

Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal

Branch- Common to All Discipline

ES401	Energy & Environmental Engineering	3L-1T-0P	4 Credits
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The objective of this Course is to provide *an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternative energy sources and their technology and application.*

Module 1: Introduction to Energy Science:

Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment; Overview of energy systems, sources, transformations, efficiency, and storage; Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energy storages, high efficiency batteries)

Module2: Ecosystems

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

Module 3: Biodiversity and its conservation

- Introduction – Definition: genetic, species and ecosystem diversity; Bio-geographical classification of India; Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, National and local levels; India as a mega-diversity nation; Hot-spots of biodiversity; Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; Endangered and endemic species of India; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Module 4: Environmental Pollution

- Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards; Solid waste Management: Causes, effects and control measures of urban and industrial wastes; Role of an individual in prevention of pollution; Pollution case studies; Disaster management: floods, earthquake, cyclone and landslides.

Module 5: Social Issues and the Environment

- From Unsustainable to Sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rehabilitation of people; its problems and concerns. Case Studies

Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies Wasteland reclamation; Consumerism and waste products; Environment Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation; Public awareness.

Module 6: Field work

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

REFERENCE

1. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.
2. Clark R.S., Marine Pollution, Clarendon Press Oxford (TB).
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai,
4. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
5. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards', Vol I and II, Enviro Media (R)
6. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press.
7. Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living, Gaia

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Mechanical Engineering, IV-Semester

ME402- INSTRUMENTATION & CONTROL

- [1] Introduction to instrument systems, classifications, functional elements of a measurement system, standards and calibration, static performance characteristics, measurement errors and uncertainties, analysis, sequential and random test, specifications of instrument static characteristics, data acquisition, reduction, data outlier detection,
- [2] Dynamic characteristics of the instruments, formulation of system equations, dynamic response, compensation, periodic input, harmonic signal non harmonic signal, Fourier transform, response to the transient input, response to random signal input, first and second order system compensation,
- [3] (a) Temperature measurements, thermometry based on thermal expansion, liquid in glass, bimetallic, electric resistance- thermometry, thermocouples, thermistors, detectors, (b) pressure and velocity measurements, barometer, manometer, dead weight tester, pressure gauges and transducers, dynamic measurements,(c) flow measurements, pressure differential meters, orifice meter, venturi meter, rota-meter,
- [4] strain gauges, strain and stress measurements, electrical circuits, compensations, motion force and torque measurements, displacement measurements, potentiometers, linear and rotary variable differential transformers, velocity measurements, electromagnetic technique, stroboscope, load cell, measurement of torque on rotating shaft, power estimation from rotating shaft.
- [5] Control systems, open loop and close loop control, mathematical modeling of dynamic systems – mechanical systems, electrical systems, fluid systems, thermal systems, transfer function, impulse response function, block diagrams of close loop systems, system modeling using software.

BOOKS:

- [1] Nakra B.C.Chaudhary K.K, Instrumentation measurement and analysisTata McGraw Hill, ISBN 0 07 451791 0
- [2] Richard S, Figiola & Donal E. Beasley, John Wiley, Theory and design of mechanical measurements.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Mechanical Engineering, IV-Semester

ME403 -THEORY OF MACHINES

- [1] Introduction, kinematics and kinetics, mechanisms and machines, degree of freedom, types of motions, kinematic concept of links, basic terminology and definitions, joints and kinematic chains, inversions, absolute and relative motions, displacement, velocity and acceleration diagrams, different mechanisms and applications,
- [2] kinematic synthesis of linkages, dynamic motion analysis of mechanisms and machines, D'Alembert's principle, number synthesis, free body diagrams, kinematic and dynamic quantities and their relationships, analytical method and graphical method
- [3] Cams, introduction, classifications of cams and followers, nomenclature, analysis of cam and follower motion, analytical cam design with specific contours, pressure angle, radius and undercutting, motion constrains and program, critical path motion, torque on cam shaft
- [4] Power transmission, kinematics of belt- pulley, flat and v –belt, rope, condition of maximum power transmission, efficiency, friction, friction devices, pivot and collars, power screw, plate and cone clutch, brakes, classifications, block, band, internal and external, friction circle, friction axis,
- [5] Gears, laws of gearing, classification and basic terminology, tooth profiles, kinematic considerations, types of gears, spur, bevel, worm, helical, hypoid etc, gear trains, epicyclic, compound,, balancing- static and dynamic, in same/ different planes, Introduction to vibration, single degree of freedom.

BOOKS:

- [1] R.L.Norton,kinematics& dynamics of machinery,Tata McGraw Hill, ISBN13 978 0 07 014480 4
- [2] A.Ghosh & A.Malik, Theory of Mechanisms and Machines,EWP Pvt Ltd,ISB 81 85095 72 8

Tutorials:

- 1.Displacement diagrams of slider crank and other linkages, analytical and graphical
- 2 Velocity diagrams and acceleration diagrams
- 3 Diagrams of cam and followers for different applications
- 4 Gears and gear trains transmission diagrams, analytical and graphical applications
- 5 Solutions to problems of industrial application using software

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Mechanical Engineering, IV-Semester

ME404- FLUID MECHANICS

- [1] Introduction, fluid and the continuum, fluid properties, surface tension, bulk modulus and thermodynamic properties, Newton's laws of viscosity and its coefficients, Newtonian and non Newtonian fluids, hydrostatics and buoyancy, meta center and metacentric height, stability of floating bodies.
- [2] Fluid kinematics, Lagrangian and Eulerian method, description of fluid flow, stream line, path line and streak line, types of flow and types of motion, local and convective acceleration, continuity equation, potential flow, circulation, velocity potential, stream function, Laplace equation, flow nets.
- [3] Fluid dynamics, system and control volume, Reynold transport theorem, Euler's equation, Bernoulli's equation, momentum and moment of momentum equation, their applications, forces on immersed bodies, lift and drag, streamlined and bluff bodies, flow around circular cylinder and aerofoils.
- [4] Flow through pipes, Reynold number, laminar and turbulent flow, viscous flow through parallel plates and pipes, Navier Stoke's equation, pressure gradient, head loss in turbulent flow (Darcey's equation), friction factor, minor losses, hydraulic and energy gradient, pipe networks
- [5] Introduction to boundary layer theory, description of boundary layer, boundary layer parameters, Von Karman momentum equation, laminar and turbulent boundary conditions, boundary layer separation, compressible flow, Mach number, isentropic flow, stagnation properties, normal and oblique shocks, Fanno and Reyleigh lines, flow through nozzles,

