

**B.E. III to VIII Semester  
(Mechanical Engineering)**

**Prospectus No. 10176**

**संत गाडगे बाबा अमरावती विद्यापीठ  
SANT GADGE BABA AMRAVATI UNIVERSITY  
(FACULTY OF ENGINEERING & TECHNOLOGY)**

## **PROSPECTUS**

**PRESCRIBED FOR  
FOUR YEAR DEGREE COURSE  
BACHELOR OF ENGINEERING  
MECHANICAL ENGINEERING  
III TO VIII SEMESTER  
EXAMINATIONS, 2009-10**

**SEMESTER PATTERN**



**2009**

**Price Rs. 15/-**

**Visit us at [www.sgbau.ac.in](http://www.sgbau.ac.in)**

**PUBLISHED BY  
Prof. J.S.Deshpande  
Registrar  
Sant Gadge Baba  
Amravati University,  
Amravati 444 602**

- 
- © "या अभ्यासक्रमिकेतील ( Prospectus ) कोणताही भाग संत गाडगे बाबा अमरावती विद्यापीठाच्या पूर्वानुमती शिवाय कोणासही पुनर्मुद्रित किंवा प्रकाशित करता येणार नाही ."
- © "No part of this prospectus can be reprinted or published without specific permission of Sant Gadge Baba Amravati University.

1  
SYLLABUS

PRESCRIBED FOR

THIRD & FOURTH SEMESTER

B. E. EXAMINATIONS

MECHANICAL ENGINEERING

SEMESTER PATTERN

THIRD SEMESTER

**Inplant Training & Industrial Visit** in the faculty of Engineering & Technology

- 1)
  - a) the inplant training shall not be compulsory,
  - b) the inplant training shall be taken by students strictly during Summer vacation. after IVth or VIth Semester examination and / or during Winter vacation after Vth or VIIth Semester examinations,
  - c) the inplant training shall not be part of examination system, however, student shall prepare and submit report after completion of training to the concerned Head of Department alongwith certificate issued by the industry,
  - d) the inplant training shall be of minimum two weeks duration,
  - e) there shall not be any liability whatsoever on the Institution with respect to inplant training of the students,
  - f) students shall undertake inplant training on their own risk and cost. An undertaking in this regards signed by student and parents shall be submitted before proceeding for training to the concerned Head of Department/ Head of Institution.
  - g) the students shall complete inplant training under the supervision of concerned person in the industry,
  - h) Institutes shall help students to organise inplant training by way of correspondance,
- 2) Industrial Visit : Industrial visit may be organised for the students. Students should prepare & submit the report on Industrial visit to the concerned Head of Department/Head of Institution.

2  
MATHEMATICS-III

SECTION-A

- 3SMP 1
- UNIT-I: Ordinary differential equations:- Complete solution, Operator D, Rules for finding complementary function, the inverse operator, Rules for finding the particular integral, Method of variations of parameters, Cauchy's and Legendre's linear differential equations. (10 Hrs.)
- UNIT-II Laplace transforms : Definition, standard forms, properties of Laplace transform, inverse Laplace transform, initial and final value theorem, convolution theorem, Laplace transform of impulse function, Unit step function, Laplace transforms of periodic function. Solution of Linear differential equations. (10 Hrs.)
- UNIT-III a) Partial differential equation of first order of following form-  
(i)  $f(p,q)=0$ ; (ii)  $f(p,q,z)=0$ ; (iii)  $f(x,p)=g(y,q)$ ; (iv)  $Pp+Qq=R$  (Lagrange's form); (v)  $z=px+qy+f(p,q)$  (Clairaut form)  
b) Statistics : Curve fitting by method of least squares (Straight and parabola only), Correlation, Regression.  
Binomial, Poisson and Normal Distribution (10 Hrs.)

SECTION-B

- UNIT-IV Complex Analysis :- Functions of complex variables, Analytic function, Cauchy-Reimann conditions, Harmonic function, Harmonic conjugate functions, Milne's method, conformal mappings ( translation, rotation, magnification, inversion, bilinear transformation), singular points, expansion of function in Taylor's and Laurent's series. Cauchy's integral theorem and formula, Residue theorem. (12 Hrs.)
- UNIT-V Numerical Analysis : Solution of algebraic and transcendental equations by Newton-Raphson method & method of false position. Solution of system of linear equations by Gauss-Seidel method, Relaxation method. Solution of first order ordinary differential equations by Picards, modified Euler's, Runge-Kutta and Taylor's method.
- UNIT-VI Vector Calculus :- Scalar and vector point functions, Differentiation of vectors, Gradient of a scalar point function, Directional derivatives, Divergence and curl of a vector point function and their physical meaning, line, surface, volume integrals, irrotational and solenoidal vector fields, Stoke's and Divergence theorem (without proof). (10 Hrs.)

**BOOKS RECOMMENDED :-**

- 1) Elements of Applied Mathematics by P.N. Wartikar and J.N. Wartikar
- 2) A Text Book of Differential Calculus by Gorakh Prasad.
- 3) Engg. Mathematics by Chandrika Prasad.
- 4) Advancing Engg. Mathematics by E.K. Kreyzig.
- 5) A Text Book of Applied Mathematics by P.N. Wartikar and J.N. Wartikar.
- 6) Higher Engg. Mathematics by B.S. Grewal.

**3SMP2                      MECHANICS OF MATERIAL**  
**SECTION-A**

- Unit-I 1. Mechanical properties: Concept of direct, bearing and shear stresses and strains, stress-strain relations, Biaxial and triaxial loading, elastic constants and their relationship, stress-strain diagrams and their characteristics for mild steel, and other metals, factor of safety,
2. Uniaxial stresses and strains: Stresses and strains in compound bars in uniaxial tension and compression, temperature stresses in simple restrained bars and compound bars of two metals only.
- Unit-II 1. Axial force, shear force & bending moment diagrams: Beams, loading and support conditions, bending moment, shear force and axial load diagrams for all types of loadings for simply supported beams, cantilevers and beams with overhangs, relation between shear force, bending moment and loading intensity.
2. Simple or pure bending theory: Theory of simple bending, section modulus, moment of resistance, bending stresses in solid, hollow and built up section, leaf springs.
- Unit-III 1. Torsion: Theory of torsion & assumptions, derivation of torsion equation, polar modulus, stresses in solid & hollow circular shaft, power transmitted by shaft, closed coiled helical spring with axial load.
2. Shear stress distribution on beam cross sections.
- SECTION - B**
- Unit-IV 1. Thin and thick cylinders and thin spherical shells subjected to internal pressures.
2. Strain energy under uniaxial tension and compression impact loads and instantaneous stresses.
- Unit-V 1. Combined direct & bending stresses: Combined direct and bending stresses, applications to short columns with eccentric loads.
2. Principal stresses: Biaxial stress system, principal stresses, principal planes, Mohr's circle of stresses, principal strains.
- Unit-VI 1. Deflection of beams

Deflection in statically determinate (simply supported, cantilever and beams with overhang) beams subjected to point loads, uniformly distributed loads, moments by double integration, and Macauley's method.

**Practical:**

Minimum seven out of following:

1. Tension test on metals.
2. Compression test on materials.
3. Shear test on metals.
4. Impact test on metals.
5. Hardness test on metals.
6. Torsion test on metals.
7. Deflection of beams.
8. Modulus of rupture test.
9. Buckling of columns.
10. Deflection of springs.

A journal/report on experiments conducted shall be submitted by each student. Practical examination shall be viva-voce based on above practical and the syllabus of the course.

**BOOKS RECOMMENDED:**

1. E.P. Popov, Mechanics of Materials: Prentice Hall of India, New Delhi.
2. S. Timoshenko and O.H. Young: Elements of Strength of Materials. East West Press Private Ltd., New Delhi.
3. Ferdinand L. Singer, Strength of Materials: Harper and Row, New York
4. Shames, I. H., Introduction to solid mechanics: Prentice Hall of India, New Delhi, 1990.
5. Natarajan, Mahadeoappa, Strength of materials
6. Junnarkar, S. B., Mechanics of materials
7. Mubeen, A., Mechanics of solids, Pearson education (Singapore) Pvt. Ltd.
8. Beer and Johnston, Mechanics of materials, Mc-Graw Hill.

**3SM3                                      FLUID POWER-I**  
**SECTION - A**

- UNIT-I:- 1) Introduction to the study of fluid motion. Mechanical properties of fluids and their influence on flow characteristics.
- 2) Fluid Statics:- Fluid pressure, pressure variation in fluids, manometers, forces on plane and curved surface buoyancy. Stability of floating bodies. (12 Hrs)
- UNIT-II:- Kinematics and dynamics of fluid flow:- Types of flows, Stream lines, potential lines, flow net, continuity equation.

One and two dimensional motion, one dimensional method of flow analysis. Bernoulli's equation. Venturimeter, Momentum equation for steady flow. Vortex motion. (8 Hrs)

UNIT-III:- Dimensional analysis: Dimensional homogeneity and dimensionless ratios. Dimensionless parameters. Similitude and model studies (6 Hrs)

### SECTION - B

UNIT-IV:- Motion of viscous fluids:-Introduction to laminar and Turbulent flows. Boundary layer concept. Separation. Drag lift on immersed bodies. Reynolds number and its significance.

(7 Hrs)

UNIT V:- Darcy's Weisbach equation i.e. Equation of pipe flow, friction charts and its use, Minor losses in pipes and fittings, losses due to sudden enlargement and contraction, Hydraulic and energy gradient lines, pipes in series and parallel. Elementary concept of water hammer. (8 Hrs)

UNIT VI:- 1. Principles of fluid machinery: Dynamic action of fluid force exerted by fluid jet on plane, curved, stationary and moving vanes. Velocity diagrams, Work done by impact, pressure due to deviated flow.

2. General Theory of Hydrodynamic Machines:- Euler's equation, Degree of reaction, classification of machines according to degree of reaction. Efficiencies: Volumetric efficiency, Hydraulic efficiency, mechanical efficiency and overall efficiency. (7 Hrs)

### PRACTICAL TERM WORK:-

At least six practicals (study/Trials) based on above syllabus, as given below shall be performed and a report there of submitted by the students.

1. Study of Manometers.
2. Measurement of fluid pressure by manometer.
3. Determination of metacentric height.
4. Verification of Bernoulli's equation.
5. Flow measurement by venturimeter.
6. Study of venturimeter.
7. Determination of Reynolds number.
8. Velocity distribution in Boundary layer & thickness of B.L.
9. Determination of coefficient of friction for pipes.
10. Determination of head loss due to sudden enlargement.

11. Determination of head loss due to sudden contraction.
12. Determination of losses in bends.
13. Determination of losses in elbows.
14. Study of flow through pipes in series & parallel.
15. Verification of momentum equation.

Note :- Practical examination shall consist of oral or Experimentation based on above term work.

### REFERENCES:-

1. Fluid Mechanics by Streeter.
2. Engineering Fluid Mechanics by K.L. Kumar
3. Hydraulic Machines by Vasandani.
4. Fluid Mechanics and Hydraulic Machines by Dr. Mody & Seth.
5. Fundamentals of Fluid Mechanics & Machines by R.K. Purohit.
6. Fluid Mechanics & Fluid Machines by R.K. Rajput.
7. Fluid Mechanics by Gardge Minzgonkar.
8. Hydraulic, Fluid Mechanics & Fluid Machines - Ramamrutham.
9. Fluid Mechanics by Yuan.

### 3SM4 ENGINEERING THERMODYNAMICS

#### SECTION - A

UNIT-I:- a) Basic concepts and properties:- Introduction, thermodynamic system and control volume, Macroscopic and microscopic approaches, properties and state of a system, point and path functions, Thermodynamic equilibrium, processes and cycles, Quasi-static process, properties such as specific volume, pressure, temperature etc. Equality of temperature, zeroth law of Thermodynamics, Temperature scales.

b) Ideal Gases and Vapours: Differences between gases and vapours, ideal gases, gas laws, equation of state, gas constant, Universal gas constant.

c) Work and Heat: Definition of work, thermodynamic work, work in compressible system, work a path function, work done during various processes, p-v diagram, definition of Heat, Heat transfer a path function, comparison of heat and work, specific Heat and latent Heat. (10 Hrs)

UNIT-II:- First law of thermodynamics: Energy of a system, classification of energy, law of conservation of energy law applied to closed system under going a cycle, Joules experiment. Energy a property of system, internal energy-a function of temperature, Joules experiment, Enthalpy, specific heat at constant volume and constant pressure. Change in

internal energy and Heat transfer during various non-flow processes.

Ist Law applied to flow processes: Steady state, steady flow process, mass balance and energy balance in steady flow process, steady flow energy equation and its application to nozzles and diffusers, throttling, turbine and compressor, pumps, heat exchangers etc. work done and Heat transfer during steady flow processes. (8 Hrs)

UNIT - III:- IInd Law of thermodynamics: Limitations of Ist law, heat engines and heat pumps. Kelvin-Planck and Clausius statements, their equivalence, reversible and irreversible processes, factors that render processes irreversible, Carnot cycle, two propositions regarding the efficiency of Carnot cycles.

The thermodynamic temperature scale. Reverse Carnot cycle. COP of heat pump and refrigeration. (7 Hrs)

### SECTION - B

UNIT IV:- Entropy:

Inequality of Clausius, entropy-a property of system, entropy change for ideal gases, entropy change of a system during irreversible process, lost work. Principle of increase of entropy.

Availability and irreversibility:- Available energy referred to cycle, decrease in available energy with heat transfer through a finite temperature difference. The Helmholtz and Gibbs functions, Availability of a finite system, availability in a steady flow system. Irreversibility and effectiveness.

(7 Hrs)

UNIT V:- Properties of Steam:

Triple point and critical point, sensible heat, latent heat, superheat and total heat of steam. Internal Energy, External work of evaporation, specific volume and entropy of steam. Dryness fraction of steam, throttling of steam, determination of dryness fraction. Steam tables and their use. T-S and H-S diagram. (8 Hrs)

UNIT VI:- a) Air Cycles: Otto, Diesel, Semidiesel, Sterling and Joule cycles, their efficiencies and mean effective pressure.

b) Vapour Cycles:- Rankine and Modified Rankine Cycle, work done and efficiency, specific steam consumption. Comparison

of Rankine and Carnot cycle, representation on P-V, T-S and H-S diagram. (8 Hrs)

### RECOMMENDED BOOKS.

1. Fundamentals of Classical Thermodynamics - by G.J. Van Wylen.
2. Thermodynamics for Engineers - by B.V. Karlekar.
3. Engineering Thermodynamics - by P.K. Nag.
4. Thermodynamics - by Yadav.
5. Basic Engineering Thermodynamics - by Joel.
6. Thermal Power Engineering - by Mathur & Mehta
7. Heat Engineering - by Kumar, Vasandani
8. Heat Power - by K.C. Pal
9. Thermal Engineering - by Purohit B.K.
10. Engg. Thermodynamics - by Rajput R.K.
11. Thermal Engg. - by P.L. Ballaney
12. Thermodynamics-An Engineering Approach - Cengel and Boles  
Mc Graw Hill  
Publications

### 3SMP5

### MANUFACTURING PROCESSES - I

#### SECTION - A

Unit-I:- Introduction to pattern making- Pattern materials, pattern making, allowances, Types of patterns, General properties of moulding sands, Mold hardness. Preparation of sand moulds of different types, Moulding processes, core making.

Sand casting Processes - Basic principle and Terminology of sand casting, gating system, types of gate, Risers design, Reserving aids, (analytical approach to riser design). (9 Hrs)

Unit-II:- Technology of melting and casting - Melting furnaces pit, open hearth, gas fired cupola and electric hearth furnaces, cupola operation development in cupola melting, Electric furnaces - Direct Arc, Indirect arc and electric induction furnace. Modernisation & Mechanisation of Foundries, Defects in castings.

Origin and classification of defects, shaping faults, Inclusions and sand defects, Gas defects, shrinkage defects, contraction defects, dimensional errors. Inspection and testing of castings:- Radiography, ultrasonic, Eddy current testing, fluorescent penetrant test. (8 Hrs)

Unit III:- Casting processes and their principle of operation and applications permanent mold casting, slush casting, shell molding, Investment or lost wax casting, vacuum process,

centrifugal casting, continuous casting, Die casting equipment and processes for Gravity, pressure and vacuum casting methods. (7 Hrs)

### SECTION - B

Unit IV :- Hot and cold working of metals : Difference in hot working & cold working extrusion & types, piercing, pipe and tube production, manufacture of seamless pipe and tubing. Cold working processes. Shearing operations, tube drawing, wire drawing, spinning, embossing and coining, squeezing and sending operations, rotary swaging, Rolling, types of rolling forging operations, upset (m/c) forging, drop hammers.

(8 Hrs)

Unit V:- Joining processes:-

Mechanical joining processes rivetting, soldering, brazing (introductory), Welding Requirements for welding, Types of welding processes-Arc welding: arc initiation, arc maintenance, and arc control, transfer of metal across the gap, Electrode efficiency, Types and purpose of Electrodes, I.S.F. for providing the shielding.

TIG & MIG processes - TIG-Electrode polarity, loss and electrode contamination, shielding gases, MIG-Spray transfer and dip transfer processes (6 Hrs.)

Unit VI:- a) Submerged arc welding & resistance welding :- Heat generation in resistance spot welding, operational characteristics of resistance welding processes such as projection welding, butt welding, percussion welding.

b) Principle of operation of friction welding, forge welding, plasma arc, thermit welding. Welding defects, Testing and Inspection of welds, Ultrasonic, Electroslag, Electron Beam, laser welding, weldability.

c) Surface Treatment-Electroplating, electroforming, and iodising, metal spraying, shot peening, polishing, mechanical cleaning. (9 Hrs)

### PRACTICE:-

1. Foundry :- Sand preparation and practice in moulding of various types of patterns. Moulding 2 jobs, pattern making 2 jobs.
2. Joining Processes:- 2 composite jobs involving electric

welding, gas welding and cutting.

A journal should be prepared and submitted on above term work. The practical examination shall consist of a job preparation and college assessment should be based upon the jobs, termwork and viva examination.

### References:-

1. Production Technology by R.K.Jain.
2. Principle of Foundry Technology by P.L.Jain.
3. Workshop Technology I & II by Raghuvanshi.
4. Processes and Materials of Manufacture by R.A.Lindberg, PHI Pub.
5. Foundry Technology by Goel Sinha.
6. Workshop Technology by Hajra Chaudhary.
7. Workshop Technology Vol. I & II by Bawa.

### FOURTH SEMESTER

#### 4 SMP 1 BASIC ELECTRICAL DRIVES & CONTROL

#### SECTION-A

Unit I: Concept of general electric drives, classification and comparison of electrical drive system, Cooling and heating of electric motors. Introduction to mechatronics, Theory and principle of Power Transistor, Power MOSFET, SCR and IGBT.

Unit II: Basic characteristics of D.C. motor, Torque equation, Modified speed - Torque characteristics. Starting and braking of Electrical D.C. motors, comparison of mechanical and electrical braking methods. Introduction, Principle, construction and working of P.C. servo motors, stepper motors, Brushless D.C. motors.

Unit III: Classification of A.C. motors, construction, types, principle of working and characteristics of 3 phase Induction motors, applications. Starting and braking of 3 phase induction motors. Classification of single phase induction motors. construction, principle and working and applications. Principle and working of universal motor, Linear Induction Motor.

#### SECTION-B

Unit IV: Conventional methods of speed control of A.C. and D.C. motors. Thyristorized stator voltage control of 3 phase induction motor, (v/f) control method, slip-power recovery scheme. Thyristorized armature voltage control of D.C. motors using phase control & Thyristorized chopper.

- Unit V : Basic principle, construction & applications of sensors and transducers, contact - non - contact type, optical proximity sensors. Switches, contact type, magnet type, electromagnetic type, sound, light, pressure, vibration transducers, Hall effect - sensors A.C. / D.C. Tachogenerators.
- Unit VI: Industrial applications - classes of duty selection of an electric drive for particular applications such as steel mill, paper mill, cement mill, textile mill, sugar mill, electric traction, coal mining, etc. Induction heating, surface harding & Dielectric heating.

#### REFERENCE BOOKS :

- 1) Introduction to Mechatronics and Measurements Systems by Michael B. Histan and David G. Aleiatove, McGraw Hill, 1993.
- 2) Mechatronics - W.Bolton, Addison Wesley, Longman Ltd., 1997.
- 3) Mechatronics - HM T Ltd., Tata McGraw Hill.
- 4) Mechatronics - Electronics in Production & Process - D.A. Dawson, N.C.Burd & A.J. Loader, Chapman Hall, 1993.
- 5) Mikell P. Groover and Emery W. Zimmer, Jr.
- 6) Benjamin C. - Automatic Control Systems - Prentice Hall, New Delhi, 1992.
- 7) Introduction to Mechatronics and Measuring Systems - Michael B. Histant and David G. Aleialove, McGraw Hill, 1999.
- 8) Mechanical Measurements - Beckwith T., Marongoni R., Liseehard, 5th Edition, Addison Wesley, 1993
- 9) Doebelin E.O. - Measurement Systems, McGraw Hill, 1975.
- 10) A First Course on Electrical Drives - S.K. Pillai.
- 11) Basic Electrical Technology (Vol. 11) - B.L. Theraja.
- 12) Drives and Control - N. Dutta.

#### 4SMP2 ENGINEERING METALLURGY

##### SECTION - A

- Unit I :- Introduction to metallurgy: Basic concept of process metallurgy, physical metallurgy, and mechanical metallurgy.
- Classification of materials & their application
- Structure of metals and alloys, formation of Alloys,
- Solid solutions, types and their formation lever rule for phase mixtures.
- Solidification of pure metals, nucleation and growth, ingot structure, dendritic solidification
- Introduction to processes for chemical analysis of metals: spectrometry, gravitometry. (07 Hrs)

- Unit II : Study of binary equilibrium diagram and invariant reactions
- Construction and study of Iron-carbon Equilibrium Diagram
- Critical temperatures
- Microstructure of slowly cooled steel
- Estimation of carbon from microstructure, structure property relation.
- Introduction to composite materials, advantage and applications. (08 Hrs.)
- Unit III : **Alloy Steels:** Classification and application of plain carbon steel
- Effect of grain size and impurities on properties of plain carbon steel
- Purpose of alloying, classification of alloying elements and their effect on steels, effect on transformation in steel,
- Low alloy engineering steels and High speed steels, their heat treatments and applications.
- Ferritic, Austenitic and Martenstic stainless steels, their properties and applications, weld decay in stainless steel. (08 Hrs.)

##### SECTION-B

- Unit IV : **Cast irons :** Constitution and properties of white, gray, Nodular and Malleable cast irons, their applications, Alloy cast irons.
- Non Ferrous Metals and Alloys :** Types, Properties and uses of Brasses and Bronzes. Important alloys of Aluminium, Lead, Tin and Zinc, their applications.
- Bearing materials, Season cracking, precipitation hardening. (07 Hrs)
- Unit V : **Principles of Heat Treatment:** - Annealing, Normalizing, Tempering Iso-thermal transformation diagrams(S-curve), super imposition of continuous cooling curves on 's' Curve. Characteristics of pearlite, bainite and martenstics transformation during continuous cooling. Quenching media, severity of quench, Austempering, Martempering and patenting, Retained austenite and sub-zero treatment.
- Hardenability, Methods of surface hardening: Carborizing, Nitriding, Cyaniding, Flame and Induction Hardening. (10 Hrs)

Unit VI : **Mechanical working of Metals:** - Hot and cold working, Relative advantages and dis-advantages, study of stress-strain curve, Luders bands Work hardening, strain Ageing; Recovery, Recrystallisation and grain growth. Metallurgical factors affecting various working processes, preferred orientation, Deformation mechanisms-Slip, twinning, critical resolved shear stress.

**Powder Metallurgy:** Manufacture of metal powders, Atomization, Milling, Reduction, Electrolysis, carbonyl. Process; Single die and double die compaction, sintering, stages of sintering. Manufacture of porous bearings and cemented carbide tip tools by P.M. techniques. Advantages, limitations and applications of powder metallurgy.  
(08 Hrs)

#### PRACTICALS:-

Eight of the practicals mentioned below shall be performed and report/Journal there of shall be submitted by voce on the above syllabus and practical work.

#### LIST OF PRACTICALS :-

1. Study of metallurgical microscope.
2. Preparation of specimen for micro-examination.
3. Moulding of specimen for micro-examination.
4. Study of micro structures of Annealed and normalised plain carbon-steels.
5. Study of micro structures of alloy steels and H.S.S.
6. Study of micro structures of various cast irons.
7. Study of micro structures of Brasses.
8. Study of micro structures of Bronzes.
9. Study of micro structures of White metal bearing alloys and alloys.
10. Study of micro structures of hardened and tempered steels.
11. To study F.e.(Equilibrium diagram & Allotropic forms of Fe.)
12. To study different Heat Treatment Process for steel.
13. To study different surface Hardening processes for steels.
14. To study effect of alloying elements on the properties of steels.
15. To measure variation in hardness by hardness tester (Jominy end quench test apparatus)
16. Study of hardness tester and conversion of Hardness number
17. Industrial visit to study heat treatment plant.

#### 4SM3

#### ENERGY CONVERSION-I

#### SECTION - A

Unit I :- Flow diagram for steam power plant with basic units such as steam generator, turbine, condenser and pump. Boilers: Introduction to water tube boilers used in thermal power plants, packaged Boilers (fire tube), High pressure boilers; Loeffler, Benson, Lamont Boilers, Boiler mountings and accessories—devices for improving Boiler efficiency.

Principle of fluidized bed combustion.

Boiler draught; Types of draught, expression for diameter & height of chimney, condition for maximum discharge, efficiency of chimney, reasons for draught loss. (7 Hrs).

Unit II:- FUEL & ASH HANDLING :

Elementary treatment on coal, coal transportation from mine to site and site to boiler house.

Fuel bed firing and suspension firing, Equipments of Mechanical grate firing, pulverised coal firing including crushers & pulverisers and burners.

Oil handling system, and burner equipment, Elementary treatment on ash handling. Type of dust collectors and disposal of dust.

Boiler performance:- Boiler rating, boiler power, equivalent evaporation, efficiency. Effect of accessories on boiler efficiency and heat balance. (8 Hrs)

Unit III:- Steam power plant: General features, representation of Rankine cycle on phase diagrams. layout, site selection, concept of co-generation.

CONDENSERS : Need, Types of condensers, quantity of cooling water required. Dalton's law of partial pressure, condenser and vacuum efficiency. Sources of air in condensers and its effect on performance. Condensate pump and air extraction pumps, air ejectors Cooling water system: cooling ponds, spray tanks, cooling towers: Natural and mechanical wet type cooling tower. (7 Hrs)

#### SECTION - B

UNIT IV :- Steam nozzles : Flow of steam through nozzles & diffusers, Maximum discharge, critical pressure ratio, Effect of friction. Determination of throat & exit areas, Nozzle efficiency, no

numerical on concept of super saturated flow & wilson line

Steam Turbines:- Principle of working, Types of steam turbines such as impulse, reaction, axial & radial flow, back pressure & condensing turbines. Compounding. Reheat, regenerative cycles, bleeding. Analysis limited to two stages only. (7 Hrs)

UNIT V :- Analysis of steam Turbines : Flow of steam through impulse & impulse reaction turbine blading. Velocity diagrams. Graphical & analytical methods for work & power developed, axial thrust and efficiency. Height of turbine blades.

LOSSES IN STEAM TURBINES:-

Nozzle losses:- blade friction, partial admission, disc friction, gland leakage losses and velocity losses.

Governing of steam turbines. (10 Hrs)

UNIT VI:- NUCLEAR POWER : Fusion, fission, Chain reaction, conversion and breeding in nuclear fission, components of reactor, coolants, moderators etc.

Different type of reactors such as boiling water, pressurised water, gas cooled, liquidised metal cooled thermal reactors. (6 Hrs)

#### PRACTICAL TERMWORK:-

At least six practicals (Study/trials) based on above syllabus, as given below shall be included in the report by the students.

1. Study of a water tube boiler (Babcoch Wilcox boiler)
2. Study of a locomotive boiler.
3. Study of a high pressure boiler.
4. Study of boiler accessories.
5. Trial on a boiler and heat balance sheet.
6. Study of boiler mountings.
7. Study and trial on a steam turbine.
8. Study of condensers.
9. Study of condensate and air extraction pumps.
10. Study of steam power plant.

Practical Examination:- Shall consist of based on above termwork and syllabus.

#### BOOKS RECOMMENDED:-

1. Power Plant Engineering (Steam & Nuclears) by P.K.Nag
2. Steam Turbine by Kearton.

3. Power Station Engineering and Economics by Sktrozki and Vopat.
4. Power Plant Engineering by M.M.Ei Wakil.
5. Therna Power Engineering by Mathur Mehta.
6. Steam and Gas Turbines by R.Yadav.
7. Power Plant Engineeirng by R.K.Rajput.
8. Thermal Engineering by P.L.Ballaniy.
9. Thermal Engineering by R.Yadav.

#### 4SMP4

#### MANUFACTURING PROCESS - II

##### SECTION - A

UNIT I :- Theory of Metal cutting: Mechanics of Metal cutting, Tool material, Tool Geometry, Tool life, Tool wear, Cutting forces and power consumption, Machinability, Metal cutting economy, Cutting fluid, Machine Tool classification. (6 Hrs)

UNIT II:- Construction, Operations and accessories of centre lathe, introduction of capstan & turret lathe, indexing mechanism, bar feeding mechanism, introduction to Automatic screw machines & Single spindle and multi-spindle automat. (8 Hrs)

UNIT III:- a) Drilling M/cs general purpose, Mass production and special purpose drilling M/cs.  
b) Processing of plastics by compression, Transfer, Injection, Extrusion. Blow-moulding, Rotational moulding and calendering. (8 Hrs)

##### SECTION - B

UNIT IV:- a) Boring M/c :- Horizontal, Vertical and jig Boring M/c.  
b) Milling M/c :- Types, Types of Milling Cutters, Dividing head, Compound and differential indexing.  
c) Gear producing M/cs. (10 Hrs)

UNIT V :- a) Grinding Machines: Bench grinders, surface grinders, centres grinders, types of bonds & Abrasive modification of grinding wheels.  
b) Study of various part & Operation of Shaper, Planer, slioter and power hack saw. (8 Hrs)

UNIT VI:- Unconventional Machining Processes:-

- a) Mechanical Processes:- Ultrasonic Machining - principle and applications. process parameters ; Abrasive and water

abrasive jet machining :- Mechanism of metal removal parameters involved.

- b) Thermal processes:- Election Beam Machining - Generation of beam, principle and applications : Laser Beam machining applications : Plasma-arc machining- Concept and generation of plasma, principle of PAM, applications.
- c) Electro Chemical Machining- Classification, fundamentals: Electro mechanical milling.
- d) Electric discharge Machining - Types dis-sie-onking, wire EDM, Mechanism of material removal, process parameters, advantages and applications. (8 Hrs)

#### **PRACTICALS:-**

Demonstration of operations related to lathe, shaper, slotter, drilling & grinding m/cs.

Machine shop practise.

One job on lathe covering taper turning and threading.

One job on shaping covering plane and inclined surfaces.

One job on milling machine.

The above jobs should include drilling, grinding, tapping etc.

Demonstration of plastic moulding machine. Term work should be submitted in the form of journal.

N.B. :- The practical examination shall consists of preparation of practical jobs and assessment by external and internal examiner.

#### **REFERENCES:-**

1. Workshop Technology - By Raghuwanshi. Vol 1 & 2.
2. Workshop Technology - By Hajra Choudhary Vol 1 & 2.
3. Plastic Technology - By W.J.Patton.

#### **4SMP5**

#### **MACHINE DRAWING**

##### **SECTION - A**

UNIT I : Sectional views:- Conversion of pictorial view into sectional orthographic projections, sectional views with different types of sections, missing views.

UNIT II : Intersection of surfaces:- Interpenetration of solids, prism and prism, cylinder and cyliner, cylinder and prism, cone and

cylinder, cone and prism.

- UNIT III: 1. Latest ISI conventions covering the standard practice in machine drawing. Conventions for various components like bearing, gears, springs, key and key ways, threads, tap holes and materials.
2. Symbolic representations for working drawing for welded joints.
3. Use of specifications for limits, fits and tolerances.
4. Conventions used for surface roughness i.e. machining symbols, M/c allowance symbols etc.

##### **SECTION - B**

UNIT IV Preparation of freehand proportionate sketches of various machine elements such as—

1. Rivets & Riveted joints.
2. Keys, Cotters and cotter joints, knuckle joints and couplings.
3. Bearing and bearing mountings.
4. Engine & machine tool components.

UNIT V Preparation of detail drawing of simple machine assemblies, like pedastal bearing, plumber block, simple eccentric, stuffing box, cross head, connecting rod, tail stock, tool post, c-clamp, screw jack, boiler safety valve etc.

UNIT VI Preparation of assembly drawing of simple machine assemblies, like pedastal bearing, plumber block, s i m p l e eccentric, stuffing box, cross head, connecting rod, tail stock, tool post, c-clamp, screw jack, boiler safety valve etc.

#### **TERMWORK:-**

Sheet No. 1 :- Sectional views of some objects and missing views.

Sheet No. 2 :- Intersection of solids.

Sheet No.3 :- Various symbols of welded joints, their working drawings, specifications for limits, fits, surface roughness symbols etc. from Unit III.

Sheet No. 4 : Dimensioned sketches of various machine elements from Unit IV.

Sheet No. 5 :- Dimensioned sketches of different elements from assemblies.

Sheet No. 6 :- Detail of assembly drawing of different machine assemblies.

Introduction & exposure to basic computer drafting packages.

At least two computer outputs using packages like Auto CAD/ Solid edge/ Solid works etc. for the engineering applications such as.

1. Profile of standard machine parts such as hexagonal nut, bolts, rivets, bearing, circlips, bracket, spring, keys, pins etc.
2. Isometric drawing of simple m/c components.

**PRACTICAL EXAMINATION:-**

This shall consist of viva voce on above termwork and syllabus.

**REFERENCES:-**

1. Machine Drawing - N.D.Bhatt
2. Engineering Drawing - N.D.Bhatt
3. Machine Drawing - N.Sidheshwar, Shastry, Kanhaiah.
4. Machine Drawing - Narayanan.

\*\*\*\*\*

**ENVIRONMENTAL STUDIES****Total Marks : 100****PART-A****SHORT ANSWER PATTERN****25 Marks****1. The Multidisciplinary nature of environmental studies**

- . Definition, scope and importance.
- . Need for public awareness.

(2 lecture hours)

**2. Social Issues and the Environment**

- . From Unsustainable to Sustainable development
- . Urban problems related to energy
- . Water conservation, rain water harvesting, watershed management
- . Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- . Environmental ethics : Issues and possible solutions.
- . Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- . Wasteland reclamation.
- . Consumerism and waste products.
- . Environment Protection Act.
- . Air (Prevention and Control of Pollution) Act.
- . Water (Prevention and Control of Pollution) Act.
- . Wildlife Protection Act.
- . Forest Conservation Act.
- . Issues involved in enforcement of environmental legislation.
- . Public awareness.

(7 lecture hours)

**3. Human Population and the Environment**

- . Population growth, variation among nations.
- . Population explosion - Family Welfare Programme.
- . Environment and human health.
- . Human Rights.
- . Value Education.
- . HIV / AIDS.
- . Women and Child Welfare.
- . Role of Information Technology in Environment and human health.
- . Case Studies.

(6 lecture hours)

**PART-B****ESSAY TYPE WITH INBUILT CHOICE****50 Marks****4. Natural resources :****. Renewable and non-renewable resources :**

- . Natural resources and associated problems.
  - Forest resources : Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
  - Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
  - Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
  - Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer - pesticide problems, water logging, salinity, case studies.
  - Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources, Case studies.
  - Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
- . Role of an individual in conservation of natural resources.
- . Equitable use of resources for sustainable lifestyles.

