBILE ENGINEERING** **3 0 0 3**

OBJECTIVES: The student will learn

- Various automobile parts, power transmission from engine to various parts of the automobile, engine cooling, lubrication and also about various pollutants and its control.

UNIT I: VEHICLE STRUCTURE AND ENGINES **9** Hrs

Vehicle construction –types-chassis layout- body-integral and chassis mounted body- vehicle specifications-power and torque requirements- choice of engine for different applications. Engine types and construction – cylinder arrangement-piston- cylinder head connecting rod – crank shaft-valves- liners-manifolds.

UNIT II: ENGINE AUXILIARY SYSTEMS AND POLLUTION CONTROL **9** Hrs

Fuel supply system to SI and CI engines–injection timing. Lubrication system-cooling system-ignition system-spark timing-firing order, electronic fuel injection system-types. Pollution from engines and their control-Indian emission standards-supercharging-turbo charging.

UNIT III: TRANSMISSION SYSTEMS **9** Hrs

Clutches –need-types-single& multi plate –diaphragm-fluid coupling-torque converter Gear boxes-manual-sliding mesh-constant mesh-synchro mesh- epicyclic gear boxes-automatic transmission. Universal joint-propeller shaft-Hotchkiss drive-torque tube drive. Differential-need-types- construction. Four wheel drive-rear axle.

UNIT IV: STEERING AND SUSPENSION SYSTEMS **9** Hrs

Principle of steering-steering geometry and wheel alignment-steering linkages-steering gear boxes-power steering. Wheel and tyre construction-type and specification-tyre wear and causes-front axles arrangements. Suspension system-need and types-independent systems-coil-leaf spring-torsion bar-shock absorbers-air suspension**.**

UNIT V: BRAKE SYSTEMS **9** Hrs

Auto Electrical Components and Alternative Power Plants. Brake –need –types-mechanical-hydraulic-pneumatic-power brake-trouble shooting of brakes. Principles of modern electrical systems-battery-dynamo-starting motor- lighting- automobile conditioning. Electric hybrid vehicle and fuel cells.

Total No. of Hrs : 45

TEXT BOOKS

1) K.K.Ramalingam, (2007) "*Automobile Engineering"*, SciTech Publications.
2) Kirpal Singh, (2012) *"Automobile Engineering vol-I&II".*
3) R.B.Gupta, (2013) "*Automobile Engineering"*, Satya Prakashan Publishing.

REFERENCES

1) Joseph Heitner, *"Automotive Mechanics*", Affiliated East West Press Ltd.
2) *"Newton and Steeds, Motor Vehicles"*, ELBS –13 EDITION.
3) William Crouse, (2007) *"Automotive Mechanics*", Tata McGraw Hill.

BME 13027 **INDUSTRIAL MANAGEMENT & ENTREPRENEURSHIP DEVELOPMENT** **3 0 0 3**

OBJECTIVES: The student will learn
- Various principles and techniques of industrial management.
- Application of industrial management in becoming an entrepreneur.

UNIT I: BRIEF OUTLINE OF MANAGEMENT CONCEPTS **9** Hrs

BPR,MBO,MBE,5S, Recruitment, Criteria, Selection process-Training methods, Training procedure, kinds of training-Job evaluation: OBJECTIVES method – Merit rating: OBJECTIVES, Methods-performance appraisal-Leadership: Styles-Communication: Types, Networks, Effectiveness –Manpower requirement planning – Organization structure.

UNIT II: INDUSTRIAL RELATIONS **9** Hrs

Trade unions, Industrial disputes, Strikes, Lock Outs, Collective bargaining's, Employees grievances, Participative management .Safety Engineering &Management –Accidents ,Accident proneness ,Accident prevention. Decision making: Types of decisions, Decisions making process, Quantitative methods.

UNIT III: ENTREPRENUERSHIP **9** Hrs

Terminology, Functions of an entrepreneur, Behavioral patterns of entrepreneur, Entrepreneurship development programs, Factors affecting entrepreneurial growth, motivation
& competencies.

UNIT IV: SMALL AND MEDIUM ENTREPRISES (SME) **9** Hrs

Project identification/ Formulation/Appraisal, Financing, OwnershipTypes, Management of capital, Costing (Project / Product), Project management using PERT/CPM, Taxation.

UNIT V: SUPPORT TO ENTREPRENEURS **9** Hrs

Institutional finance, loose finance, Hire purchase, Institutional support, Taxation benefits, Government support, Rehabilitation of sick industries. Case studies of successful / SMEs in India.

Total No. of Hrs : 45

TEXT BOOKS
1) O.P.Khanna and A.Sarup, *"Industial Engineering & Management*", Dhanpat Rai Publications (P) Ltd.
2) S.S.Khanka *"Entrepreneurial development"*, S.Chand & Co.Ltd.
3) C.B.Guptha and N.P.Srinivasan, *"Entrepreneurial Development*", Sultan Chand & Sons.

REFERENCES
1) Martland T.Telsang, *"Industrial and Business Management"*, S.Chand & Co.Ltd.
2) P.Saravanavel, *"Entrepreneurial Development"*, Ess-Peekay Publications House.
3) ED II: Faculty & External experts, *"A handbook for new entrepreneurships development*", Institute of India, Ahmedabad.

BME13L12 **PROJECT WORK** **0 0 20 10**

OBJECTIVES:

To make the students to make use of the knowledge and skill developed during their four years of study and to apply them for making an innovative product/process for the development of society and industries.

Students are expected to do a Project work either in an Industry or at the University in the field of Mechanical Engineering in group, not exceeding 4 students in a group. Each group will be allotted a guide based on the area of Project work. Number of reviews will be conducted during the semester to monitor the development of project. Students have to submit the thesis at the end of the semester and appear for the Project Viva-Voce examination conducted by one internal examiner and one external examiner.50% weight age will be given for the internal assessment and 50% weight age for the Project viva a voce examination.

BME 13E01 **DESIGN OF HEAT EXCHANGERS** **3 0 0 3**

OBJECTIVES: Students will learn
- Different types of heat exchangers and their functions.
- Design procedure of heat exchangers.

UNIT I: INTRODUCTION **9** Hrs

Construction details-type-fluid flow arrangement-parallel-counter-cross flow-shell and tube heat exchangers, double pipe heat exchangers-regenerators, recuperators, condensers-evaporators-industrial applications, Temperature distributions and its implications, LMTD, effectiveness, effect of baffles and effect of turbulence, friction factor.

UNIT II: DESIGN OF SHELL AND TUBE HEAT EXCHANGERS **9** Hrs

Design of shell and tube heat exchangers; Design procedure, pressure drop, heat transfer calculation, preliminary estimation of sizes-shell and tube sides-kenn method – Bell Delaware method.

UNIT III: COMPACT HEAT EXCHANGERS **9** Hrs

Compact heat exchangers-Types – Constructional features, heat transfer and pressure drop calculation, fined plate and tube. Gasketed plate heat exchangers-constructional features plate pack and frame-operational characteristics-flow arrangement, Heat transfer and pressure drop calculation-performance analysis-comparison with other types of heat exchangers.

UNIT IV: HEAT PIPES **9** Hrs

Heat pipes – structures - applications – basic relations – performances characteristics – effect of working fluid and operating temperature, wick – selection of material – pore size. Cooling towers – Components-types-basic relations – heat balance and heat transfer-characteristics-Typical installations.