BOOKS:

1. Massy B.S., Mechanics of fluid, Routledge Publication
2. Shames, Fluid Mechanics, Tata McGraw Hills

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Mechanical Engineering, IV-Semester

ME405- MANUFACTURING TECHNOLOGY

- [1] Analysis of Machining processes, introduction, tool geometry, tool materials, wear characteristics, cutting forces, , cutting fluids, failure of cutting tools, broaching operation, types of broaching machines, design of broaching tools, centre less grinding, thread chaser, thread grinding boring, super finishing processes like honing, lapping, electro polishing and buffing
- [2] Gear machining, types of gears, elements of gears, different methods of gear production, gear cutting on milling machine, gear machining by generation method, principles of generation of surfaces – hobbing, shaping and basic rack cutting, gear finishing by shaving and gear grinding, tooth profile grinding, suitable gear treatments
- [3] Plastics, composition of plastic materials, moulding method- injection moulding, compression moulding, transfer moulding, extrusion moulding, calendaring, blow moulding, laminating and reinforcing, welding of plastics.
- [4] Unconventional machining processes, introduction, abrasive jet machining, ultrasonic machining, electrochemical machining, electro discharge machining, electron beam machining, laser beam machining, plasma arc machining, non destructive testing of machined surfaces and tools,
- [5] Extrusion, principles, hot and cold extrusion processes, tube extrusion, sawing, power hacksaw, band saw, circular saw, Introduction to numerical control machining, NC Machine tools, NC tooling ,part programming, functions, coordinate systems

BOOKS:

- [1] Ghosh A., Mallik A.K., Manufacturing science, EWP Pvt Ltd, ISBN 81 85095 85 X
- [2] R.K.Jain, Production Technology, Khanna Publishes, ISBN 81 7409 099 1
- [3] Campbell J.S., Principles of Manufacturing Materials and Processes.
- [4] CMTI Handbook
- [5] Rao P.N., Manufacturing Technology, Tata McGraw Hill

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Mechanical Engineering, IV-Semester

ME406- SOFTWARE LAB

- [1] . Role of computers in design and manufacture. Drawing soft ware, configuration, function and facilities, parametric representation, examples of drawings and systems
- [2] Surface modeling, curves and surface representation – composite surfaces, case studies in CAD, parametric representation analytic and synthetic curves, surface manipulation, design and engineering applications,
- [3] Current developments in CAD, feature based modeling,, design by feature,
- [4] Solid modeling, boundary representation, analytic solid modeling, constructive solid geometry, sweep representation, design and engineering applications,
- [5] Strategic plan of CAD system design and development, graphic exchange, features recovery, etc.

BOOKS:

1. Donald H, Paulin M, Computer graphics, Prentice Hall,
2. Ibrahim z., CAD/CAM, Theory and Practice, McGraw Hill,
3. Mc mohan C, Browne , CAD/ CAM Principles- practice and manufacturing management, Pearson Education AsiaLtd,

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VI-Semester

ME- 6001 Industrial Engineering

Unit 1. Production, Planning and Control: Definition and importance, types of production -job, batch and mass forecasting, routing, scheduling, dispatching and follow up. Break even analysis and Gantt chart Project scheduling, application of CPM and PERT techniques Analysis and control of project cost in CPM and PERT, simple numerical problems.

Unit 2. Inventory Control : Definition, types of inventory - Codification and standardization ABC analysis.

Economic ordering quantity Procurement cost, carrying charges, lead-time, re-order point, simple problems. Definitions, types of inspection and procedure Statistical quality control - Basic theory of quality control, Process capability Control charts for variables - and R, relationship between control limits and specification limits. Control chart for fraction defective (p), control chart for number of defect

Unit 3 Job Evaluation and Wage Plans & Industrial Legislation: Objective, Methods of job evaluation, job evaluation procedure, merit rating (Performance appraisal), method of merit rating, wage and wage incentive plans.

Need for Industrial legislation, Factories act 1948, Industrial dispute act 1947, The Indian trade unions act 1926, Industrial employment act 1946, Payment of wage act 1936, Workmen compensation act 1923, Payment of bonus act 1965, Employees provident fund scheme .

Unit 4. Work Study : Definition, advantages and procedure of work-study. Difference between production and productivity, Factors to improve productivity Method Study :- Definition, objectives and procedure of method study. Symbols, flow process chart (man-machine-material), flow diagram, machine chart, two hand chart Critical examination. Developing a new method Principles of motion economy. Therblig symbols, SIMO chart, simple problems. Work Measurement -time study, definition, principle and method of time study Stop watch study - number of reading, calculation of basic time, rating techniques, normal time, allowances, standard time Simple numerical problems. Work Sampling - Definition, method, advantages and disadvantage of work sampling Applications.

Unit 5. Plant Location and Layout : Definition, factors affecting the site selection of plant Factor affecting plant layout Types of layout - process, product, combination and fixed position layout Techniques in making layout-Flow diagram, templates, distance volume matrix, travel chart Line balancing, workstation

Material Handling : Principles of economic material handling Hoisting equipment - forklift truck, Cranes- mobile motor cranes, overhead cranes, travelling bridges crane. Derrick crane. Whiler crane Conveying equipment - Package conveyors, gravity roller conveyors, screw conveyors, flight or scraper conveyors, bucket conveyors, bucket elevators, belt conveyors, pneumatic conveyors.