(8 lecture hours)

**5. Ecosystems**

- . Concept of an ecosystem.
- . Structure and function of an ecosystem.
- . Producers, consumers and decomposers.
- . Energy flow in the ecosystem.
- . Ecological succession.
- . Food chains, food webs and ecological pyramids.
- . Introduction, types, characteristic features, structure and function of the following ecosystem :-
  - Forest ecosystem
  - Grassland ecosystem
  - Desert ecosystem
  - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(6 lecture hours)

**6. Biodiversity and its conservation**

- . Introduction - Definition : genetic, species and ecosystem diversity.
- . Biogeographical classification of India.
- . Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values.
- . Biodiversity at global, National and local levels.
- . India as a mega-diversity nation.
- . Hot-spots of biodiversity.

- . Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
- . Endangered and endemic species of India.
  - . Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity. (8 lecture hours)

### 7. Environmental Pollution

- . Definition
  - . Causes, effects and control measures of :-
    - Air pollution
    - Water pollution
    - Soil pollution
    - Marine pollution
    - Noise pollution
    - Thermal pollution
    - Nuclear hazards
  - . Solid Waste Management : Causes, effects and control measures of
    - . Role of an individual in prevention of pollution.
    - . Pollution case studies.
    - . Disaster management : floods, earthquake, cyclone and landslides. (8 lecture hours)

### PART-C ESSAY ON FIELD WORK 25 Marks

#### 8. Field work

- . Visit to a local area to document environmental assets - river / forest / grass land / hill / mountain
- . Visit to a local polluted site - Urban / Rural / Industrial / Agricultural
- . Study of common plants, insects, birds.
- . Study of simple ecosystems - pond, river, hill slopes, etc. (5 lecture hours)

- (Notes :**
- i) Contents of the syllabys mentioned under paras 1 to 8 shall be for teaching for the examination based on Annual Pattern.
  - ii) Contents of the syllabys mentioned under paras 1 to 4 shall be for teaching to the Semester commencing first, and
  - iii) Contents of the syllabys mentioned under paras 5 to 8 shall be for teaching to the Semester commencing later.

#### LIST OF REFERENCES :-

- 1) Agarwal, K.C., 2001, Environmental Biology, Nidi Publ. Ltd., Bikaner.
- 2) Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad - 380 013, India, Email : [mapin@icenet.net](mailto:mapin@icenet.net) (R)
- 3) Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p.
- 4) Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)

- 5) Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T., 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p.
- 6) De A.K., Environmental Chemistry, Wiley Eastern Ltd.
- 7) Down to Earth, Centre for Science and Environment (R)
- 8) Gleick, H.P. 1993, Water in Crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press. 473p.
- 9) Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Mumbai (R)
- 10) Heywood, V.H. & Watson, R.T. 1995, Global Biodiversity Assessment, Cambridge Univ. Press 1140p
- 11) Jadhav, H & Bhosale, V.M. 1995, Environmental Protection and Laws, Himalaya Pub. House, Delhi. 284 p.
- 12) Mckinney, M.L. & Schoch, R.M. 1996, Environmental Science Systems & Solutions, Web Enhanced Edition. 639 p.
- 13) Mhaskar A.K., Matter Hazardous, Techno-Science Publications (TB)
- 14) Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. (TB)
- 15) Odum, E.P., 1971, Fundamentals of Ecology, W.B.Saunders Co., U.S.A., 574p.
- 16) Rao M.N. & Datta A.K., 1987, Waste Water Treatment, Oxford & IBH Publ. Co. Pvt. Ltd. 345 p.
- 17) Sharma B.K., 2001, Environmental Chemistry, Goel Publ. House, Meerut.
- 18) Survey of the Environment, The Hindu (M)
- 19) Townsend C., Harper J., and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
- 20) Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media (R)
- 21) Trivedi R.K. and P.K. Goel, Introduction to Air Pollution, Techno-Science Publications (TB)
- 22) Wagner K.D., 1998, Environmental Management, W.B.Saunders Co., Philadelphia, USA 499p.
- 23) डॉ. विठ्ठल धारपूरे : पर्यावरणशास्त्र- पिंपळापूरे अॅन्ड कंपनी पब्लीशर्स, नागपूर.(R)
- 24) Dr. Deshpande, A.P.Dr. Chudiwale, A.D., Dr. Joshi, P.P., Dr. Lad, A.B.: Environmental Studies, Pimpalpure & Co., Publishers, Nagpur.(R)
- 25) R.Rajagopalan : Environmental Studies, Oxford University Press, New Delhi, 2005 (R)

(M) Magazine  
(R) Reference  
(TB)Textbook

\*\*\*\*\*

**FIFTH SEMESTER****5SM1 COMPUTER SOFTWARE APPLICATIONS-I****SECTION-A**

UNIT I :- An overview of computer aided engineering, application of computers to design and manufacturing, benefits of CAD/CAM, graphic workstation, serial and parallel interfacing display devices, graphic input devices and operating systems. (5 Hrs)

UNIT II :- Principles of Computer Graphics.  
Creation of graphic primitives, graphical input techniques, display transformation in 2D and 3D, viewing transformation, scan conversion, clipping, hidden line elimination, rendering, shading, and Introduction to type of computer animation (8 Hrs)

UNIT III : Automated Drafting.  
Configuration of typical drafting packages, layers, entities, editing, display commands, hatching, dimensioning, text plotting, script files, DXF and IGES files formats, blocks, parametric programming, customization of drafting packages and graphic standards.

**SECTION - B**

UNIT IV :- a) Surface Modelling :  
Modelling of curves and surfaces, techniques of splining, cubic splines, Bezier splines, B splines.

b) Solid Modelling :  
Schemes for representing solid objects, construction, solid geometry and boundary representation, features of solid modelling packages, examples of creation of models. (8 Hrs)

UNIT V :- Introduction to the Finite Element Method:  
Fundamental concept, Historical background, Discretization, Numbering, Stress strain equilibrium, Stress-strain relationship, Boundary & support conditions, and General steps of finite element method, Shape type, Finite element Application & advantages of the FEM. (8 Hrs)

UNIT VI : 1 D/ 2 D Problems:  
Coordinates and Linear Shape Functions, The Potential energy approach, The Galerkin Approach, The global

stiffness matrix, Boundary Conditions (Penalty and Elimination Methods), (Quadratic shape functions), Constant strain triangle (CST), Isoparametric representations, Development of Truss equations, Introduction to FEM packages. (8 Hrs)

**PRACTICALS:-** Atleast five practical from the below.

- 1 Study of graphics workstation: Configuration of graphics workstation, Input/Output devices, & other peripheral devices
- 2 Editing, 2D geometries.
- 3 Creation of blocks and external reference.
- 4 3D modelling.
- 5 Simple Autolisp programs.
- 6 Introduction and study of FEM packages like Patran.
- 7 ANSYS, NISAOPT, etc. and solving 1D problems.
- 8 Creation of script and DXF files from design problems.
- 9 Study of Graphic workstation.

**REFERENCE BOOKS:-**

1. M.P.Groover and E.W.Zimmers : Computer Aided Design Manufacturing
2. V. Ramamurti : Computer Aided Design in Mechanical Engg.
3. C.S.Desai & J.F.Abel : Introduction to the Finite Element Method
4. C.S.Krishnamoorthy : Finite Element Analysis
5. CAD/CAM Theory & Practices by Ibrahim Zeid
6. CAD/CAM by P. N. Rao
7. CAD/CAM/CIM by Radhakrishnan, S. Subramanyan & V. Raju
8. A First Course in FEM by Darya Logon
9. Finite and Boundary Element Method in Engineering, by O. P. Gupta
10. Computer Graphics by Hearn Baker

**5SM2 PRODUCTION TECHNOLOGY****SECTION - A**

UNIT I :- Interpretion of production drawing, tolerance chart, its use and analysis, selection of processes on the basis of material, No. of pieces, break even analysis, etc. Selection of machines, process sheet, machine time estimation. (7 Hrs)

UNIT II :- Basic principles of work study :- definition, method study, introduction, objective, procedure, process charts, flow process charts, operation process chart, principles of motion

economy, work place layout, multiple activity chart, two handed process chart, simo chart.

Work measurement :- definition, techniques, time study, rating system, allowances, std, time estimation, PMTS, MTM.  
(9 Hrs)

UNIT III :- Concept of quality, and equality control, its parameters, quality circle, quality audit, meaning of S.Q.C. variables and attributer, different types of control charts, basic concept of sampling, inspection, operating characteristic curve, single and double sampling plans.  
(8 Hrs)

### SECTION - B

UNIT IV :- A) Standards of measurements: line standards, end standard, wave length standard.

B) Limits, fits and gauges: terminology of limits, Fits and gauges, concept of interchangeability, allowance tolerance, Indian Standard Specification for limits, fits and gauges, B.S.System.

C) Limit gauging - design of Go, NoGo gauges. (9 Hrs)

UNIT V :- a) Linear measurement: various comparators such as mechanical, electrical, optical, pneumatic comparators, their principle, operations and applications.

b) Angular measurements:- vernier, optical, bevel protractor universal bevel protector, Sine bar level clinometers, taper gauges.

c) Thread measurement:- screw thread limit and fit limits gauging of screw threads. (8 Hrs)

UNIT VI :- a) Gear measurements : alignment error, master gear, Parkinson gear tester.

b) Study and use of optical dividing head, auto collimator, tool makers microscope.

c) Interferometry, flatnesstesting, squareness testing, surface cantener testing. (9 Hrs)

**PRACTICALS :-** atleast six from the below list.

1. Preparation of tolerance charts (atleast two problems)
2. Preparation of process sheet and time estimation. (atleast two problems)
3. Work place layout for assembly and time estimation.(atleast two alternative).

4. Preparation of Quality Control Charts (atleast 3 problems).
5. Measurement of thread for given job.
6. Measurement of dimension of gears.
7. Measurement of flatness, squares of bed of machine control.
8. Design of go and no gauges.

### PRACTICALEXAMINATION:-

The practical examination shall consist of performance of one of the experiment under term work and oral on term work taken jointly by Internal and External examiner.

### REFERENCE BOOKS:-

1. Engineering Metrology - R.K.Jain
2. Work Study - By ILO.
3. Work Study - By Dr.Schimit Kappor.
4. Quality Control - By Juran.
5. Statistical Quality Control- By Grant.
6. Statistical Quality Control - By Gupta

### 5SM3

### HEAT TRANSFER

#### SECTION - A

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

UNIT II :- Insulations, critical radius of insulation, Economic thickness of insulation, Conduction through extended surfaces, analysis of a uniform C.S. fin, efficiency, fin effectiveness, Biot number. Introductin to unsteady state heat conduction, Newton's law of cooling, lumped heat capacity analysis. (8 Hrs)

UNIT III :- Radiation- general concepts and definitions, black body & grey body concept. Laws of radiation- Plank's, Stefan-Boltzman's radiation. Concept of shape factor, emissivity factor and radiation heat transfer equation. (No numericals). Radiation errors in temperature, measurement, radiation shield. (7 Hrs)

**SECTION - B**

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

UNIT V :- Free convection- velocity and thermal boundary layers for vertical plate, free convection over vertical cylinder and horizontal plate/cylinder (only concept, no derivation & analytical treatment). Use of empirical correlations in problem solving.

Condensation & Boiling - introduction to condensation heat transfer, film & drop condensation. Boiling heat transfer, pool boiling curves. (7 Hrs)

UNIT VI :- Heat exchanger - applications, classificatins, overall heat transfer coefficient, fouling. L.M.T.D. & E.N.T.U. methods, temperature profiles, selection of heat exchangers. (7 Hrs)

Introduction to working of heat pipe with and without wick

**LIST OF PRACTICALS (ANY SIX OF THE FOLLOWING):-**

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

**LIST OF BOOKS:-**

1. J.P. Holman : Heat Transfer
2. Dr. Sukhatme : Text Book on Heat Transfer
3. Yadav : Heat Transfer
4. V.M.Domkundkar : Heat & Mass Transfer
5. Incropera and Dewitt: - Introduction to Heat Transfer
6. A.J. Chapman: Heat Transfer

**PRACTICAL EXAMINATION:-** The practical examination shall consist of oral/and or experimentation based on above termwork.

**5SMP4 MEASUREMENTS SYSTEM****SECTION - A**

UNIT I :- 1. Generalised Measurement system:- Significance of measurement, generalised systems, application of measuring instruments, Types of measuring instruments.

2. General configuration and functional elements of measuring instruments, types of inputs, various methods of correction for interfering and modifying inputs.

(6 Hrs)

UNIT II :- General performance Characteristics:-

1. Static characteristics, different types of errors, combination of component errors in overall systems.

2. Dynamic characteristics: General mathematical model of zero order, first order and second order instruments, response of first and second order instruments to following inputs step, ramp, impulse and frequency.

(10 Hrs)

UNIT III :- 1. Strain Measurement:-

Types of strain gauges, strain gauge circuits, calibration, Temperature compensation, use of strain gauges on rotating shafts, selection and installation of strain gauges.

2. Pressure Measurements:-

Basic methods of pressure measurement, manometers, Transducers-elastic, gravitational, elastic : draph, strain gauge pressure cell, High pressure measurement Bridgeman type, low pressure Measurement - Mcleod, Krudsen, ionisation, Thermal conductivity gauges.

(8 Hrs)

**SECTION - B**

- UNIT IV :- 1. Force Measurement :- Various mechanical, Hydraulic, pneumatic and electrical methods.
2. Torque and Power Measurements :- Various mechanical, hydraulic & electric methods.
3. Flow Measurements : Construction- Venturi, orifice, Dall tube, rotameter, Pressure probes- Pitot static tube, yaw tube anemometer, positive displacement flow meters, turbine meter, electro-magnetic flow meter. (8 Hrs)
- UNIT V :- 1. Temperature Measurements:- Standards, Various temperature measuring devices, Bimetallic strip, liquid in glass thermometer, pressure thermometers, thermo couples, electrical resistance thermometers, Thermistors, radiation Thermometers. (6 Hrs)
2. Liquid Level Measurements :- Various methods such as- single float, displacement or force transducers, Pressure sensitivity, bubbler or pipe system, capacitance variation type (for both conducting and non conducting type liquids) Resistance variation type, Radioisotope. (2 Hrs)
- UNIT VI :- 1. Speed Measurements:- Various mechanical type tachometers, electrical types tachometers, stroboscope etc.
2. Vibration Measurements:- Seismic, Strain gauge and piezoelectric accelerometers.
3. Displacement measurements:- Linear and angular displacement measurements, LVDT, LDR, Capacitive & inductive pick ups. (8 Hrs)

**LIST PRACTICALS:-** Atleast of eight practicals from the following list.

1. Measurement of strain using strain gauges.
2. Calibration of pressure gauge with pressure gauge tester.
3. Measurement of linear displacement by LDR and inductive pick-up transducers.
4. Performance of capacitance transducer as an angular displacement measuring device.
5. Performance of inductive Transducers.
6. Flow measurement.
7. Speed measurement by a stroboscope.

8. Speed measurement by magnetic pick up or photo electric pick up tachometer.
9. Pressure measurement by strain gauge type transducer.
10. Vibration measurement.
11. Liquid level measurement.
12. Temperature measurement.

**REFERENCES:-**

1. Measurement Systems:- By Ernest O. Doebeling -Mc Graw Hill.
2. Mechanical Measurements:- By T.G. Beckwith & N.L. Bulk - Addison Werly.
3. Experimental Methods for Engineers:- By J.P. Holman - Mc Graw Hill.
4. Instrumental Measurement & Analysis : By Nakra Choudhari Tata Mc Graw Hill.
5. Instrumentation : Ramgan: Sharma & Mani - Tata Mc Graw Hill.
6. Mechanical Measurement & Control : By D.S. Kumar.
7. Engineering Measurement : By Collette & Hope ELBS.

**SSM5****THEORY OF MACHINES - I****SECTION - A**

- UNIT I :- 1. Introduction to study of mechanisms, machines, Basic definitions, Different types of links, kinematic pairs; Introduction to ball screws and linear bearings. classification of mechanisms, Grashof's law, class-I and class-II mechanisms. Inversions of single slider, double slider mechanisms, Grubler's criterion Kutzbach's theory, Different four bar mechanisms.
2. Kinematics analysis of mechanisms:- Displacement analysis: Transmission angle, coupler curve and their properties, radius of curvature of coupler curves, body and space centroids. (8 Hrs)
- UNIT II :- Kinematic analysis of mechanisms:-
1. Velocity analysis :- Relative Velocity method, instantaneous centre of rotation method, method of equivalent mechanisms, transmission ratio.
  2. Acceleration analysis:- Relative acceleration and pole method, analytical method for slider crank mechanism, Klein's construction for slider crank mechanism and four bar mechanism (10 Hrs)

UNIT III :- Synthesis of Mechanism:- Introduction to type, Number and dimensional synthesis, graphical method of two position, three position and four position, synthesis for Input output co-ordination, overlay's method, Freudentein's equation, coupler curve synthesis. (7 Hrs)

### SECTION - B

UNIT IV :- Friction

- Friction angle, friction circles and friction axis.
- Frictional torque in pivot and collar bearing.
- Brakes, clutches, and dynamometer types, constructional details, operation & calculation of leading dimensions.

(8 Hrs)

UNIT V :- Special purpose mechanisms:-

- Straight line mechanism, steering mechanism, double dwell intermittent rotary motion mechanism, quick return, toggle mechanism.
- Cams:- Introduction, types of cam & follower, different motions of followers, graphical layout of cam profiles, pressure angle, cam with specified contours.

UNIT VI :- I) Gear :- Introduction terminology, gear tooth profiles, involuetry, interference, spur, helical gears, spiral gears, and its efficiency, bevel & worm gears.-

II) Gear Trains:- Types of gear trains, speed ratio applications.