UNIT V: STRESSES IN TUBES **9** Hrs

Stresses in tubes – header sheets and pressure vessels – differential thermal expansion – thermal stresses – Shear stresses – thermal Sleeves – Vibration – noise – types of failures

Total No. of Hrs : 45

TEXT BOOKS
1) T.Taboresk, G.F.Hewitt and N.Afgan (2011) *"Heat Exchangers"* Theory and practice McGraw Hill Book Hill Book Co.
2) D.Q.Kern (2008) *"Process heat transfer"*, TMH edition 109097 – New Delhi.
3) Arthur P.Frass (1989) *"Heat exchanger design"* 2nd edition John Wiley and Sons – 109097,

REFERENCES
1) Sadik Kakac and Hongtan Lin, (2011) *"Heat Exchangers"*, CRC Press, London
2) Holger Martin (1992) *"Heat Exchangers"*, Hemisphere Publishing Corporation, London

BME 13E02 REFRIGERATION AND AIR – CONDITIONING 3 0 0 3

OBJECTIVES: Students will learn
- The working principle of refrigerators and air conditioners.
- Different cycles used in refrigeration .
- Alternate refrigerants to reduce global warming.

UNIT I: REFRIGERATION CYCLES AND REFRIGERANTS **9** Hrs

Vapour Compression Réfrigération Cycle-Simple Saturated Vapour Compression Réfrigération Cycle. Thermodynamic Analysis of the above. Refrigerant Classification, Designation, Alternate Refrigerants, Global Warming Potential & Ozone Depleting Potential Aspects.

UNIT II: SYSTEM COMPONENTS **9** Hrs

Refrigerant Compressors – Reciprocating Open & Hermetic Type, Screw Compressors and Scroll Compressors – Construction and Operation Characteristics. Evaporators – DX Coil, Flooded Type Chillers Expansion Devices - Automatic Expansion Valves, Capillary Tube & Thermostatic Expansion Valves. Condensing Units and Cooling Towers.

UNIT III: CYCLING CONTROLS AND SYSTEM BALANCING **9** Hrs

Pressure and Temperature Controls. Range and Differential Settings. Selection and Balancing of System Components-Graphical Method.

UNIT IV: PSYCHROMETRY & AIR CONDITIONING **9** Hrs

Moist Air Behavior, Psychrometric Chart, Different Psychrometric Process Analysis**.**
Summer and Winter Air-conditioning, Cooling Load Calculations, Air Distribution Patterns, Dynamic and Frictional Losses in Air Ducts, Equal Friction Method, Fan Characteristics in Duct Systems.

UNIT V: INTRODUCTION TO CRYOGENIC ENGINEERING **9** Hrs

Introduction to cryogenic engineering-applications of cryogenics in various fields-low temperature properties of materials- mechanical, thermal, electrical and magnetic properties- properties of cryogenic fluids-cryogenic fluid storage and transfer systems- cryogenic insulation.

Total No. of Hrs : 45

TEXT BOOKS
1) W.F.Stocker and J.W.Jones, (2009) *"Refrigeration & Air Conditioning"*, McGraw Hill Book Company.
2) Randall F.Barron, (1985) *"Cryogenic systems"*, Oxford University press.

REFERENCES
1) R.J.Dossat, (2005) *"Principles of Refrigeration"*, John Wiley and Sons Inc., 6th edition.
2) Manohar Prasad, (2009) *"Refrigeration and Air Conditioning"*, Wiley Eastern Ltd.

BME 13E03 **ADVANCED IC ENGINES** **3 0 0 3**

OBJECTIVES: Students will learn
- Recent advancements of I.C Engines
- Various alternative fuels for I.C engines.

UNIT I: SPARK IGNITION ENGINES **9** Hrs

Spark Ignition Engine Mixture Requirements –Feed back Control Carburetors- Fuel- Injection Systems-Monopoint and Multi point Injection –Stages of Combustion-Normal and Abnormal Combustion-factors Affecting Knock-Combustion Chambers.

UNIT II: COMPRESSION IGNITION ENGINES **9** Hrs

States of Combustion in C.I.Engine – Direct and Indirect Injection Systems - Combustion Chambers – Fuel Spray Behavior-Spray Structure, Spray Penetration and Evaporation-Air Motion - Turbo charging.

UNIT III:POLLUTANT FORMATION CONTROL **9** Hrs

Pollutant –Sources and Types –Formation of NOx - Hydro-Carbon Emission Mechanism - Carbon Monoxide Formation-Particulate Emissions-Methods of Controlling Emissions - Catalytic Converters and Particulate Traps-Methods of Measurements and Driving Cycles.

UNIT IV:ALTERNATIVE FUELS **9** Hrs

Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas-Properties, Suitability, Engine Modifications, Merits and Demerits as Fuels.

UNIT V: RECENT TRENDS **9** Hrs

Lean Burn Engines-Stratified Charge Engines-Gasoline Direct Injection Engine-Homogeneous Charge Compression Ignition –Plasma Ignition –Measurement Techniques.

Total No. of Hrs : 45

TEXT BOOK

1) V.Ganesan, (2008) "*Internal combustion engines"*, Tata McGraw Hill.

REFERENCES

1) Mathur and Sharma, (1990) "*Internal combustion engines"*.
2) John Heywood, (1988) "*Internal combustion engines fundamentals"*, Tata McGraw Hill Co.
3) Benson and White house (1983) "*Internal combustion engines Vol I & Vol II"*, pergamon press.
4) Domkundwar, "*Internal combustion engines"* Dhanpat Rai & Co. (P) Ltd.

BME 13E04 **DESIGN OF PRODUCTION TOOLS** **3 0 0 3**

OBJECTIVES**:** Students will learn

- The design of jigs and fixtures.
- Different types of press tools and various elements of a press tools.

UNIT I: LOCATING AND CLAMPING PRINCIPLES **9** Hrs

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

UNIT II: JIGS **9** Hrs

Design and development of jigs and fixtures for given component- Types of Jigs -Post, Turnover, Channel, latch, box, pot, angular post jigs , Indexing jigs ,automatic drill jigs- rack and pinion operated air operated jigs - Design and drawing of channel, box, indexing and angular post jigs

UNIT III: FIXTURES **9** Hrs

General principles of milling, Lathe, boring, broaching and grinding fixtures and shaping fixtures .Assembly, Inspection and Welding fixtures , Modular fixtures . Design and drawing of turning, milling and grinding fixtures

UNIT IV: PRESS WORKING **9** Hrs

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, recent trends in tool design- computer Aids for sheet metal forming Analysis

UNIT V: ELEMENTS OF CUTTING, BENDING, FORMING AND DRAWING DIES **9** Hrs

Design of various elements of dies, Die Block, Punch holder, Die set, Stops , Strippers , Pilots - Selection of Standard parts. Design and drawing of simple blanking, piercing, compound and progressive dies.

Total No. of Hrs : 45

TEXT BOOKS

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

REFERENCES

1) K.Venkataraman, (2005) "*Design of Jigs Fixtures & Press Tools"*, Tata McGraw Hill, New Delhi.
2) Kempster, (1974) " *Jigs and Fixture Design"*, Hoddes and Stoughton " Third Edition.
3) Joshi, P.H. Press Tools (2006) *"Design and Construction"*, Wheels publishing, 2 edition
4) Hoffman, "*Jigs and Fixture Design"*, Thomson Delmar Learning, Singapore
5) *"Fundamentals of Tool Design"*, ASTME, 6 edition
6) *"Design Data Hand Book"*, PSG College of Technology, Coimbatore.
7) Kurt Lunge, (2006) "*Handbook of metal forming"*, McGraw Hill Pub co

BME 13E05 PROCESS PLANNING AND COST ESTIMATION 3 0 0 3

OBJECTIVES: Students will learn
- Process planning activities
- Various elements of cost of a product.
- Methods of computer aided process planning.