List of suggested books :

1. Barnes Ralph M., "Motion & Time study: Design and Measurement of Work", Wiley Text Books, 2001.
2. Marvin E, Mundel & David L, "Motion & Time Study: Improving Productivity", Pearson Education, 2000.
3. Benjamin E Niebel and Freivalds Andris, "Methods Standards & Work Design", McGraw Hill, 1997.
4. International Labour organization, "Work-study", Oxford and IBH publishing company Pvt. Ltd., N.Delhi, 2001.
5. Sanders Mark S and McCormick Ernert J, "Human Factors in Engineering and Design", McGraw-Hill Inc., 1993.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VI-Semester

ME- 6002 Thermal Engineering and gas dynamics

Unit I

Steam generators: classification, conventional boilers, high-pressure boilers-Lamont, Benson, Loeffler and Velox steam generators, performance and rating of boilers, equivalent evaporation, boiler efficiency, heat balance sheet, combustion in boilers, super critical boilers, fuel and ash handling, boiler draught, overview of boiler codes.

Unit II

Phase Change Cycles: Vapor Carnot cycle and its limitation, Rankin cycle, effect of boiler and Condenser pressure and superheat on end moisture and efficiency of ranking cycle, modified Rankin cycle, reheat cycle, perfect regenerative cycle, Ideal and actual regenerative cycle with single and multiple heaters, open and closed type of feed water heaters, regenerative-reheat cycle, supercritical pressure and binary-vapor cycle, work done and efficiency calculations.

Unit III

Gas dynamics: speed of sound, in a fluid mach number, mach cone, stagnation properties, onedimensional isentropic flow of ideal gases through variable area duct-mach number variation, area ratio as a function of mach number, mass flow rate and critical pressure ratio, effect of friction, velocity coefficient, coefficient of discharge, diffusers, normal shock.

Unit IV

Air compressors: working of reciprocating compressor, work input for single stage compression different, compression processes, effect of clearance, volumetric efficiency real indicator diagram, isentropic & isothermal and mechanical efficiency, multi stage compression, inter - cooling, condition for minimum work done, classification and working of rotary compressors.

Unit V (a) Steam nozzles: isentropic flow of vapors, flow of steam through nozzles, condition for maximum discharge, effect of friction, super-saturated flow. (b) Steam condensers, cooling towers: introduction, types of condensers, back pressure and its effect on plant performance air leakage and its effect on performance of condensers, various types of cooling towers.

References:

1. Arasu Valan A; Thermal Engineering; TMH
2. Nag PK; Basic and applied Thermo-dynamics; TMH
3. Nag PK; Power plant Engineering; TMH
4. Rathakrishnan E; Gas Dynamics; PHI Learning
5. Balachandran P; Gas Dynamics for Engineers; PHI Learning
6. Yahya SM; Fundamentals of Compressible flow; New Age
7. Gordon J. Van Wylen; Thermodynamics
8. R.Yadav Thermal Engg.
9. Kadambi & Manohar; An Introduction to Energy Conversion – Vol II. Energy conversion cycles

List of Experiments (Please Expand it) (Thermal Engg and gas dynamics):

1. Study of working of some of the high pressure boilers like Lamont or Benson
2. Study of Induced draft/forced and balanced draft by chimney
3. Determination of Calorific value of a fuel
4. Study of different types of steam turbines
5. Determination of efficiencies of condenser
6. Boiler trail to chalk out heat balance sheet
7. Determination of thermal efficiency of steam power plant
8. Determination of Airflow in ducts and pipes.
9. To find out efficiencies of a reciprocating air compressor and study of multistage Compressors .
10. Find Out heat transfer area of a parallel flow/counter flow heat exchanger

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VI-Semester

ME- 6003 Heat and Mass Transfer

Unit-1 Basic Concepts: Modes of heat transfer, Fourier's law, Newton's law, Stefan Boltzman law; thermal resistance and conductance, analogy between flow of heat and electricity, combined heat transfer process; **Conduction:** Fourier heat conduction equation, its form in rectangular, cylindrical and spherical coordinates, thermal diffusivity, linear one dimensional steady state conduction through a slab, tubes, spherical shells and composite structures, electrical analogies, critical-insulation-thickness for pipes, effect of variable thermal conductivity.

Unit 2 Extended surfaces (fins): Heat transfer from a straight and annular fin (plate) for a uniform cross section; error in measurement of temperature in a thermometer well, fin efficiency, fin effectiveness, applications; **Unsteady heat conduction:** Transient and periodic conduction, heating and cooling of bodies with known temperatures distribution, systems with infinite thermal conductivity, response of thermocouples.

Unit 3 Convection: Introduction, free and forced convection; principle of dimensional analysis, Buckingham 'pie' theorem, application of dimensional analysis of free and forced convection, empirical correlations for laminar and turbulent flow over flat plate and tubular geometry; calculation of convective heat transfer coefficient using data book.

Unit 4 Heat exchangers: Types- parallel flow, counter flow; evaporator and condensers, overall heat transfers coefficient, fouling factors, log-mean temperature difference (LMTD), method of heat exchanger analysis, effectiveness of heat exchanger, NTU method; **Mass transfer:** Fick's law, equi-molar diffusion, diffusion coefficient, analogy with heat transfer, diffusion of vapour in a stationary medium.

Unit 5 Thermal radiation: Nature of radiation, emissive power, absorption, transmission, reflection and emission of radiation, Planck's distribution law, radiation from real surfaces; radiation heat exchange between black and gray surfaces, shape factor, analogical electrical network, radiation shields.

Boiling and condensation: Film wise and drop wise condensation; Nusselt theory for film wise condensation on a vertical plate and its modification for horizontal tubes; boiling heat transfer phenomenon, regimes of boiling, boiling correlations.