**PRACTICALS:-** At least eight practicals from the below list shall be performed.

- Study of inversion of four bar mechanism.
- Study of inversion of slider crank mechanism.
- Study of inversion of double slider crank mechanism.
- Study of common mechanism.
- Study of velocity analysis by relative velocity method. (2 Prob)
- Study of velocity analysis by pole technique.
- Study of Coriolis acceleration.
- Study of acceleration analysis by relative acc. method. (2 Prob)
- Study of brakes.
- Study of clutches.
- Study of dynamometer.
- Study of Graphical layout of cam profile. (3 Prob.)

- Study of gear terminology and layout of involute gear profile.
- Study of gear trains.
- Problem in position synthesis.
- Problem in input/output coordination.
- Computer aided synthesis of four bar mechanism.  
The practical examination shall consist of viva-voce on the above syllabus & practical work.
- \* Perform any one out of 1st, 2nd or 3rd practical with actual linkage kit or make a batchwise mini-project using linkages.

### BOOKS RECOMMENDED :

- Theory of Machines- By Thomas Beven.
- Theory of Machines- By Shigley.
- Theory of Machines- By Ballaney.
- Theory of Machines- By Jagdish Lal.
- Theory of Machines- By Hall.
- Theory of Machines- By Jain.
- Theory of Machines- By J.S.Rao.
- Theory of Machines- By S.S.Ratnam

\*\*\*\*\*

### SIXTH SEMESTER

#### 6SM1

#### FLUID POWER - II

#### SECTION - A

- Unit I : 1. Prime Movers :- Theory of impulse and reaction machines. Pelton, Francis and Kaplan turbines, their construction, analysis, characteristics and governing. (8hrs)
- Unit II : Centrifugal pumps :- Basic Theory, classification, construction, operation, characteristics, NPSH and cavitation in pumps. (7)
- Unit III : 1. Axial flow pump :- Basic theory, construction, operation, and characteristics. (4)
2. Other water lifting devices :-
- Air lift pump.
  - Jet Pump.
  - Hyd. Ram.
3. Computational Fluid Dynamics (CFD) : Basic Definition, Applications of CFD in the area of research & Industry.

Comparison of Experimental Fluid Dynamics and Computational Fluid Dynamics, Importance of Governing Equations and the physical meaning of the involved terms. Equation of continuity, equation of motion & energy balance equation in Cartesian & cylindrical polar coordinates. (6)

#### SECTION - B

- Unit IV : Positive displacement Pumps :-
1. Reciprocating Pumps :- Basic theory, types, construction, installation and characteristics. (5)
  2. Rotary Pumps :- Basic theory, types, construction and variable delivery pumps. (4)
- Unit V : Compressible fluid flow :- Perfect gas relationship, speed of sound wave, mach number, Isothermal and isotropic flows, shock waves, fanno and Rayleigh lines. (8)
- Unit VI : 1. Hydrostatic systems, their function, components and application such as Hydraulic press, lift, crane and fluid drive for machine tools. Intensifier and accumulator. (4)
2. Hydrokinetic systems : Fluid couplings and torque converter. (4)

#### PRACTICAL TERM WORK :

Atleast seven exercises based on the following.

- 1) Trial/study of Pelton turbine.
- 2) Trial/study of Francis turbine.
- 3) Trial/study of Kaplan Turbine.
- 4) Trial/study of centrifugal pump.
- 5) Trial/study of reciprocating pump.
- 6) Trial/study of Axial flow pump.
- 7) Study of multistage pump.
- 8) Trial/study of Hydraulic Ram.
- 9) Study of Hydrostatic components systems.
- 10) Study of Hydrostatic systems.
- 11) Study of Hydrokinetic systems.
- 12) Study of Cavitation phenomena.
- 13) Study of governing of Impulse Turbines.
- 14) Study of governing of reaction turbines.

- 15) Study of Special pumps (Air lift pump/jet pump)
- 16) Formulation of problem concerning the fluid flow in the vessel with any commercial code available like CFX, FLUENT, PHOENIX.

Practical examination shall consist of oral/and or experimentation based on above term work.

#### REFERENCES:-

- 1) Hydraulic Turbines - Daugherty.
- 2) Hydraulic Machines- Vasandani.
- 3) Hydraulic Machines- Jagdishlal
- 4) Hydraulic Machines and Systems- Anant Swamy.
- 5) Gas Dynamics- Liepman & Roshkou.
- 6) Dynamics and Thermodynamic of - Shabiro.compressible fluid flow.
- 7) Fluid Power and Machines - Agrawal (Tata Mc-Graw Hill)
- 8) Computational Fluid Dynamics – Basics and Applications by J D Anderson – Mc Hill International Publications.
- 9) Computational Fluid Dynamics – Sen Gupta

#### 6SM2

#### MACHINE DESIGN-I

##### SECTION-A

- Unit I : A) Meaning of Design, Phase of design, Design consideration, Properties of selection of materials, designation of material as per ISI, Various codes and standards.
- B) Simple stresses, factor of safety, herts contact stress, thermal stresses, impact stress, torsional stress bonding in straight and curved beams and application to hooks, c-clamps, Bi-axial stress, theories of Failure Eccentric loading. (12)
- Unit II :- Variable Stresses
- Fatigue and Endurance limit, surface finish, stress concentration, notch sensitivity, combined steady and variable, stresses. Gerber Line, Sorderbergs line, gerber line. Fatigue and fracture mechanics-Basic concepts, Ductile and Brittle fracture, Mechanism of fatigue crack initiation and propagation. Factors influencing fatigue, Modes of fracture, Fatigue tests- reverse bending test (beam cantilever type) and axial fatigue test. (12)

**SECTION 'B'**

- Unit III
- a) Design of screw and bolted joint.  
Forms and threads, types of Fastenings, standard dimensions stresses due to screwing up and external force, stresses due to combination of screwing of screwing up and external force, bolts of uniform strength, bolted joint for eccentric loads.
- b) D/N or Riveted joint  
Method of riveting, types of rivets and fived joints, caulking and fullering, failures, strength and efficieney of riveted joints, joints for boiler shell, eccentric loaded joint.
- c) Welded joint  
Types of welding and joints, strength of transvers and parallel fillet welded section, axially loaded unsymmetrical welded section, eccentrally loaded joint.
- d) Pipe joints  
Stresses in pipe, Design of pipe, type of joints design of circular, square and oval Flange pipe joint.
- e) Introduction of shrink and friction joints
- Unit IV : a) Design of Springs  
Types of spring, stresses in helical springs, Wahl's stress factor, bulking and surge, design of compression, tension, spiral helical and flat spiral springs, Introduction of leaf springs, material and construction, nipping, design of spring.
- b) Design of power screw  
Types of threads, torque required to raise loads, efficiency and helix angle, overhauling and self locking of screw, acme threads, stresses in power screw. Design of lever for brakes and values. (12)

**List of the exercise for term work**

**Practicals :** Any one of the practicals from the list should be done using software.

- 1) Design of screw jack
- 2) Design of cotter joint
- 3) Design of Knuckle joint

- 4) Design of bolts or rivets for eccentrically loaded brackets.
- 5) Design of helical spring acting as buffer or leaf spring.
- 6) Design of pipe joint with gasket inserted between flanges.

**Books Recommended**

- 1) Spotts M.F.
- 2) Oriv P.
- 3) Shigly
- 4) Maleev and Hartman
- 5) R.K.Jain
- 6) Khurmi and Gupta
- 7) Sharma and Aggrawal
- 8) Pandya and Shah
- 9) Mikell Groover and Emory W Zimmers (CAD CAM)
- 10) Design Databook by
  - i) Shivalkumar Kulkarni
  - ii) Mahadeon
  - iii) P.S.G.

**Note :-**

- 1) Use of Design data book will be permitted during Examination
- 2) The term will consist of atleast five exercises from the list given of include design calculations & related design drawing.

**6SM3 COMPUTER SOFTWARE APPLICATIONS -II****SECTION - A**

- UNIT I : Introduction :- Defination of data, database, Comparision of traditional file and database approch. Data independance, layers of database software, Database administrator, functions and responsibilities, Database system life cycle.  
  
Data Models :- Defination of data model-schema and sub schema, Introduction to relational, hierarchical and network model. (7 Hrs).
- UNIT II : Relational Database:- Definition of relation, entity, attribute, relational database, relational database design. Relational algebra. Concept of Normalisation. (6 Hrs)
- UNIT III : Artificial Intelligence:- Introduction to AI, its definition & scope. Knowledge based approach, concept of expert system (ES). characteristics of ES, Elements of ES, Application and domains of ES. (7 Hrs)

**SECTION - B**

- UNIT IV : MODELLING : Need for system modelling systems approach to modelling, open and feed back system, combination of simple feed back system, feedback time lag effects, feedback and Managarial system. (7 Hrs)
- UNIT V : SIMULATION : Introduction of simulation, Definition of Simulation, types of model, modeling of simulation, environment, components of system, Advantages disadvantages of simulation, Steps in simulation study, Area of application of simulation. (6 Hrs)
- UNIT VI : SIMULATION Computer simulation Models :- Macro, Dynamic Models, Examples- from Business and Industries, simulation langauges like SIMUIA. SIMSCRIPT, GPSS, etc. and simulation packages like QUEST Working Model etc. (8 Hrs)

**PRACTICALS:**

1. Use of expert system shells like VP-EX, GURU, VIDWAN etc, for preparing expert system for Mechanical Engg. applications like fault diensis etc.
2. Demonstration of simulation packages like QUEST, Working Model SIMULA, SIMSCRIPT, AREANA.
3. Creation of database using oracle\* for solving inventory problems, bill of materials etc.

\* Inclusion of Oracle only for Practical.

Practical examination shall consist vive-voce and & or programing based on the termwork and syllabus.

**REFERENCES:-**

1. C.J.Date, "An Introduction to Database systems "Addison Wesley, 1981.
2. E.Rich & K.Knight, "Artificial Intelligence" TMH,1991.
3. D.W.Patterson, "AI & Expert System", PHI, 1992.
4. Deo Narsingh, "System Simulation with Digital Computer", PHI.
5. Gordon G., "System Simulation", PHI.
6. Naylor T.H.et.al, "Computer Simulation Techniques", John Wiley.
7. Gottfried B.S., "Elements of Stochastic Process Simulation", Prentice Hall, London 1984.
8. Oracle Manual.
9. Jerry Bank PHI

- 10 Log Hilton McGraw Hill Publications  
11 Tata McGraw Hill – ARENA with CD (demo)

**6SM4 CONTROL SYSTEM ENGINEERING****SECTION - A**

- Unit I :- Introduction system concept, open & closed loop systems, Mathematical models of physical systems, transfer functions. Block diagrams reduction and signal flow graphs. (8 Hrs)
- Unit II :- Basic control actions and Industrial controllers :- Classification of industrial automatic controllers, control actions, proportional controllers, obtaining derivative and integral control action, effects of integral and derivative control action on systems performance. (8 Hrs)
- Unit III :- Transient Response Analysis :- Introduction Std. Test signals, steady state response of first and second order systems for stop, ramp and impulse input, transient response specifications, steady state error & error constants. (8 Hrs)

**SECTION - B**

- Unit IV :- Concept stability, necessary condition for stability, Rauths stability criterion, Root locus concept, construction of Root loci, systems with transporation lag. (8 Hrs)
- Unit V :- Frequency Response methods :-Introduction, concept of polar plot and Bode diagrams (8 Hrs)
- Unit VI :- Introduction to lead and lag compensation.  
Study of important automatic speed control systems in machine tools, Prime movers, system generators, etc. Analysis of performance characteristics. (8 Hrs)

**BOOKS RECOMMENDED :-**

- 1) Modern Control Engg. - by Katsuhiko Ogata, PHI
- 2) Automatic Control Engg. - by Kuo B.L.
- 3) Automatic Control Engg. - by F.H.Raven, Mc-Graw Hill.
- 4) Control System Engg. - by Nagrath Gopal

**6SM5****THEORY OF MACHINE-II****SECTION - A**

- UNIT I :- 1. Simple pendulum, compound pendulum, torsion, pendulum, static force analysis applied to plane motion mechanism (4 bar mechanism, slider crank chain mechanism) virtual work method, static force analysis considering friction.
2. Theory of hydrodynamic lubrication, boundary lubrication, film lubrication, rolling friction, performance of bearing. (9 Hrs)
- UNIT II :- D'Alemberts Principle, Inertia forces, Dynamic force analysis of four bar chain and reciprocating engine mechanism inertia force analysis, piston effort, crank effort, turning moment diagrams for engines, fluctuations of speed & energy, Flywheel requirements. (8 Hrs)
- UNIT III :- 1. Space mechanism:- Gyroscope, gyroscopic effect as applied to ship, aeroplane, 4 wheeler, 2 wheeler, universal joint.
2. Vehical dynamics :- Coefficient of adhesion, resistance to vehicle motion, relative drive effectiveness, braking of vehicles. (7 Hrs)

**SECTION - B**

- UNIT IV :- Free vibrations:- Equilibrium method, energy method, and layleighs method, transverse vibration of uniformly loaded shaft & several loads attached to shaft. Damped vibrations and forced vibration, Dynamic magnifier, elastic suspension. Transmissibility, vibration isolation, Introduction to Vibration systmes with more than one degree of freedom. (9 Hrs)
- UNIT V :- Torsional vibration, single rotor systems, Two Rotor system, three rotor system, geared systems, Graphical method for mult rotor system, Whirling of shaft & critical speeds. (6 Hrs)
- UNIT VI :- Balancing of Machinery:- Static, & dynamic unbalance, balancing of rotating masses in same and different transverse planes, Balancing of single cylinder, multi-cylinder V and radial engines. Partial balancing of reciprocating masses. Balancing of linkages & machine. (9 Hrs)

**PRACTICALS:-**

At least eight practical from the following list.

- 1) Determination of inertia of simple pendulum.
- 2) Determination of inertia of compound pendulum.
- 3) Determination of inertia of irregular bodies.
- 4) Experiment on state balancing of rotating masses.
- 5) Experiment on dynamic balancing of rotating masses.
- 6) Determination of gyroscopic couple.
- 7) Experiment on whirling speed of shaft.
- 8) Determining the intertia force of connecting rod by
- 9) Dynamic force analysis of four bar mechanism
- 10) Experiment on free and damped vibration of systems with one degree of freedom.
- 11) Experiment on forced damped vibration of systems with one degree of freedom.
- 12) Experiment on free damped torsional vibration
- 13) Study of universal point.
- 14) Study of vehicle dynamics.

**PRACTICAL EXAMINATION :-**

It shall consist of Viva-voce on the above syllabus & Practical work.

**REFERENCE BOOKS :-**

1. Theory of Machines - Thomas Bevan
2. Theory of Machines - Shighley
3. Theory of Machine - Ballaney
4. Theory of Machine - J.Lal
5. Theory of Machine - Hall
6. Theory of Machine - Hain
7. Theory of Machine - J.S.Rao
8. Theory of Machine - S.S.Rattanm

\*\*\*\*\*

**6 SULIMETX 6 COMMUNICATION SKILLS****Unit I : Comprehension over an unseen passage :-**

Comprehension - A - word study :-

Synonym, antonym, meanings, matching words, adjectives, adverbs, prefix and suffix, correct forms of commonly misspelled words, understanding of the given passage.

Comprehension - B - Structure study :-

Simple and compound sentences, types of conjunctions,

singular and plural, tenses and their effect on verb forms. Use of - not only - but also, if clause, since, may, can, could, would, too etc.

Active and passive forms, negative and interrogative, punctuation and capitalization. (10 Hours)

Unit II : **Principles of Communication :-**

Theoretical background - importance of communication, its process, model of communication its components & barriers.

Verbal communication, its significance, types of written communication and its style, organization of a text (Titles, summaries, headings, sequencing, signaling, cueing etc.), Important text factors (length of paragraph, sentences, words, clarification and text difficulty). Evaluation of written communication for its effectivity and subject content.

Verbal and non-verbal objectives in interpersonal skills. (10 Hours)

Unit III : **Aspects in professional communication :-**

Specific formats for written communication like - business correspondence, formal reports, technical proposals, research papers and articles, advertising and graphics. Format for day-to-day written communication like applications, notices, minutes, quotations, orders, enquiries etc.

Types of graphics and pictorial devices

Oral communications - face to face communications, group discussion and personal interviews.

Methodology of conduction of meetings, seminars, symposia, conference and workshop. (10 Hours)

**BOOKS RECOMMENDED :**

- 1) Krishna Mohan, Meera Banerjee : Developing Communication Skills, MacMillan India Limited.
- 2) Chrissie Wright (Editor) : Handbook of Practical Communication Skills, Jaico Publishing House.
- 3) Curriculum Development Centre, TTTI WR, Bhopal : A Course in Technical English, Somaiya Publication Pvt. Ltd.
- 4) F.Frank Candlin : General English for Technical Students, University of London Press Ltd.

**COMMUNICATION SKILLS LABORATORY**

**Objective :**

On completion of this laboratory the candidate should be able to demonstrate adequate skills in oral and written communication for technical English language, actively

participate in group discussions and interviews and exhibit the evidence of vocabulary building. Candidates should be assessed through continuous monitoring and evaluation.

The sample list of experiments is given below. This list can be used as guideline for problem statements but the scope of the laboratory should not be limited to the same. Aim of the list is to inform about minimum expected outcomes.

1. Assignments and tests for vocabulary building
2. Technical report writing
3. Group discussions
4. Interview techniques
5. Projects and tasks such as class news letter
6. Writing daily diaries and letters
7. Interactive language laboratory experiments.

**TEXT BOOK :** Norman Lewis : Word Power Made Easy  
<http://www.teachingenglish.org.uk>

\*\*\*\*\*

**SEVENTH SEMESTER****7SM1****MACHINE DESIGN-II****SECTION-A**

- Unit I :- a) Design of Shaft  
 Material, Design on the basis of strength considering shaft subjected to  
 - twisting moment only  
 - bending moment only  
 - Combine twisting and bending moment  
 - axial load in addition to twisting and bending.  
 Design on the basis of rigidity.
- b) Design of Key - types, strength of key
- c) Design of coupling - types, requirements of good couplings, design of sleeve coupling, clamp or compression coupling, rigid flange coupling, flexible flange coupling.
- d) Design of fly-wheel  
 Function, coefficients of fluctuation of speed and energy, energy stored in fly wheel, construction, stresses in fly wheel arms and rim, Design of fly wheel based on T-M diagram, fly wheel for Otto cycle engines and punching machines. (12Hrs)
- Unit II :- Antifriction Bearings  
 Types of bearing, construction, designations, standard load ratings by AFBMA for static and dynamic loads, life of bearings, selection of bearings, lubrication, mounting and enclosure.
- a) Journal bearing  
 types of lubrication, stable lubrication, Thick film lubrication, pressure distribution, minimum film thickness, relations of variables-viscosity, coefficient of friction, speed, pressure, length and diameter, bearing modulus, viscosity-Temperature chart, Sommerfeld number, selection of lubricant, design procedure and numericals.

- b) Design of belts

Flat belts types, material and construction of belt, types of drives, slip, creep, Design of belt.

V-Belts and Rope drive

Construction and types, design of V and Rope drive.

Chain Drive

Classification, power transmitted, clearance no of teeth on pockets, principal dimensions, selection and design of chain.

Wire Rope Selection

Construction, classification designations, stresses in wire rope, selection of wire rope for given loads. (12Hrs)

**SECTION-B**

- Unit III :- Design of Gears

Classification, law of gearing, forms and system of teeth, interference, beam strength of teeth, dynamic tooth load, wear tooth load, tooth failure.

- a) Spur gear

- b) Helical gear

Classification face width, formative teeth number, strength of gear Design of gear

- c) Bevel gear

Classification, pitch angles, strength of gear, Design of gear

- d) Worm gear

Types, efficiency of gear, Design of gear. (12 Hrs)

- Unit IV :- a) Design of Brakes.

Simple band brakes, differential band brake, single shoe brake, double shoe brake, internal expanding brakes, self locking of brakes.

- b) Design of Clutch

Material for friction surface, working of Clutch, Design of single plate clutch with uniform wear and uniform pressure condition, Design of multiplate clutch, working and design

- of centrifugal clutch.
- c) Design of I.C.Engine parts  
Cylinder,piston, piston rings, piston pin, connecting rod.
- d) Design of Governer  
Types of governer, Design of Hartnell governer (Spring, spring casing, spindle, lever, balls) (12 Hrs).
- e) Design of Crank.

#### List of Exercises for termwork

- 1) Design of shaft
- 2) Design of flywheel for otto engine
- 3) Design of bushed pin type flexible coupling.
- 4) Selection of chain.
- 5) Design of I.C.Engine parts.
- 6) Design of Hartnell governer
- 7) Design of Single plate clutch
- 8) Design of Multi plate clutch
- 9) Design of cone clutch
- 10) Design of Steel wire rope of lipt
- 11) Design of lever operated band brake.

Any one from the list should be done using Computer programming.)

Note :- (Term work will consists of at least five exercises from above list and include calculations and related Design drawing)

Any one from the list should be done using computer programming.

#### BOOKSRECOMMENDED

- 1) Spott M.F.
- 2) Oriv P.
- 3) Shigley
- 4) Maleev and Hartman
- 5) Pandya and Shah
- 6) R.K.Jain
- 7) Khurmi and Gupta
- 8) Sharma and Aggrawal
- 9) Shanmukham and Murthi

- 10) Trikha
- 11) Mech Design and System handbook - H. Rothbart
- 12) Design Databook by - Shivalkar, Kulkarni- Mahadeon- P.S.G.

Note :- Use of any design data from the above will be permitted during the examination.

#### 7SM2 ENERGY CONVERSION-II

##### SECTION - A

UNIT I :- Reciprocating Air Compressors:- Industrial uses of compressed air, Methods of compression and efficiencies of compression, Methods of reducing losses during compression single and multistaging of compressors, clearance volume and its effect on work done and volumetric efficiency, condition for minimum work in tow stage compression, Intercooling and its effects. Overall, isothermal and adiabatic efficiencies, IHP,BHP, requirements and after cooler. (7 Hrs)

UNIT II :- Rotary compressors:- Comparison between reciprocating and rotary compressors, difference between fans, blowers and compressors, general equations for rotary machines. Vane, Roots blower, construction, working and velocity diagrams of centrifugal and axial flow compressors, Performance characteristics of blowers and compressors (8 Hrs)

UNIT III :- Definitions, classifications of refrigeration system; Air refrigeration, Bell-colman cycle, reversed cannot cycle, reversed Brayton cycle, vapour compression refrigeration, vapour absorption refrigeration based on solar and waste heat recovery.

Analysis of simple saturated vapor compression cycle, representation on T-s, Ph diagrams, Need for CFC free refrigerants. (8)

Air conditioning:- Definitions, classification and applications. Psychrometric properties, psychrometric charts elementary treatment with simple problems.

##### SECTION - B

UNIT IV :- I.C.Engines:- Classification of I.C. engines, General description of petrol and diesel engine working, Studies of simple and complete carburettor with systems such as idling, compensating jets acceleration pump, choke etc. Studies of

fuel injection pump and injector. (7 Hrs)

UNIT V :- Performance Test of I.C.Engines:-

- a) Performance testing of I.C.Engine:- load speed test, Heat Balance preparation, performance curves. Methods to determine F.H.P., Principles of super charging.
- b) I. C. Engine Emissions- Review of emissions from I. C. engines, their effect on human health, causes of formation and Euro-norms. (7 Hrs)

UNIT VI:- Classification of gas turbines, construction and working Gas turbine ideal and actual cycles constant volume, constant pressure, (Open and closed) cycle analysis. Inter cooling, Regeneration and reheating application. Optimum and maximum pressure ratios, work ratios. Performance characteristics. Fields of application of gas turbine power plant. Introduction to jet propulsion, Ram jet, turbo jet. (No numerical treatment for Jet Propulsion.) (8 Hrs)

#### LIST OF EXPERIMENTS:

NOTE :- Any six of the following practical should be performed and journal reporting the studies should be submitted.

1. Performance test on a diesel engine.
2. Performance test on a petrol engine.
3. Morse test.
4. Assembling and disassembling of carburettor, fuel injection pump and injector.
5. Study of lubricating systems for I.C.Engines.
6. Trial on reciprocating compressor.
7. Trial on centrifugal blower.
8. Studies of domestic refrigerator.
9. COP calculation of vapour compression system.
10. Study of room air conditioner.
11. Study of gas turbine with the help of models.
12. Heat balance sheet for petrol/diesel engine.

**Practical Examination shall consist of viva voce based on above term work.**

#### REFERENCE BOOKS:-

1. Energy Conversion Vol.1,2,3 - V.Kadambi and Prasad.

2. Thermodynamics and Heat Engines. - By Dr.V.M.Domkundwar.
3. Gas Turbines Theory - By Cohen & C.F.Rogers.F
4. Gas Turbines and Rotary Compressors.- By Khajuria & Dubey.

#### 7SMP3 INDUSTRIAL MANAGEMENT & COSTING

##### SECTION - A

UNIT -I : Business Management:

Meaning of business, Business system, Business organization, Forms of Business organization, Concept of management science, Evolution of management thought, Scientific management (Taylorism), Modern management (Fayolism), Principles of management, Administration Vs. Organisation, Functions of management, Planning & Decision making, Organisation structure & relationships, Delegation, Decentralization, Communication, Direction, Coordination, Motivation and Control. (8 Hours)

UNIT -II : Marketing and Sales Management:

Marketing strategy, Market research, Buying motives, Types of markets, New product development, Product life cycle, Product presentation & its effect on consumer, Sales organisation, Advertising, Method of selling, Sales performance objectives.

International Marketing: Introduction to international marketing, International Marketing decisions, Practices & Problems of international marketing, Import & Export procedure. (8 Hours)

UNIT III :- a) Functions of personnel management, Human resource planning, personnel research, Recruitment, training and development workers participation in management, joint consultation, collective bargaining.

b) Materials management, classes of materials, scope of material control, scope and function of purchasing department, purchasing procedure, inventory control, ordering procedure, material identification, store function. (6 Hrs)

##### SECTION - B

UNIT IV :- Objectives, functions, principle factors, miscellaneous and estimating procedure. Estimation of weights and materials, Estimation of machining time, estimation of fabrication cost,

forging cost, foundary cost. (8 Hrs)

UNIT V :- a) Introduction to costing and costing Techniques:- Definetions, objectives, elements of costs, components of cost, job costing, simple process costing, normal and abnormal losses in process, waste, scrap. (6 Hrs)

UNIT VI :- a) Financial statement :- Profit and loss statement , balance sheet.

b) Financing of bussiness :- Basis of bussines finance, need of finance, Kinds of capital, sources of fixed & Working captial.

c) Defreciation Analysis:- Causes & significance, method of calcution of deprecitation.

#### Books Recommended :-

1. Industrial Engineering & Management - O.P.Khanna.
2. Business & Ind. Organisation and Marketing Management- S.A.Sherlekar & V.S.Sherlekar.
3. Principles on Marketing Management- Philip Kotler.
4. Personnel Mqs & Ind. Relations - C.B.Mammoria.
5. Business Orgnisation - N.C.Shukla
6. Principles & Practice of Cost Accounting - N.N.Prasad.
7. Cost Accounting - Bhar.
8. Cost Accounting - Mehta.
9. Estimating and Costing - TTTI Madras.
10. Estimating & Costing - J.S.Chareya & G.S.Nainy.
11. Practical Costing - Khanna, Pandey, Ahuja & Arora.
12. Estimating & Costing -T.R.Banga & S.C.Sharma.

#### 7SM4

#### AUTOMATION ENGINEERING

##### SECTION - A

UNIT I :- Automation:- Types, Automation for mass manufacturing and assembly, feeding devices, conveyors, chutes. Automation of continuous processing systems. Detroit type automation, Automated flow lines methods of work transport, transfer mechanism control function, analysis of automated flow lines, General terminology and analysis of automated flow line, partial automation, assembly system and line balancing.

(8 Hrs)

UNIT II :- NC/CNC:- Basic concept. N.C.Control :- Point to point, straight cut and continuous path, control codes, machine control units, closed system, NC, machine components, tooling, CNC, DNC, Manual part programming, formats, coding,programming languages. APT, ADAPT, EXAPT etc. Sensors and adaptive control, Manual part programming for drilling. Milling and lathe, Example in APT. Applications and economics of CNC. (12 Hrs)

UNIT III :- ROBOTICS :- Introduction to cybernatics, Evolution of Industrial robots, Robots anatomy, Arm geometry, drive system and and affectors, sensors, robot programming.

Evolution of geometrical configuration, reliability maintenance and safety of robotics system. Application in casting, welding, painting, m/c loading, handling, heat treatment, assembly, inspection etc. Robot economics.

(10 Hrs)

##### SECTION - B

UNIT IV :- FMS :- Introduction, group technology, schematic of FMS, Automated storage and material handling, AGV, planning analysis and application of FMS, Simulation. (12 Hrs)

UNIT V :- GROUP :- TECHNOLOGY AND PROCESS PLANNING:- Introduction - Part families, part classification and coding systems, Group technology machine cells, advantage of group technology, The planning function, retrieval type process planning system. Generative process planning systems, Benefits of CAPP, Expert systems and expert system approach to CAPP. (10 Hrs)

UNIT VI :- Computer integrated manufacturing: introduction, integration and Rationalization, sequence of functions in CIM, elements of CIM system CIM wheel, structure of CIM database system. Guidelines for CIM development, components of CIM, benefits of CIM shop floor control and process monitoring. Automated inspection and testing: introduction to automated inspection. Advantages our traditional method. Online and offline inspection techniques. (9 Hrs)

**PRACTICALS:-** At least six practicals will be based on the following topics.

1. Preparation of manual part program for to axis CNC turning operation
2. Preparation of manual part program for point to point Control systems ex. Drilling operation.

3. Examples on APT.
4. Performance on Robots. - Two experiments.
5. XY. Plotter.
6. Simulation.
7. Case study on CAPP. (Writing programs)
8. Case study on GT.
9. Performance on NC and CNC m/c. - Two experiments.
10. Study of computer aided quality control.

#### **PRACTICAL EXAMINATION:-**

The practical examination shall consist consist of viva-voce and or practical based on the termwork and syllabus.

#### **REFERENCE BOOKS:-**

- |   |   |                                   |
|---|---|-----------------------------------|
| 1. Automated Production Process             | - | Malov.                            |
| 2. Fundamentals of Ind. Automation          | - | Turgan.                           |
| 3. Metal Working Automation                 | - | Dc Groot.                         |
| 4. Production System,<br>Automation and CIM | - | Mikhal Groover.                   |
| 5. Industrial Robotics                      | - | Groover, Weiss Nagal.             |
| 6. Robotics Revolution                      | - | Peter Scott.                      |
| 7. NC Machines                              | - | Yarem Koren.                      |
| 8. Computer Aided Manufacturing             | - | N.J.Eagle Woodclitt.              |
| 9. CAD/CAM                                  | - | M.P.Graver.                       |
| 10. Computer in Manufacturing               | - | N.K.Tiwari & T.K.Kundra           |
| 11. Machine Tool Design                     | - | N.K.Mehta, Tata,<br>McGrand Hies. |

#### **7SM5**

#### **ELECTIVE-I**

#### **1)NON-CONVENTIONAL ENERGY SYSTEMS**

#### **SECTION - A**

- UNIT I :- Introduction :- Renewable & Nonrenewable sources. Solar Radiation :- Solar constant, basic earth-sun angles. spectral distribution of extra terrestrial radiations & its variation. Solar time, Direction of beam radiation, computation of radiation on inclined surfaces, solar charts, measurements of diffuse & global & direct radiations, duration of sunshine hours, computation of radiation data, Attention of solar radiation by the atmosphere. (10 Hrs)
- UNIT -II :- Radiation Transmission through covers:- Reflection and absorption of radiation, optical properties of cover systems transmittance effects of surface layers on transmittance,

transmittance absorptance product.

Solar Energy collections:- Heat transfer for solar energy utilisation, flatplate collectors such as liquid & air collector, collector overall heat transfer coefficient, temperature distribution between the tubes & the collector efficiency factor useful heat gain, heat removal & flow factors, Testing of collectors & effects of various parameters on the performance.

Introduction to various systems of concentrating collectors.

(9 Hrs)

- UNIT III :- Solar energy Utilisation:- Application of solar energy in heating, cooling, pumping, power production, distillation, drying, solar cookers, solar pond, solar furnace.

Solar Energy Storage :- Methods of storage such as sensible, latent heat & thermochemical storage, selection of method of storage, properties of storage materials and different arrangements of storages. (No analytical treatment)

(6 Hrs)

#### **SECTION - B**

- UNIT IV :- Energy from Ocean:- Tidal Power:- types of tidal plants such as single and two basin plants, power developed & operation of tidal power plant. Ocean thermal energy conversion system. Ocean temp. profile, OTE power plant development, controlled flash evaporation, indirect vapour cycle. Salinity differences conversion of salinity gradient resources, osmotic pump, dialytic battery, etc.

Wind Power:- Wind speed data, power in the wind, wind power development, types of wind mills, application for pumping and power generation. (8 Hrs)

- UNIT V :- Biomass Energy Resources : Mechanism of green plant photosynthesis. efficiency of conversion, solar energy plantation, biogas – Types of biogas plants, factors affecting production rates. Pyrolysis, Gasification : Types & classification. Straight vegetable oils as a liquid fuels and their properties, esterification process, formation of Biodiesel, Biodiesel and its properties, suitable species for Biodiesel formation and its cultivation, byproduct formation during esterification, Biodiesel economics. (8 Hrs)

UNIT VI : Direct Energy Conversion:- Photo voltaic cells : Principle, concept of energy conversion, conversion efficiency, power output and performance, storage.

Fuel Cells : Principles types of fuel cells, conversion efficiency. Geothermal Energy Resources, power generation methods like vapour dominated. water dominated, flash steam, binary fluid and total flow concept of power generation.

(7 Hrs)

#### LIST OF PRACTICALS:-

Any six practical will be based on the following topics.

1. Study of Pyrheliometer and measurement of direct radiation.
2. Study of a pyranometer and measurement of global & diffuse radiation.
3. Study of a sunshine recorder and measurement of sunshine hours.
4. Study & Testing of a flat plate collector.
5. Study of various concentrating collectors.
6. Study of a solar absorption refrigerating system.
7. Study of a solar dryer.
8. Study of wind mill, and trial on it.
9. Study of a biogas plant.
10. Study of sterling cycle engine and a trial on it.
11. Study of solar still and trial on it.
12. Study of a gasifier and trial on it.
13. Study of a photovoltaic system & trial on it.

#### Practical Examination :

It shall consist of viva-voce based on the termwork and syllabus.

#### BOOKS RECOMMENDED :-

- |    |                                  |   |                     |
|----|----------------------------------|---|---------------------|
| 1. | Energy Conversion Systems        | - | H.A.Sarensen.       |
| 2. | Solar Engg. of Thermal Processes | - | Daffic and Beckman. |
| 3. | Treatise on Solar Energy         | - | Garg.               |
| 4. | Principles of Solar Energy       | - | Kreith Kreider.     |
| 5. | Solar Energy                     | - | S.P.Sukhatme.       |
| 6. | Renewable Energy                 | - | BentSarensen.       |
| 7. | Power plant Engg.                | - | M.M.El. Wakil.      |

7SM5

#### ELCTIVE-I

#### 2) TOOL ENGINEERING

#### SECTION - A

Unit I : Introduction to metal cutting merchant cutting force circle & its numerical energy consideration in metal cutting tool wear mechanism its parameter & femidites tool life estimation, Taylor's equatn, Thustly & kudinon equatn for Tool life mach inability criteria for mach inability effect & process parameter on tool life, thermal aspect of machining operations, cutting fluid, tool material properties & type, Newly inverted tool material & their type.

Unit II : Single point cutting tool geometry, tool angle classification and nomenclature, various syst of nomenclature, shank design of S.P.T.C. study catalogue & tool selection for an appropriate machining.

Mechanics of turning operation, intro & nomenclature of grinding wheel.

Twist drill and reamers geometry type cutting force, power & torque numerical.

UnitIII: 1) Introduction & geometry of broach teetn designing of broach & cutting force

2) Intro & Geometry of plain milling cutter types of milling cutters, milling process, force acting on plain milling cutter, special cutter for VMC & HMC,

3) Threaded cutting tools : geometry of tal & die specific ref to SS & Al cutting.

4) Gear cutting tools intro of gear shaping, shaving gear hobbing

#### SECTION-B

Unit IV : Press Tool : classification of press, shear cation in die cutting operation, clearance, cutting force, shear on punch and die, center of pressure, classification of cutting operation bending of metal, drawing fundamental, type of die construction function bending of nomenclature of die component defects in press components.

Unit V : Jigs & Fixtures : Design economics, principles of locations, types of locators, prevantion of jamming, problems of chip and dust in location, use of dowels, Redundant location, principles of clamping types of clamps. Screw clamp, toggle

clamp pivoted clamp quick acting clamp drill bushes type of drill jig, plate type jig, angle plate jig, leaf jig, pump jig, turning fixture, milling fixture.

Unit VI : Economic of machine process chart preparation & machine cost of operation optimum cutting speed for minimum cost, optimum cutting speed for maximum, production, restriction on optimum cutting condition, Surface finish: Element of surface texture, effect of machining parameters, measure of specification of surface roughness, roughness with single point cutting tool.

Surface Integrity : importance, methods of improving surface integrity.

**TERMWORK : ANY EIGHT OF THE FOLLOWING:-**

1. Drawing & design of single point cutting tools.
2. Design & drg. of form tools.
3. Design & drg. of broach.
4. Design & drawing of drill.
5. Design and drawing of milling cutter.
6. Study of geometry of reamer.
7. Study of geometry of gear cutting tools.
8. Measurement of forces in orthogonal cutting by Dynamometer.
9. Study of geometry of taps & dies.
10. Design & drg. of press tools.
11. Design & drg. of jigs.
12. Design and drawing of fixtures.
13. Preparation of tool layout for the given job on lathe.

**Practical Examination :-**

It shall consist of viva-voce based on the termwork and the syllabus jointly assessed by internal and external examiner.

**REFERENCES:-**

- |   |   |                   |
|---|---|-------------------|
| 1. Tool Design                                | - | Donaldson.        |
| 2. Metal Cutting Theory & Cutting Tool Design | - | Arshinov          |
| 3. Tool Design                                | - | Ast ME.           |
| 4. Prod Techology                             | - | HMT               |
| 5. Metal Cutting Theory & Practice            | - | A.Bhattacharya    |
| 6. Fundamentals of Metal Cutting & M/c Tools  | - | Juneja.           |
| 7. Fundamental of Tool Engg.                  | - | Basu, Mishra, Pal |

**7SM5**

**ELECTIVE-I**

**(3) ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS**

**SECTION-A**

Unit I :- Introduction to AI, definition and scope, knowledge based approach, concept of Expert System (ES), Characteristics of ES, Elements of ES, Applications and Demands of ES.  
(7 Hrs)

Unit II :- Knowledge Representation, Concept of knowledge, Declarative Vs. Procedural knowledge, Production Rules, frames, Semantic Network, Propositional and predicate logics, Relational databases, schemata, comparison of various representation techniques. (8 Hrs)

Unit III :- Search Techniques, Depth first search, Breadth first search, Best-first search, minmaxing, AND/OR Graphs, Alpha-Beta search, comparison and selection of a search technique.  
(8 Hrs)

**SECTION-B**

Unit IV :- Inference Mechanism/Techniques, Meta knowledge, Rules in inferencing, deductive logic, shallow and casual reasoning, forward & backward chaining, Analog, generate and test, abduction, Non-monotonic reasoning. (8 Hrs)

Unit IV :- Probabilistic reasoning, need to represent uncertain information, uncertainty and rules, Certain factors, Uncertainty in inference chains, combination of events, inference networks with probability. Propagation of probabilities, Dempster schaffer theory, fuzzy sets.  
(9 Hrs)

Unit VI :- Design of Expert system : Selection of problem, steps in development, errors in development stages, life cycle of ES  
(7 Hrs)

**LIST OF PRACTICAL**

A Student is expected to submit a record based on the following practical works :-

- 1) Development of an Expert system for a given purpose using an Expert system shell like VPX-EX, VIDWAN, GURU etc.
- 2) Development of an Expert system software for a given purpose using PROLOG, C, FORTRAN etc.

**LIST OF REFERENCE BOOKS**

1. Artificial Intelligence - E.Rich & K. Knight
2. Introduction to A.I.- Charnaik & D.McDermott
3. The Elements of A.I.- Steven L Tanimoto (Computer Series Press.)
4. A Primer of A.I. - Christopher Fchabris (Kogan Press)
5. Intelligent Machines - William B Gevartar (Prentice Hall Inc.)
6. Intelligent Manufacturing System - Andrew Kusiak (Prentice Hall Inc.)
7. Problem Solving in A.I.- Jean Louis Lauriere (Prentice Hall Inc.)
8. Expert Systems :Principles and Programming - Joseph Gairratano (PWS-Kent Pub.,USA)
9. Principles of Expert Systems- Amar Gupta (IEEE Press, New York)

**7 SM 5****ELECTIVE-I****(4) MECHATRONICS****SECTION-A**

Unit I : Introduction to Mechatronics

Scope of Mechatronics, Basics of sensors and transducers, Selection, Contact and non Contact, Optical types, performance, examples. Actuators, principle, hydraulic, pneumatic, electrical, Contact speed, Multi speed, stepped and continuous variable, Actuator with stepping motor.

(6 Hrs.)

Unit II : Computer Process Control

Computer process interface, interface hardware. Direct Digital control, Supervisory Computer Control. (6 Hrs.)

(Ref. APS & CIM by MP Groover)

Unit III : Design of Mechatronic elements

Measuring System, Control Software and user interface, Gauging, Tool Monitoring System, Spindle drives, feed drives, Servo principles, Configuration CNC System, Interfacing, Monitoring, Dignostics. (6 Hrs.)

**SECTION-B**

Unit IV : Automatic loading & unloading devices, their purpose, Magazines, Bunkers, Orientation, Mechanism Unit Heads, Automatic production lines. (6 Hrs.)

Unit V : Pneumatic System

Study of different control components of pneumatic system & their conversion valves, auxiliary devices, synchronizing, clamping, declamping etc. Application to robotics.

(6 Hrs.)

Unit VI : Hydraulic System

Study of different control components of Hydraulic System, Valves and auxiliary devices, design and analysis of Hydraulic circuits sequencing, Synchronizing, Pneumohydraulic, CNC lubrication, Machine Tool Applications. (6 Hrs.)

**PRACTICALS :**

Practical based on above syllabus (Total 5 practicals.)

**References :**

- 1) Mechatronics by HMT, Tata McGraw Hill.
- 2) Introduction to Mechatronics & Measurement System by Michal B. Histand & David G.Aiciatore by McGraw Hill.
- 3) Automation, Production System and CIM by M.P.Groover, PHI
- 4) Automation by Maleev, MIR Publication.
- 5) Industrial Automation by Turgam, MIR Publication.
- 6) Pneumatics & Hydraulics by Steward.
- 7) CMTI Handbook by CMTI.

\*\*\*\*\*

**EIGHT SEMESTER****8SM1****ELECTIVE-II****1) I. C. ENGINES****SECTION - A**

UNIT I :- Types and cycle analysis:- Classification of I.C.Engines, Details of two stroke and four stroke cycles; Air standard cycles, Fuel air cycle and actual cycle. Effect of variation of specific heat, dissociation. Review of other losses. (7 Hrs)

UNIT II :- Fuels and alternative fuels: Elementary treatment to conventional and non-conventional fuels, fossil fuels and their limitations, potential alternative fuels-liquids and gaseous, additives and their functions

Studies of fuel injection pump and their working, different types of fuel feed systems, studies of injectors, nozzles, bosch type fuel pump. (8 Hrs)

UNIT III :- Combustion SI Engine:- Combustion in SI Engine stages of combustion, Normal and abnormal combustion, Detonation, preignition, Factors responsible for abnormal combustion effect of detonation. Octane rating of fuel, Requirement of combustion chambers for SI engines, important types, relative advantages and disadvantages and application. (8 Hrs)

**SECTION - B**

UNIT IV :- Combustion in CI Engine :- Stages of combustion in delay period, factor affecting delay period, effect of change in delay period. Diesel knock, cetane rating. Requirements of combustion chamber for CI Engine. Methods of generating turbulence in combustion chamber. Types of combustion chambers for CI engine. (8 Hrs)

UNIT V :- Performance test on IC engines, Methods of determination of PHP. Heat balance sheet, Principles of supercharge, arrangements for supercharge, Advantages and limitations of supercharge. (8 Hrs)

UNIT VI :- Review of emissions from IC engines, Their effect on human health, Causes of formation and approaches to control these pollutants Measurement of smoke, CO, Hydrocarbon, various smoke meters Infra Red detector, study of emission norms, BIS, EURO. (8 Hrs)

**BOOKS RECOMMENDED.**

- |  |   |                       |
|--|---|-----------------------|
| 1. I.C.Engine                          | - | M.L.Mathur and Sharma |
| 2. I.C.Engine & Air Pollution          | - | Obert E.F.            |
| 3. I.C.Engine                          | - | Maleelve              |
| 4. I.C.Engine                          | - | Litchy                |
| 5. I.C.Engnie                          | - | Ganeshan              |
| 6. Automobile Engineering, Vol. I & II | - | Kripal singh          |
| 7. I. C. Engines Fundamentals          | - | John B. Heywood       |
| 8. I. C. Engines                       | - | Arora & Domkundwar.   |

**8SM1****ELECTIVE II****2) PRODUCTION PLANNING AND CONTROL****SECTION - A**

UNIT I :- INTRODUCTION

Objectives and Advantages of PPC, Production Procedure, functions of PPC, production consumption cycle, Centralised and Decentralised PPC, Pre-requisites of PPC, Types of PPC systems.

Scheduling:- Introduction, Inputs of scheduling, loading and scheduling devices, factors influencing scheduling, procedure for scheduling, Techniques of scheduling. (8 Hrs)

UNIT II :- PRODUCTION FORECASTING:-

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

Forecasting error and selection of forecasting model. Types of forecasts: Constant, linear, cyclic forecasts.

Verification and Controlling:- The moving range chart, Average MB, out of control condition. (8 Hrs)

UNIT III :- PRODUCTION PLANNING :- The production order, Procedure for formulating Production order, Master Programmer, Basic problems in production planning, Quantities in Batch production, criteria for batch size determination, minimum cost batch size, Production Range, Maximum profit Batch size, Maximum return, Maximum Rate of return, Economic Batch size. (8 Hrs)

**SECTION - B**

- UNIT IV :- MACHINE OUTPUT:- Machine output, multimachine supervision by one operator, Machine Interference, Ashcroft tables, average number of consecutive servicing task, the Ashcroft Number. (8 Hrs)
- UNIT V :- ANALYTICAL STRUCTURE OF INVENTORY :- Definition of Inventory, Types of inventory and its classification, structure of inventory problems and its analysis, the Relevant cost, objectives of carrying inventories, selective inventory analysis.
- Static Model:- General characteristic, incremental analysis, opportunity cost, of risk, decision criterias under uncertainty. (8 Hrs)
- UNIT VI :- A) DYNAMIC MODEL:- CERTAINITY CASE:- General characteristic, optimum lot size model with constant demand, Quantity discounts.
- Risk Case:- General characteristic, phsystem and Q system.
- B) Material Requirement planning (MRP) :- Introduction to MRP, manufacturing resource planning (MRP-II), just in time, comparison of MRP, MRP-II and kanban, Entrepreneurship resource planning (ERP). (8 Hrs)

**LIST OF RECOMMENDED BOOKS:-**

1. Elements of Production Planning and Control by Simuel Eilon - Macmillan.
2. Production Control- John E.Biegal- Prentic Hall
3. Production Management - Hedge - John Wiley.
4. Production Planning and Control and Management - K.C.Jain & L.N.Agrawal.
5. Production systems planning Analysis & Control - James L.Riggs.
6. Production Control- F.G.Moore, McGraw Hill.
7. Inventory control, Theory & Practice- Starr & Miller.
8. Scientific inventory Managemen - Buchan & Kenigshery, Prentice Hall.
9. Production Planning and Control - L.C.Jhamb, Aaditya, Publishing House, Pune.
10. Production & Operations Management - Chunawala & Patel, Himalaya Publication House.

11. Production & Operations Management - A.Muhleman, J.Oakland & KI.Lackyer, Mcmillan India. Ltd.
12. Production & Operation Mgt. - E.E.Adam, Jr.R.J.Ebert, Prentice Hall of India.
13. Production Planning and Inv.Control - S.L.Narasimhan, D.W.Mcleavey, P.J.Billingten, PHI.
14. Industrial Orgnization & Management - A.K.Deshpande.
15. Operation Management - Buffa - Juhn Wiley.
16. Management Science - R.C.Gupt & Bhapesh Gupta
17. Principle of Operation Research for Management. - Frank Budnick, Dennis Mc leaveRechard Mojena.
18. Principle of Production Control- John L.Burbidge.
19. Quantitative Method for Management Decisions- Willian P.Cooke
20. Production Planning and Inventory Control- Mages & Badman.
21. Quantitative Methods and O.R.- R.C.Gupta.

**SSM1****ELECTIVE-II****(3) MANAGEMENT INFORMATION SYSTEM****SECTION-A**

- Unit I : BASIS OF MIS :
- What is a system, what is information and data, necessity of prompt, accurate & relevent information for effective decision making, decision tables. Types of information, Organisational structure and types of information within them, Fact gathering techniques. (8 Hrs)
- Unit II : System Analysis & Design :
- Phases of system development procedure, project request form system proposal, cost/benefit analysis, functional specifications, detailed system description, system acceptance criteria, audit and control requirements, structured system development, data flow diagram ,cntext analysis diagram, exploding a process, structured analysis, structured design, structur charts, coding schemes, input form design, system protection. (8 Hrs)
- Unit - III A) Development of MIS
- Long Range plans of MIS, Class of Information, information requirement, implementation of MIS, Management of Quality in the MIS, Organisation for the Development of MIS, Factors of success & Failure of MIS.

## B) Choice of Information Technology

Nature of IT decision, Strategic decision, Configuration design, Evaluation, IT implementation plan, (8 Hrs)

## Unit-IV :- Introduction to MIS

Preliminaries of Information System Technology Data base Management System : Concepts, Models, Design, Performance monitoring & Tuning, Security in the database environment MIS & RDBMS.

BMS Software ORACLE (8 Hrs)

## Unit V :- a) Decision Support Systems :

Concept & Philosophy AI, Knowledge based expert system. MIS & Role of DSS

## b) Enterprise Management System :

Introduction to ERP, Basic feature, benefits, Selection and Implementation EMS & MIS.

c) Business Process Re-engineering (BPR) Introduction, Business Process, Process model of Organisation and value stream model of organisation MIS & BPR. (8 Hrs)

## Unit VI :- Application of MIS

## A) Application in Manufacturing Sector :-

Personnel Management, Material Management, Marketing Management.

B) Application in Service Sector like Hospitals, Airlines, Hotels, Banks, Insurance. (8 Hrs)

**Reference Book :-**

- 1) Data Processing System Analysis and Design - Robert J Vondon
- 2) Computers and Information System - Madrvin R Gore & W Stubbe.
- 3) Information systems for operation and Management - Voichdan, Homer.
- 4) Handbook of Dbase III Plus - Ashton Tata
- 5) Management Information Systems - Ross.
- 6) Manual of ORACLE
- 7) Management Information System - W.S.Jawadekar (TMGH,1988)

**8 SM 1****ELECTIVE-II****(4) ADVANCED MANUFACTURING SYSTEMS****SECTION-A**

## Unit I : Total Quality Management (TQM) :

Understanding quality, commitment & leadership

Customer satisfaction

Employee involvement

Performance measures - Case Study

Implementation of TQM - Case Study (10)

## Unit II : Total Productive Maintenance (TPM) :

Introduction outline of TPM

Concepts of "Kobetsu-Kaizen", "Jishu-Hozen"

Planned Maintenance Systems

Operation & Maintenance skill upgrade training initial control, "Hinshitsu - Hozen" concept. (10)

## Unit III : Business Process Re-Engineering (BPR) :

Introduction, Reengg., Rethinking

The new world of work

Who will Re-Engineer ?, Succeeding at Re-Engg.- case study (10)

**SECTION-B**

## Unit IV : Value Engineering (VE)

Introduction

Value Orientation

The various phases of VE like orientation phase, Information phase, function phase .... etc.

How to manage the VE programme

Case Study (10)

## Unit V : Concurrent Engineering (CE)

Introduction to CE & need of CE

CE tools

Advances in design & manufacturing engg.

Design for manufacture, design for assembly

Rapid prototyping

Concurrent approaches to design, manufacturing and other aspects of engg. (10)

Unit VI : Just In Time (JIT)

Introduction to JIT

What is Toyota Production System

Design, Development & Management of JIT manufacturing systems

Implementation of JIT (10)

#### REFERENCES:

- 1) Besterfield D.H. et.al, "Total Quality Management", PHI, New Jersey, 1995.
- 2) Johan S. Okland, "TQM : Text with Cases", Butterworth Heinemann, Oxford, 1995.
- 3) "TPM Edited Notes" by Japan Institution of Plant Maintenance.
- 4) Michel Hammer & Jomes Champy, "Re-Engineering the Corporation, "Nicholas Brealely, London, 1994.
- 5) G.Jogannathan, "Getting More at Less Cost : The Value Engineering Way", Tata McGraw Hill, 1992.
- 6) Andrew Kusiak, "Concurrent Engineering : Automation, Tools & Techniques", John Willey & Sons.
- 7) Chanan S. Syan & Unny Menon, "Concurrent Engineering : Concept, Implementation & Practice", Chapman & Hall.
- 8) M.G.Korgaonkar, "Just in Time Manufacturing", Macmillan India Ltd., New Delhi, 1992.

\*\*\*\*\*

#### 8SM2

#### ELECTIVE-III

#### 1) REFRIGERATION & AIR CONDITIONING

##### SECTION - A

UNIT I :- Introduction to automotive air conditioning:-

Vapour compression system:-

Analysis of simple vapour compression system. Use of pressure enthalpy, Temperature entropy charts. Effect of

operating conditions such as evaporation and condenser pressure, superheating and sub cooling. Actual vapour compression system.

Refrigerants:-

Classification: primary and secondary refrigerants, desirable properties of refrigerants, merits and demerits of commonly used refrigerants such as Ammonia R-12, R-22 and their selections and eco friendly refrigeration 134a, HFC

UNIT II :- Multi stage pressure systems:-

Multistage compression: choice of Intermediate pressure, complete multistage compression. Multi-evaporator system; single compressor individual expansion valve, single compressor multi expansion valves, individual compressor multi- expansion valves, Cascade systems, its application to cryogenics Air liqulification processes- Linde-Hampson

(No numerical treatment to Cascade systems and air liquifaction system) (10 Hrs)

UNIT III :- Refrigerationsystem components and controls:-

Brief study of refrigerant compressors, condensers, evaporators, expansion valves, dryer, fillers, selection criteria for the compoonents of vapour compression systems flow controls, temperature controls, pressure controls and safty devices. Defrosting systems, testing and charging of refrigeration systems, leak detection. (No Analytical treatment is expected) (8 Hrs)

##### SECTION - B

UNIT IV :- Psychrometric properties of moisair psychrometric chart, concept of thermo-dynamic wet-bulb temperature, Representation of psychrometric process on psychrometric charts, mixing of air, evaporating cooling, Air washers.

Human Comfort:- Metabolism of human body, factors influencing comfort, conceptof effective temperature, optimum effective temperature and comfort charts. (7 Hrs)

UNIT V :- Classification of air-conditioning system & applications. Unitary system package, window type and split type air-conditioning.

Central system :- System components, types:- Direct expansion system, All water system and all air system.

Winter, summers and year round air-conditioning. Transmission and distribution. Types of supply air ducts, considerations for selection and location of outlet, distribution patterns of outlets, location of return air opening and introduction to duct design.

(No numerical treatment is expected) (9 Hrs)

UNIT VI :- Load calculation and applied psychrometry-Basic considerations and heat gains/losses sensible and latent, heat due to occupancy lighting, appliances, products, process, air conditioning systems, safety factor cooling load estimates, heating load estimates. Sensible heat factor By pass factor, apparatus dew point, effective sensible heat factor. (8 Hrs)

#### LIST OF PRACTICALS:-

Any six of the following should be conducted and a report there of should be submitted.

1. Trial on vapour compression system.
2. Trial on Air-conditioning system.
3. Study of Electrolux system.
4. Study of Water cooler.
5. Study of window Air conditioner.
6. Study of household refrigerator.
7. Study of desert cooler.
8. Study of cold storage plant.
9. Testing and changing of refrigeration system.
10. Study of defrosting system.
11. Study of ice plant.
12. Study of various refrigeration and air-conditioning controls

#### Practical Examination:-

It shall consist of viva-voce based on termwork and syllabus to be examined by internal and external examiner.

#### BOOKS RECOMMENDED:-

1. Principles of Refrigeration - J.Dosat.
2. Refrigeration and Air Conditioning- C.P.Arora
3. Refrigeration and Air Conditioning- P.L.Balaney
4. Refrigeration and Air conditioning- Manohar Prasad
5. Refrigeration & Air Conditioning- Khurmi
6. Refrigeration and Air conditioning- Arora - Domkundwar

#### 8SM2

#### ELECTIVE-III

#### 2) MACHINE TOOL DESIGN

#### SECTION - A

UNIT - I :- General requirement of machine tool design kinematics of m/c tool :- Various driving systems used in machine tools, basic design consideration in the design of variable speed range in the machine tools, layout of speed in geometric, logarithmic and arithmetic progression saw diagram, range ratio, Graphical representation of speed on structural and ray diagram, design of speed and feed boxes and their classification. (11 Hrs)

UNIT II :- a) Mechanical electrical, Hydraulic stepless regulation of speeds.  
b) Machine tool structure (bed, column, cross-rail) functions & their requirements design criterion for machine tool structure design procedure factors affecting stiffness for machine tool structure & their profile. (8 Hrs)

UNIT III :- Static & dynamic rigidity, methods of increasing rigidity of structure, machine tool elastic system, procedure for assessing dynamic stability, dynamic characteristics, single degree & multidegree of freedom systems, Experimental determination of dynamic characteristics of m/c tool, dynamic characteristics of cutting process, stability analysis, single degree, multidegree. (8 Hrs)

#### SECTION - B

UNIT IV :- Vibrations of machine tools:- Effects of vibration on m/c tool on cutting conditions, workpiece, tool life. Sources of vibrations, types of vibrations (forced, chatter, stick-slip vibrations) and its minimisation. Shock absorber, isolation tool holder, chatter in milling lathe, grinding, reduction of chatter in design & production stages. (8 Hrs)

UNIT V :- a) Machine tool guideways & slideways :- Functions, shapes of guideway, materials, methods of adjusting clearance in guideways, design of slideways for wear resistance, determination of maximum and average pressure, on slide way. Hydraulic guideway, antifriction guideway, protecting devices for slideway. (8 Hrs)

UNIT VI :- Machine tool spindle and bearings:- Functions, requirement, types and materials of spindle, machine tool compliance, design of spindle, antifriction bearing, performance indices,

preloading of bearing, Hydrostatic, multiwedge bearing, Hydrostatic journal bearing, hydrodynamic bearing. (7 Hrs)

**PRACTICALS:-**

1. Design of speed box.
2. Design of feed box.
3. Design of combination guideway.
4. Design of combination guideway
5. Acceptance lists.
6. Pneumatic trainer.
7. Hydraulic trainer.
8. Design of laths bed.

**Note:-** Atleast six practical from above list should be done.

Practical examination consists of term work based on above syllabus.

**REFERENCES:-**

1. Machine Tool Design Vol. I,II, III, IV, N .Acherkar (Mir Pub)
2. Principles of Machine Tools - Base & Pal
3. M/c Tool Design - N.K.Mehta
4. Principles of M/c Tools - Sen & Bhattacharya
5. Design Principles of Metal Cutting Machine Tools - Kondsberger
6. Machine Tool Desing Vol. I to VI - CMIT, Bangalore

**8SM2**

**ELECTIVE-III**

**3) FINITE ELEMENT METHOD**

**SECTION-A**

Unit I **Introduction of FEM:** Governing Equations, System modeling (Geometric), Discretization, Node numbering, Assembly of Stiffness Matrices.

**Fundamental Concepts of Solid Mechanics:** Stress, Strain, Strain-Displacement and Stress-Strain Relationships, Equilibrium. (08)

Unit II **Mathematical understanding required for FEM:** Matrix Algebra, Eigenvalues and Eigenvectors, Gaussian Elimination, Various Decompositions, Various Equation Solving/ Minimization Techniques, Concept of virtual work, Variational calculus, Finite Difference Techniques (08)

Unit III **3D & Axi-symmetric Analysis:** Numbering sequence for nodes of element, shape function, strain displacement relation, stress-strain relation, Nature of expression, Numerical integration. (08)

**SECTION-B**

Unit IV **Beams:** Element Formulation and Stiffness Matrices, Potential energy and Galerkin Approaches, Loads and Boundary Conditions

**Three-Dimensional Frames:**, Element Formulation and Stiffness Matrices, Coordinate systems and assembly (08)

Unit V **Heat transfer:** Introduction and application examples of heat transfer problems, Basic differential equations for conduction & convection, One-dimensional FE formulation using variational method, 2-D finite element formulation, line or point sources, (08)

Unit VI **Computer Implementation of the Finite Element Method:** Pre processing: model definition, Element Selection, Equation solver., Post processing: strain and stress recovery, Contour plotting, Input data file. (06)

**PRACTICALS:**

1. To study the computational design procedure for solving problem using FEM.
2. Problems solving based on above syllabus using FEM codes ANSYS / UG / MATLAB.
3. To study the application of FEM packages to engineering problems.

**REFERENCE BOOKS:**

1. Introduction to the Finite element Method - C.S.Desai and J.F.Abel.
2. Finite Element Analysis - C.S.Krishnamoorthy.
3. Concept and Applications of Finite Element Analysis - Robert D.Cook
4. An Introduction to FEM - J. N. Reddy
5. CAD/CAM Theory & Practices - Ibrahim Zeid
6. A First Course in FEM - Darya Logon
7. Finite and Boundary Element Method in Engineering - O. P. Gupta

**8SM2 ELECTIVE - III****(4) ROBOTICS**

- Unit I: A historical perspective of Robots, classification of Robots, economic & social considerations, structure of Robots, Resolution, Accuracy and Repeatability, point to point, continuous path system control loops, types of manipulators, End effectors:- wrist & grippers, gripping problem & compliance. (10 Periods)
- Unit II: Kinematic Analysis of Robots : Geometry based direct kinematics, Co-ordinate and vector transformation using matrix, Denavit-Hartenberg (D-H) convention, application of D-H notation, Inverse Kinematics. (12 Periods)
- Unit III: Robot –Arm Dynamics : Elementary treatment of Lagrange–Euler, Newton–Euler formulations, Generalised D- Alembert equations of motion. (10Periods)
- Unit IV: Robotic Sensors : Introduction, classification, Range sensing, range, proximity, touch, force and torque sensors. Vision system : Visual sensing, operation of machine vision system:- image acquisition, digitization, processing, analysis & interpretation, applications. (08Periods)
- Unit V: Robot programming : Programming method:- manual, Teach pendent , Walk-through, computer terminal, off-line, Languages:- Introduction to AL, AML, RAIL, RPL, VAL etc. (10 Periods)
- Unit VI: Applications of Robots :Present applications: handling, loading, unloading, welding, painting, assembly, machining, manufacturing, Future applications. (10 Periods)

**PRACTICALS:-**

1. Robot structure and types of Robot.
2. Solution to direct kinematics problems on computer.
3. Solution to inverse kinematics problems on computer.
4. Establishing accuracy & repeatability of Robot
5. Robot programming for simple task such as pick-n-place using languages like VAL, WALLI etc.
6. Demonstration of Robot application.

**REFERENCE BOOKS:-**

1. Robotics (Control, Sensing, Vision, and Intelligence), Fu, K.S., Gonzalez, R.C., Lee, C.S.G., McGraw-Hill Int. Editions, Singapore, 1987.

2. Robotic Engineering :- An Integrated Approach, Klafter , R.D., Chmielewski, T.A, Negin,M., Prentice Hall of India, 2003.
3. Introduction Robotics :- Analysis, Systems, Applications, Niku, S.B, Pearson Education Asia, New Delhi,2002.
4. Robot Technology :- Fundamentals , Keramas, J.G., Thomson Asia, Singapore, 1999.
5. The Robotics Revolution :-Scott, Peter B. Basil Blackwell Inc., UK, 1984.
6. Robotics for Engineers, Koren, Yoram
7. Industrial Robots & CIM, Surendra Kumar, Oxford & IBH Publishing Company, N.Delhi.

**8SM3****AUTOMOBILE ENGINEERING****SECTION - A**

- UNIT I :- Classification of automobiles, chasis, layout types, subsystems of automobile  
Power Unit:-Functions and locations power for propulsion, acceleration, hill climbing, gradiability and engine mounting, engine parts-types, construction and functions, Multiple cylinder engines. General considerations of engine balance vibration, firing order road performance curves.
- UNIT II :- Fuel feed systems :- fuel feed systems for petrol engines. Fuel pumps, fuel filters, fuel gauges, Air filters, Basic principles of MPFI and CRDI. Multipoint Fuel Injection Systems (MPFI), Common Rail Diesel Injection Systems(CRDI)  
Cooling system : purpose, types of cooling system, liquid cooling system-water jacket and ports, water pump and radiators, by pass recirculation system, closed system, temperature indicator, antifreeze mixtures, troubles and remedies of cooling system. (8 Hrs)
- UNIT III :- The electrical systems. Battery Capacity : standard capacity rating, battery life, battery testing, recharging of battery starter motor drive-Bendix drive, over running clutch drive, solenoid switch; solenoids witch.  
Ignition system:- Battery coil and magneto ignition system, Ignition timing and its effect on engine performance, Ignition advance mechanisms, Electronic ignition system (8 Hrs)

**SECTION - B**

UNIT IV :- Transmission system:- Construction, transmission, requirements of single plate friction clutch and multiplate clutch, clutch adjustments, clutch troubles and remedies.

Gear Boxes:- Sliding mesh, constant mesh and synchromesh gear box, function of over drives, trouble shooting and remedies. Propeller shaft, hotchkiss drive torque tube drive, differential. (7 Hrs)

UNIT V :- Braking system:- Mechanical, hydraulic brakes, power brakes, and vacuum brakes Fault finding and maintenance of brakes.

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

UNIT VI :- Suspensions :- Rigid, axle and independent suspension system, shock absorbers

Auto lubrication :- Types of lubricants, their tests and ratings, multiviscosity oils, chassis lubrication.

Engine lubrication:- types of lubricating systems, modified splash system, full and partial pressure systems, dry sump system, oil pump, oil filters system-by pass system, full flow system oil breather, crankcase ventilation, Engine lubrication troubles and remedies. (7 Hrs)

**LIST OF PRACTICALS** Atleast six practicals from the list below.

1. Study of lubricating system.
2. Circuit tracing of 4 wheeler carburettor.
3. Study of wiring diagram of electrical system.
4. Fault finding of ignition system.
5. Setting of ignition timing and spark plug gap.
6. Disassembly & assembly of two types of gear boxes.
7. Study of brake systems.
8. Study of steering system & its adjustment.
9. Disassembly & assembly of two stroke engine.
10. Exhaust analysis of S.I. Engine studies and measurement.
11. Smoke measurement in Diesel exhaust.

**Practical Examination :**

Shall be based on viva-voce both on termwork and syllabus conducted by internal and external examiner.

**BOOKS:-**

1. Automobile Engineering - Narang
2. Automobile Engineering - R.P.Sharma.
3. Automobile Engineering - Heitner E.W.
4. Automobile Engineering - Kripal Singh.
5. Automobile Engineering - Gupta.
6. Automotive Mechanics - Crouse & Anglin.

**8SMP4 OPERATIONS RESEARCH TECHNIQUES****SECTION - A**

Unit I : Operations Research - introduction, characteristics, phases, limitations; model building and classification of O.R. Models. Linear Programming- formulation, simplex methods, primal dual relationship. (8)

Unit II : Transportation problems : introduction, methods, LP formulation of transportation problems, methods for finding initial solution, Modi method. Assignment Problems : introduction, mathematical statement and solution methods of assignment problems, variations of assignment problems. (8)

Unit III: Network Models : Network models - Network construction, PERT analysis, CPM analysis, cost analysis, updating, resource smoothing and leveling. (8)

**SECTION-B**

Unit IV : Waiting line models : introduction classification of waiting line models, analysis of M/M/1 and M/M/S models, application of simulation to waiting line model and Monte-Carlo technique.

Sequencing-Processing of n jobs through 2 machines, n jobs through 3 machines, 3 jobs through n machines, n jobs through n machines. (10)

Unit V : Replacement Models -individual and group replacement policies. simulation : Introduction, basic nature of simulation, when to simulate, advantages and limitations, role of random numbers in simulations, generation of random numbers (8)

Unit VI: Dynamic Programming -introduction, characteristics, development of an optimum decision policy, dynamic programming under certainty, application of dynamic programming to linear programming. (8)

LIST OF PRACTICALS :- Atleast 6 practicals from following :-

- 1] Computer programme for PERT CPM analysis.
- 2] Computer programme for LPP.
- 3] Case study on PERT/CPM network
- 4] Formulation of LPP from real life situation.
- 5] Study of dynamic programming problems.
- 6] Case Study on transportation problems.
- 7] Case study on assignment problems.
- 8] Case study on sequencing problems.

**BOOKSRECOMMENDED:-**

1. Operations Research - Askhedkar-Kulkarni
2. Linear Programming - Paul Lomba.
3. Fundamentals of Operations Research - Aceffsasieni (Wiley Eastern)
4. PERT/CPM - Srinath
5. Operations Research - Hira & Gupta
6. Operations Research - J.C.Pant
7. Operations Research - Kanti Swarup
8. Operations Research - S.D.Sharma
9. Operations Research - C.R.Kothari
10. Operations Research - A.S.Phillipose
11. Operations Research - R.C.Patel
12. O.R. and Mathematical Models - A.S.Sharma, Tata McGraw Hill
13. Operations Research - H.Taha
14. Operations Research - Kapoor
15. Operations Research - B.E.Gillett
16. Simulation - By Narsingh Deo
17. Simulation - By J.Jordan
18. Mathematical Models in O.R. - J.K.Sharma.

**8SM5**

**PROJECT & SEMINAR**

Every Student shall deliver a seminar, and shall submit a complete report and the connected work of a project/projects allotted to him by the Department.

\*\*\*\*\*





APPENDIX-B  
FOUR YEAR B.E. DEGREE COURSE  
BRANCH : MECHANICAL ENGINEERING  
SEMESTER PATTERN  
SEMESTER : THIRD

ABBREVATIONS :-  
S - SEMESTER PATTERN  
M - MECHANICAL  
P - PRODUCTION

Sr. No.	Sub. Code	SUBJECT	Teaching Scheme			Examination Scheme										Grand Total
			L	T	P/D	Theory					Practical					
						Total Hours/Week	Duration of Papers (Hrs)	Max. Marks Theory Papers	Maximum Marks College Assessment	Total	Min. Pass Marks	Max. Marks	Max. Marks College Assessment	Total	Minimum Pass Marks	
1.	3SMP1	Mathematics-III	4	1	-	5	3	80	20	100	40	—	—	—	—	
2.	3SMP2	Mechanics of Materials	3	1	2	6	3	80	20	100	40	—	25	25	12	
3.	3SM3	Fluid Power-I	4	-	2	6	3	80	20	100	40	25	25	50	25	
4.	3SM4	Engineering Thermodynamics	4	1	-	5	3	80	20	100	40	—	—	—	—	
5.	3SMP5	Manufacturing Process-I	4	-	4	8	3	80	20	100	40	25	25	50	25	
TOTAL			19	3	8	30				500				125	625	

L : Theory Lecture  
T : Tutorial  
P : Practical  
D : Drawing / Design

FOUR YEAR B.E. DEGREE COURSE  
BRANCH : MECHANICAL ENGINEERING  
SEMESTER PATTERN  
SEMESTER : FOURTH

ABBREVATIONS :-  
S - SEMESTER PATTERN  
M - MECHANICAL  
P - PRODUCTION

Sr. No.	Sub. Code	SUBJECT	Teaching Scheme			Examination Scheme										Grand Total
			L	T	P/D	Theory					Practical					
						Total Hours/Week	Duration of Papers (Hrs)	Max. Marks Theory Papers	Maximum Marks College Assessment	Total	Min. Pass Marks	Max. Marks	Max. Marks College Assessment	Total	Minimum Pass Marks	
1.	4SMP1	Basic Electrical Drives & Control	3	1	2	6	3	80	20	100	40	25	25	50	25	
2.	4SMP2	Engineering Metallurgy	4	-	2	6	3	80	20	100	40	25	25	50	25	
3.	4SM3	Energy Conversion-I	4	1	2	7	3	80	20	100	40	25	25	50	25	
4.	4SMP4	Manufacturing Process-II	4	-	2	6	3	80	20	100	40	25	25	50	25	
5.	4SMP5	Machine Drawing	2	-	4	6	4	80	20	100	40	25	25	50	25	
TOTAL			17	2	12	31				500				250	750	

APPENDIX-C  
FOUR YEAR B.E. DEGREE COURSE  
BRANCH : MECHANICAL ENGINEERING  
SEMESTER PATTERN  
SEMESTER : FIFTH

ABBREVATIONS :-  
S - SEMESTER PATTERN  
M - MECHANICAL  
P - PRODUCTION

L : Theory Lecture  
T : Tutorial  
P : Practical  
D : Drawing / Design

Sr. No.	Sub. Code No.	SUBJECT	Teaching Scheme			Examination Scheme											
			L	T	P/D	Theory					Practical						
						Total Hours/Week	Duration of Papers (Hrs)	Maximum Marks College Assessment	Total	Min. Pass Marks	External	Maximum Marks Internal	Total Marks	Minimum Passing Marks			
1.	5SM1	Computer Software Applications-I	4	-	2	6	3	80	20	100	40	25-	25	50	25		
2.	5SM2	Production Technology	4	-	2	6	3	80	20	100	40	25	25	50	25		
3.	5SM3	Heat Transfer	4	1	2	7	3	80	20	100	40	25	25	50	25		
4.	5SMP4	Measurement System	4	-	2	6	3	80	20	100	40	--	25	25	12		
5.	5SM5	Theory of Machine-I	3	1	2	6	3	80	20	100	40	25	25	50	25		
TOTAL			19	2	10	31						500					

**GRAND TOTAL : 725**

SEMESTER : SIXTH

Sr. No.	Sub. Code No.	SUBJECT	Teaching Scheme			Examination Scheme											
			L	T	P/D	Theory					Practical						
						Total Hours/Week	Duration of Papers (Hrs)	Maximum Marks College Assessment	Total	Min. Pass Marks	External	Max. Marks Internal	Total Marks	Minimum Passing Marks			
1.	6SM1	Fluid Power-II	4	1	2	7	3	80	20	100	40	25	25	50	25		
2.	6SM2	Machine Design-I	4	1	2	7	4	80	20	100	40	25	25	50	25		
3.	6SM3	Computer Software Applications-II	3	-	2	5	3	80	20	100	40	25	25	50	25		
4.	6SM4	Control System Engineering	4	1	-	5	3	80	20	100	40	—	—	—	—		
5.	6SM5	Theory of Machine-II	4	1	2	7	3	80	20	100	40	25	25	50	25		
6.	6SULIMTX6	Communication Skills	2	1	-	3	2	40	10	50	20	15	10	25	12		
TOTAL			21	5	8	34						550					

**GRAND TOTAL : 775**

APPENDIX-D  
 FOUR YEAR B.E. DEGREE COURSE  
 BRANCH : MECHANICAL ENGINEERING  
 SEMESTER PATTERN  
 SEVENTH SEMESTER

L : Theory Lecture  
 T : Tutorial  
 P : Practical  
 D : Drawing / Design

ABBREVIATIONS :-  
 S - SEMESTER PATTERN  
 M - MECHANICAL  
 P - PRODUCTION

Sr. No.	Sub. Code No.	SUBJECT	Teaching Scheme			Examination Scheme									
			L	T	P/D	Theory				Practical					
						Total Hours/Week	Duration of Papers (Hrs)	Maximum Marks	College Assessment	Total	Min. Pass Marks	External	Maximum Marks	Internal	Total Marks
1.	7SM1	Machine Design-II	3	-	2	5	4	80	20	100	40	25	25	50	25
2.	7SM2	Energy Conversion-II	4	1	2	7	3	80	20	100	40	25	25	50	25
3.	7SMP3	Industrial Management and Costing	3	1	-	4	3	80	20	100	40	--	--	--	--
4.	7SM4	Automation Engineering	4	1	2	7	3	80	20	100	40	25	25	50	25
5.	7SM5	Elective-I	3	1	2	6	3	80	20	100	40	25	25	50	25
6.	8SM5	Project & Seminar	-	-	4	4	-	--	--	---	--	--	--	--	--
TOTAL			17	4	12	33				500				200	

**GRAND TOTAL : 700**

NOTE : The Elective will be offered as per the availability of the faculty with the College/Institute & only if the number of students opting for such elective are minimum thirty.

**7SM5 ELECTIVE-I**

- 1) Nonconventional Energy System
- 2) Tool Engineering
- 3) Artificial Intelligence & Expert Systems
- 4) Mechatronics

APPENDIX-D  
FOUR YEAR B.E. DEGREE COURSE  
BRANCH : MECHANICAL ENGINEERING  
SEMESTER PATTERN  
EIGHTH SEMESTER

ABBREVIATIONS :-  
S - SEMESTER PATTERN  
M - MECHANICAL  
P - PRODUCTION

Sr. No.	Sub. Code	SUBJECT	Teaching Scheme			Examination Scheme									
			L	T	P/D	Theory				Practical					
						Total Hours/Week	Duration of Papers (Hrs)	Maximum Marks	College Assessment	Total	Min. Pass Marks	External	Maximum Marks	Internal	Total Marks
1.	8SM1	Elective-II	4	1	-	5	3	80	20	100	40	--	--	--	--
2.	8SM2	Elective-III	4	1	2	7	3	80	20	100	40	25	25	50	25
3.	8SM3	Automobile Engineering	4	1	2	7	3	80	20	100	40	25	25	50	25
4.	8SMP4	Operations Research Techniques	4	1	2	7	3	80	20	100	40	25	25	50	25
5.	8SM5	*Project & Seminar	-	-	4	4	-	--	--	---	--	75	75	150	75
<b>TOTAL</b>			<b>16</b>	<b>4</b>	<b>10</b>	<b>30</b>				<b>400</b>				<b>300</b>	

**GRAND TOTAL : 700**

NOTE : ALL PERIODS ARE OF ONE HOUR DURATION.

\*1. College Assessment  
a) Project 50) 75}  
b) Seminar 25) } 150  
2. University Oral Exam. 75}

NOTE : The Elective will be offered as per the availability of the faculty with the College/Institute & only if the number of students opting for such elective are minimum thirty.

8SM1 Elective-II

- 1) I.C.Engines
- 2) Production Planning & Control
- 3) Management Information Systems
- 4) Advanced Manufacturing Systems

8SM2 Elective-III

- 1) Refrigeration & Air Conditioning
- 2) Machine Tool Design
- 3) Finite Element Methods
- 4) Robotics

**\* REGULATION NO. 12 OF 2002**

**Examinations leading to the Degree of Bachelor of Engineering (Mechanical Engineering) (Four Year Degree Course.... Semester Pattern) Regulation, 2002.**

Whereas it is expedient to frame the Regulation in respect of Examinations leading to the Degree of Bachelor of Engineering (Mechanical Engineering) (Four Year Degree Course.....Semester Pattern) for the purposes hereinafter appearing the Management Council is hereby pleased to make a following Regulation.

1. This regulation may be called "Examinations leading to the Degree of Bachelor of Engineering (Mechanical Engineering) (Four Year Degree Course....Semester Pattern) Regulation, 2002.
2. This Regulation shall come into force w.e.f. the Academic session-
  - i) 2000-01 for Ist & IInd Semester B.E.,
  - ii) 2001-02 for IIIrd & IVth Semester B.E.,
  - iii) 2002-03 for Vth & VIth Semester B.E., and
  - iv) 2003-04 for VIIth & VIIIth Semester B.E.
3. The Schemes of Teachings and Examinations for Ist & IInd, IIIrd & IVth, Vth & VIth, and VIIth & VIIIth Semester in respect of Bachelor of Engineering (Mechanical Engineering) (Four Year Degree Course.... Semester Pattern) shall be as per Appendices A, B, C, and D appended with this Regulation respectively.

\*\*\*\*\*

---

\*As amended vide Regulation Nos. 15 of 2007 and 48 of 2007

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**

**\* ORDINANCE NO. 42 OF 2005**

**Examination in Environmental Studies leading to Bachelor Degree, Ordinance, 2005**

Whereas it is expedient to frame an Ordinance relating to Examination in Environmental Studies leading to Bachelor Degree level, hereinafter appearing, the Management Council is hereby pleased to make the following Ordinance.

1. This Ordinance may be called "Examination in Environmental Studies leading to Bachelor Degree, Ordinance, 2005."
2. This Ordinance shall come into force from the Academic session 2005-06.
3. In this Ordinance and in other ordinances relating to the examination, unless there is anything repugnant in the subject or context :-
  - (i) "Academic session" means a session commencing on such date and ending with such date of the year following as may be appointed by the Management Council.
  - (ii) "Admission to an examination" means the issuance of an admission card to a candidate in token of his having complied with all the conditions laid down in the relevant ordinance, by a competent officer of the University.
  - (iii) "Applicant" means a person who has submitted an application to the University in the form prescribed for admission to an examination.
  - (iv) "Candidate" means a person who has been admitted to an examination by the University.
  - (v) "Regular Candidate" means an applicant who has applied for admission to a University examination through an affiliated college, Department or Institute in which he/she has prosecuting a regular course of study.
  - (vi) "Examinee" means a person who present himself/herself for an examination to which he/she has been admitted.
  - (vii) "Examination" means an examination prescribed by the University under the relevant Ordinance.
  - (viii) "External Candidate" means a candidate who is allowed to take a University examination in accordance with the provision of Original Ordinance No. 151.

---

\* As amended vide Ord. Nos. 7/2006 and 10/2007.

- (ix) “ Non-Collegiate Candidate” means a candidate who is not a collegiate candidate.
  - (x) An “Ex-student” is a person who having once been admitted to an examination of this University, is again required to take the same examination by reason of his failure or absence thereat and shall include a student who may have joined a college, Department or Institute again in the same class.
  - (xi) “Bachelor Degree Examination” means a examination leading to Bachelor Degree of the University.
  - (xii) “Previous Year” means a year following by final year of Bachelor Degree.
4. Save as otherwise specifically provided, the conditions prescribed for admission to the examination under this Ordinance shall apply to all persons who wish to take the examination to the Degrees of the University mentioned in para 5 below.
5. The conditions prescribed for admission to examination under this Ordinance shall apply to following degrees of the University :-
- 1) Bachelor of Arts
  - 2) Bachelor of Performing Arts
  - 3) Bachelor of Fine Arts
  - 4) Bachelor of Mass Communication
  - 5) Bachelor of Social Work
  - 6) Bachelor of Commerce
  - 7) Bachelor of Business Administration
  - 8) Bachelor of Science
  - 9) Bachelor of Computer Science
  - 10) Bachelor of Computer Applications
  - 11) Bachelor of Pharmacy
  - 12) Bachelor of Science (Home Science)
  - 13) Bachelor of Technology (Cosmetics)
  - 14) Bachelor of Engineering
  - 15) Bachelor of Engineering (Part Time) (Civil)
  - 16) Bachelor of Textile
  - 17) Bachelor of Technology (Chemical Technology)
  - 18) Bachelor of Technology (Chemical Engg.)
  - 19) Bachelor of Architecture, and
  - 20) Bachelor of Laws (Five Year Course)
- 6 i) Environmental Studies shall be a compulsory subject for a previous year examination of the following Bachelor Degrees of the University,

- 1) Bachelor of Arts
  - 2) Bachelor of Performing Arts
  - 3) Bachelor of Fine Arts
  - 4) Bachelor of Mass Communication
  - 5) Bachelor of Social Work
  - 6) Bachelor of Commerce
  - 7) Bachelor of Business Administration
  - 8) Bachelor of Science
  - 9) Bachelor of Computer Science
  - 10) Bachelor of Computer Applications
  - 11) Bachelor of Pharmacy
  - 12) Bachelor of Science (Home Science)
  - 13) Bachelor of Technology (Cosmetics)
  - 14) Bachelor of Engineering (Part Time) (Civil)
- ii) Environmental Studies shall be a compulsory subject for IIIrd & IVth Semester of the following Bachelor Degrees of the University,
- 1) Bachelor of Engineering
  - 2) Bachelor of Textile
  - 3) Bachelor of Technology (Chemical Technology)
  - 4) Bachelor of Technology (Chemical Engineering)
  - 5) Bachelor of Architecture, and
- iii) Environmental Studies shall be a compulsory subject for Vth & VIth Semester of the Degree of Bachelor of Laws (Five Year Course)
- iv) Students admitted to Second Year/Third Year/IVth Semester/ VIth Semester of various degree examination courses in different Faculties in the academic session 2005-06 or thereafter shall have to appear for examination in the subject Environmental Studies.
7. The main examination leading to Environmental Studies shall be held in Summer and supplementary examination in Winter every year, at such places and on such dates as may be appointed by Board of Examinations.  
**Explanation:-** Examination shall be conducted on the basis of one common question paper for all Bachelor Degree Examination courses irrespective of annual or semester pattern.
8. Scope of the subject for annual pattern examination and or semester pattern examination shall be as provided under the syllabus.
9. Common question paper for all courses covered under this Ordinance alongwith answer books shall be supplied by the University to the Colleges, Departments and Institutes for conducting the examination of the subject.

10. Valuation of the answer books relating to this subject shall be done at College/Department/Institution level only. Remuneration for valuation of answer books shall not be paid by the University.  
Provided that prescribed evaluation fee for evaluation of each answer book/s of an external examinee/s appeared from the examination centre shall be paid to each examination centre.
11. It shall be obligatory on the part of the College/Department/Institute to submit candidate wise following information to the University on or before the date as may be prescribed by the University :-

Sr. No.	Grade/Category	Marks secured
1.	“A”	- 60 and above
2.	“B”	- 45 to 59
3.	“C”	- 35 to 44
4.	“D”	- 25 to 34
5.	“Fail”	- 24 and below
6.	“Absent”	

12. For the purposes of teaching, learning and examination, the Committee consisting of three teachers shall be appointed by the Principal/ Head of the Department/Head of the Institution under his/her Chairmanship/ Chairpersonship. While appointing three teachers on the said committee, the Principal shall take care that the teachers to be appointed on the committee, if necessary, shall be from different faculty.
13. i) Duration of theory examination of this subject shall be three hour.  
ii) For all Bachelor Degree examinations, common question paper of 100 marks shall be provided by the University.  
iii) Distribution of these 100 marks shall be as follows :-
- |   |   |          |
|---|---|----------|
| a) Part-A, Short Answer Pattern           | - | 25 Marks |
| b) Part-B, Essay type with inbuilt choice | - | 50 Marks |
| c) Part-C, Essay on Field Work            | - | 25 Marks |
14. Medium of instruction shall be English or Marathi or Hindi. Question paper shall be supplied in English and Marathi and Hindi. A candidate shall have option to write answers in English or Marathi or Hindi.
15. Examination for the subject Environmental Studies shall be compulsory for external candidates appearing as a fresh candidate at Winter and/or summer examination.

16. For teaching of the subject, there shall be atleast two hour per week.  
For teaching the subject to the regular candidates, a full time approved teacher of the University and or a person having Postgraduate Degree in any faculty with second class shall be considered eligible.
17. For teaching of the subject, additional fee to be charged to regular candidate shall be as prescribed by the University.
18. Every College/ University Teaching Department shall charge additional fee of Rs. 100/- to every Student of the subject Environmental studies. Out of this Rs. 100/-, the College/University Teaching Department shall have to pay Rs. 25/- to the University as an examination fee of each candidate for the subject environmental studies.
19. The Grade secured by an examinee in the examination of this subject shall not be considered for providing the facility of A.T.K.T. in next higher class.
20. The provisions of Ordinance No. 18/2001 shall not be applicable for securing a grade or higher grade in the examination of this subject.
21. Result of the Final Year of the respective Degree shall not be declared of an examinee unless he/she secures any one of the grade in the examination of subject.
- Provided an examinee admitted to Five Year LL.B. course desiring not to continue his/her education beyond Sixth Semester of the said course shall have to secure any one of the grade in the examination of the subject otherwise his/her result of Sixth Semester for awarding B.A. degree shall not be declared.
22. Certificate shall be issued, to the successful examinees in the subject Environmental Studies, after the examination.

\*\*\*\*\*