UNIT I: PROCESS PLANNING **9** Hrs

Definition – OBJECTIVES – Scope – approaches to process planning- Process planning activities – Finished part requirements- operating sequences- machine selection –material selection parameters- Set of documents for process planning- Developing manufacturing logic and knowledge- production time calculation – selection of cost optimal processes.

UNIT II: COMPUTER AIDED PROCESS PLANNING **9** Hrs

Variant process planning - Generative approach -Forward and Backward planning, Input format, Logical Design of a Process Planning - Implementation considerations. Application of computer softwares in process planning.

UNIT III: ELEMENTS OF COST **9** Hrs

Introduction - Importance and aims of Cost estimation - Estimation procedure. Material Cost - Determination of Material Cost Labour Cost - Determination of Direct Labour Cost - Expenses - Cost of Product (Ladder of cost) - Illustrative examples. Analysis of overhead expenses - Factory expenses - Depreciation - Causes of depreciation - Methods of depreciation - Administrative expenses - Selling and Distributing expenses - Allocation of overhead expenses.

UNIT IV: PRODUCT COST ESTIMATION **9** Hrs

Estimation in forging shop - Losses in forging - Forging cost - Illustrative examples. Estimation in welding shop - Gas cutting - Electric welding - illustrative examples. Estimation in foundry shop - Estimation of pattern cost and casting cost - Illustrative examples.

UNIT V: ESTIMATION OF MACHINING TIME AND COST **9** Hrs

Estimation of machining time and cost for Lathe operations - Estimation of machining time and cost for drilling, boring, shaping, planning, milling and grinding operations - Illustrative examples. Value engineering - cost reduction

Total No. of Hrs : 45

TEXT BOOKS
1) M.Adithan and B.S. Pabla, (1989) *"Estimating and Costing"*, Konark Publishers Pvt. Ltd.
2) V.Jayakumar (2012) *"Process Planning and Cost Estimation"*, Lakshmi Publication.

REFERENCES
1) Nanua Singh, (1996) *"System approach to Computer Integrated Design and Manufacturing"*,John Wiley & Sons, Inc.
2) Joseph G. Monks, (1982) *"Operations Management, Theory & Problems"*, McGraw Hill Book Company.
3) T.R. Banga and S.C. Sharma, (2011) *"Estimating and Costing"*, Khanna Publishers, 16thEdition
4) Sadhu singh, (2002) *"Computer aided Design and manufacturing*", Khanna publisher ,new delhi, second edition.

BME 13E06 **COMPUTATIONAL FLUID DYNAMICS** **3 0 0 3**

OBJECTIVES: Students will learn
- Governing equation of fluid dynamics.
- Methods of solving the equations.

UNIT I: GOVERNING EQUATIONS AND BOUNDARY CONDITIONS **8** Hrs

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

UNIT II: FINITE DIFFERENCE METHOD **9** Hrs

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** Hrs

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** Hrs

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

UNIT V: CALCULATION FLOW FIELD BY FVM **9** Hrs

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 No. of Hrs : 45

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

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

BME 13E07 **MECHANICAL VIBRATIONS** **3 0 0 3**

OBJECTIVES: Students will learn
- Multi degree of freedom system in different modes.
- Vibration measurement techniques

UNIT I:INTRODUCTION **9** Hrs

Relevance of and need for vibration Analysis- Mathematical Modelling of Vibrating Systems – Discrete and Continuous Systems – Review of Single degree of Freedom Systems – Free and Forced Vibrations, Various Damping Models

UNIT II:TWO DEGREE-OF-FREEDOM SYSTEMS **9** Hrs

General Solution to Free vibration problem-Damped Free Vibration, Forced Vibration of un-damped System – Dynamic Vibration Absorbers-Technical Applications.

UNIT III:MULTI-DEGREE OF FREEDOM SYSTEMS **9** Hrs

Free and Forced Vibrations of multi-degree of freedom systems in longitudinal, torsional and lateral modes – Matrix methods of solution – normal modes – orthogonal principle- energy methods, Introduction to vibration of plates.

UNIT IV:CONTINOUS SYSTEMS **9** Hrs

Torsional vibrations – Longitudinal vibrations of rods – Transverse vibrations of beams- Governing equations of motion – Natural frequencies and normal modes – energy methods.

UNIT V:VIBRATION MEASUREMENT **9** Hrs

Vibration monitoring-Data Acquisition- Vibration parameter selection – vibration sensors-accelerometers-Performance characteristics-sensor location-signal pre-amplification – vibration meters-vibration signatures-standards-vibration testing equipment-in-site, Balancing of rotors.

Total No. of Hrs : 45

TEXT BOOK
1) J.S.Rao and K.Gupta, (1999) *"Introductory Course on Theory and Practice of Mechanical Vibrations"*, Wiley Eastern Ltd.

REFERENCES
1) P.Srinivasan, (1990) *"Mechanical Vibration Analysis"*, Tata-McGraw Hill, New Delhi.
2) G.K.Grover, (2006) *"Mechanical Vibrations"*, New Chand and Bros, Roorkey.

BME 13E08 **TURBO MACHINES** **3 0 0 3**

OBJECTIVES: Students will learn
- Various components of a turbo machine and their functions.
- Application of turbo machines.

UNIT I: INTRODUCTION **7** Hrs

Principles-Energy Transfer between Fluid and Rotor, Classification of Fluid Machinery, Dimensionless Parameters, Specific Speed, Applications, Stage Velocity Triangles, Work and Efficiency for Compressors and Turbines.

UNIT II: CENTRIFUGAL FANS, BLOWERS AND COMPRESSORS **9** Hrs

Centrifugal Fans, Blowers and Compressors, Construction Details, Inducers, Backward and Radial Blades, Diffuser, Volute Casing Stage Work, Stage Pressure Rise, Stage Pressure Coefficient, Stage Efficiency, Degree of Reaction, Various Slip Factors, H-S Diagram for centrifugal compressor.

UNIT III: AXIAL FLOW FANS AND COMPRESSORS **9** Hrs

Axial Flow Fans and Compressors, Stage Velocity Triangles, Blade Loading and Flow Coefficients, Static Pressure Rise, H-s Diagram, Degree of Reaction, Work Done Factors, Free and Forced Vortex Flow, Performance, Stalling and Surging.

UNIT IV: AXIAL & RADIAL TURBINE STAGES **10** Hrs

Axial Turbine Stages, Stage Velocity Triangle, Work, Single Stage Impulse Turbine, Speed Ratio, Maximum Utilization Factor, Multistage Velocity Compounded Impulse, Multistage Pressure Compounded Impulse, Reaction Stages, Degree of Reaction, Zero Reaction Stages, Fifty Percent Reaction Stages, Hundred Percent Reaction, Negative Reaction, Free and Forced Vortex Flow. Inward Flow Radial Turbine Stages, 90 degrees IFR Turbine. H-S diagram, Degree of Reaction, Steam Turbine Governing.