References:

1. Sukhatme SP; Heat and mass transfer; University Press Hyderabad
2. Holman JP; Heat transfer; TMH
3. Nag PK; heat and Mass Transfer; TMH
4. Dutta BK; Heat Transfer Principles And App; PHI Learning
5. Mills AF and Ganesan V; Heat transfer; Pearson
6. Cengel Yunus A; Heat and Mass transfer;TMH
7. Yadav R; Heat and Mass Transfer; Central India pub-Allahabad

8. Baehr HD;Stephan K; Heat and Mass Transfer; MacMillan Pub
9. Incropera FP and Dewitt DP; Heat and Mass transfer; Wiley

List of Experiments (Pl. expand it):

- 1 Conduction through a rod to determine thermal conductivity of material
- 2 Forced and free convection over circular cylinder
- 3 Free convection from extended surfaces
- 4 Parallel flow and counter flow heat exchanger effectiveness and heat transfer rate
- 5 Calibration of thermocouple
- 6 Experimental determination of Stefan-Boltzmann constant

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VI-Semester

ME- 6004 Metal Cutting & machine Tools

Unit I: Lathe: Classification of machine tools and their basic components; lathe- specification, components & accessories, various operations on lathes, capstan & turret lathes, tool layout, methods of thread production, machining time, single point cutting tools, tool signature and nomenclature

Unit II: Grinding: Types of grinding machines, surface, cylindrical and internal grinding, grinding wheels, specifications, wheel turning and dressing without eccentricity, centre-less grinding.

Unit III: Milling: Vertical, horizontal and universal type machines, specifications and classifications of milling machines, universal dividing head plain and different indexing, gear cutting, milling cutters. **Drilling & Broaching:** Fixed spindle, radial and universal drilling machines, drilling time, broaching principle, broaches and broaching machines.

Unit IV: Shapers: Classification and specifications, principle parts, quick return mechanism, shaper operations, speed feed, depth of cut, machining time. Surface qualities, equipment used for rating surfaces, rms. CLA value, causes for surface irregularities. **Gear Cutting:** Die casting, methods of forming gears, generating process, Gear shaping, gear shaving, gear grinding gear testing.

Unit V: Tool Wear, Tool Life and Machinability : Tool wear mechanisms, Types of tool damage during cutting, Wear and chipping characteristics of different tool materials, Tool wear equations, tool failure criteria, Tool life equations, Effect of process parameters on Tool life, Tool life testing, Machinability, Surface finish and surface integrity.

References:

1. Rao PN; Manufacturing Technology vol I and II; TMH
2. Hazra Chadhary; Workshop Tech.II; Media Promoter and Pub
3. Lindberg RA; Processes and Materials of Manufacturing; PHI.
4. Raghuvanshi;BS; Work shop technology Vol-I, II; Dhanpat Rai Delhi
5. HMT; Production Processes; TMH

List of Experiment (Pl. expand it):

1. To make a job on lathe machine with all operations like turning, step turning, drilling , taper turning , thread cutting and knurling .
2. Study of center less grinding machine/ tool and cutter type grinding machine.
3. Study of horizontal/ universal milling machine, diving head and indexing mechanism of it.
4. To cut a spur gear on milling machine using rapid indexing method.
5. Study of radial drilling machine and preparing a job on it.
6. To study a sapping machine to learn about working of quick return mechanism.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VI-Semester

Elective –II ME- 6005 (1) Total Quality Management & Statistical Quality Control

Unit 1 Evolution of total quality management, historical perspective, teamwork, TQM and ISO 9000; information technology and Business Process Re-engineering (BPR); TPM and quality awards; aids and barriers to quality mgt, creating vision and initiating transformation, establishing programs for education and self coordination, policy setting and review, flowchart of policy mgt and relation with daily mgt. improvements, measurement of key indicators; quality mgt leader; cross functional teams and coordination, policy setting and review, flowchart of policy mgt and relation with daily mgt.

Unit 2 Process- definition, variation and feedback, funnel-marble experiment- rules of adjustment and its effects, quality- definition, goalpost and kaizen view, quality of design, conformance and performance; Taguchi loss function, cost of quality, chain action of improving quality to productivity to motivation and low cost; Deming's theory of mgt, fourteen points and variance reduction; attributes enumerative and variables analytic studies.

Unit 3 SQC-Control charts: basic discrete and continuous distributions, measures of central tendency, variability and shapes, sampling, size and central value theorem, control chart structure, process plotting and stability, study of out-of-control evidences, defect detection and prevention, use of control charts in evaluating past, present and future trends; attribute control charts, count and classification charts, construction and interpretation of p , np , c and u charts, PDSA cycle(plan, do, study, act), and R charts, and s charts, individual and moving range chart, trial control limits and out of control points.

Unit 4 Process diagnostics: Between and Within Group variations, periodic and persistent disturbances, control chart patterns-natural, level-shift, cycle, wild, multi-universe, relationship and other out of control patterns; diagnosing a process, brainstorming; cause-effect, Ishikava, interrelationship, systematic and matrix diagrams; change concepts and waste elimination

Unit 5 Process improvement: Performance and technical specifications, attribute-process and variable-process capability studies; unstable and stable process capability studies and examples; attribute and variable improvement studies; Inspection: acceptance sampling(AS)- lot formation, single, double and multiple/sequential sampling plans, operating characteristic (OC) curve, producer and consumer risk, theoretical invalidation of AS, kp rule for stable and chaotic processes.

References:

1. Gitlow HS, Oppenheim et al; Quality Management; TMH
2. Gryna FM; Juran's Quality Planning and Analysis; TMH
3. Crosby Philips; Quality is still free; New Amer Library
4. Kulkarni VA and Bewoor AK; Quality Control; Wiley
5. Jankiraman B and Gopal RK; Total Quality Management- Text and Cases; PHI Learning

6. Sugandhi L and Samual A; Total Quality Management; PHI Learning
7. Subburaj R; Total Qality Management; TMH
8. Naidu Babu and Rajendran; TQM; New age International pub;
9. Chase Richard B et al; Operations management; SIE-TMH
10. Chary SN; Production and Operations Management; TMH

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VI-Semester

Elective –II ME- 6005 (2) Finite Element Method

Unit-I

Introduction

Structural analysis, objectives, static, Dynamic and kinematics analyses, Skeletal and continuum structures, Modeling of infinite d.o.f. system into finite d.o.f. system, Basic steps in finite element problem formulation, General applicability of the method.

Unit-II

Element Types and Characteristics

Discretization of the domain, Basic element shapes, Aspect ratio, Shape functions, Generalized co-ordinates and nodal shape functions. 1D spar and beam elements, 2D rectangular and triangular elements, Axisymmetric elements.

Unit-III

Assembly of Elements and Matrices

Concept of element assembly, Global and local co-ordinate systems, Band width and its effects, Banded and skyline assembly, Boundary conditions, Solution of simultaneous equations, Gaussian elimination and Cholesky decomposition methods, Numerical integration, One and 2D applications.

Unit-IV

Higher Order and Isoparametric Elements

One dimensional quadratic and cubic elements, Use of natural co-ordinate system, Area co-ordinate system continuity and convergence requirements, 2D rectangular and triangular requirement.

Unit-V

Static & Dynamic Analysis

Analysis of trusses and frames, Analysis of machine subassemblies, Use commercial software packages, Advantages and limitations

Hamilton's principle, Derivation of equilibrium, Consistent and lumped mass matrices, Derivation of mass matrices for 1D elements, Determination of natural frequencies and mode shapes, Use of commercial software packages.

References:

- Rao, S.S., The Finite Element Method in Engineering, 2nd ed., Peragamon Press, Oxford.
- Robert, D. Cook., David, S. Malkins, and Michael E. Plesha, Concepts and Application of Finite Element Analysis 3rd ed., John Wiley.
- Chandrupatla, T.R. an Belegundu, A.D., Introduction to Finite Elements in Engineering, Prentice Hall of India Pvt. Ltd.
- Zienkiewicz O C, The Finite Element Method, 3rd ed, Tata McGraw Hill.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VI-Semester

Elective –II ME- 6005 (3) Power Plant Engineering

Unit I: Introduction to methods of converting various energy sources to electric power, direct conversion methods renewable energy sources, solar, wind, tidal, geothermal, bio-thermal, biogas and hybrid energy systems, fuel cells, thermoelectric modules, MHD-Converter.

Unit II: Fossil fuel steam stations: Basic principles of siting and station design, effect of climatic factors on station and equipment design, choice of steam cycle and main equipment, recent trends in turbine and boiler sizes and steam conditions, plant design and layout, outdoor and indoor plant, system components, fuel handling, burning systems, element of feed water treatment plant, condensing plant and circulating water systems, cooling towers, turbine room and auxiliary plant equipment., instrumentation, testing and plant heat balance.

Unit III: Nuclear Power Station: Importance of nuclear power development in the world and Indian context, Review of atomic structure and radio activity, binding energy concept, fission and fusion reaction, fissionable and fertile materials, thermal neutron fission, important nuclear fuels, moderators and coolants, their relative merits, thermal and fast breeder reactors, principles of reactor control, safety and reliability features.

Unit IV: Hydro-Power Station: Elements of Hydrological computations, rainfall run off, flow and power duration curves, mass curves, storage capacity, salient features of various types of hydro stations, component such as dams, spillways, intake systems, head works, pressure tunnels, penstocks, reservoir, balancing reservoirs, Micro and pico hydro machines, selection of hydraulic turbines for power stations, selection of site.

Unit V: Power Station Economics: Estimation and prediction of load. Maximum demand, load factor, diversity factor, plant factor and their influence on plant design, operation and economics; comparison of hydro and nuclear power plants typical cost structures, simple problems on cost analysis, economic performance and tariffs, interconnected system and their advantages, elements of load dispatch in interconnected systems.

References:

- 1- Nag PK; Power plant Engg; TMH
- 2- Al-Wakil MM; Power plant Technology; TMH
- 3- Sharma PC; Power plant Engg; Kataria and sons, Delhi
- 4- Domkundwar; Power Plant Engg; Dhanpatrai & sons.
- 5- Rajput RK; A text book of Power plant Engg.; Laxmi Publications.
- 6- Yadav R; Steam and gas turbine and power plant engg by

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VI-Semester

Elective –II ME- 6005 (4) IPR (Intellectual Property Rights)

Course Objective

Acquaint the students with the basic concepts of Intellectual Property Rights; and sensitize the students with the emerging issues in IPR and the rationale for the protection of IPR.

UNIT I Introduction

Introduction and Justifications of IPR, Nature of IP, Major forms of IP- *Copyright, Patent, Trade Marks Designs, Geographic indication, layout design of Semi conductors, Plant varieties, Concept & Meaning of Intellectual Property.*

Major international documents relating to the protection of IP - *Berne Convention, Paris Convention, TRIPS.* The World Intellectual Property Organization (WIPO).

UNIT II Copyright

Meaning and historical development of copyright , Subject matter , Ownership of copyright, Term of copyright, Rights of owner, Economic Rights, Moral Rights. Assignment and licence of rights, Infringement of copyright, Exceptions of infringement, Remedies, *Civil, Criminal, Administrative*, Registration Procedure.

UNIT III Patents

Meaning and historical development,. Criteria for obtaining patents, Non patentable inventions, Procedure for registration, Term of patent, Rights of patentee, Compulsory licence, Revocation, Infringement of patents, Exceptions to infringement, Remedies, Patent office and Appellate Board.

UNIT IV – Trade Marks, Designs & GI

Trade Marks: Functions of marks, Procedure for registration, Rights of holder, Assignment and licensing of marks, Infringement, Trade Marks Registry and Appellate Board.

Designs: Meaning and evolution of design protection, Registration, Term of protection, Rights of holder, unregistered designs.

Geographical Indication: Meaning and evolution of GI, Difference between GI and Trade Marks, Registration, Rights, Authorised user.

UNIT V Contemporary Issues & Enforcement of IPR

IPR & sustainable development, The Impact of Internet on IPR. IPR Issues in biotechnology, E-Commerce and IPR issues, Licensing and enforcing IPR, Case studies in IPR

Course Outcome:

1. Students will be able to understand Primary forms of IPR
2. Students will be able to assess and critique some basic theoretical justification for major forms of IP Protection
3. Students will be able to compare and contrast the different forms of IPR in terms of key differences and similarities.
4. Students will be able to understand the registration procedures related to IPR.
5. Students will be exposed to contemporary issues and enforcement policies in IPR.

References:

1. P. Narayanan, *Intellectual Property Law*, Eastern Law House
2. . Neeraj Pandey and Khushdeep[Dharni, *Intellectual Property Rights*, PHI, 2014
3. N.S Gopalakrishnan and T.G. Agitha, *Principles of Intellectual Property*, Eastern Book Co. Lucknow, 2009.
4. Anand Padmanabhan, *Enforcement of Intellectual Property*, Lexis Nexis Butterworths, Nagpur, 2012.
5. *Managing Intellectual Property The Strategic Imperative*, Vinod V. Sople, PHI.
6. Prabuddha Ganguli, " *Intellectual Property Rights*" McGraw Hill Education, 2016.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

Credit Based Grading System

Mechanical Engineering, VI-Semester

ME-6007 Creativity and Entrepreneurship Development

Course Objective:

- Understand and use tools for generating entrepreneurial ideas and problem solving.
- Understand and use tools for the selection of ideas.
- Understand and gain the skills that are needed to implement ideas in today's society
- Understand Entrepreneurship's part in process that includes idea generation and implementation.
- Understand the concept of Entrepreneurship and its place in today's society

Course Outcomes:

- Recognize an opportunity for a user group and frame an appropriate design challenge that addresses the need for the user.
- Practice observation, interview and empathy skills to evolve a thorough understanding of the needs of the user.
- Share and integrate team leanings.
- Generate, develop and describe creative ideas that address the design challenge.

Syllabus:

1. The concept of Entrepreneurship, its history and its place in society.
2. The concept of Entrepreneurship and its relation to concept of innovation.
3. Creative processes for idea generation and problem solving.
4. Business plan.
5. Role of creativity, innovation and business research.
6. Entrepreneurship opportunities in contemporary business environment.

Reference Books :

1. Dollinger M.J. "Entrepreneurship strategies and resources," 3rd edition Pearson Education New Delhi.
2. Panda, Shiba charan "Entrepreneurship development", Anmol publication New Delhi.
3. Richard Blundel & Nigel locket, "Exploring Entrepreneurship : practices & perspectives Oxford.
4. Charles E. Banford & Garry D. Bruton, "Entrepreneurship – A small business Approach, Mcgrawhill Education.
5. P. Narayana Reddy, "Entrepreneurship" : Text and cases, Cengage learning
6. Rajeev Roy, "Entrepreneurship" Oxford.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VIII-Semester

ME- 8001 Advance Machine Design

- [1] Fundamentals of technical systems, systems approach fundamentals, assemblies and components, phases and interactions of design process, design tools and resources, standards and codes, uncertainty and reliability, design based on reliability,
- [2] Design based on theory of elasticity, design based on theory of plasticity, design based on failure analysis, failure modes of mechanical components, statistical approach to failure and design modifications, design based on propagation of defects in production and life cycle of components.
- [3] Design based on tribology, effect of variable coefficient of friction, effect of variability of modulus of elasticity, effect of different lubrication parameters, Effect of surface characteristics. Effect of different kinds of wear and design changes as per wear mechanisms.
- [4] Limit design analysis, simple case of deformation beyond elastic limit, design of parts of unsymmetrical sections, shear centre of different engineering sections, parts subjected to unsymmetrical bending,
- [5] Strain gauges, electrical wire resistance gages, bonding gage factor, measuring circuits, strain gage rosette, potentiometric circuits, circuit sensitivity, application of strain gages in practical problems, photoelasticity, photoelastic bench, stress analysis,

Various design soft ware and applications

Books:

1. The strain gage primere, CC Perry and HR Lissener, McGraw - Hill
2. G.E.Dieter, Engineering Design.
3. Failure analysis, vol,1,2,
4. Fracture Mechanics, Fundamentals and applications, TL Anderson, CRC Press
5. CMTI Handbook

Tutorial topics.

- [1] force analysis of CNC machine tool design, five axis machines, six axis machines,
- [2] Design aspects of linkages of industrial robots, classifications and applications.
- [3] Function structure diagram
- [4] Design analysis of production sequences and processes of automation

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VIII-Semester

ME- 8002 Refrigeration & Air conditioning

Unit-I Introduction: Principles and methods of refrigeration, freezing; mixture cooling by gas reversible expansion, throttling, evaporation, Joule Thomson effect and reverse Carnot cycle; unit of refrigeration, coefficient of performance, vortex tube & thermoelectric refrigeration, adiabatic demagnetization; air refrigeration cycles- Joule's cycle Boot-strap cycle, reduced ambient cycle and regenerative cooling cycles.

Unit-II Vapor compression system: Vapor compression cycle, p-h and t-s diagrams, deviations from theoretical cycle, sub-cooling and super heating, effects of condenser and evaporator pressure on cop; multi-pressure system: removal of flash gas, multiple expansion & compression with flash inter cooling; low temperature refrigeration: production of low temperatures, cascade system, dry ice, production of dry ice, air liquefaction system,.

Unit-III (a) Vapor absorption system: Theoretical and practical systems such as aquaammonia, electrolux & other systems; (b) **Steam jet refrigeration:** Principles and working, simple cycle of operation, description and working of simple system, (c) **refrigerants:** nomenclature & classification, desirable properties, common refrigeration, comparative study, leak detection methods, environment friendly refrigerants and refrigerant mixtures, brine and its properties

Unit-IV Psychometric: Calculation of psychometric properties of air by table and charts; psychometric processes: sensible heating and cooling, evaporative cooling, cooling and dehumidification, heating and humidification, mixing of air stream, sensible heat factor; principle of air conditioning, requirements of comfort air conditioning, ventilation standards, infiltrated air load, fresh air load human comfort, effective temperature & chart, heat production & regulation of human body,

Unit-V Air conditioning loads: calculation of summer & winter air conditioning load, bypass factor of coil, calculation of supply air rate & its condition, room sensible heat factor, grand sensible heat factor, effective sensible heat factor, dehumidified air quantity. Problems on cooling load calculation. Air distribution and ventilation systems

References:

1. Arora CP; Refrigeration and Air Conditioning; TMH
2. Sapali SN; Refrigeration and Air Conditioning; PHI
3. Ananthanarayan; Basic Refrigeration and Air conditioning; TMH
4. Manohar Prasad; Refrigeration and Air Conditioning; New Age Pub
5. Ameen; Refrigeration and Air Conditioning; PHI
6. Pita ; Air conditioning Principles and systems: an energy approach; PHI
7. Stoecker W.F, Jones J; Refrigeration and Air conditioning; McGH, Singapore
8. Jordan RC and Priester GB Refrigeration and Air Conditioning, PHI USA
9. Arora RC; Refrigeration and Air conditioning; PHI Learning

List of Experiments :-

Refrigeration and Air Conditioning AU/ ME 8002

1. General Study of vapor compression refrigeration system.
2. General Study of Ice Plant
3. General Study and working of cold storage
4. General Study Trane Air Condition (Package Type).
5. General Study of Electrolux Refrigeration
6. General Study One tone thermax refrigeration unit.
7. General Study of Water cooler
8. General Study of Psychrometers (Absorption type)
9. General Study of Leak Detectors (Halide Torch).
10. General Study and working of Gas charging Rig.
11. General Study of window Air Conditioner.
12. General Study and working of Vapor compression Air conditioning Test rig.
13. Experimentation on Cold Storage of Calculate COP & Heat Loss.
14. Experimentation on Vapor compression Air Conditioning test rig.
15. Changing of Refrigerant by using Gas Charging Kit.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VIII-Semester

Elective –V ME- 8003 (1) Tribology

- [1] Introduction, history of tribology, early scientific studies of - friction, Wear Lubrication. Tribo-Surface preparations and characteristics. Surface contacts, Hertz contact stresses, residual stress, surface fatigue, creep, stress relaxation, fracture mechanics, elastic, visco elastic and plastic behavior of materials. Choice of materials.
- [2] Friction, laws of friction, rolling/sliding friction, theory of adhesion and abrasion, different mechanisms of friction , stick slip characteristics, interface temperature, thermal analysis, Molecular mechanical theory of friction, operating conditions and system parameters, calculations of coefficient of friction, design of friction devices.
- [3] Wear, different types of wear mechanisms, adhesive, abrasive impact,percussion erosion, fretting wear calculations of wear rate, two body/ three body wear, wear prevention, wear of metal cutting and metal forming tools, wear mapping of materials, cavitation, surface fatigue, corrosion, performance levels classifications and specifications of lubricants,
- [4] Lubrication, lubricants and additives, composition and properties of lubricants, maintenance of oil and emulsions, industrial hygiene aspects, technical regulations for lubricants. boundary/ mixed and fluid film lubrication, industrial methods of lubrications, SAE,BIS, ASTM, IP, DIN Standards.oil testings.wear and chemistry of lubricants.
- [5] Nano tribology, Instrumental tests,. Bearings, clutches and brakes, slide units, dynamic seals, Automobile applications, machine tools/ press machines applications. Other applications and case studies

Books:

- 1 . Principles and applications of tribology, Bharat Bhushan, John Wiley& sons, ISBN 0 471 59407 5
- 2. Tribology,, - lubrication ,friction and wear, I V Kragelsky and V V Alisin, Mir publication, ISBN 1 86058 288 5
- 3 . Applied Tribology,M M Khonsari and E. R. Booser, John Wiley, ISBN 0 471 28302 9

Tutorial topics.

- [1] Testing equipments of tribology.
- [2] Various industrial applications of tribology.
- [3] NEMS and MEMS applications

[4] Solid, liquid and mist/ gas lubricants.

[5] Surface coatings.

[6] Chemical analysis of materials

[7] Various simulations

[8] AFM/ FFM , SFA, STM, studies.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VIII-Semester

Elective –V ME- 8003 (2) Failure analysis & Trouble Shooting

- [1] Failure data and statistical distributions analysis. Reliability. The component's life cycle. The equipment's life cycle. Mechanical mechanisms associated with the components. Forces and vibration analysis. Safety factors. Different applications and case studies.
- [2] Failure analysis from the tribological considerations. Friction, wear and lubrication analysis, wear maps, lubricants and alternatives. Surface compatibility and elastic matching. Methods of friction reduction. Geometrical accuracies assembly requirements
- [3] Failure analysis from material selection and subsequent treatments. Alloying elements, heat/mechanical treatments. Mechanical elastic and plastic behavior of materials. Alternative newer materials. Microscopic/ macroscopic analysis.
- [4] Failure analysis from the production methods and maintenance procedures considerations. Faulty methods, fittings, assembly and disassembly problems, faulty maintenance methods, reconditioning, reverse engineering, Hand tools and preparation of inspection procedure.
- [5] Failure analysis and trouble shooting with specific processes and subsequent testing of individual components. Make or buy decisions, value analysis. NDT method of testing. BIS and other specifications.

Books:

- 1 Machinery failure analysis and trouble shooting, H.P. Block and F.K. Geitner, Gulf publishing co., ISBN 0-87201-872-5

Tutorial topics.

- [1] Understanding the drawings and use of different drawing software.
- [2] Limits, fits and dimensional/ geometrical/ assembly tolerances, Surface finish
- [3] Mechanical destructive and non destructive tests.
- [4] Solid, liquid and mist/ gas lubricants.
- [5] Trial, commissioning and test charts.
- [6] Chemical analysis of materials
- [7] Calibration of inspection instruments.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VIII-Semester

Elective –V ME- 8003 (3) Advance Machining Process

- [1] Mechanical processes, process selection, mechanics of cutting, metal removal rate, cutting tool system design, ultrasonic machining, abrasive jet machining, water jet machining, , effect of parameters and variables, applications and limitations, recent developments in mechanical processes.
- [2] Electrochemical and chemical metal removal processes, electrochemical machining[ECM], elements of ECM, power source and control system, electrolytes, tool work system, chemistry of the process, tool design and metal removal rate, process faults, material removal and surface finish, electrochemical grinding, electrochemical deburring, electrochemical honing, chemical machining,
- [3] Thermal metal removal processes, electric discharge machining[EDM], spark erosion, mechanism of metal removal, spark erosion generator, electrode feed control, vibrating electrode system, dielectric fluid, flushing, accuracy, plasma arc machining[PAM], non thermal generation of plasma, mechanisms and parameters, equipments, electron beam machining[EBM], generation and control of electron beam, theory and process capabilities, neutral particle etching, laser beam machining, hot machining, methods of local heating, tool life and production rate.
- [4] Rapid prototyping fabrication methods, fundamentals, technologies, applications, principles and working of 3D printing, subtractive v/s additive manufacturing process, VAT photo polymerization, material and binder jetting, continuous liquid inter phase production, direct metal laser sintering.
- [5] Technologies of micro fabrication, types of micro system devices, industrial applications, micro fabrication processes, LIGA process .Technologies of nano fabrication, importance of size, scanning probe microscope, carbon Buckyballs and nano tubes, nano fabrication processes,

Books:

1. Mikell P. Groover, Fundamentals of Modern Manufacturing, Wiley India, ISBN 978 81 265 2301 6
2. Pandey P.C, Shan H.S., Modern Machining Processes, Tata McGraw Hill, ISBN 0 07 096518 8
3. Lal G.K, Gupta V, Reddy N.V., Narosa Publishing House, ISBN 81 7319 709 1
4. CMTI Handbook

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VIII-Semester

Elective –VI ME- 8004 (1) Optimization Technique

- [1] Introduction to optimization, engineering applications in brief, design constraints and objectives, classifications, classical optimization techniques, single and multi variable optimization with no constraints/ equality / inequality constraints.
- [2] Linear programming, definitions and theorems, standard forms of linear programming , algorithms, two phases of the simplex methods, duality in programming, decomposition of principle, sensitivity analysis, transportation problems, quadratic programming.
- [3] Non linear programming, unconstrained techniques one dimension minimization methods, elimination and interpolation methods, practical considerations, implementation in multivariable problems, comparisons, constrained optimization techniques, direct / indirect methods, test problems, trusses, welded beams, gear train design, heat exchanger design.
- [4] dynamic programming, introduction, posynomial, geometrical programming, unconstraint/ constraint minimization, applications of geometric programming, multistage decision processes, suboptimization and principles of optimality, computational procedures, linear programming as a case of dynamic programming, continuous dynamic programming, design of continuous beam, trusses,
- [5] Integer linear and non linear programming, graphical representation, stochastic programming, Introduction to genetic algorithm, neural network based optimization, practical aspect of optimization,

Books:

1. S.S. Rao, Engineering optimization, New Age International Publishers,ISBN: 81 224 1149 5
2. A. Ravindran,K. Ragsdell and G. Reklaitis, Engineering Opimization, John wiley &Sons
3. K. Deb, Optimization for Engineering Design, Prentice Hall of India

Tutorial topics.

- [1] Lagrange Multipliers and use in optimization problems
- [2] Simplex method, Dual simplex method
- [3] Constraint qualifications
- [4] Convex programming problems
- [5] Comparison of elimination methods
- [6] Newton method, quasi Newton method
- [7] Penalty function method
- [8] Simulated Annealing

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VIII-Semester

Elective –VI ME- 8004 (2) Product Design

- [1] Basic concepts of engineering products' drawings. Softwares' applications for preparation of drawings, designs and animations. (5L)
- [2] Creativity , Concept generation – Intuitive / Rational and as per customers choice amongst alternatives. Needs and wants. Products' specifications and product architecture.
- [3] A brief review of engineering materials and their properties. Concepts of tribology – Friction, Wear and Lubrication (5L)
- [4] Basic concepts of limits, fits and tolerances in individual components and assemblies. A brief review of process planning, Jigs, Fixtures, manufacturing methods and shop floor practices. Review of drawings and design from industrial and manufacturing aspects. A brief review of quality assessment and control (5L)
- [5] Basic concepts of ergonomics and related proportions. Value analysis , cost analysis, market impact and feed back data from market to designer. The product life cycle. Intellectual property rights/ Patent procedures and governments' support for export/import substitutions..

Books:

1. K.T.Ulrich and S.D.Eppinger," Product design and development".
2. G.E.Dieter, Engineering Design.
3. Product design – Otto, Wood,

Tutorial topics.

- [1] Why-whom-how-how much – when – where – end result :safety, social effects
- [2] Fish bone diagram
- [3]Function structure diagram
- [4] Sequence diagram
- [5]Liaison diagram
- [6] Datum Flow Chain diagram
- [7] Specifications and ergonomics
- [8] Drawings
- [9]Process sheets : Required m/cs, equipment,time and motion studies,costings
- [10] Basic mechanical component design
- [11] Manufacturing methods
- [12]Design traits and Biasness
- [13] Maintenance schedule , services , analysis ,
- [14] Software available

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VIII-Semester

Elective –VI ME- 8004 (3) MAINTENANCE MANAGEMENT

- [1] Maintenance, definition, preventive, corrective, on- line off- line maintenance, window maintenance, emergency, reconditioning, design out maintenance . “ product- item- machine – plant structure characteristics. Design , cost and safety aspects.
- [2] Production- maintenance system, Maintainability, Maintenance procedures, guidelines for matching procedures to items, universal maintenance procedures. shutdown programs
- [3] Maintenance organization, work load, resource characteristics, administrative structure, work planning, scheduling and control strategy, feed back, combinations of manpower, tools and spares. Documentations. Network planning, computer based management information systems,.
- [4] restoration of components, assembly, disassembly bush bearing, housings, Ball and roller bearings, key-splines, couplings shafts- lead screw fittings, clutches- brakes, belt pulley, chain sprocket, guideways, machine hydraulics, pneumatics, electrical works and motors, seals, and packings. Fasteners , welding, machining, repair cycles, repair complexities, maintenance stages. Lubrication, accuracies and technological test charts.
- [5] Failure statistics, Failure data, failure patterns/ statistical models, Failure analysis, applications of different models, Depreciation and average machine life. case studies.

Books:

- 1 .Maintenance management – Hand book, Higgins
- 2.Maintenance planning and control, Anthony Kelly

Tutorial topics.

- [1] Drawings, manuals and specifications.
- [2] Limits, fits and tolerances, