MECHANICAL ENGINEERING DEPARTMENT

B.Tech. MECHANICAL

Course of Study & Scheme of Examination

2016-17

Maulana Azad National Institute of Technology

Bhopal

DEPARTMENT OF MECHANICAL ENGINEERING (B.Tech.)
SCHEME

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
MTH111/ MTH121	Mathematics 1 / Mathematics 2	3	-	-	3
CE112	Basic Civil Engineering	3	-	-	3
PHY113	Physics	3	-	-	3
HUM114	Communication Skill	3	-	-	3
CSE115	Computer Programming	3	-	-	3
ME116	Engineering Graphics	2	2	-	3
CSE117	Computer Program Lab.	-	-	3	2
PHY118	Physics Lab.	-	-	3	2
					Total credit 22

I semester Soft Technology Division/ II semester machine Technology Division

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
MTH121/ MTH111	Mathematics 2/Mathematics 1	3	-	-	3
CH 122	Engineering Chemistry	3	-	-	3
CE123	Environment Engineering and biology	3	-	-	3
EE124	Basic Electronics and Electrical Engineering	3	-	-	3
ME125	Basic Mechanical Engineering	3	-	-	3
CE126	Solid Mechanics	3	-	-	3
ME127	Workshop Practice	-	-	2	1
EE128	Electrical and Electronic Lab.	-	-	2	1
CH 129	Chemistry Lab.	-	-	3	2
					Total credit 22

Third Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
ME211	Engineering Thermodynamics	3	-	-	3
ME212	Mechanical Drawing	2	2	-	3
ME213	Materials science & engineering	3	-	-	3
ME214	Kinematics of machines	3	-	-	3
ME215	Introduction to Manufacturing processes	3	-	-	3
ME216	Strength of materials	3	-	-	3
ME217	Thermal Engineering Lab. I	-	-	2	1
ME218	Computer aided graphics Lab.	-	-	2	1
ME219	Strength of materials Lab.	-	-	2	1
ME220	Manufacturing Lab. 1	-	-	2	1
					Total credit 22

Fourth Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
MTH221	Mathematics - 3	3	-	-	3
ME222	Machine Tool Engineering	3	-	-	3
ME223	Dynamics of Machines	2	2	-	3
CE224	Fluid Mechanics & hydraulic Machines	3	-	-	3
ME225	Machine Design - 1	2	2	-	3
EE226	Electrical machines & Electronics	3	-	-	3
ME227	Dynamics of Machines lab	-	1	3	2
CE228	Fluid mechanics Lab.	-	-	2	1
EE229	Electrical Machines & Electronics Lab.	-	2		1
					Total credit 22

Fifth Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
MTH 311	Mathematics 4	3	-	-	3
ME312	Internal combustion engines	3	-	-	3
ME313	Measurement and control	3	-	-	3
	Departmental elective 1	3	-	-	3
	Departmental elective 2	3	-	-	3
	Open elective	3	-	-	3
ME314	IC engines Lab.	-	1	3	2
ME315	Measurement and Metrology Lab.	-	-	2	1
ME-316	Thermal engineering Lab. 2	-	1	3	2
					Total credit 23

Sixth Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
ME321	Heat transfer	3	-	-	3
ME322	Machine Design 2	2	2	-	3
ME323	Industrial engineering	3	-	-	3
	Departmental elective 3	3	-	-	3
	Departmental elective 4	3	-	-	3
	Open elective	3	-	-	3
ME324	Heat Transfer lab	-	-	2	1
ME325	Manufacturing laboratory -2	-	-	2	1
ME326	Minor Project	-	3	3	3
					Total credit 23

List of Departmental electives

ME331 Mechatronics ME332 Measurement Techniques
ME333 Material Handling
ME334 Production & Operations Management ME335 Industrial Tribology
ME336 Automobile Engineering ME337 Turbomachinery
ME338 Supply Chain Management ME339 Lean Manufacturing Engg.
ME 340 REVERSE ENGINEERING AND RAPID PROTOTYPING

List of Open Electives

ME351 Operation Research ME352 Environmental Quality Monitoring
ME353 Statistical Quality Control (SQC) ME355 Industrial safety Engineering
ME 356 Mechanics of Deformable solids ME 357 Vibration

Seventh Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
ME411	Refrigeration and air conditioning	3	-	-	3
	Departmental Elective 5	3	-	-	3
	Departmental Elective 6	3	-	-	3
	Open Elective 3	3	-	-	3
	Open Elective 4	3	-	-	3
ME412	Refrigeration and Air Conditioning Laboratory	-	-	2	1
ME413	Major Project/Seminar	-	4	2	3
ME414	Educational Tour & Trg.	-	-	2	1
					Total credit
					20

Eight Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
HUM-421	Industrial management	3	-	-	3
	Departmental Elective 7	3	-	-	3
	Departmental Elective 8	3	-	-	3
	Open Elective 5	3	-	-	3
	Open Elective 6	3	-	-	3
ME428	Major project & Seminar	-	6	2	4
ME429	General Proficiency	-	-	2	1
					Total credit
					20

List of Departmental electives

ME431 Energy conversion system ME432 Concurrent Engineering
ME433 Flexible Manufacturing System ME434 Computer Aided Design
ME435 Computer Aided Manufacturing
ME436 Computer Aided Facility Planning ME437 Tool Engineering
ME438 Robotics ME 446 TQM
ME439 Computational Combustion & Turbulence Modelling
ME 440 Advanced Machine Design ME 445 Advance Production Engineering
ME441 Nuclear power engineering ME 442 Wind Energy Technology
ME 443 Nano Manufacturing ME 444 Entrepreneurship And New Venture Creation

List of Open Electives

ME451 Solar energy- ME452 Industrial Organization & Management
ME453 Composite Materials ME454 Material Management
ME455 Maintenance engineering and management ME456 Computational Fluid dynamics
ME 457 Technology Entrepreneurship ME 458 Finite Element Methods
ME459 Experimental Stress Analysis ME 461 Advance Production Engineering
ME 462 Advance Machine Design ME 463 Total Quality Management

SYLLABUS

Third semester

ME211ENGINEERING THERMODYNAMICS

Basic Concepts: Continuum, macroscopic approach, thermodynamic systems, path and process; different modes of work; Zeroth law of thermodynamics; First Law of Thermodynamics: Energy, enthalpy, specific heats, Second Law of Thermodynamics: Kelvin-Planck and Clausius statements and their equivalence, reversible and irreversible processes, Carnot theorems, Clausius inequality and concept of entropy, availability and irreversibility.

Properties of Pure Substances: Thermodynamic properties of pure substances in solid, liquid and vapor phases, phase rule, ideal and real gases, equations of state, Thermodynamic Relations:. Helmholtz and Gibbs free energy, Coefficient of volume expansion and isothermal compressibility, Maxwell Relations, Thermodynamic cycles: Carnot Cycle, Ideal Rankine cycle, Binary Vapour Power Cycle, Air-standard Otto cycle, Air-standard Diesel cycle, Brayton cycle, calculation for work and efficiency

References

1. Thermal Engineering — S. Domkundwar
2. Thermal Engineering — R.K. Rajput
3. Thermodynamics — E.J. Lay
4. Gas Turbines — Cohen & Rogers

ME212 MACHINE DRAWING

Product Life Cycle Management, Isometric, projections and interpenetration of surfaces. Dimensioning Assembly and Part Drawings of simple assemblies and subassemblies of machine parts viz. I.C. Engine components, Bearings, Joints, Valves, machine tools (Shaper) etc. Principles of Sectioning & Dimensioning, IS/ISO codes; Limits, tolerances and Fits. Surface finish; Symbols for weld, process flow. Assembly Drawing Generation with CAD Software

References

1. Engineering Drawing with Auto CAD — T. Jayapoovam
2. Engineering Graphics including AutCAD — Lakshminarayan and Vaishwanar
3. Machine Drawing by — Lakshminarayan and Vaishwanar
4. Engineering Graphics — K.R. Mohan

ME213 MATERIAL SCIENCE AND ENGINEERING

Crystal structure; Space lattice constants; Miller indices; Imperfections in crystals, point defects and line defects and surface defects. Plastic Deformation of Metals and Alloys: dislocation; slip and twinning. theory of work hardening; Theories of recrystallisation and grain growth,

Phase and Phase Equilibrium : Types of phases, Solid solution, Hume Rothery's rules, Solidification of alloys; Phase diagrams, Phase and Lever Rules relationship, Iron–Carbon equilibrium diagram. Iron Carbon alloys,. Heat Treatment TTT diagram, Hardenability, case hardening.

Engineering Materials: Alloy steels, Tool steel, Spring steel, Corrosion resistant steel. Nonferrous alloys and their applications, Polymers : different types, their properties, selection. Ceramics, composites and their applications. Introduction to nano materials and applications.

References

1. Material Science — Narula, Narula & Gupta

2. A first course on Material Science Raghavan
3. Principles of Physical Mettalurgy Reedhill
4 Material Science Callister

ME214 KINEMATICS OF MACHINES

Kinematics :Types of plane motion, links, pair, kinematics of chains, mechanism and machines, constraints and degree of freedom, Gruber's equation, inversion of four bar, slider crank and double-slider crank chain, Movability Criterion.

Motion analysis: Absolute and relative motion, kinematics quantities and their relationship: vector diagrams ,instantaneous centers and Kennedy's theorem, velocity analysis, acceleration analysis, ,velocity and acceleration of reciprocating parts. Computer aided analysis of mechanisms.

Toothed Gears: Fundamental law of gearing, classification and terminology, geometry and kinematics considerations of various tooth profiles..

Cams: Classification, types of motion curve and analytical construction of cam, profile for different followers, pressure angle and cam size, cam with specified contours, cam synthesis, Gyroscope: Gyroscopic Torque equation.

References

1. Theory of machines Rattan
2. Mechanism & machine theory Rao & Dukkipati
3 Theory of mechanism & machines Ghosh and Mallik
4 Theory of machines Thomas Bevan

ME215 INTRODUCTION TO MANUFACTURING PROCESSES

Cold and Hot Working of Metals: Press-working equipment and Operations, Shearing, Drawing, Spinning, Stretch Forming, Wire Drawing, Embossing, Squeezing, Swaging, Coining and Bending Operations, Calculation of Press Capacity.

achine tools, Type of lathe, Lathe specifications, Lathe operations, Geometry of Single-point Cutting Tools, Lathe centers, Mandrels, Chucks, Collets, Face plates, Steady and Follow rests, Tool holders, cutting tool materials, Drilling Machine, , Geometry of Twist Drills, Boring, Reaming, Spot facing, Counter Sinking and Counter Boring. Shaping and Planers and their operating mechanisms, Welding: Resistance welding, Gas welding, Arc welding, Thermit welding, Friction welding, Electron- laser beam welding, TIG- MIG welding. Weldability of metals, Welding defects and remedies.

Foundry: Pattern types, allowances for pattern, pattern materials Moulding methods and machines, Moulding sand testing, Mould design. Casting methods, Solidification, Defects & Remedies. Melting Furnaces, Design and Operation. Machine moulding, core moulding, shell moulding, investment moulding, plastic moulding, permanent mould casting, die casting and centrifugal casting.