UNIT V: HYDRO-DYNAMIC POWER TRANSMISSION **10** Hrs

Hydro-Dynamic Power Transmission: Theory of Hydro Coupling – Elements – Design and Constructional Features. Torque Converter – Design Consideration – Characteristics- Constructional Details, Application in Vehicles and Machinery. Wind Turbines – Types – Horizontal and Vertical Axis Turbines – Darias Turbine, Wind Rotor Aerodynamic Modeling – 2D Aerodynamic Theory – Glauert Momentum Vortex Theory, Performance of Wind Turbines.

Total No. of Hrs : 45

TEXT BOOK
1) Yahya,S.H., (2005) *"Turbines, Compressors and Fans"*, Tata McGraw Hill Publishing Company, 109096.

REFERENCES
1) Gopalakrishnan G and Prithiviraj D., (2010) *"Treatise on Turbomachines"*, Jupiter Publications.
2) David M. Eggleston and Forest S.Stoddard, (1987) *"Wind Turbine Engineering Design"*, Van Nostrand,
3) Shepherd D.G., (2000) *"Theory of Turbo Machines"*, MacMillan 109609.

BME 13E09 **DESIGN OF EXPERIMENTS** **3 0 0 3**

OBJECTIVES: Students will learn
- Basic concepts of Design of Experiments
- Regression analysis of simple models.

UNIT I: INTRODUCTION **9** Hrs

Introduction to experimental design principles, simple comparative experiments – Basic Statistical concepts- Hypothesis testing – Inferences about the differences in means, paired comparison with advantage -Simple applications of DOE problems.

UNIT II: SINGLE FACTOR EXPERIMENTS **9** Hrs

Single factor experiments, ANOVA- randomized blocks, Latin square designs and extensions- Statistical analysis-estimation of model parameters-pair wise comparison tests.

UNIT III: MULTI FACTOR EXPERIMENTS **9** Hrs

Introduction to factorial designs, two levels**,** 2^k factorial designs, confounding and blocking in factorial designs, applications to manufacturing problems.- Fractional factorial designs, two-level, three-level and Mixed-level factorials and fractional factorials.

UNIT IV: REGRESSION ANALYSIS **9** Hrs

Regression models including multiple regression models – Confidence intervals in multiple regressions and some simple applications.

UNIT V: SPECIAL EXPERIMENTAL DESIGN **9** Hrs

Response surface methodology, parameter optimization, robust parameter design- Experimental design for fitting response surfaces- Random and mixed factor models, nested and split plot designs – Introduction to ANOCOVA with its advantages.

Total No. of Hrs : 45

TEXT BOOK

1) Montgomery, D. C. (2001), "*Design and Analysis of Experiments"*, John Wiley & Sons. Inc.

REFERENCES

1) Myers and Montgomery (1995), "*Response surface Methodolgy: Process and product optimization, using Designed Experiments"*, Wiley, New York.
2) Montgomery andRunger (1999), "*Applied Statistics and Probability for Engineers*", 2nd Edition, Wiley, New York.
3) McCullargh and Nelder J.A. (1989), "*Generalised Linear Models"*, 2nd Edition, Chapman and Hall, New York.

BME 13E10 **INDUSTRIAL ROBOTICS** **3 0 0 3**

OBJECTIVES: Students will learn
- Basic components of an industrial robot
- Sensors used in robots
- Robot programming methods
- Robot applications

UNIT I:INTRODUCTION **9** Hrs

Definition of a Robot – Basic Concepts –- Robot components –manipulator-configurations –joints- degree of freedom. Types of Robot Drives – Basic Robot Motion types – Point to Point Control – Continuous Path Control.

UNIT II:COMPONENTS AND OPERATIONS **9** Hrs

Basic Control System Concepts – open loop and closed loop control-Control System Analysis – Robot Actuation and Feed Back, Manipulators – Direct and Inverse Kinematics, Co-ordinate Transformation – Brief Robot Dynamics, Types of Robot and Effectors – Grippers – Tools as End Effectors – Robot / End Effort Interface.

UNIT III:SENSING AND MACHINE VISION **9** Hrs

Range Sensing – Proximity Sensing – Touch sensing – Force and Torque Sensing. Introduction to Machine Vision – functions and applications.

UNIT IV:ROBOT PROGRAMMING **9** Hrs

Methods – Languages –programming for pick and place applications-palletizing. Capabilities and Limitation – Artificial Intelligence – Knowledge Representation – Search Techniques – AI and Robotics.

UNIT V:ROBOT CELL DESIGN AND APPLICATIONS **9** Hrs

Robot cell design-types and control.
Applications of Robots –process applications in welding and painting – Assembly applications– Material Handling applications.

Total No. of Hrs : 45

TEXT BOOK

1) K. S. Fu, R. C. Gonalez, C.S.G. Lee, *"Robotics Control Sensing Vision and Intelligence"*, McGraw Hill International Edition, 10987.

REFERENCES

1) Mikell P. Groover, Mitchell Weiss, (2008) *"Industrial Robotics, Technology, Programming and Application"*, Tata McGraw Hill International Editions, 10986.
2) Richard D. Klafter, Thomas A. Chonieleswski and Michael Negin, (1989) *"Robotic Engineering – An Integrated Approach"*, Prentice Hall Inc., Englewoods Cliffs, NJ, USA, 109809.

BME 13E11 COMPUTER INTEGRATED MANUFACTURING 3 0 0 3

OBJECTIVES: Students will learn

- Functions of CIM
- Group Technology concept and Flexible manufacturing cells and systems
- Computer aided production management system.
- Different types of computer networks.

UNIT I: FUNDAMENTALS OF CAD/CAM **6** Hrs

Computer aided design-Design process-Application of computer in design- Computer aided Manufacturing-Functions-Product life cycle and CAD/CAM- Computer Integrated Manufacturing-functions-CIM architecture.

UNIT II: GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING **9** Hrs

Group technology - part families-parts classification and coding-Opitz and MICLASS system-production flow analysis -Machine cell design-benefits of Group technology- Computer Aided Process Planning (CAPP)-Retrieval type and Generative CAPP systems.

UNIT III: COMPUTER INTEGRATED PRODUCTION MANAGEMENT SYSTEMS **12** Hrs

Production planning - Master production schedule-capacity planning-inventory management-MRP I and MRPII – Cost planning and control-Shop floor control-Functions- Shop floor control systems-Automatic identification method-Bar code technology-Automated data collection systems-Data acquisition system-multilevel scanning.

UNIT IV: COMPUTER NETWORKS FOR MANUFACTURING **9** Hrs

Computer in manufacturing-LAN-Net work topology-Data access methods-Transmission lines-Data transmission rate- MAP-TOP and layers of OSI.

UNIT V: FLEXIBLE MANUFACTURING SYSTEMS **9** Hrs

Components of FMS –Functions - Layout configuration - FMS workstations - Computer control system - Automated material handling equipments – Conveyors - Automated guided vehicle system- Automated storage - retrieval systems- components and controls.

Total No. of Hrs : 45

TEXT BOOKS

1) Mikell P. Groover , (2007)*"Automation, Production System and Computer Integrated, Manufacturing (CIM)"*, Prentice-Hall of India Pvt. Ltd.
2) Mikell.P.Groover and V.Zimmers, (1984) *"CAD/CAM"*, Prentice-Hall of India Pvt. Ltd.

