LIST OF ELECTIVES
(Effective from the session 2007-2008)

Elective-I (Seventh semester)

TME-011 Engineering Materials
TME-012 Advanced Synthesis of Mechanism
TME-013 Thermal Turbo Machines
TME-014 Unconventional Manufacturing Processes
TME-015 Refrigeration & Air-Conditioning System Design
TME-016 Total Quality Management (TQM)
TME-017 Environmental Protection & Management *
TME-018 Product Development and Design *
TME-019 Operations Management Models & Concepts *

Elective-II (Eighth semester)

TME-021 Mechanical Vibrations
TME-022 Advanced Fluid Mechanics
TME-023 Non-conventional Energy Resources and Utilization ^
TME-024 Fundamentals of Bio-Medical Engineering
TME-025 Non Destructive Testings *
TME-026 Concurrent Engineering *
TME-027 Management Information System *
TME-028 Automatic Controls *
TME-029 Concept of Modern Physics *

Elective-III (Eighth semester)

TME-031 Experimental Stress Analysis
TME-032 Optimization Techniques in Engineering
TME-033 Advanced Welding Processes
TME-034 Maintenance Engineering & Management *
TME-035 Industrial Ergonomics *
TME-036 Advanced Dynamics of Machines *
TME-037 Introduction to Nuclear Engineering *
TME-038 Energy Management *
TME-039 Six Sigma Methods & Applications *

* New electivess
^ This subject (TME-023) will not be available to those students who have already studied similar open elective with the name Non-Conventional Energy

THU 501

INDUSTRIAL ECONOMICS AND PRINCIPLES OF MANAGEMENT

Industrial Economics:

Unit –1.Introduction: Nature and significance of Economics. Meaning of Science, Engineering and Technology and their relationship with economic development. 4

Unit –2. Basic Concept: The concept of demand and supply. Elasticity of Demand and Supply. Indifference Curve Analysis, Price Effect, Income Effect and Substitution Effect. 6

Unit –3. Money and Banking: Functions of Money, Value of Money, Inflation and measures to control it. Brief idea of functions of banking system, viz., Commercial and central banking, Business fluctuations. 8

Management:

Unit –4. Introduction: Definition, Nature and Significance of Management,. Evaluation of Management thought, Contributions of Max Weber, Taylor and Fayol. 10

Unit –5. Human Behaviour: Factors of Individual Behaviour, Perception, Learning and Personality Development, Interpersonal Relationship and Group Behaviour. 10

References:

1. Dewett, K.K. / Modern Economic Theory/S.Chand & Co.
2. Luthers Fred/ Organizational Behaviour.
3. Prasad L.M./ Principles of Management.
4. A.W. Stonier & D.C. Horgne / A TextBook of Economic Theory/ Oxford Publishing House Pvt. Ltd.

TME-502
MACHINE DESIGN -I

UNIT-I

* **Introduction,** Definition, Methods, standards in design & selection of preferred size. 3
* **Selection of materials** for static & fatigue loads, Materials for components subjected to creep, BIS system of designation of steels, steels, plastics & rubbers. AISI (American Iron & Steel Institution), ASTM rubber testing methods. 4

UNIT-II

* **Design against static load.**
  Modes of failure, Factor of safety, stress-strain relationship, principal stresses, theories of failure 4
* **Design against fluctuating load** stress concentration, stress concentration factors, Fluctuating/alternting stresses, fatigue failure, endurance limit, design for finite & infinite life, Soderberg & Goodman criteria. 4

UNIT-III

* **Joints**
  Welded joint, screwed joints, ecentric loading of above joints, design for fatigue loading. 3
* **Shaft, keys & coupling**.
  Design against static and fatigue loads, strength & rigidity design, Selection of square & flat keys & splines, rigid & flexible couplings. 4

UNIT-IV

* **Mechanical springs**
  Design of Helical and leaf springs, against static & fatigue loading. 4
* **Design analysis of Power Screws**
  Form of threads, square threads, trapezoidal threads, stresses in screw, design of screw jack. 4

UNIT-V

***Introduction to Product Development & Design Process**

Definition of Design, Design Process, Need Analysis, Need based developments, Design by Evolution, Technology based developments, Examples. Case Studies. Brain-storming. 8

Books

1. Design of M/c Elements : Bhandari, TMH
2. Machine design : Sharma & Agarwal, Kataria
3. M/C Design : Maleev & Hartman,
4. Machine Design SI edition by Shigley, Mcgraw Hill
5. Machine Design by Black & Adams, Mcgraw Hill.
6. Design of machine elements by Spotts

TME-503
DYNAMICS OF MACHINES

UNIT-I
Force Analysis, Turning Moment & Fly wheel:
Static force analysis of linkages, Equivalent offset inertia force, Dynamic analysis of slider crank & Bar mechanism. Piston and Crank effort, Inertia, Torque, Turning moment diagrams, Fluctuation of energy, Flywheel. 4

UNIT-II
Balancing of machines:
Static and dynamic balancing, Balancing of rotating and reciprocating masses, Primary and secondary forces and couples. **5**

UNIT-III
Friction:
Pivot and collar friction, Friction circle, Single plate, Multiplate and Cone clutches, Michelle & Kingsbury thrust bearing and rolling contact bearing, Belts and pulleys, Flat and V-belts, Design and selection. **7**

Brakes and Dynamometers (Mechanical Type):
External and internal shoe brakes, Band and Block brakes, Hydraulic brakes, Absorption and Transmission dynamometers. **7**

UNIT-IV
Governors:
Dead weight and spring loaded governors, Sensitivity, Stability, Hunting, Isochronism, Effort and Power, Friction and Insensitivity, Introduction to inertia governors. **6**

UNIT - V
Gyroscopic Motion:
Principles, Gyroscopic acceleration, Gyroscopic couple and Reaction. Effect of gyroscopic couple upon the stability of aeroplanes, ship, two & four wheelers. **4**

Mechanical Vibration:
Single degree free & forced, Undamped & Damped vibrations, Critical speeds.

Books and References

1.Theory of Machine: Thomas Bevan (ELBS/CBS pub. New Delhi)
2.Theory of Machine: S.S.Ratan (TMH)
3. Mechanisms & Dynamics of Machines-Mabie
4. Theory of Machine & Mechanism-Shiglay
5. Theory of Machine- R.K.Bansal (Laxmi publication)
6. Mechanisms and Machine Theory-A.K.Ambekar (Jain Bros)
7. Theory of Machines- W.T.Green
8. Mechanisms and Machine Theory- Rao & Dukhipati(New Age)
9. Theory of Machine & Mechanism- Ghosh & Mallik
10. Theory of MachineS-P.L.Ballaney (Khanna pub.)

TME-504
MANUFACTURING SCIENCE-II

Unit-I

A Metal Cutting and Machine Tools

Metal Cutting-

Mechanics of metal cutting. Geometry of tool and nomenclature .ASA system Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required. Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Brief introduction to machine tool vibration and surface finish. Economics of metal cutting. 8

Unit-II

Machine Tools

(i) Lathe : Principle, types, operations, Turret/capstan, semi/Automatic, Tool layout. 2
(ii) Shaper, slotter, planer : operations & drives. 1
(iii) Milling : Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required. 2
(iv) Drilling and boring : Drilling, boring, reaming tools. Geometry of twist drills. 2

Unit-III

Grinding & Super finishing

(v) Grinding : Grinding wheels, abrasive, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and Cylindrical grinding. Centerless grinding. 4

(vi) Super finishing : Honing, lapping, polishing. 1

Limits, Fits & Tolerance and Surface-roughness:

Introduction to Limits, Fits, Tolerances and IS standards, and surface-roughness. 3

Unit-IV

B. Metal Joining (Welding)

Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding : Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing . 8

Thermodynamic and Metallurgical aspects in welding and weld,. Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. Weld decay in HAZ. 3

Unit-V

C. Introduction to non conventional Machining and Welding

Benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding application such as LBW, USW, EBW, Plasma arc welding, Explosive welding. 6

Books

1. Manufacturing science by Ghosh and Mullick
2. Fundamentals of Metal Cutting and Machine tools by Boothroyd
3. Production Technology by R.K. Jain
4. Production Technology - H.M.T.
5. Production Engineering Science by P.C. Pandey
6. Modern Machining Processes by P.C. Pandey & H.S. Shan
7. Manufacturing science by Degarmo
8. Fundamentals of metal cutting & machine tools - Juneja & Shekhon
9. Process & materials of manufacturing - Lind burg.
10. Advanced Machining Process - VK Jain

TME-505
HEAT & MASS TRANSFER

UNIT-1

Introduction to Heat Transfer:

Concepts of the mechanisms of heat flows: conduction, convection and radiation; effect of temperature on thermal conductivity of materials; introduction to combined heat transfer mechanism. 2

Conduction :

One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; initial and boundary conditions. 3

Steady State one-dimensional Heat conduction :

Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; thermal resistance concept; Analogy between heat and electricity flow; thermal contact resistance; critical thickness of insulation. 3

UNIT-2

Fins of uniform cross-sectional area; errors of measurement of temperature in thermometer wells. 2

Transient Conduction:

Transient heat conduction Lumped capacitance method, Time constant unsteady state heat conduction in one dimension only, Heisler charts. 4

UNIT-3

Forced Convection:

Basic concepts; hydrodynamic boundary layer; thermal boundary layer, flow over a flat plate; flow across a single cylinder and a sphere; flow inside ducts; empirical heat transfer relations; relation between fluid friction and heat transfer; liquid metal heat transfer. 4

Natural Convection :

Physical mechanism of natural convection; buoyant force; empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and aylinders, and sphere. 3

UNIT-4

Thermal Radiation :

Basic radiation concepts; radiation properties of surfaces; black body radiation laws; shape factor; black-body radiation exchange; Radiation exchange between diffuse nonblackbodies in an enclosure; radiation shields; solar radiation. 7

UNIT-5

Heat Exchanger :

Types of heat exchangers; fouling factors; overall heat transfer coefficient; logarithmic mean temperature difference (LMTD) method; effectiveness-NTU method; compact heat exchangers.

Condensation And Boiling :

Introduction to condensation phenomena; heat transfer relations for laminar film condensation on vertical surfaces and on a horizontal tube; Boiling modes pool boiling, curve, forced convective boiling. 3

Introduction To Mass Transfer :

Introduction; Flick's law of diffusion; steady state equimolar counter diffusion; steady state diffusion though a stagnant gas film. 2

Books

1. Elements of Heat transfer by Bayazitouglu & Ozisik, McGraw-Hill Book Company.
2. Heat Transfer By J.P. Holman, McGraw-Hill International edition.
3. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill International edition.
4. Principles of Heat Transfer by Frank Kreith, McGraw-Hill Book co.
5. Fundamentals of Momentum, Heat and Mass Transfer by James R.Welty; John Wiley & Sons (Pvt). Ltd.
6. Heat Transfer, by Vijay Gupta, New Age International (P) Ltd. Publishers
7. Heat Transfer, by Y.V.C. Rao, University Press.
8. Heat Transfer, by R. Yadav, Central Publishing House, Allahabad.

TME 552
MACHINE DESIGN – I – LAB
(Say min 8 out of these)

1. Design & drawing of Riveted joints for given operating conditions.
2. Design of an eccentrically loaded welded, riveted of bolted joint.
3. Design of bolted joint for fluctuating loads.
4. Design & drawing of a cotter joint.
5. Design & drawing of a knuckle joints.
6. Design & drawing of a simple screw jack.
7. Design of shaft for different loading conditions.
8. Design & drawing of rigid coupling(flanged type).
9. Design & drawing of a flexible coupling (pin-bush type)
10. Design & drawing of a leaf spring for an automobile.
11. Design & drawing of a helical spring for a given application
12. Product Development Design problems/exercise

Note -

1. Students may be advised to use design data book for design.
2. Drawing shall be made wherever necessary on small drawing sheets.

TME-553
DYNAMICS OF MACHINES -LAB

Min. 8 out of following (or such) experiments to be done:

1. Study of simple linkers/models/mechanisms.
2. Exp. on Velocity acceleration.
3. Exp. on cam.
4. Exp. on Governor.
5. Exp. on critical speed of shaft (whirling of shaft)
6. Exp. on Gyroscope
7. Exp. on Balancing (static & dynamic)

8. Exp. on 4-bar mechanism
9. Exp. on Gears (tooth profile, interference etc.)
10. Exp. on Gear trains.
11. Exp. on Brakes
12. Exp. on clutch
13. Exp. on synthesis of planner linkages
14. Exp. on Mechanism
15. Exp. on Vibration (spring)
16. Exp. on Vibration (beam)
17. Exp. on Vibration (Torsional)
18. Exp. on Engine

TME-554

MANUFACTURING SCIENCE -II - LAB

say min 8 experiments out of the following
(or such expriment alongwith study of the machines/processes)

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on Milling machine.
5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill.
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses
11. Gas welding experiment
12. Arc welding experiment
13. Resistance welding experiment.
14. Soldering & Brazing experiment
15. Experiment on unconventional machining.
16. Experiment on unconventional welding.
17. Experiment on TIG/MIG Welding.
18. Macro and Microstructure of welding joints, HAZ.

TME-555

HEAT & MASS TRANSFER - LAB

(min 8 experiment of the following or such experiment)

1. Conduction - Composite wall experiment
2. Conduction - Composite cylinder experiment
3. Convection - Pool Boiling experiment
4. Convection - Experiment on heat transfer from tube-natural convection.
5. Convection - Heat Pipe experiment.
6. Convetion - Heat transfer through fin-natural convection .
7. Convection - Heat transfer through tube/fin-forced convection.
8. Any experiment on radiation - Such as on Stefen's Law, detrmination of emissivity, etc.
9. Any experiment on radiation - Such as on solar collector, etc.
10. Heat exchanger - Parallel flow experiment
11. Heat exchanger - Counter flow experiment
12. Any other suitable exp such as on critical insultation thickness.
13. Conduction - Determination of thermal conductivity of fluids.
14. Conduction - Thermal Contact Resistance Effect.

TME-601

OPERATIONS RESEARCH

Unit-I

Linear Programming-

Introduction & Scope, Problem formulation, Simplex methods, primal & dual problem sensitivity analysis. 8

Unit-II

Transportation & Assignment problems. 4

Dynamic Programming-

Multistage decision problems & solution, Principle of optimality. 4

Unit-III

Decision theory-

Decision under various conditions. 4

Game Theory-

Minimax & maximum strategies. Application of linear programming. 4

Unit-IV

Stochastic inventory models-

Single & multi period models with continuous & discrete demands, Service level & reorder policy 8

Unit-V

Simulations-

Simulation V/S mathematical modeling, Monte carlo simulation, simulation languages, Example & cases. 4

Queing models-

Introduction Model types, M.M. 1 & M/M/S system cost consideration 4

Text Books

Operations Research by : Wangner
Production Planning of Operation Management : by Buffa.
Optimization Techniques by : S.S. Rao.
Operations Research by : Taha

TME 602
I C ENGINES

Unit-1

Introduction to I.C Engines:

Engine classification, Air standard cycles, Otto, Diesel, Stirling, Ericsson cycles, Actual cycle analysis, Two and four stroke engines, SI and CI engines, Valve timing diagram, Rotary engines, stratified charge engine. 5

Fules:

Fules for SI and CI engine , important qualities of SI engine fuels, Rating of SI engine fuels, Important qualities of CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines. 3

Unit–2

SI Engines:

Carburetion, Mixture requirements, Carburetor types Theory of carburetor, MPFI. 3

Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and it's control, combustion chamber design for SI engines. 2

Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition. 2

Unit–3

CI Engine:

Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings. 4

Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamber design of CI engines. 2

Scavenging in 2 Stroke engines, pollution and it's control. 2

Unit-4

Engine Cooling: Different cooling systems, Radiators and cooling fans. 2

Lubrication: Engine friction, Lubrication principal, Type of lubrication ,Lubrication oils, Crankcase ventilation. 2

Supercharging: Effect of altitude on power output, Types of supercharging. [2]
Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines. 4

Unit-5

Compressors:

Classification, Reciprocating compressors, Single and multi stage, Intercooling, volumetric efficiency. 3

Rotary compressors, Classification, Centrifugal compressor, Elementary theory ,Vector diagram efficiencies, Elementary analysis of axial compressors, Surging and stalling, Roots blower, Waned compressor, Performance analysis. 4

BOOKS:

Fundamentals of Internal Combustion Engine by Gill, Smith,Ziurs, Oxford & IBH Publishing COIC Engines, by Rogowsky, international Book Co.
A Course in International Combustion Engines, by Mathur & Sharma, Dhanpat Rai & Sons.
Reciprocating and Rotary Compressors, by Chlumsky, SNTI Publications Czechoslovakia .
I.C Engine Analysis & Practice by E.F Obert.
I.C Engine, by Ganeshan, Tata Mc Graw Hill Publishers.
I.C Engine, by R. Yadav, Central Publishing House, Allahabad

TPI-601
PRODUCTION PLANNING & CONTROL

Unit-I

Introduction: Types and characteristics of production systems Objective and functions of Production, Planning & Control, Place of production, Planning in Engineering, manufactures organisation. 3

Preplanning: Forecasting & Market Analysis. Factory Location & Layout, Equipment policy and replacement. Preplanning production, capacity planning. 5

Unit-II

Production Planning: Aggregate Planning, MPS, Material Resource Planning, Selection of material methods, machines & manpower. Routing, Scheduling and Dispatching and its sheets & charts, Production Line Balancing **8**

Unit-III

Production and Inventory Control: Progress control through records and charts. Types of inventories, Inventory Classification. Inventory Control under constraints Economic lot (batch) size. Trends in purchasing and store keeping, JIT production MRP II, comparison of Push & Pull systems, ERP, CAPPC. 8

Unit-IV

Productivity: Importance, Productivity patterns, productivity measurements & ratios, improvement-maintenance process. **4**

Human Factors & Ergonomics: Human abilities, Training & motivation safety programs, workplace design & working conditions. **3**

Unit-V

System Economics & Operations Economy: System Economics: Life cycle analysis, Capacity planning, Decision support system. **3**

Operations Economy: Replacement Planning, Sensitivity Analysis, Capital rationing, Product cost analysis and estimation, Allocation of resources. **5**

Books :

Elements of Production Planning & Control –Eilon
Production Planning & Control – Jain and Agarwal
Operations Management – Buffa.
Production System – J.L. Riggs.

TME - 603
MACHINE DESIGN -II

UNIT 1

Spur Gears: Conjugate action, involute gears, gear cutting methods, tooth loads, strength of spear gears in bending and in wear. Dynamic loading, Gear materials, design of gears and involute splines. Gear profile corrections, AGMA and Indian standards. **6**

Helical Gears: Tooth relationship, tooth proportions. Design of helical gears, crossed helical gears, AGMA and Indian standards.

Worm And Bevel Gears: Analysis of loads and stresses, power rating, efficiency. Gear standard and proportions. **4**

UNIT II

Bearing and Lubrication: Types of ball bearings, roller bearing, needle roller bearing, life of bearing, reliability considerations, Selection of ball, roller, tapered roller and thrust bearings, Lubrication and sealing. Mounting of bearings. **6**

Sliding Bearings: Hydrodynamic theory of lubrication, types of bearings, design of bearings using design charts, boundary lubrication, hydrostatic bearings, hydrodynamic thrust bearing. Lubrication and lubricants. **8**

UNIT III

Engine Parts: Design of engine parts such as connecting rod, crankshaft and cylinder & piston. **10**

Note that there are 3 big units instead of usual 5 units

References:

1. Mechanical Engineering Design- Joseph E. Shigley Mc Graw Hill Publications.
2. Design of Machine Members- Alex Valance and V1 doughtie, Mc- Graw- Hill Co.
3. Machine Design- D.N.Reshetov, Mir publishers: Moscow.
4. Machine Design- M.F. Spott. Prentice Hall: India
5. Fundamental Of Machine Design(vol:1, 1-5) Porlov, Mir pub. Moscow
6. Machine Elements: Dobrovsky, Mir. Pub.moscow data books
7. Fundamentals of machine design- Richard M.Phelan, Tata Mc-graw Hill pub.
8. Machine Design- Maleev and Hartman, CBS
9. Machine Design- Sharma and Agrawal, Kataria
10. Design of Machine Elements-Bhandari,TMH
11. Machine Design- Black and Adams, Mc Graw Hill

TME-604
FLUID MACHINERY

Introduction:

Classification of Fluid Mechanics, Application of momentum and momentum equation to flow through hydraulic machinery, Euler's fundamental equation. 5

Impact of jet:

Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat & curve), effect of inclination of jet with the surface. 3

Hydraulic Turbines:

Classification of turbines, Impulse turbines, constructional details, velocity triangles, power and efficiency calculations, governing of Pelton wheel. 9

UNIT-II

Reaction Turbines:

Fransis and Kaplan turbines, constructional details, velocity triangles, power and efficiency calculations, degree of reaction, draft tube, cavitation in turbines, principles of similarity, unit and specific speed, performance characteristics, selection of water turbines. 9

UNIT-III

Centrifugal Pumps:

Classifications of centrifugal pumps, vector diagram, work done by impellor, efficiencies of centrifugal pumps, specific speed, model testing, cavitation and separation, performance characteristics. 7

UNIT-IV

Positive Displacement Pumps:

Reciprocating pump theory, slip and coefficient of discharges, indicator diagram, effect and acceleration, work saved by fitting air vessels, comparison of centrifugal and reciprocating pumps, positive rotary pumps, Gear and Vane pumps, performance characteristics. 7

UNIT-V

Other Machines:

Hydraulic accumulator, Intensifier, Hydraulic press, Lift and Cranes, theory of hydraulic coupling and torque converters, performance characteristics. 5

Water Lifting Devices: Hydraulic ram, Jet pumps, Airlift pumps. 3

BOOKS:

Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvt ltd.
Hydraulic Machines: Theory & Design, V.P.Vasandhani, Khanna Pub.
Applied Hydraulics by Addison
Hydraulic Machines by R K Rajput, S.Chand & co Ltd.
Hydraulic Machines by D S Kumar

TME 606
REFRIGERATION & AIR CONDITIONING

Unit-1

Refrigeration:

Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P.

Air Refrigeration cycle:

Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART). 8

Unit-2

Vapour Compression System:

Single stage system, Analysis of vapour compression cycle, use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Different configuration of multistage system, Cascade system. 8

Unit-3

Vapour Absorption system;

Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature– concentration diagram & Enthalpy – concentration diagram , Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison. 5

Refrigerants:

Classification, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants. 3

Unit-4

Air Conditioning:

Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal hear gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP). 9

Unit-5

Refrigeration Equipment & Application:

Elementary knowledge of refrigeration & air conditioning equipments e.g compressors, condensers, evaporators & expansion devices, Air washers, Cooling, towers & humidifying efficiency, Food preservation, cold storage, Refrigerates Freezers, Icc plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning. 7

Books:

Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd.Pub.
Refrigeration and Air conditioning by C.P Aurora.
Refrigeration and Air conditioning by Arora & Domkundwar.
Refrigeration and Air conditioning by stoecker & Jones.
Refrigeration and Air conditioning by Roy J. Dossat.
Refrigeration and Air conditioning by P.L. Baloney.
Thermal Environment Engg. by Kuhen, Ramsey & Thelked.

TPI-603
PRINCIPLES OF MACHINE TOOL DESIGN

Unit-I

Introduction: Developments is machine tools, types of machine tools surface, profits and paths produced by machine tools. Features of construction and operations of basic machine tools e.g. lathe, drill, milling shapes and planers, grinding machine etc. General requirement of machine tool design. Machine tool design process. Tool wear, force Analysis. 8

UNIT-II

Machine Tools Drives: Classification of machine tool drives, group Vs individual drives, Selection of electric motor, A brief review of the elements of mechanical transmission e.g. gear, belt and chain drives,

slider-crank mechanism, cam mechanism, nut & Screw transmission, Devices for intermittent motion, reversing & differential mechanisms. Couplings and clutches Elements of hydraulic transmission system. e.g. pumps, cylinder, directional control valves, pressure valves etc. Fundamentals of Kinematics structure of machine tools. **8**

Unit-III

Regulation of Speed and Feed rates : Laws of stepped regulation, selection of range ratio, standard progression ratio, selection of best possible structural diagram, speed chart, Design of feed box, Developing gearing diagrams. Stepless regulation of speed and feed in machine tool, speed and feed control. **7**

Unit-IV

Design of Machine Tool Structure: Requirements and design criteria for machine tool structures, selection of material Basic design procedure for machine tool structures, design of bed, column and housing, Model technique in design. **5**

Design of guideways and power screws: Basic guideway profiles, Designing guideway for stiffness a wear resistance, hydrostatic and antifriction grandways. Design of sliding friction power Screws. Design of spindlier & spindle supports. **3**

Layout of bearings, selection of bearings for machine tools 2

Unit-V

Dynamics of machine tools: General procedure for assessing the dynamic stability of cutting process, closed loop system, chatter in machine tools. 5

Control Systems : Functions, requirements & types of machine tool controls, controls for speed & feed change. Automatic and manual Controls. Basics of numerical controls. Machine tool testing. 3

Books :

Machine Tools Design & Numerical Controls –N.K. Mehta, T.M.H. New Delhi.
Design of Machine Tools – S.K. Basu Allied Publishers.
Principles of Machine Tools, Bhattacharya A and Sen.G.C. New Central Book Agency.

TME 653
MACHINE DESIGN –II – LAB

(At least 2 experiments/turns (lecture –classes) from each of the four following sections. Say, 3 turns for A, 3 turns for B and 4 turns for C, total 10.)

A. Computer and Language -

Lectures should be given by teachers on introduction to computer and languages such as C Input Output statements, control statements, if, for, while, switch statement etc., Function and its uses, Structures. To make student able to write computer program in C.

B. WRITING COMPUTER PROGRAM FOR CONVENTIONAL DESIGN-

After Section B, student can write computer program for the design done in theory subjects.

C. Design Problem as a mini project

Student will be given a real life design problem and they have to complete design of it manually using hand-book etc, they can also take help of computer & programming, if needed.

TME-654
FLUID MACHINERY LAB

Say min 8 experiments from following or such experiment)

1. Impact of Jet experiment.
2. Turbine exp. on Pelton wheel.
3. Turbine exp. on Francis turbine.
4. Tubrine exp. on Kaplan turbine.
5. Exp. on Reciprocating pump.
6. Exp. on centrifugal pump.
7. Exp. on Hydraulic Jack/Press
8. Exp. on Hydraulic Brake
9. Exp. on Hydraulic Ram
10. Study through first visit of any pumping station/plant
11. Study through second visit of any pumping station/plant.
12. Any other suitable experiment/test rig such as comparision & performance of different types of pumps and turbines.

TME-656

REFRIGERATION & AIR CONDITIONING LAB

Say min 8 out of following

1. Experiment on refrigeration test ring and calculation of various proformance parameters.
2. To study different types of expansion devices used in refrigreation system.
3. To study different types of evaporators used in refrigeration systems.
4. To study basic components of air-conditioning system.
5. Experiment on air-conditioning test rig & calculation of various performance parameters.
6. To study air washers
7. Study of window air conditioner.
8. Study & determination of volumetric efficiency of compressor.
9. Visit of a central air conditioning plant.
10. Visit of cold storage.

TPI-653
MACHINE TOOL DESIGN LAB

Say min 8 out of the following

Measurement and analysis of cutting forces in orthogonal turning.
Flank wear – time characteristics for single point cutting tools.
(i) Checking the level of installation of a lathe in horizontal & vertical planes (ii) Checking the bed ways for straightness and parallelism.
Testing the main spindle of a lathe for axial movement and true running.
Process capability determination of a center lathe.
Flatness checking of a surface plate.
A study of devices for intermittent motion used in machine tools e.g. ratchet gear & Geneva Mechanism.
A study of Kinematics structure of lathe/milling machine.
A study of the drives for reciprocation used in machine tools.
Development the speed chart and gearing diagram for a gassed head lathe.
A study of the cone pulley drive in center lathe and development of its ray diagram for the speed structure.
Efficiency testing of lathe at various parameters-values.
Accuracy analysis of finished cylindrical work-pieces produced on a lathe.
Cutting (turning) with inclined placed tool (in tool fixture).
Turning with two simultaneously cutting tool (one from front on usual tool post and the other tool from back on tool-fixture on carriage)

TME 701
COMPUTER AIDED DESIGN (CAD)

UNIT – I

Introduction and review of computer programming:

Introduction to CAD/CAE, Element of CAD, Concepts of integrated CAD/CAM, CAD Engineering applications, its importance & necessity. Review of C, C++, statements such as if else for while & switch, functions, pointer-notations, structure & class, concept of OOP. **5**

Computer Graphics –I

Computer systems, Graphics input devices- cursor control devices, Digitizers, Scanners, speech oriented devices and touch panels, Graphics display devices – CRT, colour CRT monitors, DVST, Flat- panel display, Graphics output Devices. **3**

UNIT-II

Computer Graphics-II

Graphics software, Graphics functions, output primitives- Bresenham's line drawing and Mid-point circle algorithms. **3**

Geometric Transformations

Word/device co-ordinate representations, 2D and 3D geometric transformations, Matrix representation-translation, scaling, shearing, rotation and reflection, composite transformations, concatenation, rotation about arbitrary axis. Exercise and programs**.** **5**

UNIT –III

Plane Curves:

Curve representation, Interpolations Vs approximation, Parametric Continuity conditions, Spline Curves- Hermite spline, Bezier spline and B- spline Curves and its Properties. **4**

3-D Graphics:

Polygon surfaces – Polygon mesh representations, Quadric and Superquardic surfaces and Blobby objects, Fractals. Solid modeling- wire mesh and sweep representation, constructive solid geometry, Boolean operations, Boundary representations. Colour models. **4**

UNIT – IV

Computer Aided Design of Machine Elements and other Systems:

CAD of machine elements such as shaft, springs, bearings and problems from other systems such as heat exchanger, inventory control etc. Writing Computer program in C, Drafting/Design of software such as Auto-CAD and Pro-E. **7**

UNIT – V

Numerical Methods:

Introduction, Errors in numbers, Binary, octal and Hexadecimal number representation. Root-finding & Optimisation. Interactive methods- Bisection method, Regula-Falsi method, Newton Raphson method, Interpolation- Lagrange and Newton's interpolation, Curve fitting-Least Square method, Numerical differentiation-interpolation methods, Numerical integration- Trapezoidal and Simpson Method. **6**

Finite Element Methods

Introduction and Application of FEM, Stiffness Matrix/ Displacement Matrix, One/Two Dimensional bar & beam element (as spring system) analysis. **3**

Books/References

1. Computer Graphics by Hearn & Baker (Pearson / Prentice hall)
2. Computer Aided Design by R.K.Srivastava.
3. Computer Graphics –Theory & Practice- Foley, Van Dam, Feiner, (Pearson Education)
4. CAD/CAM Theory and Practice – Ibrahim Zeid (Mc Graw Hill International)
5. Computer Aided Analysis & Design of Machine Elements (Rao & Dukkipati)
6. Mathematical Elements for Computer Graphics – Rogers & Adams (Mc Graw Hill)
7. C AD/CAM – Groover & Zimmers (Prentice Hall of India Pvt Ltd)
8. Computer Oriented Numerical Methods – Rajaraman (Prentice Hall)
9. FEM – SS. Rao.

TME-702
COMPUTER AIDED MANUFACTURING (CAM)

Unit-I

1. Introduction

Introduction to Automation and need and future of NC systems and CAM. Advantages & disadvantages. Classification. Open and closed loop systems. Historical development and future trends. 4

2. Features of NC Machines-

Difference between ordinary and NC machine tools. Methods for improving Accuracy and Productivity. 3

Unit-II

3. NC Part Programming-

(a) Manual (word address format) programming. Examples Drilling and Milling. 4

(b) APT programming. Geometry, Motion and Additional statements, Macro- statement. 5

Unit-III

4. System Devices- Introduction to DC motors, stepping motors, feed back devices such as encoder, counting devices, digital to analog converter and vice versa. 3

5. Interpolators- Principle, Digital Differential Analysers. Linear interpolator, circulator Interpolator and its software interpolator. 4

6. Control of NC Systems- Open and closed loops. Automatic control of closed loops with encoder & tachometers. Speed variation of DC motor. Adaptive control. 3

Unit-IV

7. Computer Integrated Manufacturing system- Group Technology, Manufacturing cell, Transfer lines, FMS, CIM, CAD/CAM, CAPP, Concept of Mechatronics & MEMS. 6

Unit-V

8. Robotics- NC machine vs Robots. Types and generations of Robots. Robot applications. Economics, Robot programming methods. VAL and AML with examples. 6

9. Intelligent Manufacturing

Introduction to Artificial Intelligence for Intelligent manufacturing. 2

Books/References-

1. Computer control of Manufacturing systems by Koren

2. Robots by Koren
3. NC Machines by Koren
4. CAD/CAM by Groover.
5. NC Machine Tools by S.J. Martin.

TME-703
AUTOMOBILE ENGINEERING

Unit-I

Power Unit and Gear Box :

Principles of Design of main components. Valve mechanism. Power and Torque characteristics. Rolling, air and gradient Resistance. Tractive effort. Gear Box. Gear ratio determination. Design of Gear box. 7

Unit-II

Transmission System :

Requirements. Clutches. Toque converters. over Drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering and Front Axle. Castor Angle, wheel camber & Toe in Toe out etc.. Steering geometry. Ackerman mechanism, Understeer and Oversteer. 8

Unit-III

Braking System :

General requirements, Road, tyre adhesion, weight transfer, Braking ratio. Mechanical brakes, Hydraulic brakes. Vaccum and air brakes. Thermal aspects. 5

Chasis and Suspension System :

Loads on the frame. Strength and stiffness. Various suspension systems. 3

Unit-IV

Electrical System :

Types of starting motors, generater & regulators, lighting system, Ignition system , Horn, Battery etc. 5

Fuel Supply System :

Diesel & Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburator etc. MPFI. 4

Unit-V

Automobile Air Conditioning:

Requirements, Cooling & heating systems 2

Cooling & Lubrication System :

Different type of cooling system and lubrication system. 2

Maintenance system :

Preventive maintenance, break down maintenance, and over hauling system. 2

References-

1. Automotive Engineering- Hietner
2. Automobile Engineering - Kripal Singh.
3. Automobile Engineering - Narang.
4. Automotive Mechanics- Crouse
6. Automobile Engineering - Newton and Steeds.

TME-751
CAD/CAM Lab
Say 10 experiments
(6 from CAD experiments, 4 from CAM experiment)

A. CAD Experiments-

1. Line drawing or Circle drawing algorithm experiment : writing the program and running it on computer.
2. Transformations algorithm experiment for translation/rotation/scaling : writing program and running it on computer.
3. Design problem experiment : writing the program for design of machine element or other system and running it on computer.
4. Optimisation problem experiment : writing a program for optimising a function and runing it on computer.
5. Auto CAD experiment : understanding and use of Auto CAD commands.
6. Writing a small program for FEM for 2 spring system and running it. Or using a FEM package.

7. Use of Graphic software standards packages e.g. GKs/PHICS/GL etc.
8. Use of pro Engineer/Ideas etc.

B. CAM experiments-

1. Writing a part-programming (in word address format or in APT) for a job for drilling operation (point-to-point) and running on NC machine.
2. Writing a part programming (in word address format or in APT) for a job for milling operation (contouring) and running on NC machine
3. Experiment on Robots and it programs
4. Experiment on Transfer line/Material handling.
5. Experiment on difference between ordinary machine and NC machine, study or retrofitting.
6. Experiment on study of system devices such as motors and feed back devices.
7. Experiment on Mechatronics & controls.

ME-753
AUTOMOBILE ENGG. -LAB

Say any10 study & exp. from the following or such experiments)

1. Study & experment on braking system.
2. Study & experiment on fuel supply system.
3. Study & experiment on ignition system.
4. Study & experiment on steering system.
5. Study & experiment on transmission system.
6. Study & experiment on suspension system.
7. Study safety aspect of automobile design.
8. Study & experiment on Lighting or lubrication system.
9. Study & experiment on lubrication and cooling system.
10. Comparative study features of common small cars (such as fiat, Ambassador, Maruti, Matiz, Santro, Indica and its variations) available in India.
11. Comparative study & technical features of common scooters & motorcycles available in India. Case study/term paper.
12. Comparative Study & Technical features of common heavy vehicles available in India. Case study/term paper.
13. Engine tuning and carburator servicing experiment.
14. Experiment & study of MPFI system.
15. Experiment on fuel consumption measurement.
16. Review experiment on IC Engines & modern trends.
17. Visit of an Automobile factory.
18. Study & experiment of main gear box and differential gear box.

TME-801
POWER PLANT ENGINEERING

Unit-I

Introduction

Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion, calculations. 3

Variable Load problem

Industrial production and power generation compared, ideal and realised load curves, terms and factors. Effect of variable load on power planoperation, methods of meeting the variable load problem. 2

Power plant economics and selection

Effect of plant type on costs, rates, fixed elements, energy elements, sustomer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection. 3

Unit-II

Steam power plant

Powerplant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories. General layout of steam power plant. Different systems such as fuel handling system, pulverizers and coal burners, combustion system, draft, ash handling system, feed water treatment and condenser and cooling system, turbine auxiliary systems such as governing, feed heating, reheating , flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency. 8

Unit-III

Diesel power plant

General layout, performance of diesel engine, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance. 2

Gas turbine power plant

Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants. 6

Unit-IV

Nuclear power plant

Principles of nuclear energy, basic components of nuclear reactions, nuclear power station. 3

Hydro electric station

Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems. 4

Non Conventional Power Plants

Introduction to non-conventional power plants (Solar, wind, geothermal, tidal)etc. 2

Unit-V

Electrical system

Generators and generator cooling, transformers and their cooling, bus bar, etc. 2

Instrumentation

Purpose, classification, selection and application, recorders and their use, listing of various control rooms. 3

Pollution

Pollution due to power generation 2

References

1. "Power Plant Engineering" F.T. Morse, Affiliated East-West Press Pvt. Ltd, New Delhi/Madras.
2. "Power Plant Engineering" Mahesh Verma, Metropolitan Book Company Pvt. Ltd. New Delhi.
3. "Power Plant Technology" El-Vakil, McGraw Hill.
4. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
5. Steam & Gas Turbines & Power Plant Engineering by R.Yadav, Central Pub.House.

TPI 801
QUALITY CONTROL

Unit-I

Introduction : Concept and evoluation of quality control. Measurement & Metrology, precision vs accuracy. Process capability, standrdisation & Interchangeability. 3

Inspection and Gauges : Inspection methods. Types of Gauges. Limits Fits and Tolerances. Non-Destructive Testings & Evaluation. 5

Unit-II

Control Charts for SQC : Statistical Quality Control (SQC). Control charts for variables such as X, R charts and control charts for attributes such as p-chart, c-chart. Construction & use of the control charts. Process capability. 8

Unit-III

Acceptance Sampling for SQC : Principle of acceptance sampling. Producer's and consumer's risk. Sampling plans –single, double & sequential. Sampling by attributes and variables. 7

Unit-IV

Reliability : Introduction to reliability, bath-tub curve. Life expectancy. Reliability based design. Series & Parallel System. 3

Defect Diagnosis and prevention : Basic causes of failure, curve/control of failure. **MTBF.** Maintainability, Condition monitoring and dignostic techniques. 4

Value Engineering : Elements of value analysis, Techniques. 2

Unit-V :

TQM : Inspection, Quality control , Quality Assurance and Quality Management and Total Quality Management. Implementation of TQM . ISO 9000 and its series, Zero defect. Quality circle . Taguchi method. Six sigma concept. 5

Other Factors in Quality : Human Factors such as attitude and errors. Material-Quality. Machine Capability and Manufacturing process limitations. Quality in sales & service. Methods for improving accuracy & quality. Quality Circle. 3

Reference:

1. Statistical Quality Control by Grant and Leavarworth, McGraw Hill

2. Maintenance for Reliability by Rao.

TME-802
MECHANICAL SYSTEMS DESIGN

UNIT I

Engineering Process and Systems Approach:

Basic concepts of systems, attributes characterizing a system, system types. Application of systems concepts in Engineering, advantages of systems approach, basic problems concerning systems. Concurrent Engineering. A case study: e.g. viscous lubrication system in wire drawing. **4**

Problem Formulation:

Nature of engineering problems, Needs statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraints. A case Study: e.g. heating duct insulation – system high- speed belt drive system. **4**

UNIT II

System Theories:

System analysis, Black Box approach, state theory approach, component integration approach, Decision process approach; A case study : e.g. automobile instrumentation panel system. **4**

System Modeling:

Need of modeling, Model types and purpose, linear systems, mathematical modeling, Concepts; A case study: e.g. A compound bar system. **4**

UNIT III

Graph Modeling and Analysis:

Graph Modeling and analysis process, path problem , Network flow problem, A case study: e.g. material handling system. **4**

Optimization Concepts:

Optimization process, selection of goals and objectives- Criteria, methods of optimization analytical, combinational, subjective. A case study: e.g. aluminium extrusion ion system. **3**

UNIT IV

System Evaluation:

Feasibility assessment, planning horizon, time value of money, financial analysis. A case study: e.g. manufacture of a Maize-Starch system. **4**

Calculus Methods for optimization:

Model with one decision variable, model with two decision variables, model with equality constraint, Model with inequality constraint. A case study: e.g. optimization of an insulation – system. **4**

UNIT-V

Decision Analysis:

Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict Probability density function, Expected monetary value, utility value, Baye's theorem: A case study: e.g. Installation of a Machinery. **4**

System Simulation:

Simulation concepts, simulation models, computer applications in simulation, spread sheet simulation. Simulation process, problem definition, input model construction and solution, limitations of simulation approach. A case study: e.g. An inventory control in a Production – Plant. **5**

REFERENCES:

1. Design And Planning of Engineering Systems – by D.D.Reredith, K.V.Wong, R.W.Woodhead, and R.R.Worthman, Prentice Hall Inc., Englewood Cliffs, New Jersey.
2. Design Engineering- by J.R.Dixon, Tata Mc Graw Hill Publishing Company, New Delhi.
3. An Introduction to Engineering Design Method – by V.Gupta and P.N. Murthy, Tata Mc. Graw Hill.
4. Engineering Design – Robert Matousck, Blackie and Son Ltd., Glasgow.
5. Optimisation Techniques – S.S.Rao.
6. System Analysis and Project Management- Devid I. Cleland, William R.King, Mc Graw Hill.

TME-803
PROJECT MANAGEMENT

Unit-I :Project Management Concepts:

Introduction, project characteristics, taxonomy of projects, project identification and formulation. Establishing the project and goals. Nature & context of project management; phases of PM, A framework for PM issues, PM as a conversion process, project environment & complexity. Organizing human resources, organizing systems & procedures for implementation. Project direction. **8**

Unit-II : Project Organization & Project Contracts:

Introduction, functional organization, project organization, matrix organization, modified matrix organization, pure project organization, selection of project organization structure, project breakdown structures, project contracts, types of contracts, types of payments to contractors. **8**

Unit-III : Project Appraisal & Cost Estimation:

Introduction, technical appraisal, commercial appraisal, economic appraisal, financial appraisal, management appraisal, social cost/benefit analysis, project risk analysis. Cost analysis of the project, components of capital cost of a project, modern approach to project performance analysis. **8**

Unit-IV: Project Planning & Scheduling:

Introduction to PERT & CPM, planning and scheduling networks, time estimation, determination of critical path, CPM model, event slacks & floats, PERT model, expected time for activities, expected length of critical path, calculating the project length and variance, PERT & CPM cost accounting systems, lowest cost schedule, crashing of networks, linear programming formulation of event oriented networks, updating of networks, LOB technique. **8**

V- Modification & Extensions of Network Models:

Complexity of project scheduling with limited resources, resource leveling of project schedules, resource allocation in project scheduling - heuristic solution.

Precedence networking- examples with algorithm, decision networks, probabilistic networks, computer aided project management- essential requirements of PM software, software packages for CPM. Enterprise-wide PM, using spread sheets for financial projections. 8

ENGINEERING MATERIALS
TME-011

UNIT-I

Ferrous Materials, their Properties and Applications:

Plain carbon steels, their properties and application: plain carbon steels, effects of alloying elements in plain carbon steels. Alloy steels, tools steels, stainless steels, low and high temperature resisting steels, high strength steels, selections, specifications, form and availability of steel. 8

Cast irons-white, grey, modular malleable and alloy cast irons. Recognised patterns of distribution of graphite flakes in grey cast iron. 2

UNIT-II

Heat Treatment of Steels

TTT diagrams, annealing, normalising, hardening and tempering of steel. Austempering and martempering of steel. Hardenibility, Journing end quench test. Grauisis and its determination. Effect of graion the properties of steel. 5

Surface hardening of steel :

Carbonising nitriding carbonitriding cyniding, flues and inducation hardenirng microscopic determination of case depth and depth of hardening. 3

Unit-II

Nonferrous materials, their properties and application, brasses, bronzes, cupro-nickel alloys, aluminum, magnesium and titanium alloys, bearing materials, selection, specific form and availability. Heat treatment of nonferrous materials – soputionising and precipitations hardening 8

Unit-IV

Composites

Polymer – polymer, metal-metal, ceramic –ceramic, ceramic-polymer, metal-ceramic, metal-polymer composites. Dispersion reinforced, particle reinforced, laminated and fibre reinforced composites. 6

UNIT-V

ELASIOMERS AND MASULLANEOUS

Types, properties and identifications of different types of rubbers vulcanisation, fabrication and forming techniques of rubber. Introduction of plastics and ceramics – types, application and process. Smart materials-introduction and types. Selection of materials and factors effecting defselection, Selection process and systematic evaluation. 9

TME – 012
ADVANCED SYNTHESIS OF MECHANISMS (Elective – I)

UNIT I

Basic Concepts:

Mechanisms, Classifications, Rigid & Absolute motion, Connections & degree of Freedom, 4-bar mechanisms–planar & spatial, Inversion and equivalent linkage, Transmission angle. **3**

Kinematic Analysis of Planar Motion:
Relative velocity, Instantaneous center, Poles and Centrodes, Acceleration, Acceleration difference. **4**

UNIT II

Type, Number & Dimensional Synthesis:
Kinematic synthesis, Type synthesis, Number synthesis, Dimensional synthesis, Accuracy points, Chebyshev polynomial. **4**

Four Bar Coupler Point Curves:
4-bar linkages, Equation of coupler curves, Double points and symmetry, Robert- Chebyshev theorem. **3**

UNIT III

Geometrical Methods of Synthesis:
Poles and Relative Poles of 4-bar linkage, Poles & Relative Poles of Slider crank mechanism, Synthesis with 3 accuracy points, Pole triangle, 4 position synthesis, example. **8**

UNIT IV

Algebraic Method of Synthesis:
Displacement equation of 4- bar linkage, Crank- follower synthesis with 3 accuracy points, Four bar function generator with 3 accuracy points, Crank and follower synthesis angular velocities and acceleration. **8**

UNIT V

4-accuracy point synthesis of slider- crank mechanism and 4- bar mechanism, five accuracy point synthesis of crank and follower mechanisms, Structural error, Mechanical errors in 4 –bar mechanisms. **8**

References:

1. Kinematic Synthesis of Linkages: Hartenberg RS and Denavit J, Mc Graw Hill.
2. Kinematic & Linkage Design: AS Hall Jr., Prentice Hall India.
3. Mechanisms & Machine Theory: Amitabh Ghosh & AK Mallick.
4. Mechanism Design: Analysis & Synthesis: Erdman & Sandor, Prentice Hall.

TME013
THERMAL TURBO MACHINES

UNIT-I

Brief history of turbo machinery, introduction to blowers, pumps, compressors, steam & gas turbines, turbojet, Review of laws of thermodynamics & SFEE in reference to turbo machinery, Energy transfer in turbo machines, Euler's equation, Velocity diagrams for axial & radial turbo machinery and pumps. Definition of various efficiencies, Introduction to blowers, pumps, compressors, steam & gas turbines turbojet. 8

UNIT-II

Centrifugal compressors- Principle of operation, work done and pressure rise, Diffuser, state losses, ship factors, Performance, characteristics. 4

Axial flow compressor- basic operation, Elementary theory, Factors affecting stage pressure ratio, Blockage in compressor annulus, Degree of reaction, 3-D flow, Design process, blade design, calculation of stage performance. Supersonic & transonic stages, Performa ce. 4

UNIT-III

Axial flow turbines-Elementary theory of axial flow turbine, Vortex theory, Choice of blade profile, pitch and chord, Estimation of stage performance. 4

UNIT-IV

Steam turbines- Constructional details, working of steam turbine. 4

Pumps : Pumps, main components, indicator diagram and modification due to piston acceleration, performance and characteristics, axial flow pumps. 4

Radial flow turbines: Single velocity triangle Enthalpy- Entropy diagram, State losses, performance, Characteristics. 4

UNIT-V

Gas Turbine Starting & Control Systems: Starting ignition system, combustion system types, safety limits & control.

Turbine Blade coding: Cooling techniques, types

Mechanical Design consideration: Overall design choices, Material selection, Design with traditional materials. 8

Books-

1. Gas turbine theory : Gohen & Rogers, Addison Weslay Longman Ltd.
2. Design of high efficiency turbomachinery and gas turbines, David Gordon Wilson, Theodosios Korakianitis, Prentice Hall International.
3. Turbomachinery : S.M. Yahya.

4. Turbine, Compressors and Fans, S.M. Yahya, Tata Mc Graw Hill.
5. Gas Turbine- Ganeshan, Tata Mc Graw Hill.

TME014
UNCONVENTIONAL MANUFACTURING PROCESSES

Unit-I

Introduction: Limitations of conventional manufacturing processes, need of unconventional manufacturing processes and its classification. 5

Unit-II

Unconventional Machining Process: Principle and working and applications of unconventional machining process such as Electro-Discharge machining, Electro-chemical machining, ultrasonic machining, Abrasive jet machining etc. 8

Unit-III

Principle and working and application of unconventional machining processes such as laser beam machining, Electron beam machining, Ultrasonic machining etc. 8

Unit-IV

Unconventional welding processes: Explosive welding, Cladding etc. Under water welding, Metallising, Plasma are welding/cutting etc. 8

Unit-V

Unconventional Forming processes: Principle, working and applications of High energy forming processes such as Explosive Forming, Electromagnetic forming, Electro-Discharge forming, water hammer forming, explosive compaction etc. 10

Books

1. Modern Machining Processes – P.C. Pandey
2. Unconventional Machining – V.K. Jain

TME015
REFRIGERATION & AIR CONDITIONING SYSTEM DESIGN

Unit-I

Psychrometry of Air Conditioning Processes, Design Conditions & Load Calculations

Psychrometric Processes in Air Conditioning Equipments, By pass Factor and Apparatus Dew Point of Cooling & Dehumidifying Coils, Dehumidified air quantity, Analysis of Air Conditioning systems for summer & winter conditions, Inside & out side design conditions for comfort, Industrial Air Conditioning.

Cooling & Heating Load calculations- Heat transfer through building structures, solar heat gain, Infiltration & ventilation air, Internal heat gain, Occupancy & Product load, Room sensible heat factor, Effective sensible heat factor & Grand sensible heat factor, capacity of the plant. 10

Design & Selection of Air conditioning Apparatus

Heat & moisture transfer in Air conditioning apparatus, Enthalpy potential, Analysis of Coil & Spray Equipments Design of Cooling & Dehumidifying coils, Design of Air Washer & Cooling Towers. 4

Unit-II

Analysis of Complete Vapour Compression System – Design and Balancing of System Components

Type of Refrigerant Compressors, Condensers, Evaporators & Expansion devices used in Vapour Compression Refrigeration Cycles, Design and Selection of individual components and their performance characteristics, Use of P-H charts for different Refrigerants in performance predication of the cycle.

Analysis of the complete vapour-compression-system and determination of 'Balance Points' using Graphical and Analytical methods, system simulation.

Layout & selection of Refrigerant, water and Brine pipings for the designed system.

Selection of Refrigeration and Air conditioning Controls for the system. 12

Unit-III

Air Handling System-Transmission and Distribution of Air

Various inlets & outlets for supply and return air, Room Air Distribution.

Duct Design- Air Flow Through a duct : Static & Dynamic Losses; Pressure Drops in Ducts due to Duct Friction, Change of Direction, Area and Velocity; Friction Charts; Equal Friction, Velocity Reduction & Static Regain method for Duct Design. Type of Fans and their performance characteristics, Design & Selection of Fans. 8

Applications in Food Preservation

Methods of Food Freezing, Preservation conditions and storage Period for different food products, Cold Storage-Long term & Short Term Storage of Food Products, Economic consideration, Important insulation materials for Cold Storage and their desirable properties.

Ice Plant -Ice manufacture, Brine temperature, Frezing Time, Ice Cans per ton of Ice Harvest. 6

References

1. Refrigeration & Air Conditioning - By C.P. Arora
2. Refrigeration & Air Conditioning - By Manohar Prasad
3. Principles of Refrigeration (S.I.Units) - By Roy J.Dossat
4. Air Conditioning Engineering - By W,P.Jones
5. Heating, Ventilating and Air Conditioning - By Mc Quistion, Parker & Spitler
6. Refrigeration & Air Conditioning Data Book – Manohar Prasad
7. Ashrae hand Book – Fundamentals
8. Refrigeration & Air Conditioning-Stoecker & Jones
9. Refrigeration & Air condioning – By P.L.Ballaney

Important Notes

1. This syllabus has been prepared keeping in view an **'Open Book Examination'**
2. Text Books, Hand Books , Data Books, Refrigeration & Air conditioning Tables & Chatts are allowed in the examinations.

TME-016
TOTAL QUALITY MANAGEMENT (TQM)

Unit-I

Quality Concepts

Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design, Review off design, Evolution of proto type. 3

Control on Purchased Product

Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. 2

Manufacturing Quality

Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims. 3

Unit-II

Quality Management

Organization structure and design, Quality function, decentralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme. 5

Human Factor in Quality

Attitude of top management, co-operation, of groups, operators attitude, responsibility, causes of operators error and corrective methods. 2

Unit-III

Control Charts

Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts. 5

Attributes of Control Charts

Defects, construction and analysis off-chart, improvement by control chart, variable sample size, construction and analysis of C-chart. 5

Unit-IV

Defects Diagnosis and Prevention

Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle. 8

Unit-V

IS0-9000 and its concept of Quality Management:

ISO 9000 series, Taguchi method, JIT in some details 7

References:

1. Lt. Gen. H.LaI, "Total Quality management", Wiley Eastern Limited, 1990. .
2. Greg Bounds. "Beyond Total Quality Management". McGraw Hill, 1994.
3. Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992.

ENVIRONMENTAL PROTECTION AND MANAGEMENT
TME-017

Unit 1. Introduction, Importance of environmental protection for engineering & Scientists Chemistry of hazardous materials. 6

Unit 2. Toxic Materials and its environmental & health effects. 8

Unit 3. Fundamentals of environmental laws. Laws related to Air pollution, water pollution, toxic substance control, safe drinking-water, occupational safety & health & noise control. 9

Unit 4. Environmental hazards and their control, General principle of Hazards Control. Hazard & its control from: Chemicals, noise & vibration, radiation, hazardous waste, heat & cold, fire, tools & machines,Personal-protective-equipment 10

Unit5. Environmental impact assessment, rationale for assessing impact, Phases of environmental impact assessment. Air and water quality managements. 7

Books:

1. Ecology, impact assessment & environmental planning – By walter E.Westman-Johuwilly & jons U.S.A.
2. Hand book on Hazardous materials management – By Tom Carson – Inptitute of Hazardous materials management, USA.
3. Environmental Law Handbook-By J. Gordon Arbuckle- Government Institutes Inc. Rockville, M.D., USA.
4. Safety & Health for engineers – By Roger L.Brauer – Van Nostrance Reinhold – Newyork, USA.
5. Environmental chemistry – By Stanley E. Manehan. Books/cole Publishing company motherly, California.
6. Public Policies for Environmental Protection – By Paul R. Portney Resources for the future. Washington D.C.

TME-018
PRODUCT DEVELOPMENT & DESIGN

UNIT-I

Product, Definition, Scope, Terminology etc. **2**

Design definitions, old and new design methods, Design by evolution, Examples such as evolution of sewing m/c, bicycle, safety razor etc., Need based developments, Technology based developments. Physical realisability & Economic feasibility of design concepts. **6**

UNIT-II

Morphology of design, Divergent, transformation and convergent phases of product design, identification of need, Analysis of need. **2**

Design for what? Design criteria, functional, aesthetics, ergonomics, form, shape, size, colour.. **2**

Mental blocks, Removal blocks, Ideation techniques, Creativity, Check list. **2**

UNIT-III

Transformations, Brainstorming & Synetics, Morphological techniques. **4**

Utility concept, Utility value, Utility index, Decision making under Multiple criteria. **2**

Economic aspects, Fixed and variable costs, Break-even analysis **3**

UNIT-IV

Reliability considerations, Bath tub curve, Reliability of systems in series and parallel, Failure rate, MTTF and MTBF, Optimum spares from Reliability considerations. **4**

Design of display and controls, Man-machine interface, Compatibility of displays and controls. **1**

Ergonomic aspects, Anthroprometric data and its importance in design. **2**

Application of Computers in Product development & design. **3**

UNIT-V

Existing techniques such as work-study, SQC etc. which could be used to improve method & quality of product. **2**

Innovation versus Invention. Technological Forecasting. **3**

Use of Standards for Design. **2**

Books/references

1. Product Design & Manufacturing - A.K.Chitab &R.C.Gupta, PHI (EEE).
2. The Technology of Creation Thinking - R.P.Crewford – Prentice Hall
3. The Art of Thought – Grohem Walls – Bruce &Co., New York
4 Product Design & Decision Theory - M.K. Starr - Prentice Hall
5. Engg . Product Design -C .D. Cain, Bussiness Books.
6. Industrial design for Engineers –W .H. Mayall, Itiffe.

7. Human Factor Engg. – Mccormick EJ , Mc GrowHill.
8. Engineering: An Introduction to Creative profession – GC Beakley Hw leach, Macmillan.

OPERATIONS MANAGEMENT : MODELS & CONCEPTS
TME-019

Unit-I : Production & Operations Strategy:

Production & Operation Strategy, Capacity growth planning, economics of scale & economics of scope, make or buy, dynamic capacity expansion, issues in plant location, learning curves, experience curves, learning & experience curves and manufacturing strategy, matching process & product life cycles, recent advances in manufacturing technology and control **8**

Unit-II : Forecasting Methods & Aggregate Planning:

Time horizon in forecasting, characteristics of forecasts, subjective and objective forecasting methods, casual methods, time series methods, evaluating forecasts, methods for forecasting stationery series, exponent ional smoothing, methods for seasonal series.

The aggregate planning problem, evaluation of chase strategy & constant work force plan, solution of aggregate problem as LP problem, linear decision rule, disaggregating the aggregate plan. **8**

Unit-III : Inventory Control & MRP:

Inventory control subject to known demand, characteristics of inventory systems, relevant costs, the EOQ model with and with and without order lead time, EOQ & JIT, quantity discount model, resource constrained multiple product systems, inventory control subjected to uncertain demand, determining optimal policy. **4**

MRP: the explosion calculus, lot sizing schemes- heuristic lot sizing, incorporating lot-sizing algorithms into explosion calculus, use of MRP in real world. **4**

Unit-IV : Operation Scheduling:

Characteristics of job shop scheduling problems, comparison of specific sequencing rules- FCFS, SPT, EDD, critical ratio. Theory of sequencing for single machine- with rules such as SPT,EDD, and minimum number of tardy jobs (NT). Minimizing the NT. Incorporating the precedence constraints. Sequencing algorithms for multiple machines- n jobs x 2 machines, extension to 3 machines, 2 job flow shop problem, stochastic scheduling- static analysis, vehicle scheduling & assembly line balancing. **8**

Unit-V : Facility Layout & Location:

The facility layout problems, patterns of flow, activity relationship chart, from/to chart. Layout types, layout problem & assignment model, computerized layout planning techniques e.g. CRAFT, COFAD, ALDEP, CORLEP, PLANET etc.

Locating new facilities, measures of distance, single facility, rectilinear distance problem, minimax problem, Euclidean distance problem, gravity problem, straight-line distance problem, locating multiple facilities. **8**

TME 021
MECHANICAL VIBRATION

UNIT- I

INTRODUCTION: Periodic motion, harmonic motion, superposition of simple harmonic motions, beats, fourier analysis. **3**

Single Degree Freedom System:

Free vibration, Natural frequency, Equivalent Systems, Energy method for determining natural frequency, Response to an initial disturbance, Torsional vibrations, Damped vibrations, Damping models – Structural, Coulomb and Viscous damping, Vibrations of system with viscous damping, Logarithmic decrement, Viscous dampers. **5**

UNIT- II

Single Degree Freedom: Forced Vibration

Forced vibration, Harmonic Excitation with viscous damping, Steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments- Displacement, Velocity, Acceleration and Frequency measuring instrument. **8**

UNIT- III

Two Degree Freedom System:

Introduction, Principal modes, Double pendulum, Torsional system with damping, Coupled System, Undamped dynamic, vibration absorbers, Centrifugal pendulum absorber, Dry friction damper, Untuned viscous damper. **8**

UNIT- IV

Multidegree Freedom System: Exact Analysis

Undamped free and forced vibrations of multidegree system, Influence numbers, Reciprocal Theorem, Torsional vibration of multi rotor system, Vibration of geared system, Principal coordinates, Continuous systems- Longitudinal vibration of bars, Torsional vibrations of Circular shafts, Lateral vibration of beams. **8**

UNIT- V

Multidegree Freedom System: Numerical Analysis

Rayleigh's, Dunkerley's, Holzer's and Stodola's methods, Rayleigh – Ritz method. **5**

Critical Speed of Shafts:

Shafts with one disc with and without damping, Multi-disc shafts, Secondary critical speed. **3**

Reference :

1. Mechanical Vibration – P. Srinivasan – TMH
2. Mechanical Vibration – G. K. Grover – Jain Bros. Roorkee.
3. Mechanical Vibration –W.T. Thomson
4. Mechanical Vibration – Theory & Application – Tse, Morse & Hinkle
5. Introduction Course on Theory and Practice of Mech. Vibration – J.S. Rao & K. Gupta, New Age Publishers.
6. Mechanical Vibration Practice with Basic Theory – V. Rama Murthy – Narosa Publishers.

TME-022
ADVANCED FLUID MECHANICS

UNIT-I

Review of kinematics of fluid motion, method of describing fluid motion, translation, rate of deformation, the material derivatives, acceleration, vorticity in cartesian & polar coordinates, Reynolds transport theorem, Stress at a point, velocity profile, wall shear stress. 7

UNIT-II

Non-viscous incompressible flow- Equation of continuity, Euler's equation of motion, Bernoulli's equation, circulation and its theorem, stress function, velocity potential, irrotational flow, two dimensional source, sink, source-sink pair, doublet vortex, superposition of source-sink with rectilinear flow, Rankine body, Superposition of rectilinear flow and doublet, flow around a spinning circular cylinder, Magnus effect, lift & Drag, Skin friction. Lift of aerofoils. 9

UNIT-III

Boundary layer Concept-Introduction to boundary layer formation, Novier-stokes equation, Boundary layer thickness, momentum thickness, energy thickness, Boundary layer equations, Momentum-Integral equation - Von Korman, Blasius solution of boundary layer on a flat plate without pressure gradient, Flow with very small Reynolds number, Hogen poisseuille flow, Plane Couette flow, Hydrodynamic theory of lubrication. 8

UNIT-IV

Compressible flow- Propagation of pressure change, sound velocity, elastic waves, Mach number, Mach cone, isentropic flow relations in terms of sonic velocity and mach number, Stagnation properties, Regions of flow, Energy equation, Effect of Mach number on compressibility. Propagation of infinitesimal waves, Non-steep finite pressure wave and steep finite pressure waves, Expansion waves Isentropic flow with variable area, Mach number variation and its effect on Flow through nozzles and diffusers. Area ratio, impulse function, Use of Gas/Air tables. 8

UNIT-V

Flow with normal shock waves- Development of shock wave, rarefaction wave, governing equations, Prandtle-Meyer relation. Thermodynamic properties across shock. Wind tunnels. 3

Flow in constant area duct with friction-Fanno curves, Fanno flow equations, Solution of fanno flow equations. Variation of flow properties. Tables & charts for Fanno flow. 3

Flow in constant area duct with heat transfer- Rayleigh line, Fundamental equations, Rayleigh flow relation, Variation of flow properties. Tables & Charts for Rayleigh flow. 2

Books:

1. Fluid Mechanics by White.
2. Fluid Mechanics by Streeter
3. Fluid Mechanics by Som & Biswas

4. Fluid Mechanics by K.L. Kumar
5. Fluid Mechanics by A.K. Jain
6. Fundamentals of Compressible flow by S.M. Yahya
7. Gas Dynamics by Z. Hussain
8. Viscous fluid flow by white
9. Computational Fluid Dynamics by Anderson
10. Gas Dynamics by E. Radhakrishnan

NON-CONVENTIONAL ENERGY RESOUCES AND UTILISATION
TME 023

NOTE: This subject can only be taken, if not taken similar subject as open elective.

UNIT-1

Indian and global energy sources, Energy exploited, Energy planning, Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy. 3

Solar radiations:

Extra terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, Measurement of solar radiations, Solar radiation geometry, flux on a plane surface, latitude, declination angle, surface azimuth angle, hour angle, Zenith angle, solar altitude angle expression for angle between incident beam and the normal to a plane surface (no derivation), Local apparent time, Apparent motion of sun, Day length. 4

UNIT-2

Solar energy:

Solar thermal power and it's conversion, Solar collectors, Flat plat, Concentric collectors, Cylindrical collectors, Thermal analysis of solar collectors. 3

Solar energy storage, Different systems, solar pond. 2

Applications, Water heating, Space heating & cooling, Solar distillation, solar pumping, solar cooking, Greenhouses, Solar power plants. 3

UNIT-3

Biogas:

Photosynthesis, Bio gas production Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications, Biomass conversion techniques, Energy plantation, Fuel properties. 5

Wind energy:

Properties of wind, Availability of wind energy in India, wind Velocity, win machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Economic issues, Recent development. 3

UNIT-4

Electrochemical effects and fuel cells:

Revisable cells, Ideal fuel cells, Other types of fuel cells, Efficiency of cells, Thermions systems. 3

Tidal power:

Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy Limitations of tidal energy conversion systems. 2

Hydrogen Energy:

Properties of hydrogen in respect of it's use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel. 2

UNIT-5

Thermoelectric systems:

Kelvin relations, power generation, Properties of thermoelectric materials, Fusion Plasma generators. 3

Geothermal energy:

Hot springs, Steam ejection, Principal of working, types of geothermal station with schematic representation, Site selection for geothermal power plants. Advanced concepts Problems associated with geothermal conversion. 3

Ocean energy;

Principal of ocean thermal energy conversion, Power plants based on ocean energy, problems associated with ocean thermal energy conversion systems. 3

Books:

Bansal Keemann, Meliss," Renewable energy soucesa and conversion technology", Tata Mc Graw Hill.
Rai G.D,"Non-Conventional energy Sources", Khanna Publishers.
Ashok V. Desai,"Nonconventional Energy", New Age Internantional Publishers Ltd.

TME-024
FUNDAMENTALS OF BIOMEDICAL ENGINEERING
(Elective II)

UNIT I

Biomechanics

Statics and dynamics of the musculoskeletal system, forces and moments. Acting in the skeletal system and the various techniques used to describe them. Forces and moments with in the body such as forces acting at hip and knee joint and in the extremities. Analysis of pathological situations of human joints. **9**

UNIT II

Biomaterials

Stress strain behaviour of bone. The mechanical properties including elasticity, hardness, viscoelasticity, surface and fatigue properties of skin; soft tissues; bone; metals; polymers and ceramics. Biocompatible materials and its applications. The effects of degradation and corrosion. **8**

UNIT III

Bio Fluid Flow

Fluids-laminar and turbulent flow, boundary layer, non-newtonian and pulsatile models, blood rheology, circulatory system, blood-flow in arteries, veins and heart, synovial fluid, joint friction. **6**

UNIT IV

Bioinstrumentation

Fundamentals of producing a medical image, image collection techniques, image reconstruction algorithms, detailed examination of the four main areas of medical imaging : Nuclear Medicine and positron Emission Tomography, Ultrasound, Diagnostic Radiology, Magnetic Resonance and its clinical applications. Physiological signals, noise, and available sensors and transducers and their characteristics **9**

UNIT V

Computing for Biomedical Engineers

Health care information and communications, Including telemedicine, medical informatics, networks and privacy. Data Collection, Medical coding and classification. Standards for medical data interchange. Aspects of database design, client/server topologies. **6**

Reference:

1. Basic orthopedic biomechanics, Editors-VC Mow & Wc Hayes, Lippincott Raven Publishers.
2. Biomaterials Science- An Introduction to Materials in Medicine. Buddy D.Rattner, Allan S.Hoffman, Frederick J.Schoen, Jack E.Lemmons, Editors, Academic Press.
3. Biomaterials: An Introduction(second edition) Joon B.Park & Roderic S.Lakes, Plenum Press, 1992.
4. Biofluid Mechanics, Jagan N.Mezumdar; World Scientific Pub.Co.,NJ 1992
5. Handbook of Biomedical Instrumentation, RS Khandpur.
6. Mthematical models in biology and medicine- J.N.Kapur, Affliated East West Press Pvt. Ltd., NewDelhi-India
7. Bone Mechanism – W.C.Heys, CRC Press
8. Computers in Medicine- Lele.

NON DESTRUCTIVE TESTING
TME-025

L T P
3 1 0

Unit-1

INTRODUCTION:

Scope and advantages of N.D.T. some common NDT methods used since ages - visual inspection, Ringing test, and chalk – test (oil-whiting test) their effectiveness in detecting surface cracks, bond strength and surface defects. 6

Unit-2

Common NDT methods

Dye – penetrant tests – principle, scope, equipment and techniques. Zyglo testing.

Magnetic Particle Tests- Scope of test, Principle equipment and technique. DC And AC magnetization, use of day and wet powders magnaglow testing. Interpretations of results. 7

Unit-3

RADIOGRAPHIC METHODS

X-ray radiography – principle, equipment and methodology. Interpretation of radiographs, Limitations Gama ray radiography. Principle, equipment, source of radioactive material and technique. Precautions against radiation hazards, Advantage over x-ray radiography methods. 8

Unit-4

ULTRASONIC TESTING METHODS

Introduction Principle of Operation – piezoelectricity. Ultrasonic probes, cathode ray oscilloscope techniques and advantages limitation and typical applications. 8

Unit-5

Testings of castings, forgings & weldments

Application of NDT methods in inspection of castings, forgings and welded structures with illustrative examples. Case studies. Sample-testings in the lab. 8

[This course to be offered where NDT laboratory facilities are available]

TME-026

CONCURRENT ENGINEEIRNG

Unit-I

INTRODUCTION:

Background and challenges faced by modern production environment, sequential engineering process, Concurrent engineering definition and requirement, meaning of concurrent objectives of CE, benefits of CE, Life cycle design of products, life cycle costs. 4

SUPPORT FOR CE

Classes of support for CE activity, CE organizational, structure CE, team composition and duties, Computer based Support, CE Implementation Process. 4

Unit-II

DESIGN PRODUCT FOR CUSTOMER

Industrial Design, Quality Function Deployment, house of quality, Translation process of quality function deployment (QFD). 3

Modeling of Concurrent Engineering Design

Compatibility approach, Compatibility index, implementation of the Compatibility model, integrating the compatibility Concerns. 4

Unit-III

Design for Manufacture (DFM)

Introduction, role of DFM is CE, DFM methods, e.g. value engineering, DFM guidelines, design for assembly, creative design methods, product family themes, design axioms, Taguchi design methods, Computer based approach to DFM. Evaluation of manufacturability and assemblability. 9

Unit-IV

Quality by Design

Quality engineering & methodology for robust product design, parameter and Tolerance design, Quality loss function and signal to noise ratio for designing the quality, experimental approach. 9

Unit-V

Design for X-ability

Design for reliability, life cycle serviceability design, design for maintainability, design for economics, decomposition in concurrent design, concurrent design case studies. 7

Books

1. Concurrent Engineering Kusiak John Wiley
2. Concurrent Engineering Menon Chapman & hall

MANAGEMENT INFORMATION SYSTEM

TME-027

Unit-I

Organisation & Types, Decision Making, Data & information, Characteristics & Classification of information, Cost & value of information, Various channels of information & MIS. **6**

Unit-II

Foundation of Information System : Introduction to Information System in Business Fundamentals of Information System, Solving Business Problems with Information System, Concept of Balanced MIS, Effectiveness & Efficiency Criteria. Tool and Techniques of MIS- dataflow diagram, flow chart etc. **10**

Unit-III

Business application of information technology, electronic commerce, Internet, Intranet, Extranet & Enterprise Solutions, Information System for Business Operations, Information system for managerial Decision Support, Information System for Strategic Advantage. **8**

Unit-IV

Managing Information Technology, Enterprise & Global Management, Security & Ethical Challenges, Planning & Implementing Change.

Reports: Various types of MIS reports, GUI & Other Presentation tools. **6**

Unit-V

Advanced concepts in information system: Enterprise Resource Planning: introduction, various modules like Human Resources, Finance, Accounting, Production & Logistics. Supply Chain Management, CRM, Procurement Management System Object Oriented modeling case studies. 10

Books

O.Brian, "Introduction to Information System", Mc-Graw Hill.
O.Brian, "Management Information System", TMH.
Alter, "Information Systems : A Management Perspective", Addison Wesley.
Arora & Bhatia, "Information Systems for Managers", Excel
Bansal, "Information System Analysis & Design", TMH.
Jawadegar, "Management Information System", TMH.
Murdick, "Information System for Modern Management", PHI.
Alexis Leon, "Enterprise Resource Planning", TMH.

TME-028
AUTOMATIC CONTROLS

Unit-I

Introduction : Concept of automatic controls-open loop and closed-loop systems, block diagrams, transfer functions. Application of Laplace Transform in control system. 4

Representation of control components and Systems : Translation and rotational mechanical components, electrical components, series and parallel combinations, cascade systems, analogous system. 4

Unit-II

System Response : First systems response to impulse, ramp and sinusoidal inputs, unit step response of second order system. 4

Modes of Controls : Basic control actions on off control proportional control. 3

Unit-III

Controller Mechanisms : Pneumatic, hydraulic and electric controllers, general principles for generating proportional control actions. Concept of control valve. 4

Control system analysis : Stability of control system, Routh's criterion, Root locus Plot for simple system. 4

Unit-IV

Frequency response analysis: Polar plot, Bode plots Niquisth stability criteria, gain and phase margins. 4

Root locus plots: Simple Transfer functions, transient response from root locus plots. 3

Unit-V

Industrial Applications: Industrial applications such as for – Temperature controls in furnace, oven etc.; Flow controls in fluid flow & fluid machines e.g. turbines; Industrial environment controls. 5

Case studies: Illustration of use & importance of Controls with a few case-studies. 2

References/Books :

1. Automatic control Theory-Raven, McGraw-Hill Book Co.
2. Industrial Automatic Controls-Lajoy, Longmans Green & Co.
3. Automatic Control systems-B.C.Kuo, Prentice-Hall [1976]
4. Modern Control Engineering-K. Ogata, Prentice-Hall of India
5. Introduction to Control Engineering and Linear Control
6. Systems-W. Leonhard, Allied Publishers Pvt. Ltd. [1976]
7. Control systems Engineering-I J. Nagrath and M. Gopal New Age Pvt. Ltd.
8. Automatic Process Control – D P Eckman, Wiley Eastern Ltd.

TME-029
CONCEPTS OF MODERN PHYSICS

Unit-I

Quantum Mechanics: Wave-Particle Duality. Atomic-models. Quantum Physics- Planck, Bohr, de-Brogli, Schrödinger, Heisenberg, Born. Quantum and Wave Mechanics. Feynman Diagrams. 7

Unit-II

Particle Physics & Dynamics: Molecule, Atom and Nucleus. Elementary Particles (& antiparticles) and its characteristics & historical development. Conservation laws. Quarks and quark-model. Simple particle-interaction/dynamics. 7

Unit-III

Relativistic Mechanics : Special-Relativity. Relativity as a bridge of electricity and magnetism. Minikowaskian space-time. Introduction to General-Relativity (almost without Tensors), concept of curved space-time and gravity as curvature. Tests of Special & General Relativity. 10

Unit-IV

Astro-physics and Cosmo-Dynamics: Brief review of universe big-bang to black-hole including nucleo-synthesis, solar-system and galaxy. Hubble's law. Critical density, space- from closed, flat, open. Recent studies on Dark-matter and Dark-energy and its possible candidates. 9

Unit-V

Unification of forces: Fundamental forces- gravitational, electrical, magnetic, strong-nuclear & weak-nuclear. Maxwell (& Faraday) unification of electric & magnetic field as electromagnetic. Brief introduction (with Feynman diagram) to GSW Electro-weak unification, and Standard-model. Brief mention of GUT, and String/M-theory. 7

Books

Stephen Hawking- Brief History of Time
Besier- Concept of Modern Physics
Krane- Modern Physics
Kaku- Beyond Einstein
Griffith- Quantum Electrodynamics
Griffith- Elementy Particles
Hartle- Gravity
Bryan Greene- Elegant Universe

TME-031
EXPERIMENTAL STRESS ANALYSIS

UNIT I

Elementary Elasticity:

Stress: Introduction, Stress Equations of Equilibrium, Laws of Stress Transformations, principal Stresses, Two-Dimensional State of Stress, Stresses Relative to Principal Co-ordinate System, Special States of Stress. **4**

Strain: Introduction, Displacement and Strain, Strain Transformation Equation, Principal Strains, Compatibility, Volume Dilation, Stress Strain Relations, Strain Transformation Equations and Stress Strain Relations for Two-Dimensional State of Stress. **4**

UNIT II

Strain Measurements: Introduction, Properties of Strain Gage Systems, Types of Strain Gages, Grid-Method of Strain Analysis. **4**

Brittle Coating Method: Coating Stresses, Failure Theories, Brittle Coating Crack Patterns, Resin and Ceramic Based Brittle Coating, Test Procedure, Analysis of Brittle Coating Data. **4**

UNIT III

Electrical Resistance Strain Gages: Introduction, Strain Sensitivity in Alloys, Strain Gage Adhesives, Gage Sensitivity and Gage Factor. **4**

Strain Gage Circuit: Potentiometer and its Application, Wheat-Stone Bridge, Bridge Sensitivity, Null Balance Bridges. **3**

Analysis of Strain Gage Data: Three Element Rectangular Rosette, Delta Rosette, Stress Gage, Plane Shear-Gage. **3**

UNIT IV

Theory of Photoelasticity: Introduction, Temporary Double Refraction, Stress Optic Law, Relative Retardation, Stressed Model in Plane Polariscope, Effect of Principal Directions, Effect of Principal Stress Difference, Stressed Model in Circular Polariscope, Light and Dark Field arrangements, Tardy Compensation, Fringe Sharpening and Multiplication by Partial Mirrors. **8**

UNIT V

Two Dimensional Photoelasticity : Introduction, Isochromatic Fringe Patterns, Isoclinic Fringe Patterns, Compensation Techniques, Calibration Methods, Separation Methods, Shear Difference Method, Electrical Analogy Method, Oblique Incidence Method, Materials for Two-Dimensional Photoelasticity. **7**

Text Books:

1. Experiment Stress Analysis by James W. Dally and William F. Riley, International Student Edition, McGraw-Hill Book Company.

2. Experiment Stress Analysis by Dr. Sadhu Singh, Khanna Publishers.

^ ***Applicable only to those institutes which have the facility for Stress Analysis Lab***

TME-032
OPTIMISATION TECHNIQUES IN ENGINEERING

Unit-I

Unconstrained Optimization: Optimizing Single-Variable Functions, conditions for Local Minimum and Maximum, Optimizing Multi-Variable Functions. 4

Unit-II

Constrained Optimization: Optimizing Multivariable Functions with Equality Constraint: Direct Search Method, Lagrange Multipliers Method, Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn –Tucker Sufficient Conditions. 8

Unit-III

Optimization: Quasi-Newton Methods and line search, least squares optimization, Gauss-Newton, Levenberg- Marquartd, Extensions of LP to Mixed Integer Linear Programming (MILP), Non-Linar Programming, The Newton Algorithm, Non-Linear Least Squares, Sequential Quadratics Programming (SQP), Constrained Optimization, SQP Implementation, Multi-Objective Optimization, Branch and Bound Approaches, Genetic Agorthms and Genetic Programming, Singular Based Optimization, On-Line Real-Time Optimization, Optimization in Econometrics Approaches – Blue. 10

Unit-IV

Optimization and Functions of a Complex Variable and Numerical Analysis: The Finite Difference Method for Poisson's Equation in two Dimensions and for the Transient Heat Equation, Eulers Method, The Modified Euler Mehtod and the Runge-Kutta Method for Ordinary Differential Equations, Gaussian Quardative Tranzoidal Rule and Simpson's 1/3 and 3/8 Rules, the Newton Raphson in one and two Dimensions, Jacobi's Iteration Method. 10

Unit-V

Optimization in Operation Research: Dynamic Programming, Transportation – Linear Optimization Simplex and Hitchcock Algorithms, Algorithms, Minimax and Maximum Algorithm, Discrete Simulation, Integer Programming – Cutting Plane Methods, Separable Programming, Stochastic Programming, Goal Programming, Integer Linear Programming, Pure and Mixed Strategy in theory of Games, Transshipment Problems, Heuristic Methods. 8

Books.

1. Winston W L: Operations Research: Applications and Algorithms
2. Rao S.S., Optimization: Theory and Applications.
3. Walsh G R: M methods of Optimization.
4. Williams H.P.: Model Building in Mathematics Programming.
5. Williams H.P.: Model Solving in Mathematics Programming
6. G.L. Nemhauser and L.A. Wolsey: Intger and Combinational Optimization.
7. R.G. Parker and R.L. Rardin:Discrete Optimization.
8. C.H. Papadimitrious and K. Stegilite: Combinational Optimization: Algorithms and Complexity

TME033
ADVANCED WELDING TECHNOLOGY

Unit-I

Introduction : Importance and application of welding, classification of welding process. Selection of welding process. 2

Review of conventional welding process : Gas welding, Arc welding, MIG, TIG welding. Resistance welding. Electroslag welding, Friction welding etc. Welding of MS.CI, Al, Stainless steel & Maurer/Schacfflar Diagram. Soldering & Brazing. 8

Unit-II

Advanced welding Techniques- Principle and working and application of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding etc. 8

Unit-III

Advanced welding Techniques (continued) : Principle and working and application of advanced welding techniques such as explosive welding/ cladding, Underwater welding, Spray-welding / Meetallising, Hard facing. 8

Unit-IV

Weld Design : Welding machines/equipments and its characteristics. Weld defects and distortion and its remedies, Inspection/testing of welds, Macrostructure & microstructure of welds, HAZ, Weld Design, Welding of pipe-lines and pressure vessels. Life predication. 7

Unit-V

Thermal and Metallurgical consideration.: Thermal considerations for welding, temperature distribution, Analytical analysis, heating & cooling curves. Metallurgical consideration of weld, HAZ and Parent metal, micro & macro structure. Solidification of weld and properties. 7

Books

Welding Hand Book

TME-034

MAINTENANCE ENGINEERING & MANAGEMENT **L T P 3 1 0**

Unit-I

Introduction, operating life cycle, reliability, Failure data analysis, failure rate curve, hazard models, elements in series, parallel, mix, logic diagrams, improving reliability, redundancy-element, unit, standby, maintainability, availability, reliability and maintainability trade off. 8

Unit-II

Maintenance Strategies: Break down maintenance, planned maintenance, strategies, preventive maintenance, design out maintenance, planned lubrication, total productive maintenance, zero break down, preventive inspection of equipment used in emergency. 8

Unit-III

Replacement planning maintain or replace decision, replacement of items that deteriorate identical equipment, replacement of items that fail without deterioration individual, group replacement, replacement in anticipation of failure. 8

Unit-IV

Break down maintenance planning, assignment model, waiting time models expected waiting time, minimum cost service rate, PERT. 8

Unit-V

Maintenance Management, production maintenance system, objectives and functions, forms, policy, planning, organization, economics of maintenance, manpower planning, materials planning, spare parts planning and control, evaluation of maintenance management. 8

Books:

1. Management of systems – R.N. Nauhria & R. Prakash.
2. Operations Research – Wangner.

INDUSTRIAL ERGONOMICS

TME-035

Unit-I

1. **Introduction:** Importance applications and principles of occupational ergonomics. 2
2. **Physiological Principles:** Muscular work, Nervous control of movements, Improving working efficiency. Optimal use of muscle strength. /Guidelines for work layout. 4
3. **Skilled work:** Acquiring skill, control of skilled movements. Design of tools and equipments for skilled work. 3

Unit-II

3. **Heavy work:** Energy consumption, Efficiency, Heart rate as a measure of workload. 2
4. **Work-station Design:** Anthropometric data, Reach and clearance dimensions. Percentiles to be accommodated. 5

Unit-III

5. **Working Heights:** Comfortable working postures. Room to grasp or move things, and operate controls. Sedentary work. Its advantages, disadvantages and limitation. Sedentary workplace design. Design of VDT workstations, Design of Key board. 5
7. **Handling Lads:** The Human spine, back troubles associated with industrial work, Intervertebral disc,
   disc pressure, slip of disc, Bio-mechanical models of lower back. Recommendations for handling loads. 3
8. **Man-Machine System:** Display equipment, Controls, Relation between control and display instruments, Mental activity, Fatigue, Occupational stress, Job design in monotonous task. 3

Unit-IV

9. **Human Visual System:** Accommodation, Aperture of the pupil, Adaptation of reline, eye movements Visual capacity, Visual strain, Physiology of reading. 3
10. **Ergonomic Principles of Lighting:** Light sources, measurement, physiological requirements of artificial lighting, arrangement of light. Light for fine work and for VDT offices. 3

Unit-V

11. **Noise and Violation:** Sound perception, Noise load, damage to hearing, physiological and psychological effects of noise. Protection against noise, Vibrations and their effect on performance.3
12. **Working Environment:** Thermo-regulation in human body, comfort indoors, Air quality and its dryness, Air pollution and ventilation. Heat in industry Recommendations for comfort indoors. Daylight, colours and music for pleasant work environment. 4

Books

1. Fitting the task to the Man, E. Gandjean, Taylor and Francis.
2. A guide to Ergonomics of Manufacturing, Helander, M., East-West Press.
3. Human Factor in Engineering and Design, Sanders, M.S., and Mc Cormik, E.J., Mc Graw.Hill

ELECTIVE

TME-036

ADVANCED DYNAMICS OF MACHINERY

UNIT I

Dynamic Analysis of Mechanisms and Machines: Introduction, Motion of Rigid Body under a System of Forces, Principle of Virtual Work, D'Alembert's Principle and Dynamic Equilibrium, Dynamic Force Analysis, Stresses in Moving Members, Motion Analysis, Equivalent Force and Mass Method. **8**

UNIT II

Dynamics of Direct Acting Engine Mechanisms: Introduction, Piston Motion, Turning Moment on Crank-Shaft, Dynamically Equivalent Link, Approximate Expression for Turning Moment, Correction to the Approximate Expression, Turning Moment Diagram, Fluctuation of Crank-Shaft Speed, Flywheel Analysis. **8**

UNIT III

Balancing of Inertia Force and Moments in Machines: Introduction, Balancing of Rotating Masses, Two-Plane Balancing, Determination of Balancing Masses, Balancing of Internal Combustion Engines. **7**

UNIT IV

Gyroscopic action in Machines: Introduction, Motion of a Rigid Body in Three- Dimensions, Principal Axes, Angular Velocity and Momentum about Principal Axes, Euler's Equation of Motion, Euler's Modified Equation, Simple Precession of a Symmetrical Gyroscope in Angular Precession, Gyroscopic Effects in Machines, Gyroscopic Stabilization. **8**

UNIT V

Dynamics of Rotating Shafts: Introduction, Critical Speed, Shaft with an Unbalanced Disc at Mid-Span, Generalized Forces, Lagrange's Equation of Motion, Gyroscopic Effect on Critical Speed. **8**

Text Book:

1. Theory of Mechanisms and Machines by Amitabh Ghosh and Ashok Kumar Malik, Affiliated East- West Press Pvt. Ltd, New Delhi.
2. Theory of Machines and Mechanisms by Joseph Edward Shigley and John Joseph Uicker, J.R. International Student Edition, Mc-Graw Hill International Company.

TME-037

INRODUCTION TO NUCLEAR ENGINEERING

UNIT-1

Nuclear forces and binding energy of the nucleus, Nuclear stability and radioactivity, Law of radioactive decay. 5

Binary nuclear reactions, Energy release in fission and fusion reactions, concepts of microscopic and macroscopic cross sections. 4

UNIT-2

Nuclear fuels in fission and fusion reactors, Types of nuclear reactors, Fissile and fertile materials, Neutron chain reaction in fission reactors, Neutron flux, Concept of criticality for bare homogeneous reactors, Coolants, moderators, Control and structural materials. 8

UNIT-3

Heat generations and steady state temperature distribution in fuel elements, Heat removal, single and two phase heat transfer and fluid flow correlations. 5

Thermodynamic analysis of a nuclear power plants. 3

UNIT-4

Neutron lifetime, Delayed neutrons, Concept of reactivity and point reactor kinetics, Qualitative discussion of safety and radioisotopes in industry, Agriculture & medicine. 6

Brief discussion of safety and radioactive waste disposal. 2

UNIT-5

Interaction of nuclear radiation with matter, Shielding, Radiation exposure & dose, Applications of nuclear radiation & radioisotopes in industry, Agriculture & medicine. 7

Books:

Nuclear Reactor Engineering By S. Glastone and A . Sesonske.
Basic Nuclear Engineering, by K.S. Ram.
Introduction to Nuclear Engineering, by J.R lamarsh.
Nuclear Electricity, by lan Hore-Lacy.

TME_038
ENERGY MANAGEMENT

UNIT-1

Introduction to energy, Sources of energy, Forms of energy, Energy reserves, renewable energy sources, Unites of energy and the laws of thermodynamics,, Energy consumption and GDP, energy database , Energy demand analysis, Costs of exploration and utilization of depletable resources, energy pricing, National energy plan. 7

UNIT-2

energy audit concepts, Energy audit based on 1^{st} law and 2^{nd} law of thermodynamics, Mass and Energy balances, Availability analysis, Evaluation of energy conserving opportunities, Economic analysis and life cycle costing. 7

UNIT-3

Energy conservation areas, Energy transmission and storage, Plant wide energy optimization Models, Data base for energy management , Energy conservation through controls, Computer aided energy management, Program organization and methodology. 7

UNIT-4

Electrical energy conservation in building lighting, heating, ventilating and air conditioning, Energy efficient motor, power factor improvement in power systems, Energy audit of Combustion process, Boilers, Turbines, compressors, Pumps, Heat exchangers, Condensers, Use of industrial, wastes. 9

UNIT-5

Energy environment interaction, Environmental issues, Global warning, Carbon dioxide emissions, Depletion of ozone layer, Government's regulations, Energy economy interaction. 7

BOOKS:

Energy Management and condevtion, by Clive Beggs, Butterwoth- Heinemann Elsevier Science.
Optimising Energy Efficiency in the Industry, By Rajan, Tata Mc Graw Hill Publishers.
Guide to energy Management , By C.L Capehart, Fairmont Press.
Renewable Energy Sources and their Environment Impact, by Abbasi & Abbasi, Prentice Hall of India.
Environmental Risks and Hazards by Cutter, Prentice Hall of India.
Energy and Power Risk Management: New Developments in Modeling, Pricing and Hedging, buy Alexander Eydeland, John Wiley & Sons.
Energy Management Handbook by, Wayne C. Turner.
Thermodynamics, By Kenneth Wark, Tata Mc Graw Hill Publishers.
Exergy Analysis of Thermal, Chemical and Metallurgical Process, By Jan Szargut, David R. Morris, Frank R. Steward, Hemisphere Pub, Springer Verlag Publisher

SIX SIGMA METHODS & APPLICATION
(TME 039)

Unit 1

Quality Perception : Quality in Manufacturing, Quality in Service Sector; Differences between Conventional and Six Sigma concept of quality; Six Sigma success stories.
Statistical foundation and methods of quality improvement.
Descriptive statistics: Data Type, Mean, Median, Mode, Range, Variation, Standard Deviation, Skewness, Kurtosis.

Probability Distribution : Normal, Binomial, Poisson Distribution

Unit 2

Basics of Six Sigma: Concept of Six Sigma, Defects, DPMO, DPU, Attacks on X'S, Customer focus, Six Sigma for manufacturing, Six Sigma for service. Z score,

Understanding Six Sigma organization, Leadership council, Project sponsors and champions, Master Black Belt, Black Belt, Green Belts.

Unit 3

Methodology of Six Sigma, DMAIC, DFSS, Models of Implementation of Six Sigma, Selection of Six Sigma Projects.

Unit 4

Six Sigma Tools: Project Charter, Process mapping, Measurement system analysis, Hypothesis Testing, Quality Function deployment, Failure mode effect analysis, Design of Experiments.

Unit 5

Sustenance of Six Sigma, Communication plan, Company culture, Reinforcement and control, Introduction to softwares for Six Sigma, Understanding Minitab, Graphical analysis of Minitab plots.

References:

1. Six Sigma: SPC and TQM in manufacturing and service, Geoff Tennant, Gower Publishing Co.
2. Six Sigma for managers, Greg Brue, TMH
3. What is Six Sigma, Pete Pande, TMH
4. The Six Sigma Way, Peter S. Pande, TMH Team Field book
5. The Six Sigma way, Peter S. Pande, TMH

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LUCKNOW

Revised Syllabus
III[rd] and IV [th] Year
[Effective from the session 2006-07]

B.TECH. MECHANICAL ENGINEERING / INDUSTRIAL & PRODUCTION ENGG.