References

1. Fundamentals of Modern Manufacturing Mikell P. Groover,
2. Fundamentals of Machining and Machine Tools Boothroyd,
3. Introduction to Manufacturing Processes John A. Schey
4. Work shop technology Hazra Choudry

ME 216 STRENGHT OF MATERIALS

Stresses and Strains, Impact Loading, Allowable Stresses and Allowable Loads, Thermal Stresses, Elastic Constants and their relationships, Stresses in Composite Sections, Axially Loaded Members.Stress – Strain Diagrams and Mechanical Properties of Materials. Stresses on Inclined Sections, Stress Transformation, Strain Transformation, Principal Stresses and Principal Strains. Strain Energy in Tension, Compression, Shear and due to Principal Stresses.Torsion of Shafts of Circular Cross Section, Simple Torsion Theory, Solid and Hollow Shafts, Non – uniform Torsion, Power Transmission through Circular Shafts, Strain Energy in Torsion and Pure Shear, Compound Shafts. Stresses in Beams, Relationship Between Loads, Shear Forces and Bending Moments, Pure Bending and Nonuniform Bending, Curvature of Beams, Longitudinal Strains in Beams, Normal Stresses and Strains in Beams, Design of Beams for Bending Stresses. Deflection of Beams, Differential Equations of the Deflection Curve, Method of Integration, Macaulay‘s Method, Method of Superposition, Moment - Area Method, Strain Energy of Bending, Castigliano’s Theorem and its application, Maxwell‘s Reciprocal Theorem. Springs, Close Coiled Helical Springs, Spiral and Leaf Springs. Columns and Struts, Buckling and Stability, Columns with Pinned Ends and with Other Support Conditions, Design Formulas for Columns. Thin Cylindrical and Spherical Pressure Vessels.

References

1. Strength of Materials G.H.Ryder
2. Strength of Materials Rajput

ME217 THERMAL ENGINEERING LABORATORY -1

List of experiments

1. General study of Boilers, its mountings & accessories
2 Study of Nestler’s Boiler
3 Study of power plant
4 Study of cut models of Internal Combustion Engines
5 Study of cut of cut model of 4 cylinder 4 stroke petrol engine.
6 Load Test on Ruston Diesel Engine

ME218COMPUTER AIDED GRAPHICS LABORATORY

List of experiments

1. Introduction of computer aided software and application
2 Basic commands of 2D modeling
3 Basic commands of 3D modeling
4 Modeling of simple 3D components
5 Introduction of Basic Assembly tools.
6 Assembly of 3D components knuckle joint, coupling, tool head of shaping machine.
7 Drawing of assembly using CAD software knuckle joint, coupling, tool head of shaping machine

ME219 STRENGHT OF MATERIALS LABORATORY

The laboratory experiments related to material testing such as tension test, torsion test, compression test, hardness test and impact test will be performed. The experiments based on photeleastcity concepts in Mechanics of Materials such as determination of elastic

constants, spring test and verification of basic theorems etc will be included. A student has to perform at least ten experiments in the semester.

References

1. Experiments in Engineering Materials — Higgerson
2. Experimental Physical Metallurgy — Kehl

ME220 MANUFACTURING LABORATORY 1

List of Experiments

1. Principal parts of tool, tool geometry, Demonstration on lathe machine: Various parts and its functions, job & tool holding procedure, operational aspects etc.,
2. Simple jobs on center lathe involving plain turning, step turning, taper turning and facing.
3. Practice in shaping machine, drilling machine and grinding machine.
4. Practice on Milling machine, job holding procedures, making simple jobs
5. Different types of lathe operations. Calculations of cutting speed, material removal rate and machining time for lathe, drill and shaping machines.
6. Spot welding

Fourth Semester

MTH221 MATHEMATICS- 3

Boolean Algebra and Its Applications, Fundamentals of Fuzzy Set Theory.

Calculus of Variations: Variational Problems, Approximate Solution of Boundary Value Problems.

Statistics: Curve fitting, Correlation and Regression Analysis Probability Distribution, Sampling and Testing of Hypothesis.

Optimization Technique: Linear Programming Problem, Transportation & Assignment Problem.

References

1. Operation research — S. D. Sharma
2. Numerical Optimization Techniques with Applications — Suresh Chandra
3. Mathematical Statistic — M. Ray
4. Mathematical Statistic — Fruend

ME 222 MACHINE TOOL ENGINEERING

Automatic mass production lathes classification and operations, Turrets classification and operations, Tool lay out, Cycle time, Screw machines. CNC Machining, classification and fundamentals of operation & programming. Milling: Milling machines, specifications, Types of milling operations, cutter-types with geometry, materials, milling machine accessories, dividing heads, simple, compound, differential and angular indexing and calculations for cutting of different types of gears.

Grinding machines and grinding process, Grinding wheel, Types nomenclature and their selection. Centre less grinding and job feeding arrangement, Dressing and truing of grinding wheels. Super finishing processes: Honing, lapping, superfinishing, polishing and buffing. Gear cutting on milling machine and by generating methods viz, hobbing, shaping, and rack cutting, gear finishing by shaving and grinding. Thread: Types of thread and application,

Standards, Thread making methods and machines, die threading and tapping. Broaching operation, types of broaching machines and broaches design, broaching tools.

References

1.Principles of Manufacturing Materials & Processes. Campbell J. S.
2. Manufacturing Processes. Lindberg
3. Workshop Technology part II and III Chapman W. A. J.
4.Workshop Technology Hazra Choudhry or Raghuwanshi

ME223 DYNAMICS OF MACHINES

Flywheel and Governors: Fluctuation of energy and speed, design of flywheel, force analysis of governors, controlling force curves, sensitivity, stability.. Friction devices: power screw, plate, cone and centrifugal clutches, band and block brakes. Dynamometer Absorption and transmission types. Transmission of power by belts, ropes and chains. Gear trains:simple and epicyclic, force analysis: piston, connecting rod and crank shaft

Dynamics of Reciprocating Machines: Equivalent dynamical systems, inertia forces, bearing loads, Crank shaft torque delivered, forces on connecting rod, forces on crank shaft.

Vibration: Free, damped and forced vibrations of single degree of freedom for a mechanical system, transverse vibration of loaded and unloaded shafts, transverse vibration of shafts having several loads , critical speed for whirling of shaft. torsional vibrations of two and three rotor systems, vibration transmission and isolation, vibrations in two degrees of freedom for a mechanical system

Balancing: Balancing of rotating masses in one plane and in different parallel planes, balancing of four bar linkages including slider crank mechanism, principal of balancing machines.

References

1. Theory of mechanism & Machines J.E. Shigley and Uicker
2. Mechanical Vibration W.T. Thomson
3. Mechanics of Machines V.Ramamurti
4 . Mechanical Vibrations G.K.Grover.

CE224 FLUID MECHANICS & HYDRAULIC MACHINES

Review of Fluid Properties, Fluid Statics, Fluid Kinematics, continuity equation, velocity potential, stream function, flow nets. Fluid Dynamics, Bernoulli's equations and its applications, Impulse momentum equation, moment of momentum equation and their applications. Fluid Measurements, Velocity and flow measurement devices. Dimensional Analysis and Dynamic similitude, similarity laws, specific model investigations. Introduction to viscous & turbulent flow, Reynolds experiment, laminar flow through circular pipes and parallel plates.

Turbines classifications, impact of free jets, major and minor lossesin pipes, siphon, transmission power through pipe lines., specific speed and unit quantities. Design aspects of Pelton turbine- its construction, power and efficiency for ideal case, characteristic curves. Design aspects of reaction turbines, construction & setting, draft tube theory, characteristic curves, cavitations.

Centrifugal pumps,various types and their important components,manometric, total head, specific speed, cavitations. Principle of working and characteristic curves. Reciprocating pumps : principle of working, single acting and double acting pump.

References

1. Fluids Mechanics & Hydraulics Machines — Modi & Seth
2. Fluids Mechanics & Hydraulics Machines — A.K. Jain
3. Fluid Mechanics — Streeter & Wylie
4. Fluids Mechanics & Hydraulics Machines — R.K.Bansal

ME225 MACHINE DESIGN –1

Design of fasteners: Knuckle, cotter, threaded joint, design and drawing of permanent fasteners - riveted joints, welded joints, eccentric loading of riveted joints, welded and bolted joints, and computer aided design of at least one joint. Concepts of creep and fatigue, design of shaft, design for power transmission including combined bending and torsion and design of shaft couplings, effects of stress concentration. Spring design: Helical springs, closed and open coiled tension, compression springs and their ends, design of leaf springs, power screws - designing for various types of screw jacks, lead screw of lathe machine and screw press. Design methods, preliminary design, conceptual design, detailed design, concurrent engineering, reverse engineering, and creative design. Hydraulic presses and pneumatic presses.

References

1. Mechanical Engineering Design — J.E. Shigley and Charles R. Mischke, TMH
2. Engineering Design — G.E. Dieter
3. Machine Design — Kulkarni, TMH
4. Handbook of Mechanical Design — G.M.Maitra and L.V. Prasad

EE226 ELECTRICAL MACHINES & ELECTRONICS

Polyphase systems: measurement of 3 phase power for balanced and unbalanced loads. Single phase and three phase transformers, Induction motor construction, classification, working and various characterstics for slection and applicatiuons of industrial motors, thyrister and their characterstics, basic chopper, rectifier and inverter. Examples and construction features of stepper motor, servo motor and brushless permenant magnet motor.

Reference

1. Basic electronic engineering — V.N.mishra and SRMishra
2. Power electronics — M M singh
3. Principle of electrical motors and power electronics — G B Gupta

ME227 DYNAMICS OF MACHINE LABORATORY.

List of Experiments

Rearranged the Experiments on the availability of equipments in the Lab

1. To find the Speed at which jump Phenomenon occurs in the CAM follower Systems.
2. To verify the Formula for Gyroscopic Couple.
3. To determine whirling speed of the shaft on the whirling apparatus & to verify the Dunkerley's formula on it.
4. To find the Torsional frequency of Vibrations (Undamped and Damped) of single and two rotor systems.
5. To find Frequency of vibrations of a damped force Vibrating Systems.
6. To find Natural Frequency of Vibration of Compound and Torsional Pendulums (Bifilar and Trifilar Suspensions).

7. To determine the amplitude and frequency of forced damped vibration of simply supported beam without damping condition.
8. To determine the amplitude and frequency of forced damped vibration of simply supported beam without damping condition
9. To obtain the controlling force curves in watt, Porter, Proell and Hartnell Governors
10. Balancing of Rotor on the Dynamic Balancing Machine.

CE228 FLUID MECHANICS LABORATORY

1. Experiments on fluid flow through various channels and devices
2. Study and performance analysis on hydraulic machines

EE229 ELECTRICAL MACHINES &ELECTRONICS LABORATORY

List of experiments

1. Measurement of reactive power
2. Load test on 3 phase induction motor
3. No loadand blocked rotor test on 3 phase induction motor
4. No loadand blocked rotor test on 1 phase induction motor
5. Swimson test on 1 phase ransformer
6. Study of semiconductor devices

Fifth Semester

MTH311 MATHEMATICS 4

Numerical Methods: Solution of Algebraic and Transcendental Equations, Solution of Linear and Non-Linear Simultaneous Equations, Finite Differences, Interpolation, Numerical Differentiation and Integration, Numerical Solution of Ordinary & Partial Differential Equations.

References

1. Numerical Analysis — Hildebrand
2. Numerical Analysis — Scarborough
3. Numerical Methods — E .Balaguruswamy
4. Numerical Methods for scientific and Engineering — M.K.Jain

ME312 INTERNAL COMBUSTION ENGINES

Internal Combustion Engines:,S.I. and C.I. Engine operating parameters & performance characteristics,

Fuels and fuel systems: theory of carburaion, SI engine fuel injection systems, SPFI, MAI, PISU, CI engine fuel injection systems classification.

Combustion in SI Engines: Combustion in SI Engines, Combustion in C.I. Engines: Alternate Engines : Rotary combustion I.C. Engine, Stratified charge engine, Principle of working and salient features.Fuel Engines. Super-charging in IC engines: Types and classification. Reciprocating Air compressors: Working & performance Characteristics

References

1. A Course in I.C. Engines — M.L. Mathur & R.P. Sharma
2. Internal Combustion Engines — V. Ganesan
3. Introduction to I.C. Engines. — Richard Stone.
4. Fundamentals of I.C. Engines — J.B. Heywood

ME313 MEASUREMENT AND CONTROL

Standard of Measurements: Principles of Measurement, Line and end standards, Slip Gauges, End bars, Angle Measurement, Angle Gauges. Concept of limits fits and tolerances, Types of fits, Universal and local interchangeability, Systems of limits, fits and tolerances, Selective assembly and matched fits, B.S., I.S.O. and I.S. systems. Design of limit gauges, their types and manufacture.