REFERENCES

1) N. Viswanadham and Y. Narahari, (1992) *"Performance modeling of automated manufacturing systems"*, Prentice-Hall of India Pvt. Ltd.
2) P. Radhakrishnan and S. Subramanian, (2008) *"CAD/CAM/CIM"*, Wiley Eastern Ltd.
3) Gideon Halevi and Roland D. Weill, (2001) "*Principles of process planning"*, Chapman Hall
4) P. Gu and D. H. Norrie, (1995) *"Intelligent Manufacturing planning"*, Chapman Hall.
5) Andrew Kusik, (1990)*"Intelligent Manufacturing system"*, Prentice-Hall of India Ltd.

BME 13E12 NON CONVENTIONAL SOURCES OF ENERGY 3 0 0 3

OBJECTIVES: Students will learn

- The concept, principles and characteristics of different renewable energy systems.
- Energy conversion techniques

UNIT I:INRODUCTION **9** Hrs

Role and Potential of new and renewable source, the solar energy option, Environmental impact of solar power. PRINCIPLES OF SOLAR RADIATION**:** Physics of the sun, the solar constant, extra terrestrial and terrestrial solar radiation, solar radiation on titled surface, Instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT II:SOLAR ENERGY **9** Hrs

SOLAR ENERGY COLLECTION**:** Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.
SOLAR ENERGY STORAGE**:** Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications, solar heating/cooling techniques, solar distillation and drying, photovoltaic energy conversion.

UNIT III:WIND ENERGY AND BIOMASS **9** Hrs

WIND ENERGY**:** Sources and potentials, horizontal and vertical axis windmills, performance characteristics.
BIOMASS**:** Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-Gas digestors, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation, economic aspects.

UNIT IV:GEO THERMAL,TIDAL AND WAVE ENERGY **9** Hrs

GEOTHERMAL ENERGY**:** Resources, types of wells, methods of harnessing
OTEC**:** Principles, utilization, setting of OTEC plants, thermodynamic cycles.
TIDAL AND WAVE ENERGY**:** Potential and conversion techniques, mini hydel power plants, and their economics.

UNIT V:DIRECT ENERGY CONVERSION **9** Hrs

Need for DEC, Carnot cycle, limitations, principles of DEC. Thermo-electric generators, Seebeck, Peltier and Joule Thompson effects, figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect: magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamics conversion, economic aspects.
Fuel cells: principle, Faraday's laws, thermodynamic aspects. Selection of fuels and operating conditions.

Total No. of Hrs : 45

TEXT BOOKS

1) G.D.Rai, (2004) *"Non-Conventional Energy Sources*" Khanna Publishers.
2) Ashok V Desai, (2003) "*Non-Conventional Energy"*, Wiley Eastern.
3) K.M.Mittal, (2007) "*Non-Conventional Energy Systems"*, Wheeler Publishing.
4) Ramesh & Kumar, (2007) "*Renewable Energy Technologies"*, Narosa Publishing House.

REFERENCES

1) Twidell & Weir, (2006) "*Energy Sources"*, Taylor & Francis
2) Sukhame, (2009) "*Solar Energy"*.
3) B.S.Magal Frank Kreith, (2010) "Solar Power Engineering"
4) Frank Kreith & John F Kreider, (2010) "*Principles of Solar Energy"*.

BME 13E13 NON CONVENTIONAL MACHINING TECHNIQUES 3 0 0 3

OBJECTIVES: Students will learn

- Newer machining techniques, machining parameters and its applications.

UNIT I: INTRODUCTION, ELECTRICAL DISCHARGE MACHINING **10** Hrs

Need For Unconventional Processes – Classification - Electrical Discharge Machining Processes, Operating Principles – Dielectric – Electrode Material – Tool/Wear – Processes Parameters – Metal Removal Rate – Applications – Current Developments In EDM.

UNIT II: ELECTRO CHEMICAL MACHINING **8** Hrs

Electro Chemical Machining Process – Principles – Equipments – Metal Removal Analysis - Tool Material – Insulation – Process Parameters – ECH,ECG Etc., – Applications.

UNIT III: ELECTRON BEAM, LASER BEAM AND PLASMA ARC MACHINING **9** Hrs

EBM process - principle - Gun construction - vacuum and non-vacuum technique – applications. LBM process, principles, pumping processes, Types of Emission- Beam control – Applications.

UNIT IV: ULTRASONIC MACHINING **8** Hrs

Ultrasonic Machining Processes – Working Principles – Transducers – Concentrators - Nodal Point Clamping - Feed Mechanism - Metal Removal Rate – Process Parameters – Applications.

UNIT V: ABRASIVE, WATER JET AND HYBRID MACHINING **10** Hrs

AJM Processes – Principle – Equipment – Metal Removal Rate – Process Parameters – Applications. WJM Process – Principle – Equipment – Applications. Introduction to hybrid machining-Electro Chemical Discharge Machining, Abrasive electrical discharge grinding-Principle, advantages, limitations and applications.

Total No. of Hrs : 45

TEXT BOOKS

1) P.K.Mishra (1997) *"Non Conventional Machining"*. The Institution Of Engineers (India) text book Series
2) Vijay.K. Jain (2007) *"Advanced Machining Processes"* Allied Publishers Pvt. Ltd., New Delhi

REFERENCES

1) Benedict. G.F. (1987) *"Nontraditional Manufacturing Processes"* Marcel Dekker Inc., New York.
2) Pandey P.C. and Shan H.S. (2007) *"Modern Machining Processes"* Tata McGraw-Hill, New Delhi.
3) Mc Geough, (1998) *"Advanced Methods of Machining"* Chapman and Hall, London.
4) Paul De Garmo, J.T.Black, and Ronald.A.Kohser, (2001) *"Material and Processes in Manufacturing"*, Prentice Hall of India Pvt. Ltd., New Delhi ,8th Edition.
5) P.C.Sharma, (1995) "*TEXT BOOK of Production Engineering"*.

BME 13E14 **ENTERPRISE RESOURCE PLANNING** **3 0 0 3**

OBJECTIVES: Students will learn
- Building of business model in resource planning
- Impact of IT in ERP

UNIT I: INTRODUCTION TO ERP **9** Hrs

Integrated Management Information, Seamless Integration - Supply Chain Management- Integrated Data Model- Benefits Of ERP - Business Engineering And ERP- Definition Of Business Engineering - Principle of business engineering - Business engineering with information technology.

UNIT II: BUSINESS MODELING FOR ERP **9** Hrs

Building The Business model - ERP implementation – An Overview – Role Of Consultant, Vendors and Users, Customization – Precautions - ERP Post implementation options ERP Implementation Technology – Guidelines for ERP Implementation.

UNIT III: INTRODUCTION TO ORGANIZATIONAL TRANSFORMATION **9** Hrs

Fundamental elements of organizational transformation - Principles-Methodology -Models (LMI CIP, DSMCQ & PMP) - Process improvements in models (Moen & Nolan strategy, NPRDC, LMI CIP) - Tools and Techniques.

UNIT IV:GLOBAL INDUSTRIAL COMPETITION AND INFORMATION TECHNOLOGY **9** Hrs

Coping with competition – the impact and value of IT Systems – impact and value of IT – Value chain of a firm and strategic use of IT – development trends of IT. Introduction to SAP and its applications in ERP

UNIT V: SUPPLY CHAIN MANAGEMENT **9** Hrs

The concept of supply chain, logistics, customer and supply chain relation, role of IT in supply chain management – strategy and structure of supply chain – factors of supply chain – stages in supply chain progress.

Total No. of Hrs : 45

TEXT BOOKS
1) Leon, (2014) "*Enterprise Resource Planning*", McGraw Hill, New Delhi
2) P. N. Rastogi, *"Re-Engineering And Re-inventing the Enterprise*" , Wheeler Publishing
3) Dr. J. A. Edosomwan , (1995) "*Organizational transformation and Process Re-Engineering"* 1 edition.

REFERENCES
1) Jose Antonio Fernandz, (2005) *"The SAP R/3 Handbook*", TMH, 3 edition
2) Vinod Kumar Garg and N.K.Venkita Krishnan, (2004) "*Enterprise Resource Planning Concepts and Practice"*, PHI.

BME 13E15 **COMPOSITE MATERIALS** **3 0 0 3**

OBJECTIVES: Students will learn
- Different composites and their manufacturing methods
- Design parameters of composites

UNIT I: INTRODUCTION **9** Hrs

Limitations of Conventional Materials- Definition of Composite Materials- Types and Characteristics Applications.

UNIT II: MATERIALS **9** Hrs

Fibers- Materials- Fiber Reinforced Plastics- Thermo set Polymers- Coupling Agents, Fillers and Additives- Metal Matrix and Ceramics Composites.

UNIT III: MANUFACTURING **9** Hrs

Fundamentals- bag moulding- compression moulding pultrusion- filament winding- other manufacturing process- quality inspection and non-destructive testing.

UNIT IV: MECHANICS AND PERFORMANCE **9** Hrs

Introduction to Micro-mechanics- Unidirectional Lamina-Laminates- Inter laminar Stress- Statics Mechanical Properties- Fatigue Properties- Impact Properties- Environmental Effects- Fracture Mechanics and Toughening mechanisms, Failure Modes

UNIT V: DESIGN **9** Hrs

Failure Predictions- Design Considerations- Joint Design- Codes- Design Examples. Optimization of Laminated Composites- Application of FEM for Design.

Total No. of Hrs : 45

TEXT BOOKS
1) P.K.Mallick, (2006) *"Fiber-Reinforced Composites"*, Monal Deklatr Inc., New York.
2) B.D.Agrawal and L.J.Broutmam, (2006) "*Analysis and Performance of Fiber Composites"*, John Wiley and Sons, New York.

REFERENCES
1) Micael hyer, (1998) *"Stress Analysis of Fiber- Reinforced Composite Materials"*, Tata McGraw Hill.
2) Ronald Gibson, (2007) *"Principles of Composite Material Mechanics"*, Tata McGraw Hill.

BME 13E16 **ENGINEERING ETHICS** **3 0 0 3**

OBJECTIVES: Students will learn the responsibilities of an engineer towards,

- Safety in work environment
- Need of the society
- Professional rights and employee rights.

UNIT I: ENGINEERING ETHICS **9** Hrs

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 - Theories about right action - Self-interest-Customs and religion - Uses of ethical theories

UNIT II: ENGINEERING AS SOCIAL EXPERIMENTATION **9** Hrs

Engineering as experimentation - Engineers as responsible experimenters - Codes of ethics -A balanced outlook on law

UNIT III: ENGINEER'S RESPONSIBILITY FOR SAFETY **9** Hrs

Safety and risk - Assessment of safety and risk - Risk benefit analysis-Reducing risk-Indian Ethical Case studies.

UNIT IV: RESPONSIBILITIES AND RIGHTS **9** Hrs

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** Hrs

Multinational corporations - Environmental ethics-Computer ethics-Weapons development-Engineers as managers-Consulting engineers-Engineers as expert witnesses and advisors-Moral leadership-Sample codes of conduct- Bhopal gas tragedy Case study.

Total No. of Hrs : 45

TEXT BOOK

1) Mike Martin and Roland Schinzinger, (1996)*"Ethics in Engineering"*, Tata McGraw Hill, New York.

REFERENCES

1) Charles D.Fleddermann, *"Engineering Ethics"*, prentice Hall, New Mexico, 1090909.
2) Laura Schlesinger, *"How Could You Do That: The Abdication of Character, Courage, and Conscience"*, Harper Collin , New York, 109096.
3) Stephen Carter, *"Integrity, Basic Books"*, New York, 109096.
4) Tom Rusk, *"The Power of Ethical Persuasion: From Conflict to Partnership at Work and in Private Life"*, Viking, New York, 109093

BME 13E17 **INDUSTRIAL ENGINEERING** **3 0 0 3**

OBJECTIVES: Students will learn
- Various techniques of work measurement
- Details of plant layout and material handling devices
- Basic concepts of ERP.

UNIT I:WORK STUDY & WORK MEASUREMENT **9** Hrs

Work study – Techniques – Productivity, Improving productivity by reducing work content- Human factors in work study.
Method study – Basic procedure – Recording techniques - Micro–motion study, Threbligs, SIMO chart, Principles of motion economy.
Work Measurement – Techniques – Time study – Allowances – Work sampling – PMTS – MTM.

UNIT II:SITE SELECTION, PLANT LAYOUT & MATERIAL HANDLING **9** Hrs

Site Selection: Importance of plant location – choice of site for location –State regulations on location – Industrial Estates. Plant layout: Types of factory buildings, OBJECTIVES of good plant layout, Principles, Techniques used, Types, Flow pattern, Line Balance, computerized plant layout. Material Handling: Functions, OBJECTIVES, principles, Devices used, Relation between plant layout and material handling.

UNIT III:ERGONOMICS **9** Hrs

Techniques – Analysis – Equipment Design – Fatigue – Motivation theory of Fatigue – Fatigue tests-Duties of a human factor Engineer – Human effectiveness improvement through ergonomics**.**

UNIT IV:WAGES & INCENTIVES **9** Hrs

Wages: Wage & salary policies, systems of wage payments, Principles of wage administration, National Wage Policy, Fair wage committee report, Need based minimum wage Incentives: Need, Incentive plans, Comparison of various Incentive plans, Administration of wage incentives.

UNIT V:ENTERPRISE RESOURCE PLANNING (ERP) **9** Hrs

Need for optimal use of Resources, MRP I & II, Supply chain Management, Evolution of ERP, BPR, Lean Manufacturing, Popular ERP Packages, Implementation of ERP, Benefits of ERP.

Total No. of Hrs : 45

TEXT BOOKS
1) O.P. Khanna, (2005) *"Industrial Engineering and Management*", Khanna Publishers.
2) K.KAhuja, "*Industrial Management"*, Khanna Publishers.
3) Martand Telsang, "*Industrial Engineering and Production Management"*.

REFERENCES
1) M.Mahajan, "*Industrial Engineering and Production Management"*, Dhanpat Rai &CO.,
2) B. Kumar, (2005) "*Industrial Engineering"*, Khanna Publishers.
3) International Labour Organization (ILO), (2004) *"Introduction to Work study"*, Universal Publishing Corporation.
4) H. B. Maynard, "*Industrial Engineering, Handbook"*, McGraw Hill Book Company, International Edition.
5) Marvin E. Mandel, *"Time & Motion study"*, Prentice Hall, Private Limited, International Edition.
6) James M Apple, "*Principles of Layout & Materials Handling"*, Ronalds Press, International Edition.
7) V. K. Garg & N.K. Venkitakrishnan, (2004) "*Enterprise Resource Planning, Concepts & Practice"*, Prentice Hall of India Private Limited.

BME 13E18 TOTAL QUALITY MANAGEMENT 3 0 0 3

OBJECTIVES: Students will learn
- Various principles and tools of TQM
- ISO standards

UNIT I: INTRODUCTION **9** Hrs

Definition of Quality, Dimensions, Planning of quality, conformance to specification, Quality costs-. Basic concepts and evolution of Total Quality Management, Principles of TQM, Deming Philosophy Deming prize MBNQA. Barriers to TQM Implementation.

UNIT II: TQM PRINCIPLES **9** Hrs

Customer satisfaction-Customer Perception of Quality, Customer Complaints. Service Quality, Customer Retention. Employee Involvement- Motivation, Empowerment, Teams. Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement-Juran Triology, PDSA Cycle,58,Kaizen.Supplier Partnership- Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures-Basic Concepts. Strategy, Performance Measure.

UNIT III: SIX SIGMA **9** Hrs

The Seven Tools Of Quality, Statistical Fundamentals, Control Charts For Variables And Attributes, Process Capability, Concept Of Six Sigma, Phases And Defective Units Of Six Sigma .Overview Of GB,BB,MBB Leadership Characteristics ,Leadership Concept , Role Of Senior Management, Lean Management Principle, Strategic Planning New Seven Management Tools.

UNIT IV: TQM TOOLS **9** Hrs

Benchmarking-Reasons to Benchmark, Benchmarking Process. Quality Function Deployment (QFD), pareto, process flow diagram, check sheets and histogram Taguchi Quality Loss Function. Total Productive Maintenance (TPM)-Concept, Improvement Needs, FMEA-Stages of FMEA.

UNIT V: QUALITY SYSTEMS **9** Hrs

Need For ISO 09000 And Other Quality Systems , ISO 09000 – 2000 Quality System -Elements. Implementation Of Quality System, Documentation , Quality Auditing, Quality Council, Quality statements ,Quality Management System TS 1609409, ISO 14000 Concept, Requirements And Benefits. Introduction To Capability Material Management(CMM), People Capability Management(PCM).

Total No. of Hrs : 45

TEXT BOOK

1) Dale H Besterfied , "*Total Quality Management"*, Prentice Hall Publishing House

REFERENCES

1) S.Ramachandran,Dn.S.Jose, "*Total Quality Management"*, Airwalk Publications, First Edition, December.
2) Kulneet Suri, (2004 – 05) "*Total Quality Management: Priciples & Practce, Tools & Techniques"*, S.K. Kateria & sons, First Edition,
3) James R.Evans & William M.Lidsay, "*The Management and Control of Quality"*, (^{5th} Edition), South Western(Thomson Learning),2002(ISBN 0-324-06680-5).
4) Feigenbaum.A.V. *"Total Quality Management"*, Tata Mcgraw-Hill, 109091.
5) Oakland.J.S. "*Total Quality Management"*, Butterworth-Heinemann Ltd.,Oxford,109809
6) R.S.Nagarajan,A.A.Arivalagar, "*Total Quality Management"*, New Age International(p) Ltd., Publishers, First Edition.

BME 13E19 **INDUSTRIAL SAFETY ENGINEERING** **3 0 0 3**

OBJECTIVES: Students will learn
- Safety policies and their importance
- Design for safety **.**

UNIT I: INTRODUCITON **10** Hrs

A safety concept – Functions and role of safety – Fundamentals of loss control – Safety costs – Direct and in direct costs of accidents – Life Cycle Costs – Influence of Environment on Safety (noise, lighting, temperature, humidity)

UNIT II: SAFETY MANAGEMENT **10** Hrs

Safety Committee – System Safety Engineering – policy – operator error – Qualitative error predictions – accountability – fault tree analysis – operating hazard analysis – risk assessment – safety analysis programme – Safety Sampling.

UNIT III: PRODUCT SAFETY **10** Hrs

Design for safety – Design engineering tasks – hazardous Characteristics of Products – Fault Hazard Analysis – Diagram Of Severe Failures – post design check list of hazards.

UNIT IV: ACCIDENT PREVENTION **10** Hrs

Accident and claim losses – high potential accidents – accident prevention – modern concepts of accident prevention – accident investigation records – minimizing effects of accidents – motivating safety programme – training – role of supervisor – management safety programme.

UNIT V: SAFETY REGULATIONS AND STATUTES **5** Hrs

Law of safety progress – regulatory agencies and statue laws – statute law Vs common laws – occupational safety and health agency

Total No. of Hrs : 45

TEXT BOOK

1) William hammer, *"Product Safety Management and Engineering"* Prentice Hall int. society, 10980.

REFERENCES

1) Danier.C.Peterson *"Techniques of Safety Management"*, Tata McGraw Hill Kogakish Ltd, Japan, 10971.
2) *"Check list for work place inspection for improving safety, health and working condition"*, International Labour organization Geneva, 10987.
3) *"Safety and failure of components, Proceeding of Mechanical Engineering"*, London, Vol.184, part 38, 109094.

BME 13E20 **ERGONOMICS** **3 0 0 3**

OBJECTIVES: Students will learn
- Design of work space for human comfort
- Recent trends in ergonomics

UNIT I: INTRODUCTION **9** Hrs

Inter disciplinary nature of ergonomics – modern ergonomics – human performance – information processing – factors affecting human performance – physical workload and energy expenditure. Ergonomics evaluation and analysis

UNIT II:WORK SPACE DESIGN **9** Hrs

Anthropometry – work space design for standing and seated workers – arrangement of components with in a physical space – interpersonal aspects of work place design.

UNIT III: DESIGN OF EQUIPMENT **9** Hrs

Ergonomics factors to be considered – design of display and controls – design for maintainability – heat stresses – manual lifting.

UNIT IV:DESIGN FOR ENVIRONMENT **9** Hrs

Illumination – climate – noise – vibration – heat – cold – lighting – design considerations – effect of noise on task performance.

UNIT V:RECENT TRENDS **9** Hrs

Legislative trends – trends in work system design – occupational diseases – application of ergonomics in automobiles. New ergonomics approach ,advance in industrial ergonomics

Total No. of Hrs : 45

TEXT BOOK
1) Martin Helander, *"A guide to ergonomics of manufacturing"*, TMH 109096.

REFERENCES
1) Bridges. R.S. *"Introduction to Ergonomics"*, Tata McGraw Hill, 109095.
2) Mc Cormic, J., *"Human Factors in Engineering and Design"*, Tata McGraw Hill, 109092.
3) Wilson. J.R.Corlect. E.N. *"Evaluation of Human Work a practical ergonomics methodology"*, Taylor and Frances, 109090.
4) Shackle. B, Richardson. S, *"Human Factors for Information Usability"*, Cambridge university press, 109091.

BME 13E21 **NANOTECHNOLOGY** **3 0 0 3**

OBJECTIVES: Students will learn

- Basics and applications of nano technology
- Various nano materials and their manufacturing methods
- Nano measurement devices.

UNIT I: INTRODUCTION **9** Hrs

History of Nanotechnology and Nanoscience-Molecular nanotechnology-Molecular, Atomic, Microstructures scale- Barriers of implementing of Nanoscience- Hazards-Applications.

UNIT II: NANOMATERIAL **9** Hrs

Introduction to Nanomaterials- Nano powder-Nanoparticles-Nanodots-Nano powder-other material Fullerene-Nanotube-Types-Different shape-properties and characteristics of Nano tubes-applications

UNIT III: NANO MANUFACTURING **9** Hrs

Introduction to Nano Fabrication- Top down method-Bottom up method Synthesis methods of nanomaterial-CVD-LA-Ball milling-Shear mixing-Sonication-other methods, Difficulties in production of Nano materials

UNIT IV: NANO MEASURMENT **9** Hrs

Introduction to Nano measurement- TEM-SEM-Raman Spectroscopy-Differential Scanning Calorimeter-TGA-others Marpolgy of various Nano materials

UNIT V: NANO COMPOSITE/NANO INTERDISICIPLINE TECHNOLOGY **9** Hrs

Introduction to Nano Composites-Polymer-Metal-Ceramic-Nano Composites application
Introduction to Inter-disicipline Nano Technology-Nano Electronics-Nano Chemical-Nano biological-Nano Medicine-etc.,

Total No. of Hrs : 45

TEXT BOOK

1) Mick Wilson, (2004) *"Nanotechnology Basic science and Emerging Technologies)*", Overseas press.

BME 13E22 **DISASTER MANAGEMENT** **3 0 0 3**

OBJECTIVES: Students will learn

- Types of disasters and methods to handle such situations.

UNIT I: INTRODUCTION **9** Hrs

Introduction – Disaster preparedness – Goals and OBJECTIVES of ISDR Programme- Risk identification – Risk sharing – Disaster and development: Development plans and disaster management –Alternative to dominant approach – disaster-development linkages -Principle of risk partnership

UNIT II: DISASTER MANAGEMENT AND RISK REDUCTION IN PROCESSING **9** Hrs

Types of disasters and disaster plans: Processing machines and utilities. Sustainable livelihoods and their Protection – Recovery from disaster – Protective finishes for disaster management and their standards: Fire, Chemical and Bio-chemicals. Textiles health monitoring and Disaster aids.

UNIT III: AWARENESS OF RISK REDUCTION **9** Hrs

Trigger mechanism – constitution of trigger mechanism – risk reduction by education – disaster information network – risk reduction by public awareness

UNIT IV: DEVELOPMENT PLANNING ON DISASTER **9** Hrs

Implication of development planning – financial arrangements – areas of improvement – disaster preparedness – community based disaster management – emergency response.

UNIT V: SEISMICITY **9** Hrs

Seismic waves – Earthquakes and faults – measures of an earthquake, magnitude and intensity – ground damage – Tsunamis and earthquakes

Total No. of Hrs : 45

TEXT BOOKS

1) Pardeep Sahni, Madhavi malalgoda and Ariyabandu, *"Disaster risk reduction in south Asia"*, PHI
2) Amita sinvhal, (2010) *"Understanding earthquake disasters"* TMH.

REFERENCES

1)Pardeep sahni, Alka Dhameja and Uma medury, *"Disaster mitigation: Experiences and reflections"*, PHI

BCS 13E31 ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEM 3 0 0 3

OBJECTIVES: Students will learn

- Basics of AI and expert system
- Methods of developing expert system
- Applications of AI and expert system

UNIT I:INTRODUCTION **9** Hrs

Introduction – Evolution of Artificial Intelligence Production Systems – Search Strategies- Hill Climbing, back tracking, graph search{algorithm A and A*} Properties of A* Algorithm, monotone restriction specialized production systems – AO* algorithm.

UNIT II:KNOWLEDGE BASED SYSTEM **9** Hrs

Searching game trees: Minimax Procedure alpha beta pruning. Introduction to predialcate calculus Answer extraction – Introduction to knowledge based system – knowledge processing techniques – knowledge inference techniques.

UNIT III:EXPERT SYSTEMS **9** Hrs

Expert system Definition – Various stages in developing expert system -knowledge representation using Semantics, predicate calculus, frames – scripts – knowledge acquisition techniques – factors to be considered while building expert systems.

UNIT IV:DEVELOPING AN EXPERT SYSTEM **9** Hrs

Forward chaining, Backward chaining – Tools for developing an expert system – Explanation facilities – Meta knowledge – fuzzy reasoning.

UNIT V:APPLICATION OF A.I **9** Hrs

Building various expert systems – Case study Dendral, Mycin etc. Introduction to various application of A.I – Natural language processing – Natural language understanding – perception – learning using Neuarlnets.

Total No. of Hrs : 45

TEXT BOOK

1) Eliane Rich, (2004) "*Artificial Intelligence"*, McGraw hill international, 3rd edition.

REFERENCES

1) N.J. Nilson, (1982) "*Principles of AI"*, Spring verlag 10983.
2) David. W. Rolston, (1988) *"Principles of AI & Expert system Development*", Tata McGraw Hill.
3) Donald. A. Waterman, (2002) "*A guide to expert system"*, first edition.
4) P.H. Winston, "*Artificial intelligence"*, Addison wessley.
5) Fredrick Hayes , Roth, Donald. A.Waterman and Doughlas .B. Lent (editors), (1983) *"Building expert systems*", Addison wesley 10983, first edition.

BCS 13E32 **VISUAL PROGRAMMING** **3 0 0 3**

OBJECTIVES: Students will learn
- Graphical user input concepts
- Visual Basic and Visual C++Programming

UNIT I: INTRODUCTION TO WINDOWS PROGRAMMING: GUI CONCEPTS **9** Hrs

Overview of Windows programming– Creating the window – Displaying the window – message Loop – windows procedure – WM_PAINT message – WM_DESTROY message – An Introduction to GDI – Scroll Bars – Keyboard – Mouse –Menus.

UNIT II: VISUAL BASIC PROGRAMMING **9** Hrs

IDE – First Visual Basic Program – Introduction to Forms –Intrinsic Controls – Working with Files – Accessing Databases with Data Control – Classes and Objects– ADO Object Model.

UNIT III: VISUAL C++ PROGRAMMING **9** Hrs

Windows Programming Model – Visual C++ Components –Microsoft Foundation Classes Library Application Framework – Getting Started with Appwizard –Basic Event Handling, Mapping Modes, and a Scrolling view – Graphics Device Interface, Colors and Fonts – Modal Dialog and Windows Common Dialogs – Modeless Dialog and Windows Common Dialogs – Using ActiveX Controls – Windows Message Processing and Multithreading.

UNIT IV: ADVANCED CONCEPTS **9** Hrs

Menus – Keyboard Accelerators – Rich Edit Control – Tool Bars – Status Bars – A Reusable Frame Window Base Class – Reading and Writing Documents – SDI and MDI Environments – Splitter Windows and Multiple Views.

UNIT V: APPLICATIONS OF WINDOWS PROGRAMMING **9** Hrs

Dynamic Link Library – Component Object Model –Object Linking and Embedding – Data Base Management with Microsoft ODBC.

Total No. of Hrs : 45

TEXT BOOKS
1) Charles Petzold, (2012) *"Windows Programming"*, Microsoft Press, 109096, 5th edition.
2) Francesco Balena, (2006) *"Programming Microsoft Visual Basic 6.0"*, Microsoft Press, Indian Reprint
3) David Kruglirski.J, *"Programming Microsoft Visual C++"*, Fifth Edition, Microsoft Press, 109098,

REFERENCES
1) G.Cornell, (2008) *"Visual Basic 6"*, Tata McGraw Hill, 109098.
2) Deital & Deital, T.R.Nieto, (2003) *"Visual Basic 6, How to Program"*, Prentice Hall of India, 1090909,