Measuring Instruments: Comparators, Types, use and limitations, Optical Instruments, Projectors, Tool makers microscope, Measurement of geometrical Features, Measurement of Straightness, Flatness, Parallelism, Perpendicularity, Roundness, Cylindricity, Squareness and Symmetry, Interferometer and its applications, Automated Inspection, In process gauging and Principles of Co-ordinate Measuring Machine.

Measurement of Surface Roughness: E & M System, Surface roughness in various manufacturing processes, Measurement of Screw Threads and Gears : Measurement of elements of screw, threads, pitch and effective diameter measurement and errors in screw threads elements and their effect, Inspection of gears, Various methods of measuring gear tooth thickness, Measurement of base pitch, effective diameter and profile.

References

1. Metrology — Gupta I. C.
2. Metrology — Jain R. K.
3. Statistical Quality Control — Grant Leavenworth, McGraw Hill

ME314 I.C.ENGINES LABORATORY

List of Experiments

1. Heat balance sheet for Ruston Diesel Engine
2. The effect of ignition timing on Newage Petrol Engine
3. The IP of on Newage Petrol Engine by morse test
4. Variable speed load test on on Newage Petrol Engine
5. The 2 wheeler chassis dynamometer.
6. Morse test on IP of Suzuki 3 cylinder Petrol Engine
7. Variable speed load test on Single Cylinder 4 Stroke petrol engine

ME315 MEASUREMENT AND METROLOGY LABORATORY

List of Experiments

1. Calibration of Micrometer and Vernier Caliper
2. Inspection of Jig plate
3. Measurement of taper angle by sine bar
4. Measurement of various angles using Profile Projector
5. Measurement practice by using Coordinate Measuring Machine
6. Programming practice for measurement of complex jobs using CMM
7. Measurement practice on Surface Roughness Tester
8. Preparation of X-bar and R charts for the given data, interpretation of the charts
9. Preparation of p and c charts for the given data and interpretation of results

ME316 THERMAL ENGINEERING LABORATORY 2

1. Study of steam power plant

2. Study of oil fired boiler
3. Measurement of dryness fraction of steam
4. Performance of steam turbine
5. Performance of steam nozzle and surface conduction
6. Measurement of volumetric efficiency of two stage compressor.

Sixth Semester

ME 321 HEAT TRANSFER

Steady State Conduction: Fourier's law and general conduction equation in Cartesian coordinate, Analysis of composite slabs, cylinders and spheres, insulation desirable properties and critical thickness of insulation,.

Unsteady state Heat Transfer: Newtonian heating/cooling, Lumped parameter analysis, periodic heat flow, solution of unsteady state problems using Heisler charts.

Convection: Analysis of free and forced convection using dimensional analysis, significance of various dimensionless numbers empirical co-relations for plates and pipes under natural/forced convection conditions. Concept of thermal and hydrodynamic boundary layers.

Radiation: Mechanism, electromagnetic spectrum, reflectivity, absorptivity, transmissivity, emissivity, emissive power, intensity of radiation, Planck's law, Wien's law, Stefan Boltzman's law and Kirchoff's law. View factor for simple geometries and view factor relations, Concept of black and gray body, Black body, radiation shields.

Heat Exchangers: Definition and classification, concept of LMTD and overall heat transfer coefficient, fouling factor, NTU method to analysis exchangers performance. Derivation of LMTD and effectiveness for parallel and counter flow heat exchangers.

Fins: Heat transfer and temperature distribution in rectangular fins (Longitudinal & annular) of uniform cross section, effectiveness and efficiency of fin.

Condensation and Boiling: Heat transfer condensation process: Mechanism of condensation, Nusselt's theory, drop wise & film wise condensation;

Boiling heat transfer, nature of vaporization, nucleate pool boiling, empirical co-relation for boiling heat transfer, factors affecting boiling film coefficients.

References

1. Heat and Mass Transfer — Dr. D.S. Kumar
2. Engg. Heat and Mass Transfer — Mahesh M. Rathore
3. Introduction to Heat Transfer — Incropera & Dewitt
4. Heat and Mass Transfer — Yunus Cengel

ME322 MACHINE DESIGN 2

Fatigue - Importance in Engineering design, concept of fatigue, fatigue strength and endurance limit, stress concentration, Goodman and modified Goodman diagram, Soderberg and Gerber hypotheses, effect of loading type, size, surface finish, notch, surface treatment, and corrosion, cumulative fatigue damage, applied problems.

Gears - design consideration, Hertzian stresses, design load, beam strength, surface strength, design procedure for helical and spur gears, design calculation for bevel and worm

gears. Creep- temperature considerations in design, designing for creep, thermal stresses, applied problems. Bearing- Classification, design of hydrodynamic bearings, selection of ball and roller bearings.
Design of the Rotating Machines e.g. Centrifugal Pump, , Gear Box. Introduction to various Advanced CAD software's.

References

1. Mechanical Analysis and Design — Burr and Chetan
2. Centrifugal Pumps and Blowers — Church & Jagdish Lal
3. Mechanical Engineering Design — J.E. Shigley & Charles R.
4. Machine Tool Design — N.K. Mehta

ME323 INDUSTRIAL ENGINEERING

Introduction to industrial engineering, history and development of I.E., concept of productivity, partial and total productivity, ethods to increase productivity, work content, measurement of work content, techniques to improve work content. Work study: use and applications, technique, Human factors in work study. Method study: objectives, basic procedure in various charts, flkow process, two handed chart etc. use of photographic techniques, SIMO charts, principle of motion encnomy.
Work measurement, purpose, basic procedure, various techniques used, PMTS, time study, rating, work sampling, analytical estimation, cae studies, wage incentives, meqsured days work and wage incentives, different types of plans, design of inetives plans, Management , function of management, decsison making. Total productivity, management (TPM) management information system for TPM.
References

1. Industrial engineering and production management — M.Mahajan
2. Industrial engineering and management — Banga
3. Production and operation management — Martunch

ME324 HEAT TRANSFER LAORATORY.

List of Experiments

1. Determination of overall heat transfer coefficient for parallel and counter flow heat exchangers
2. Determination of effectiveness of given double pipe heat-exchanger
3. Determination of overall heat transfer coefficient for cross flow air/water heat exchanger
4. Performance of heat pipe as compared with thermal siphon and air pipe
5. Thermal conductivity of a material by guarded plate apparatus
6. Determination of heat transfer coefficient in forced convection
7. Determination of heat transfer coefficient in natural convection
8. Determination of Stefan Boltzman constant by Stefan Boltzman apparatus
9. Determination of emissivity by emissivity measurement apparatus
10. Determination of transient thermal history of a metal

ME 325 MANUFACTURING LABORATORY 2

List of Experiments

1. CNC Lathe Machine
   a) Understand operation procedures of the machine.

b) Demonstration of operating procedure with the help of a work piece.
c) Understand safety operations.

2. CNC Milling Machine
   a) Understand operation procedures of the machine.
   b) Demonstration of operation procedure with the help of a work piece.
   c) Understand safety operations.
3. Robotics
   a) Understand the operational procedure of Robot & mobile robot
   b) Understand the applications of robotics in advanced manufactur

ME 326 MINOR PROJECT

The student has to select a project work based on topic of interest. Periodically the implementation will be evaluated by the project guide. The work starts in seventh semester and continues through eighth semester. The end of each semester student will be evaluated by departmental committee formed by HOD**.**

Departmental electives

ME 331 MECHATRONICS

Elements of Mechatronics system, control Systems, Feedback, open loop and closed loop control, Measurement Systems, Mechatronics systems, Evolution of Mechatronics, Architecture of Mechatronics, Sensors & Transducers, Performance terminology, Various types of sensors and transducers, signal conditioning, data presentation. Actuation systems, Mechanical actuators, Applications, Electrical actuators and their applications, Hydraulic and pneumatic actuation systems. Logic Building and Processing, Logic Gates, combinational and sequential logic, fuzzy logic, microprocessor, programmable logic controller. Applications in CNC, FMS,

Indroduction to mechatronics system modeling and simulation of physical systems, transducer, signal systems and conrol, actuator systems, feedback and intelligent systems, micro processor and micro controller, application of mechatronics system

Introduction to Instruments: application of instrument systems, functional elements of a measurement system, classification of instruments. Measurements, methods and application: Force, Torque and power, pressure, temperature etc. measurements. Introduction to NDT, scope and advantage of NDT, Non destructive techniques: Ultrasonic Crack detection, Magnetic particle for various materials, Eddy current, Dye Penetrant, radiography, acoustic emission.

References

1. Mechatronics — W. Bolton
2 Mechanical Measurements — Beckwith & Beck
3 Indroduction to mechatronics — Appu Kuttan

ME332 MEASUREMENT TECHNIQUES

Fundamentals of industrial measurement: Basic principles of measurement, basic characteristics and dynamics of measuring instruments. Transducers and serving elements: Classification capability of transducers, digital transducer, hydropneumatic sensor, thickness sensor, mechano-electrical transformation Stress-strain measurement and strain gauges: Introduction, mechanical strain gauge, optical strain gauge, stress measurement by photo elastic, instruction for strain gauge stress-strain relationship,

Measurement of vibration: Common causes of vibration, diagnosis and remedial measurement methods for vibration measurements, vibrations, vibration amplifier for permanent monitoring. Speed measurement: Mechanical techometer, electric techometer, different types of techometer, pneumatic types speed transmitting elements. Temperature Measurement: Technical temperature measurement, method for measuring Temperature, radiation properties, optical properties, electrical properties, thermocouples, thermistors Analysis: Spectroscopic analysis, absorption spectrometer, gas analysis, Chramotography, infrared gas analyser. Level Measurement: Direct and indirect methods, electrical conductivity method, robotics method, solid level detector, level measurement by capacitance proBs. **References**

1. . Industrial Instrumentation — D.P. Eckman
2. Mechanical Measurements — Backwith and Buck
3. Instrumentation Measurements and Analysis — Nakre & Chaudhary

ME333 MATERIALS HANDLING

Materials handling **:** General introduction, definition of terms i.e. batched goods, charged pallet ratio, general cargo, handling, integrated transport, line load etc. Material handling: Engineering and economic factors, relationship to plant layout. Selection of material handling equipment. Types of equipments and their maintenance, Unrestricted Equipment: General information, counterbalancing of trucks, powered stokers, order pickers, side loader and forwarding trucks, straddle carriers and mobile lifting frame, hand pallet trucks and stokers, air cushion handling frames, carts and trolleys. Area restricted: General information on line restricted material handling equipment. Different type of conveyers like roller, wheel, belt, slat, chain, overhead rail etc. Railmounted trolleys, trolley and tractors, automatically guided vehicles, lift, elevators, other equipment, sorting installations. Position restricted: Jib cranes and other fixed industrial robots. Auxiliary equipment: Load carriers (Pallets, Stillage etc.) warehouse layouts, goods reception and dispatch equipment, equipment for assembling and securing loads.

References

1. Material Handling System Design — James Apple
2. Hand Book of Industrial Engg. — G. Saliendy
3. Facilities Planning — James Tomphines & John
4. Industrial Engg. — John M. Hill

ME334 PRODUCTION AND OPERATIONS MANAGEMENT

Introduction to Production and Operations management, difference between production, operations and manufacturing, production systems, production system model, types of production systems, Job, Batch, Mass and Continuous production systems, Flexible production systems, Lean production systems. Push and Pull production control systems. Facility design, facility location planning, factors affecting facility location decision, facility layout planning, principles and methods of facility layout design, shop floor management techniques. Forecasting, scheduling, Routing, dispatching and follow up.

Inventory management: function of inventory, inventory control problems, economic order quantity, reordering procedure, lead time, types of inventory control. Purchase management, its functions, methods and principles. Stores management, Material handling. Aggregate planning, Aggregate planning methods, master scheduling, master scheduling methods,

Materials Requirement Planning (MRP), MRP I and II, MRP system parameters, MRP logic, Scheduling, scheduling methods. Product development: Various stages, Concurrent engineering, Quality Function Deployment, modern product development approach. Design of production system, Quality Management, Quality circles, Six sigma concepts, Introduction to ISO9000, ISO14000, ISO18000, ISO22000, Introduction to Total Quality Management (TQM).

References

1. Operations Management: Theory and problems — Joseph G. Monks
2. Production and Operations Management An Applied Modern Approach , Joseph S. Matinich
3. Industrial Engineering and Production Management — Martand Telsang
4. Fundamentals of Supply Chain Management — Chopra and Mendle

ME335 INDUSTRIAL TRIBOLOGY

Introduction: Surface interactions, science of rubbing surface, wear rate, modelling and solution of simple problems. Material properties influencing interactions: Introduction, elastic properties, plastic deformation properties, relation between the strength and other properties of solids, chemical reactivity of surfaces,absorbed surface layer, surface energy, relation between surface energy and hardness, surface interfacial energies of solids under engineering condition.

Surface Interaction: Size of real contact area and effect of surface energy, size of junction, rheologial properties.Wear in tribological joints - classification, calculation methods with allowance for stiffness, wear limits, reliability of joints, simple examples Friction: Introduction, laws, function, properties of uncontaminated metals in air, outguessed metal surface, calculation of flash temperature using surface energy, stic-slip and its prevention. Quantitative expression for abrasive wear, of hardness and particle size on abrasive wear rate, surface fatigue wear, brittle fracture wear, corrosive wear with types. Lubrication: Solid film lubrication, boundary lubrication with single and multiple penetration model, properties of lubricants, effectiveness of lubrication-intermediate temperature, behaviour of a solid lubrication below melting point effect of speed, load on lubrication..

References

1. Basic Lubrication Theory — A. Cameron
2. Friction and wear of Materials — E. Rabinwicz
3. Maintenance Engg. Hand Book — L. Higgens

ME336 AUTOMOBILE ENGINEERING

Development & Advances in Automobile Engineering: Engine induction and Exhaust Systems: Requirements and considerations. Manifold flow paths and tuning. Introduction to exhaust gas extraction. Turbocharging, types, variable geometry turbocharger. Engine valve operating systems: Effect of Valve timing and valve lift on engine operation; variable valve lift and variable valve timing. Valve operating conditions. Multi valva engines. Advanced Engine systems: Ignition systems for petrol engines. Advanced cooling concepts, radiators and thermostat. Wind shield wiper fuel gauge. Chassis and suspension: Requirements and general consideration of strength and stiffness. Engine mountings, types of suspension. Transmission: Clutch, types, fluid flywheel, torque converter, gear boxes, universal joint, propeller shaft, differential, rear axles and their types, front axles and their types. Steering: Factor controlling rolling and directional stability, castor angle, wheel camber, stearing

geometry and system, power assisted steering. Brakes: Principle of braking system, braking mechanism, mechanical and hydraulic brakes, power brakes, vacuum and air brakes. Wheels and Tyres: Wheel drum, tyre, materials and manufacturing of tyres, trouble shooting and maintenance.

References

1. Automotive Mechanics Heitner
2. Automobile Engg. GBS Narang
3. Automobile Engg. TR Banga & Nathu Singh

ME 337 TURBO-MACHINES

Basic Concepts of Turbo Machines. Continuity equation, Momentum equation and Energy equation. Measurements with various flow devices: Pitot tube, Orifice meter and Rota meter. Blade theory: Aerofoil section, types of aero-foils, Drag and Lift coefficients, Cascade testing and curves, cascade lift and drag coefficients, losses in a cascade. Power absorbing machines: Rotary Compressors & Blowers: Classification, Centrifugal compressor, Static and total heat, Velocity Diagrams, Work done by Impeller, Width of blades, slip factor and slip coefficient, Surging, Rotating Stall and Choking, Characteristics curves, Axial flow compressors, Comparison between Rotary, axial flow and reciprocating compressors.

Steam Nozzles: Steady flow energy equation and its application to steam nozzle. Isentropic expansion of steam through convergent and divergent nozzles. Critical pressure, condition for maximum discharge, choking of nozzles, effect of back pressure. Super saturated flow through nozzles, flow with friction, nozzle efficiency, steam ejectors and injectors. Power producing machines: Steam Turbines, gas turbines and jet propulsion.

References

1. Turbo Machines A. V. Arasu
2. Compressible Fluid Flow S.M. Yahya
3. Steam and Gas Turbine W. Kearton
4. Turbomachines Appu Kuttan

ME338 SUPPLY CHAIN MANAGEMENT

Introduction to Supply chain management: meaning and objectives, Characteristics of global supply chains, Supply chain relationship to business performance, Key tasks of supply chain managers, Role of Government in controlling international trade and its impact on supply chain, Supply Chain Strategy , Supply chain as a competitive advantage, Supply Chain Security-International Sourcing. Planning the global supply chain, Risk management in the global context, Performance measurement and evaluation in global supply chains, E commerce advantages and disadvantages for SCM – e-commerce as an enabler: evolution of world class supply chains , ERP.Importance of Coordination in Supply Chain, Effect of lack of Coordination on performance, Obstacles to Coordination, Strategies to achieve coordination, Building Strategic Partnership and Trust In Supply Chain.

Key concepts in relationship marketing concepts: Characteristics of relationships , promise, trust, commitment,, satisfaction, quality, Service competition, customer value, customer defections, customer loyalty, loyalty programs. Sustaining Customer Relationships**.** E-Customer Relationship Management, The Economics of e-Loyalty, The importance of trust , Price rational vs. price obsessive consumers, loyalists vs. butterflies, Upselling and crossselling. Relationship Capital, e CRM, Internet strategies facilitating CRM, including personalization, collaborative filtering, data mining, data warehousing and real-time profiling

References

1. Supply Chain Logistics Management Bowersox, Closs & Cooper
2. World Class Supply Management Burt, Dobbler, Starling
3. Designing and Managing the supply chain David Simchi, Levi & Philip Kaminski

ME339 LEAN MANUFACTURING ENGINEERING

Lean manufacturing, introduction, background, lean thinking, importance of philosophy, strategy, culture, alignment, focus, systems view, Cases of Lean Production Systems, Lean production preparation, system assessment, process and value, system mapping, sources of waste, Lean production processes, approaches and techniques, Importance of focussing upon flow, 5 Ss, Stability, Just in Time, Cellular system, Setup time reduction, Total productive maintenance, Poka Yoke, Standards, Leveling, Visual Management

Employee involvement, teams, training, supporting and encouraging involvement, involving people in change process, communication, importance of culture, Start up of lean processes and examples of applications, sustaining involvement and change, auditing, follow up actions.

References

1. Simplified Lean Manufacturing Elements, Rules, Tools & Implementation Gopal Krishnan
2. Lean and Agile Manufacturing Systems Idis Zehruddin Muhammed,
3. Lean Manufacturing Perspectives and Applications Aruna Desai

ME: 340 REVERSE ENGINEERING AND RAPID PROTOTYPING:

Course Objectives: This course aims at responding to the perceived gap between imparting the theoretical knowledge and exposure to the training in modern design methods and state of art technology. The goal of this course is to provide the students with an opportunity to conceive design and implement products quickly and effectively using the rapid prototyping technology and reverse engineering.

Course Description: This course combines lectures on reverse engineering and rapid prototyping technologies with the hands on training on Rapid prototyping technology. RP Procedure, Principle, Techniques and Materials: Introduction to RP, Technology Description, Definition to RP, Overview of RP, Benefits and Application. Direct digital manufacturing, system classification, Liquid based RP Systems, Solid Based RP systems, Powder Based RP systems, Stereo lithography (SLA), Selective Laser Sintering (SLS), 3-D Printing, Fused Deposition Modeling (FDM), Laminated Object Manufacturing (LOM), Solid Ground curing (SGC), Laser Engineered Net Shaping (LENS), Multi jet Modeling, Direct Metal Printing, 3-D Inkjet Printing, Electron Beam Melting,. Introduction to Metal RP, Direct Metal Laser Sintering, Pre Processing and Post Processing. Material properties, color, dimensional accuracy, stability, surface finish, machinability, environmental resistance, operational properties, Photopolymers, SL Resins, Sintering Materials, FDM Materials, LOM Materials, Model Makers Materials & their Physical, Mechanical, Thermal, Electrical properties.

CAD Designing: Introduction, Model preparation, Slicing, Support structures and machine instructions. CAD-CAM and its integration, Development of CAD CAM., The importance of being Rapid, The nature of RP/T, The state of RP/T industry. Rapid Prototyping Defined. Time compression Technologies, Product development and its relationship with rapid prototyping.

STL Files & RP Software's: Process overviews, STL interface Specification, STL data generation, STL data Manipulation, Advantages and limitations of STL file format. STL file Generation, File Verification & Repair, Build File Creation, and Part Construction, Part Cleaning and finishing, Process Strength & limitations. Open files. Repair of STL files. Alternative RP interfaces. STL file generation, Defects in STL files and repairing algorithms.

Tool Path, Part Orientation, Support Generation, Editing and Slicing. RP Software's: Magic or Mimic's, Axure RP Pro, Solid View/Pro RP.
Rapid Tooling : Introduction, Comparison between Conventional Tooling and Rapid Tooling, Soft Tooling Bridge Tooling, Rapid Injection Molding, Metal Filled Epoxy Tooling, Powdered Metal Tooling, One Piece Mould Approach, Two Piece Mould Approach, Advantages, limitations Applications

Reverse Engineering, Integration of RP and RE: History of Reverse Engineering, Scope and tasks of RE, Preserving and preparation for the four stage process, Evaluation and Verification- Technical Data Generation, Data Verification, Project Implementation, Equipment Involved in the Reverse Engineering technique, Domain analysis- process of duplicating Applications and case studies. Cognitive approach to program understated, Integrating formal and structured methods in reverse engineering, Integrating reverse engineering, reuse and specification tool environments to Rapid Prototyping, Interdisciplinary Application of RP and RE

REFERENCE:

1. Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991
2. White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology, 1994
3. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994
4. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996
5. Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996
6. Co-ordinate Measurment and reverse engineering, Donald R. Honsa, ISBN 1555897, American Gear Manufacturers Association.
7. Bjorke, Layer Manufacturing, Tapir Publisher. 1992.
8. Jacobs, PF (Ed), Rapid Prototyping and Manufacturing, Society of Manuf. Engrs, 1992.
9. Burns, M., Automated Fabrication: Improving Productivity in Manufacturing, 1993.
10. Jacobs, P.F. (Ed.), Stereolithography and Other RP&M Technologies: From Rapid Prototyping to Rapid Tooling, Society of Manuf. Engrs. NY, 1996.
11. Chua C. k. and L. K. Fai, Rapid Prototyping: Principles and Applications in Manufacturing.
12. Gibson, I. (Ed.), Software Solutions for Rapid Prototyping, Professional Engineering Publications, London. 2002.
13. http://nptel.ac.in

Seventh Semester

ME411 REFRIGERATION & AIR CONDITIONING

Introduction: Definition, history of refrigeration, standard rating of refrigerating machines, C.O.P. of refrigerating machines, types of refrigerating machines, vortex tube refrigeration and thermoelectric refrigeration. Air compression refrigeration: Basic air compression cycle. Flow diagram its working and function of its main components. Air cycle systems for aircraft and missiles, numerical examples.

Vapour compression refrigeration: Theoretical vapour compression cycle, its working and representation on P-H, T-S and P-V diagrams. Coefficient of performance, practical vapour compression cycle, dry and wet compression, COP as heat pump, Components their types and relative merits. Advanced vapour comparison systems. Absorption Refrigeration System: Simple absorption systems, Steam Ejector Refrigeration Refrigerants: Requisites of an ideal refrigerant, properties of commonly used refrigerants ammonia, Freon-12, Freon-22 etc. Alternate eco friendly refrigerant.

Production of low Temperature(Cryogenics): Limitations of vapour compression system for the production of low temperature. Multi stage system, cascade system. Production of solid CO2. Joule Thomson effect and liquification of gases. Application of low temperature. Vortex Tube. air conditioning systems: summer and winter: importance of each of these on human comfort and health

Psychometry: Definition, properties of air, vapour mixtures, definitions of psychometric properties, representation of psychometric properties on chart, psychometric processes and their representation on psychometric chart for calculations.

Load calculations (comfort air conditioning): Sources of heat and moisture gains as applied to summer air conditioning. Their relative importance in various weather conditions and applications air conditioning, their relative importance. Methods of reducing winter air conditioning load.

Industrial airconditioning: Purpose of industrial air conditioning, justification of industrial air conditioning, components of cooling loads for typical application.

References

1. Refrigeration and Air-conditioning — P.L. Balaney
2. Refrigeration and Air-conditioning — S. Domkundwar & C. Arora
3. Refrigeration and Air-conditioning — C.P. Arora

ME412 REFRIGERATION AND AIR CONDITIONING LABORATORY

List of Experiments

S N	Proposed List of Experiments
01	Study of Window A.C. and Domestic Refrigerator
02	Measurement of COP of Vapour compression Refrigeration system
03	Measurement of COP of Ice Plant
04	Performance measurement of Central Air Conditioning system
05	Measurement of By-pass factor of cooling coil of Air Conditioning system
07	Performance measurement of Auto Mobile Air Conditioning system
08	Performance measurement of Evaporative cooler
09	Study of Refrigerant charging Kit

ME413 MAJOR PROJECT/SEMINAR

The student has to select a project work based on topic of interest. Periodically the implementation will be evaluated by the project guide. The work starts in seventh semester and continues through eighth semester. The end of each semester student will be evaluated by departmental committee formed by HOD**.**

ME414 EDUCATION TOUR &TRAINING

Students have to undergo a short or long tour and visit the industry of their interest, prepare a write up and present with suitable demonstration. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure.

Eighth Semester

HUM 412 INDUSTRIAL MANAGEMENT

Fundamentals of industrial management (MBE) and productivity principles of management, Management of organizational behavior, Human and industrial relations, human behavior management information systems, professionalethics. Personnal management practices, motivation, leadership, Human resource development, wages and salaryadminisration, labour, industrial laws, accident and safety, material management, deterministic inventory control models,statistical quality control, financial management, marketing and sales management.

References

1. Industrial Engineering and Management	I R.Banga
2. Industrial Engineering and Management	O P Khana
3. Industrial organization and Management	Tara chand and Nem chand
4. Indusrial management	KK Ahuja

ME428 MAJOR PROJECT/SEMINAR

The student has to select a project work based on topic of interest. Periodically the implementation will be evaluated by the project guide. The work starts in seventh semester and continues through eighth semester. The end of each semester student will be evaluated by departmental committee formed by HOD**.**

ME429 GENERAL PROFICENCY

The department committee evaluate the general proficiency in the subject.

Departmental Electives

ME431 ENERGY CONVERSION SYSTEMS

Introduction: need for energy conservation. Energy conservation in production of heat, Introduction to different energy conversion systems,site selection criteria of thermal power plant layout of modern thermal power plant, details of different components of thermal power plant selection criteria of different components of thermal power plant ex. Fuel consumption encnomy, firing arrangement and selection of burners,. Fluidized bed combustion. Energy conservation in use of heat. Economical design of furnace, water treatment, drying, conditioning and industrial space heating, boiler accessories etc.

Selection of cycles: Combined cycle, power generation for better energy efficiency management.

combined cycle power plant. Energy conservation furnish better management techniques, improved production design, improved production powers, substituted materials, waste recovery and recycling. New and renewable energy technologies. Appropriate energy technology for rural development. Energy conservation in production, agriculture sector. Instrumentation and control in energy conservation: Economics of conventional and new and renewable energy technologies. Environmental aspects and case studies :

References

1.Power plant Engineering Domkundwar

2. Power plant Engineering G.D. Rai
3. Power plant Engineering R.L. Agrawal
4. Energy Technology S. Rao & B.B. Parulka

ME432 CONCURRENT ENGINEERING

Definition of CE- Sequential verses CE- Need of CE- Basic principals of CE- Benefits of pit Falls of CE Implementation of CE, Integrating Mechanisms: - Introduction – Various interacting Mechanisms, Quality by Design: QFD-QFD Methodology – Taguchi Methods of Robust design, Design for Manufacturing: - introduction –PDS- Value Engineering – Design Guidelines – Design Axioms –poka Yoke – Manufacturability Analyzer, Rapid Prototyping: - introduction –Need & Use of RP –Various RP Technique Design for Assembly introduction Various DFA Techniques, Design for Reliability: - Introduction serviceability Fundamentals Reliability Analysis During Design –General Design for Reliability Principles, Design for Serviceability: introduction –Serviceability – Factors affecting serviceability Service modes – Serviceability evaluation, Design for Maintainability, Design for Economics: - Introduction – Fundamental approaches to design Economic Justification, Decomposition in CE: Introduction – Decomposition of design process- Decomposition of design constraints, A 1A based System for CE: Introduction – An1 A based frame work for CE - Conflict detection and Conflict resolution, KBE System in CE: - Role of KBE System – KBE System –KBE and Design optimization.

References

1. Fundamentals Concurrent Engineering Kuldeep Singh Sangwan
2. Concurrent Engineering: Concepts, implementation and practice Chanan S.
3. Concurrent Engineering: Automation, Tools and Technique Andrew Kushik

ME433 FLEXIBLE MANUFACTURING SYSTEMS (FMS)

Review of Computer Aided Design and Drafting (CADD): The design processes, advantages and applications of CAD, computer hardware system, computer programming languages, model storage and data structure, CADD software packages – AutoCAD, orthographic projections. CAD/CAM Interface and Product Design: Rationale for CAD/CAM, Computer-Aided Manufacturing, Elements of CAM Systems, NC in CAM, Product Design and Development. Machine Tool Control: Elements of the NC Systems, Types of Control Systems, NC Part Programming, Computer Aided Part Programming, Machining Centers.

Manufacturing Systems and Automation: Trends in Manufacturing Systems, system Defined, Classification of Manufacturing Systems, Leveling and balancing the manufacturing Systems, Robotics and Automated Guided Vehicles: Definition Robotics, Terminology, Types of Robots, basic robot motion and their control, robot programming, Automated Guided Vehicles. Typical applications in manufacturing like in welding, assembly, material handling, spray painting etc., Group Technology (G T): Part families, parts classification, machine group/cell, cad/cam and GT, applications. Flexible Manufacturing Systems and Computer Integrated Manufacturing Systems: (FMS) (CIMS): Components of FMS, components of CIMS, applications. Hardware and software pertaining to FMS installations.

References

1. Computer Aided Manufacturing Rao P N Tewari N K and Kundra T K
2. Introduction to Robotics – A System Approach Rehg J A
3. CAD/CAM Handbook Tercholz E

4. Robotics: An Introduction Malcolm D R Jr

ME434 COMPUTER AIDED DESIGN

Introduction to computer technology, computer systems, operating the computer system, hardware in computer aided design. Mechanical design process, benefits of computer aided design, role of design analysis programs in CAD. Principles of interactive computer graphics, geometric modelling, modelling and display of curves and surfaces, introduction and application of a graphic software (e.g. Auto CAD, Creo, CATIA, ANSYS, ABAQUS, SOLIDWORKS, INVENTOR etc.).Computer aided design and drafting data base facility, part library, standard component and symbol library creation and operation, associability between master entities and occupancies, attribute definition and generation of bill of materials, database management. Introduction to optimal design and optimization techniques for design of mechanical elements, computer aided optimum machine elements such as springs, shafts, bearings gears, etc.

References

1. Computer Aided Design Taylor & Taylor Series
2. Computer Aided Design Sadhu Singh
3. Computer Aided Design Grover & Zimmer

ME435 COMPUTER AIDED MANUFACTURING

C. N.C. System : Definition, applications, Historical background Role of Computers in Manufacturing. Computer Numerical control in CAM: Definition, basic components of CAM system, Procedure, Co-ordinate system, motion control systems, Advantages of CNC system; Features of CNC Machine tools, Application of CNC systems, Economics of CNC machining centers, Part Programming : CNC part programming : manual part programming, computer aided part programming

Robot Technology: Introduction, Industrial Robots, Robot physical Configuration, Basic Robot motions, Technical features, such as work volume, precision of movement speed o movement, weight carrying capacity, type of drive systems, Programming of the robot, Introduction to robot languages, End erectors, work cell control and interlocks, Robotic sensors, Robot applications & economics, Intelligent robots, interfacing of a vision system with a Robot, **FMS:** Definition and broad characteristics of Flexible Manufacturing Cells, , Group technology Systems FMS hardware CNC machines tools, robots, AGVs, ASRs, Inspection and Cleaning stations - Control aspects of FMS-DNC of machine tools, cutting tools, Types of Flexibility in FMS, Flexible and Dynamic Manufacturing Systems, Computer Aided Inspection: Principles and interfacing, software metrology. Applications of Lasers in precision measurements - Laser interferometer, speckle measurements, laser scanners. Coordinate Measuring Machine - Types of CMM - Probes used - Applications - Non contact CMM using Electro optical sensors for dimensional metrology - Non contact sensors for surface finish measurements. Image processing and its application in inspection.

References

1. Automation, Production Systems and Computer Integrated Manufacturing M.P.Grover,
2. Principal of Computer integrated manufacturing S.KantVajpayee.
3. Numerical control and computer aided manufacturing Kundra, Rao & Tiwari

ME436 COMPUTER AIDED FACILITY PLANNING

Elements of plant design systematic layout planning, industrial component and its consideration. Objectives types, goal, design process and techniques of facility planning, Schematic technique, travel charting, sequence analysis systematic layout –planning mathematical models, optimizing heuristics algorithm, branch and board technique, quadramatic assignment techniques, travelling salesman problem, single goal improvement type models, single goal construction type models.

Multiple facility design problem and construction type existing improvement type, multiple goal models and modifications, design problem solving technique, Estimation of distribution parameters. Empirical models, computer aided models. Estimation of distribution parameters in multigoal facilities design problem, computer aided techniques for finding optimum and sub optimum and sub optimum facilities design problem solution, Computer aided facility management, application software, application areas, Application of CAFM in manufacturing sector and service sectors.

References

1. Computer Aided Processes — M Chidambaram
2. Computer Aided Process Control — S.K.Singh
3. Computer Aided Facilities Planning — H Lee Hales

ME437 TOOL ENGINEERING

Single Point cutting tool, form tools, milling cutters, drills, reamers, broaches, gauges and gauge design, machine tool drives, gear box design, acceptance test of machine tools, design of jigs and fixtures.

ME438 ROBOTICS

Introduction: Robot, classification of robot, characteristics of robot, performance, advantages and disadvantages of robot, application of robot, Fundamentals of robot: Various system, structure and definition, terms relating to type of industrial robots, basic term relating to robot performance and characteristics, Controlling the robot systems: Introduction to drives, mechanical, hydraulic, pneumatic drives, electric drive, feed back control ,Sensing System: Introduction, types of sensor, machine vision, artificial intelligence, control techniques, robot language features, Robot safety: Introduction, potential safety hazards, safety planning check list, safety guide lines, latest development in safety measurement.

References

1. Introduction to robotics: mechanics and control — John J. Craig
2. Robotics for Engineers — Y. Koren

ME439 COMPUTATIONAL COMBUSTION & TURBULENCE MODELING

Introduction to computational combustion and turbulence, Combustion and thermo-chemistry, Mass Transfer analysis, Chemical Kinetics of Combustion, Coupling chemical and thermal analysis of reacting systems, Simplified Conservation equation for reacting flows, Laminar Premixed & Diffusion Flames, Droplet Evaporation and Burning, Turbulent flows, Turbulent premixed and non-premixed flames, Burning of solids, Pollutant Emissions,

References

1. An introduction to combustion — Stephen R T urns
2. Theortical and numerical combustion — T Poinsot

ME 440 ADVANCED MACHINE DESIGN

Residual stresses: causes, manufacturing process causing thermal gradient, impact etc. Contact stresses and Hertzian stresses. Optimization in design, economic consideration, human considerations, stiffness and rigidity considerations in design, shock and impact considerations in design, Design against fracture. Wear consideration in design, tribology, concept of friction, wear and lubrication, effect of surface films, designing for wear life, erosive and corrosive wear. Creativity in design and alternative design. Product design, different modules of design theory. Aesthetic form, shape and colour. Detailed design and working drawing: Petrol Engine/Diesel Engine, Lathe/Milling/Drilling Machine, computer aided design of one assembly from the above.

References

1. Engineering Design G.E. Dieter
2. Handbook of Mechanical Design G.M.Maitra and L.V. Prasad
3. Machine Tool Design N.K. Mehta
4. Machine Design Robert L. Norton

ME441 NUCLEAR POWER ENGINEERING

Atomic structure, properties of sub-atomic particles, isotopes, radiation quanta, mass-energy equivalence,radio-active decay, nuclear reactions, artificial radioactivity, nuclear equations, nuclear fission, the mononuclear fission, particle acceleration

Neutron Physics**:** Fission process and reactor behavior, reactor classification, fast and breder reactors, thermal reactors, critical size, effect of delayed neutrons, reactor control. Construction and design of nuclear reactors, materials fuels, moderator, coolant, stainless steels and special metals. Generation and transfer of heat. Comparison of cooling methods, electromagnetic pumps, liquid metal techniques, radiation detectors, shielding. Handling of fuel elements and fission products, disposal of radioactive wastes, radiation hazard and health physics, useful by products their separation and use of nuclear power economics, comparison with conventional methods

References

1 Power plant Engineering Domkundwar
2. Power plant Engineering G.D. Rai

ME442 WIND ENERGY TECHNOLOGY

Historical perspective, latest developments, state of art of wind energy technology, turbine rating, cost of energy, wind power plant economics, installation and operation costs, decommissioning, national scenario and worldwide developments, present status and future trends. Nature of atmospheric winds; wind resource characteristics and assessment; anemometry; wind statistics; speed frequency distribution, effect of height, wind rose, Weibull distribution, atmospheric turbulence, gust wind speed, effect of topography. Aerodynamics of aerofoil; lift; drag; stall; effect of Reynold's number; actuator disc; momentum theory and Betz coefficient; design of wind turbine blade; effect of stall and blade pitch on coefficient of power vs tip speed ratio and coefficient of torque vs tip speed ratio characteristics, optimal choice of cut-in, rated and cut-out wind speeds, blade materials. Vertical and horizontal axis turbines, design characteristics, multiple stream tube theory, vortex wake structure; tip losses; rotational sampling, wind turbine design programs, aerodynamic loads, tower shadow, wind shear, blade coning, gyroscopic, transient and

extreme loads. Aerodynamic damping and stability, teetering motion, stiff and soft towers. Power train dynamics, design standards. Innovative designs and recent advances in wind energy conversion systems. Pitch control, yaw control, aerodynamic braking, teeter mechanism. Wind turbine dynamics with DC and AC generators: induction and synchronous generators, permanent magnet generator, variable speed operation, effect of wind turbulence. Power electronics ,Converter and Inverter interfaces for wind energy utilization system for isolated and grid connected system. Wind farm electrical design, Planning of wind farms, special application for developing countries, maintenance and operation, wind farm management, site selection. Environmental assessment; noise emission, visual impact, avian mortality, telecommunication interference etc. Instrumentation, data loggers, remote monitoring and control. Remote sensing applications like SODAR, LIDAR, SAR etc.

Books & Reference:

1. Ahmed Siraj (2016). WIND ENERGY: Theory and Practice, 3/e PHI, *Eastern Economy Edition* ISBN 978-81-203-5163-9 New Delhi.
2. Thomas Ackermann (2012). Wind Power in Power Systems, 2/e Wiley Publications, ISBN 978-0-470-97416-2 Germany.

ME 443 NANO MANUFACTURING

Introduction to Nano-manufacturing and Nanotechnology, Advantages, disadvantages and applications of Nanotechnology and Nano-manufacturing, Top-down and Bottom-up techniques, self-assembly, self-assembled monolayer. Characterization Techniques: Scanning Electron Microscope, Transmission Electron Microscope, Atomic force microscopy (AFM), Scanning Probe Microscope (SPM), Scanning Tunneling Microscope (STM), X-ray Diffraction (XRD). Nano-lithography: Photolithography: UV Photolithography, X-ray Lithography, Electron Beam Lithography, Particle Beam Lithography's, Probe lithography's. Micro and Nano machining, Focused Ion beam machining. Chemical methods in Nano-manufacturing, Si processing methods: Cleaning /etching, Epitaxy, Molecular-beam epitaxy, chemical beam epitaxy, CVD, Metal-organic CVD (MOCVD), Plasma enhanced CVD (PE-CVD), Sol-gel Technique. Properties and application of Nano Materials: Fullerene Structure, Carbon nano tubes, Nano Particles, Processing of Nanocomposites, Micro & Nano Electromechanical Systems (MEMS, & NEMS).

Course outcome: To acquire basic knowledge of different Nano manufacturing Techniques like lithography, Epitaxy, CVD, Sol-gel techniques etc. Also to acquire knowledge of various characterization techniques like SEM, TEM, AFM, SPM, STM, XRD

References:

1. Introduction to nanotechnology by Charles P. Poole Jr. & Frank J. Owens Publisher: John Wiley & Sons (Asia) Pvt. Ltd.

2. Nanotechnology: Introduction to Nanostructuring Technoques by Michael Kohler, Publisher: John Wiley & Sons (Asia) Pvt. Ltd.
3. Magnetic Microscopy of Nanostructures by H. Hopster & H. P. Oepen, Publisher: Springer
4. Micro-engineering, MEMS and Interfacing: A practical Guide by Danny Banks, Publisher: Taylor & Francis
5. Nanomaterials Chemistry Recent Developments and New Directions by C. N. R. Rao, Publisher: John Wiley & Sons (Asia) Pvt. Ltd.
6. Nanophysics and Nanotechnology by Edward L. Wolf, Publisher: John Wiley & Sons (Asia) Pvt. Ltd.
7. Nanostructures: Tsakalakos, Ovidko & Vasudevan, Springer Verlag

ME 444 ENTREPRENEURSHIP AND NEW VENTURE CREATION ENTREPRENEUSHIP:
The Entrepreneurial Perspective Introduction to entrepreneurship, need and importance of entrepreneurship, charms of becoming entrepreneur, evolution of entrepreneurship, characteristics of an entrepreneur, barriers of entrepreneurship, achievement motivation to become entrepreneur, creativity & innovation, decision making and other behavioral aspects of entrepreneurship.

BUSINESS OPPORTUNITY RECOGNITION: Opportunity Recognition and Planning to establish Micro and Small Enterprises, Opportunity identification process, opportunity evaluation process.
ASSESSMENT OF MARKET: Market research, market survey, Identification of relevant resources, Steps in establishing an enterprise /industry, procedure and formalities to establish a SSI or business enterprise.
BENEFITS & INCENTIVES: Incentives and benefits available to MSEs and new entrepreneurs, Information about various support agencies.
BUSINESS PLAN: Formulation of Business Plan Preparation of market survey report, techno economic feasibility assessment, preparation of preliminary and detailed business plan.
MANAGEMENT OF MICRO & SMALL ENTERPRISE: Marketing Management Marketing and sales management, demand forecasting, advertising, product mix, characteristics of a good sales person, Govt support in marketing, Financial Management of small scale industries Sources of finance, Debt financing, Venture capital sources, Lease finance, Banking policies & incentives available to entrepreneurs, Loans-types and benefits, Book keeping and accountancy, working capital management, various financial ratios, Costing, Break-Even-Analysis.

References

1. Managing innovation and entrepreneurship in technology-based firms: Martin, Michael J.C
2. Technological entrepreneurism: enterprise formation, financing and growth: Cardullo, Mario W.
3. Growing new ventures, creating new jobs: Rice, Mark P

ME445 ADVANCED PRODUCTION ENGINEERING

Metal Cutting Theory: Geometry of cutting tools, metal machining, chip formation, types of chips, force analysis, velocity relationship, stress and strain analysis, power and energy relationships, thermal aspects, dynamometers for turning and drilling. Evaluation of

machinability, tool wear and tool life, cutting forces, surface finish, economies of metal machining and cutting fluids, Machine Tools System: Design analysis of machine tools, elements, structure, slideways and guides, spindle unit drives in machine tools, layout of gear box, stepped regulators, stepless regulators, and hydraulic regulators. Tool Design of CNC machines Tooling principles and tool layouts for turrets, automates, operation planning considerations, designing of cams. Tooling for CNC machines, Design of single point cutting tools, rigidity, design of chip breakers, dynamic chip breaking, design of press dies, component of die, cutting action in a die, clearance, cutting forces, shear, center of pressure, Usefulness of jigs and fixtures, principles of design, locating and clamping, diamond pin locator, jig bushes, drill jigs, milling, turning, boring and broaching fixtures, assembly fixtures, welding fixtures, indexing devices, materials for jigs and fixtures, economics of jigs and fixtures.

Unconventional Machining Processes: Mechanical Processes: Ultrasonic Machining, Elements of USM, Acoustic Head and Design etc., Abrasive Jet Machining, Variables effecting AJM, Water Jet Machining, Equipment and process details, Electrochemical Processes: elements of process, electrolytes & their properties, chemistry of process, metal removal rate. Thermal aspect, temperature rise & pressure-flow rate, tool design, accuracy & surface finish, advantages, application & limitations of the process, Thermal processes: Electrical discharge machining, mechanism of metal removal, accuracy and surface finish, application & future trends, Plasma Arc Machining, mechanism of metal removal, accuracy and surface finish, economics and application of plasma jets, Electro/Laser Beam Machining: Electro beam machining: generation and control of electron beam, process capability and limitations. Laser beam machining: Principles of working, thermal aspect, material removal, cutting speed and accuracy, advantages & limitations.

References

1. Tool Design	Donaldson
2. Production Technology	R.K. Jain
3. Metal Cutting Principles	Bhattacharya
4. Manufacturing Processes	Ghosh Amitabh

ME 446 Total Quality Management

Introduction to TQM, Importance of TQM in manufacturing and service industry, Basic approach of TQM, Concept of Quality Circle, Tools and system for quality management Just in time(JIT) production system, quality production through JIT and Kanban, focus on total customer satisfaction Development of process Failure Mode & Effect Analysis (FMEA), Falt Tree analysis (FTA) Implimentation and need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 Quality system Strategic Quality Planning Case studies of TQM

Reference Books

1. Dale H Bersterfilled Total Quality Management Pearson Education Asia

2. James R Evan and William M Lindsya The management and Control of Quality

3. Oaland J.S. tqm Text with Cases Butterworth Heinemann Ltd Oxfod

4. Suganthi L and Anand Samuel Total Quality Management Prentice Hall (India).

5. Girish Pathak Total Quality Management Macmillian publisher India Ltd

List of Open elective for V and VI semester:

ME351 OPERATIONS RESEARCH

Introduction; definition and scope of operations research, various models used in OR, problem formulation and model construction. Linear programming: concept of optimality, Graphical solution, simplex method, duality, degeneracy. Transportation and assignment model: transportation and assignment problem as special cases of linear programming balanced and unbalanced transportation and assignment problems. Minimization and Maximization problems, Condition of optimality, Optimality test. Inventory system: definition, structure of inventory systems, EOQ without shortages and with shortages allowed for uniform demand and infinite replenishment, deterministic models, multi item inventory problem. Game theory: Introduction, pay off matrix, competitive games with pure strategy, Mini-max criteria, principal of dominance and mixed strategy. Queuing theory: introduction of probability theory, queuing problem, case of poison arrival and exponential service time for single channel systems, introduction to multichannel systems. Network analysis: project planning, Critical path, difference between PERT & CPM, Crashing method, Simulation, Monte-Carlo method, application of simulation in engineering, introduction of dynamic programming and non-linear programming

References

1. Operation research — P.K.Gupta & D.S. Hira
2. Operation research — Sesiani, Arkoff &Arkoff
3. Principles of Operation research — Wagner
4. Operation research — A.P. Verma
5. Operations Research — Kanti Swarup
6. Operations Research H. Taha

ME352 ENVIRONMENTAL QUALITY MONITORING

Principals of instrumentation: advantages. Applications and limitations of the analytical techniques- spectrophotometry, atomic absorption and emission spectrophotometry, flame photometry, nephelometry, inductively coupled plasma spectrometry , mass spectrometry, FTIR, NMR, electrochemical methods: polrography, ionselective electrodes, chromatography: classification, general ideas about absorption,partition and column chromatography, paper and thin layer chromatography, gas chromatography, high performance liquid chromatography, ion chromatography, remote sensing application: basics of remote sensing, application of remote sensing in environmental monitoring – landforms, soil, vegetation, land use and wetland mapping, monitoring of air quality parameters: methods, equipments, standards monitoring of water and soil quality parameters: methods, equipments, units and standards , environmental quality modeling, environmental quality indices.Case studies.

References

1. Instrumental Methods of Analysis — HH Willard & LL Dean, John Wiley,
2. Instrumental Methods of Chemical Analysis — GW Ewing
3. Modern Methods of Chemical Analysis — RL .Recsok & LD Shields
4. Fundamentals of Molecular Spectroscopy — CN. Banwell

ME354 STATISTICAL QUALITY CONTROL (SQC)

Introduction to Quality Control, Fundamentals of statistical concepts and techniques in quality control and improvement, graphical methods and data representation. Statistical process control using control charts, Control charts for variables and attributes, Process capability analysis. Acceptance sampling plans for attributes and variables, operating characteristic curves, A & L system for Lot by Lot acceptance sampling, Sampling plans, MILSTD411, Dodge -Romig sampling plans, LTPD, AOQL.

Chain sampling, Continuous sampling, Skip lot, Economic design of sampling plans. Life testing, Life cycle curve and probability distributions in modelling reliability, system reliability. Experimental Design and Taguchi Methods, Factorial designs, Signal to noise ratio, Taguchi definition of Quality

References

1. Statistical quality control — Doulas C. Montgomery,
2. Statistical quality control by — Grant Leaven worth
3. Quality planning and analysis — J.Juran

ME355 INDUSTRIAL SAFETY ENGINEERING

Training for Safety: Industrial training, training in workshop and laboratories, schools, colleges and universities, communicating the safety message, Safe Practices in Industry and Chemical Handling: Commercial vehicles, compressed air, entry into confined spaces, fire control manual, automatic, static electricity, grinding operations, ionizing, radiation, mechanical safety and electrical control, gear manual handling, mechanical handling, running pipes, steam boilers and pressure vessels welding operations.

Provisions for safe working: Commercial occupations, construction industry, port transport industry, getting standards for safe equipment, working with machinery. Creating a safe environment, ergonomics as an aid to safety. Lighting for safety. Noise control. Safety colors, signs and codes, Personal Protection and welfare: Medical services, first aid and causality treatment, eye protection, personal equipment and protection, respiratory equipment, skin care, Some view on Safety: The role of factory inspectorate, safety organization in the works, trade unions and safety, legal aspects of industrial safety, the cost of industrial injuries.

References

1. Safety Management — John V. Grimaldi & Rollin H.
2. Industrial Safety Hand Book — William Hand ley
3. Safety Security & Risk Management — V.K. Singh

ME356 MECHANICS OF DEFORMABLE SOLIDS

Statically Indeterminate Axially Loaded Bars and Structures, Flexibility Method and Stiffness Method, Thermal Effects, Misfits and Prestrains. Principal Strains, Electrical Resistance Strain Gauges, Strain Measurements and Rosette Analyses. Combined stress systems – combined bending and torsion, combined bending, torsion and direct thrust, combined bending, torsion and internal pressure, Open Coiled Helical Springs subject to axial load and axial torque. Thick Cylinders, Lame Theory, Comparison with Thin Cylinder Theory, Compound Cylinders, Shrinkage Allowance, Hub shrunk on Solid Shaft, Force Fits, Wire – wound Thick Cylinders, Thick Spherical Shells. Fixed Beams, Fixed beam subjected to a concentrated load at the center, Fixed beam carrying UDL throughout its length, Fixed beam

with an eccentric load. Continuous Beams, Clapeyron's Theorem of Three Moments, Continuous beam with fixed end.

. **References**

1. Mechanics of Materials Vol.1 & Vol.2 E.J.Hearn
2. Strength of Materials Rajput

ME 357 VIBRATIONS

Elements of a vibrating system, Free vibration of single-degree of freedom linear systems, Methods of vibration analysis: Energy method, Newton's method & Rayleigh method, Differential equations of motion for first order and second order linear systems. Damped free vibration, viscous, coulomb damping, dry friction, logarithmic Decrement. Forced Vibration of single degree of freedom linear systems. Response of first orders systems to harmonic excitation. Frequency response. Response of second order systems to harmonic excitation. Harmonic motion of the base, vibration isolation, transmissibility, force transmission to foundations. Vibration measuring Instruments eg. Scismic mass, vibrometer, Accelerometer. Energy dissipation. Forced vibration with coulomb hystersis or structural & viscous damping. Torsional vibration of one, two and three rotor system. Equivalent shafting. Torsional vibration of a geared system. Transverse vibration of beams

References

- Theory of Vibrations W.T.Thomson
- Theory of Vibrations Grover & Nigam

List of Open elective for VII and VIII semester:

ME451 SOLAR ENERGY

Solar energy perspectives and prospects.

Solar system - solar radiation - solar constant - isolation on the surface of earth measurement data and estimation. Utilization of solar energy, potential uses of solar energy, technical and economic viability, low and high temperature solar energy devices. Solar Collectors: Flat plate type: Flat plate collectors-characteristics of flat plate collectors, loss coefficient and heat transfer to the flowing medium. Flat plate collectors: design and performance of solar water heaters- optimization of tilt. Solar Collectors: Focussing type: Various type of focusing collectors, materials and performance characteristics. Design of focussing collectors, Energystorage-need for storage - thermal and physico chemical storage -solar ponds.

Applications: Solar air heaters-design, analysis and performance**.** Solar refrigeration - Ammonia water and ammonia sodium thiocynate systems food preservation**..** Space heating/cooling, solar heating systems-solar cooling systems**..** Solar drying-agriculture and industrial drying, cabinet type dryer-general considerations. Solar stills-portable and large units, theoretical consideration performance**..** Use of solar energy in bio-gas production Photovoltaic conversion Solar power generation - system analysis, design and economic considerations

References

1. Solar Engg. Thermal Procession Buffa & Buckman
2. Solar Energy G.D. Rai

3. Engg. Technology S. Rao & D.B Parulkar
4. Solar Energy Sukhatme

ME452 INDUSTRIAL ORGANISATION & MANAGEMENT

Industrial Evolution in India: Downfall of early industries, evolution of modern industry, effects of partition, industrial policy and progress after independence.

Forms of Industrial Organization: Single Proprietorship, Partnership, Joint Stock companies., Cooperatives and State Enterprises.

Growth of Industry and Management: Meaning of industrial management, functions and tools of management, growth of management concepts. Principles of Management: Management, different functions of management: Planning, organizing, coordination and control., Structure of an industrial organization., Functions of different departments. Relationship between individual departments. Human and Industrial Relations, Human relations and performance in organization. Understand self and others for effective behavior, Behaviour modification techniques, Industrial relations and disputes, Relations with subordinates, peers and superiors, Characteristics of group behaviour and trade unionism., Mob psychology, Grievance, handling of grievances, Agitations, strikes, lockouts, picketting and gherao, Labour welfare, Workers' participation in management.

Professional Ethics: Concept of ethics, Concept of professionalism, Need for professional ethics.

Code of professional ethics, Typical problems of professional engineers, Professional bodies and their role.. Motivation: Factors determining motivation, Characteristics of motivation, Methods for improving motivation, Incentives, pay, promotion, rewards, Job satisfaction and job enrichment..Leadership: Need for leadership, Functions of a leader, Factors for accomplishing effective leadership, Manager as a leader. Human Resource Development: Introduction, Staff development and career development, Training strategies and methods. Accidents and Safety: Classification of accidents; according to nature of injuries i.e. fatal, temporary; according to event and according to place. Causes of accidents-psychological, physiological and other industrial hazards. Effects of accidents. Accidents-prone workers. Action to be taken in case of accident with machines, electric shock, road accident, fires and erection and construction accidents. Safety consciousness & publicity., Safety procedures, Safety measures-Do's and don'ts & good housekeeping (5S)., Safety measures during executions of Electrical Engineering works. Environmental Management: Basics of environmental pollution, various management techniques for control of environmental pollution, various control acts for air, water, solid waste and noise. Objectives of Industrial Management: Defining management objectives, managerial activity and objectives, tests of management of objectives, primary, secondary personal and social objectives of management.

References

1.Industrial Organization Pepall L., Richards D., and Norman G.
2. The Theory of Industrial Organization. Tirole, J.
3. Industrial Engineering and Management TR Banga.
4. Industrial Engineering and Management OP Khanna,
5. Industrial Management VK Sharma, OP Harkut.

ME453COMPOSITE MATERIALS

Introduction, definition and classification of composite materials, Types of reinforcements, Types of Matrix, Interface, Wettability, Polymer and Metal matrix composites: Types, lamina, laminate, orthotropy, anisotropy in composites, Processing of Composites: Primary and Secondary Manufacturing- Lay-up, Autoclave Molding, Filament Winding, Pultrusion, Compression Molding, RTM and RIM, Interface and Applications. Introduction of ceramic matrix composites, Nano-composites.

Micromechanics of composites, Density of composites, Predication of elastic constants, strength and stiffness, Load transfer in fiber and particulate reinforced composites, Macro-mechanics of composites, Elastic constants of an isotropic material and a lamina, Analysis of laminated composites, Constitutive classical laminate theory, Stress and strain in laminate composites, Tensile and compressive strength of unidirectional fiber composites, Introduction to fracture mechanics, failure mechanics and crack propagation in composites, Design consideration for composite materials, Performance of composite under fatigue and impact loading.

References

1. Composite Materials: Science and Engineering Krishnan K. Chawla
2. Mechanics of Composite Materials Autar K. Kaw
3. Composite Materials S. C. Sharma.
4. Composite Manufacturing: Materials, Product & Process Engineering, Sanjay K. Mazumdar

ME454 MATERIALS MANAGEMENT

Forecasting & Purchasing: Forecasting in purchase and sales, methods of purchasing, Functions,

organization of purchase department, mass production purchasing and its procedure, Functions and organization of purchase department source selection, negotiation, make or buy decision how much to

buy. Inventory planning (MRP) and Spare parts Management : Types of Inventory, Computer control in materials planning, factors affecting ordering quantity, in process inventories, raw materials supplies, The problem of spare parts, pattern of failure, Reliability and variety, reduction, classification of spares replenishment, service level, work-in-process.

Inventory Controls and its Various Models: Ordering procedures, re-ordering, reorder point and quantity, economic lot size, economic ordering quantity, quantity discount, influence of uncertainty, continuous supply. Selection Control, ABC, XYZ, HML, VED, FSN, SDE, and SOS analysis. Spare parts management of spares Reliability and Quality of spares. Spare parts procurement , spare parts marketing and pricing. Management of absolute spares. Store keeping and Management Codification: Objectives of storekeeping, function of store organization, store organization, location of storekeeping department, factor affecting location, centralized and decentralized storing. Store Planning: Methods of store-keeping, moving materials into and out of stock, protection of stores, codification, materials requisition. Preservation of stores, disposal of surplus & scrap.

References

1. Materials Management S.C. Sharma
2. An Integrated Concept of Materials Management N.M. Shah
3. Maintenance & Spare parts Management P. GopalKrishnan,, K. Bannergee

ME455 MAINTENANCE ENGINEERING & MANAGEMENT

Introduction **-**Fundamentals of Maintenance Engineering. Maintenance Engineering its importance in material & energy conservation, inventory control, productivity, safety, pollution control etc. Safety Regulations, pollution problems, human reliability, total quality management (TQM), total productivity maintenance (TPM), environmental issues in maintenance, ISO 9000 Maintenance Management - types of maintenance strategies, Planned and unplanned maintenance, breakdown, preventive & predictive maintenance.Their comparison, advantages & disadvantages. Limitations , computer aided maintenance, maintenance scheduling, spare part management, inventory control, organisation of maintenance department.

Tribology in Maintenance, friction wear and lubrication, friction & wear mechanisms, prevention of wear, types of lubrication mechanisms, lubrication processes. Lubricants - types, general and special purpose, additives, testing of lubricants, degradation of lubricants, seal & packings. Machine Health Monitoring - Condition based maintenance, signature analysis, oil analysis, vibration, noise and thermal signatures, on line & off line techniques, Instrumentation & equipment used in machine health monitoring. Instrumentation in maintenance, signal processing, data acquisition and analysis, application of intelligent systems, data base design.

Reliability, availability & maintainability (RAM) Analysis - Introduction to RAM failure mechanism, failure data analysis, failure distribution, reliability of repairable and non repairable systems, Improvement in reliability , reliability testing, reliability prediction, utilisation factor, system reliability by Monte Carlo Simulation Technique.

References

1. Maintenance Engineering Hand Book — Higgins
2. Maintenance & Spare parts Management — Gopal Krishnan
3. Industrial Maintenance Management — S.K. Shrivastava
4. Hand book of Condition Monitoring — CNR Rao

ME456 COMPUTATIONAL FLUID DYNAMICS (CFD)

Introduction: Mathematical Background: Classification of differential equations, representative differential equations for heat transfer and fluid flow; Boundary and initial condition; Integral forms. Survey of Numerical Methods Used in Heat Transfer and Fluid Mechanics

Finite Difference Methods: Basic concepts, Direct approximation approach, Taylor series, Control Volume approach, Truncation error, Discretization and round off errors; convergence, numerical stability, Solution of simultaneous equations, Transient diffusion. Finite Element Methods: Steps for FEM solution, Fundamentals, Interpolation functions, Galerkin method, Elements, Assembly, Steady Diffusion, Transient Diffusion Finite Volume Methods: Problem formulation for one-dimensional convection diffusion equations. Simulation of Transport Process Conduction Heat Transfer: Steady and unsteady state one & two dimensional problems. Explicit, Implicit and Crank-Nicolson scheme, ADI and ADE methods. Convection Heat Transfer: Boundary Layer Flows, Similarity solutions, Derived Variables, Patankar/Spalding Methods for two-dimensional flows. Elliptic Solutions: Control Volume formulation. Energy and other scalar equations, Momentum equations, Segregated Solution method; SIMPLE & SIMPLER schemes, Stream Function – Vorticity Transport method. Turbulence: Examples of turbulent flows, Stress relations, Reynolds stresses,

turbulence model computations, Analogy between Heat Transfer and Momentum, Linearization of source terms. Working knowledge of Ansys Fluent will also be provided under the following topics: ICEM-CFD Geometry import, Geometry creation in ICEM-CFD, ICEM-CFD Tetra Meshing, ICEM-CFD Hexa Meshing

ME457 TECHNOLOGY ENTREPRENEURSHIP

The Entrepreneurial Perspective Introduction to entrepreneurship, need and importance of entrepreneurship, charms of becoming entrepreneur, evolution of entrepreneurship, characteristics of an entrepreneur, barriers of entrepreneurship, achievement motivation to become entrepreneur, creativity & innovation, decision making and other behavioral aspects of entrepreneurship, Opportunity Recognition and Planning to establish SSI Opportunity identification process, opportunity evaluation process, market research, market survey, Identification of relevant resources, Steps in establishing an enterprise / industry, procedure and formalities to establish a SSI or business enterprise, Incentives and benefits available to SSI units and new entrepreneurs, Information about various support agencies.

Formulation of Business Plan Preparation of market survey report, techno economic feasibility assessment, preparation of preliminary and detailed business plan. Marketing Management Marketing and sales management, demand forecasting, advertising, product mix, characteristics of a good sales person, Govt support in marketing, Financial Management of small scale industries Sources of finance, Debt financing, Venture capital sources, Lease finance, Banking policies & incentives available to entrepreneurs, Loans-types and benefits, Book keeping and accountancy, working capital management, various financial ratios, Costing, Break-Even-Analysis

References

1. Managing innovation and entrepreneurship in technology-based firms Martin, Michael J.C
2. Technological entrepreneurism: enterprise formation, financing and growth Cardullo, Mario W.
3. Growing new ventures, creating new jobs Rice, Mark P
4. Entrepreneurship development programme in India and its relevance to developing countries Patel, V.G.

ME458 FEM

Unit - I Introduction : Prototyping, Traditional Prototyping v/s Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP methods.

Unit – II CAD Modelling and Data Processing for RP : CAD model preparation, Data Requirements, Data formats (STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), STL file repair, Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation, Introduction of MAGIC & MIMICS software.

Unit – III ; Photo polymerization process : Stereo lithography (SL), SL resin curing process, SL scan patterns, Micro stereo lithography, Applications of Photo polymerization Processes. Powder Bed Fusion process : Selective laser Sintering (SLS), Powder fusion mechanism and powder handling, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Applications of Powder Bed Fusion Processes. Extrusion based process : Fused Deposition Modelling (FDM), Principles, Plotting and path control, Applications of Extrusion-Based Processes. 3D Printing process : 3D printing (3DP), Research achievements in printing deposition, Technical challenges in printing, Printing process modelling, Applications of Printing Processes. Sheet Lamination process : Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications. Beam

deposition process : Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Processing-structure-properties, relationships, Benefits and drawbacks
Unit – IV; Errors in RP Processes : Processing, Pre processing, Post processing errors, Part building errors in SLA, SLS. Applications of RP techniques : Design & Engineering analysis, Planning applications, Rapid Tooling, Medical Applications of RP.
Unit – V ;Reverse Engineering : Basic concept, Digitization techniques, Model Reconstruction, Data Processing for Rapid Prototyping, Reverse Engineering (RE) Methodologies and Techniques, Selection of RE systems, RE software, RE hardware, RE in product development.
References:
1. Chua C K, Leong K F, Chu S L, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific.
2. Gibson D W Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer.
3. Noorani R, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons.
4. Liou W L, Liou F W, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press.
5. Kamrani A K, Nasr E A, Rapid Prototyping: Theory and practice, Springer

ME459 EXPERIMENTAL STRESS ANALYSIS (ESA)

Types of strain gauges, resistance wire strain gauges, materials and cementing methods, temperature compensation, circuits and measuring techniques, strain gauge rosettes, testing and selection of gauges, mounting and installation of electrical resistance gauges
Photoelasticity, polariscope and its elements, isoclinics and isochromatics, stress optic law, compensation techniques, methods to evaluate principal stresses, photoelastic materials, three-dimensional photoelasticity, stress freezing and slicing method. Brittle coating methods and its application in evaluation of stresses

References

1. Experimental Stress Analysis Dally and Riley.
2. Experimental Stress Analysis A.Mubeen.

ME461 ADVANCED PRODUCTION ENGINEERING

Metal Cutting Theory: Geometry of cutting tools, metal machining, chip formation, types of chips, force analysis, velocity relationship, stress and strain analysis, power and energy relationships, thermal aspects, dynamometers for turning and drilling. Evaluation of machinability, tool wear and tool life, cutting forces, surface finish, economies of metal machining and cutting fluids, Machine Tools System: Design analysis of machine tools, elements, structure, slideways and guides, spindle unit drives in machine tools, layout of gear box, stepped regulators, stepless regulators, and hydraulic regulators. Tool Design of CNC machines Tooling principles and tool layouts for turrets, automates, operation planning considerations, designing of cams. Tooling for CNC machines, Design of single point cutting tools, rigidity, design of chip breakers, dynamic chip breaking, design of press dies, component of die, cutting action in a die, clearance, cutting forces, shear, center of pressure, Usefulness of jigs and fixtures, principles of design, locating and clamping, diamond pin locator, jig bushes, drill jigs, milling, turning, boring and broaching fixtures, assembly fixtures, welding fixtures, indexing devices, materials for jigs and fixtures, economics of jigs and fixtures.

Unconventional Machining Processes: Mechanical Processes: Ultrasonic Machining, Elements of USM, Acoustic Head and Design etc., Abrasive Jet Machining, Variables effecting AJM, Water Jet Machining, Equipment and process details, Electrochemical Processes: elements of process, electrolytes & their properties, chemistry of process, metal removal rate. Thermal aspect, temperature rise & pressure-flow rate, tool design, accuracy & surface finish, advantages, application & limitations of the process, Thermal processes: Electrical discharge machining, mechanism of metal removal, accuracy and surface finish, application & future trends, Plasma Arc Machining, mechanism of metal removal, accuracy and surface finish, economics and application of plasma jets, Electro/Laser Beam Machining: Electro beam machining: generation and control of electron beam, process capability and limitations. Laser beam machining: Principles of working, thermal aspect, material removal, cutting speed and accuracy, advantages & limitations.

References

1. Tool Design — Donaldson
2. Production Technology — R.K. Jain
3. Metal Cutting Principles — Bhattacharya
4. Manufacturing Processes — Ghosh Amitabh

ME 462 ADVANCED MACHINE DESIGN

Residual stresses, causes, manufacturing process causing thermal gradient, impact etc. Contact stresses and Hertzian stresses. Optimization in design, economic consideration, human considerations, stiffness and rigidity considerations in design, shock and impact considerations in design, Design against fracture. Wear consideration in design, tribology, concept of friction, wear and lubrication, effect of surface films, designing for wear life, erosive and corrosive wear. Creativity in design and alternative design. Product design, different modules of design theory. Aesthetic form, shape and colour. Detailed design and working drawing: Petrol Engine/Diesel Engine, Lathe/Milling/Drilling Machine, computer aided design of one assembly from the above.

References

1. Engineering Design — G.E. Dieter
2. Handbook of Mechanical Design — G.M.Maitra and L.V. Prasad
3. Machine Tool Design — N.K. Mehta
4. Machine Design — Robert L. Norton

ME 463 TOTAL QUALITY MANAGEMENT

Introduction to TQM, Importance of TQM in manufacturing and service industry, Basic approach of TQM, Concept of Quality Circle, Tools and system for quality management Just in time(JIT) production system, quality production through JIT and Kanban, focus on total customer satisfaction Development of process Failure Mode & Effect Analysis (FMEA), Falt Tree analysis (FTA) Implimentation and need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 Quality system Strategic Quality Planning Case studies of TQM

Reference Books

1. Dale H Bersterfilled Total Quality Management Pearson Education Asia
2. James R Evan and William M Lindsya The management and Control of Quality
3. Oaland J.S. tqm Text with Cases Butterworth Heinemann Ltd Oxfod
4. Suganthi L and Anand Samuel Total Quality Management Prentice Hall (India).
5. Girish Pathak Total Quality Management Macmillian publisher India Ltd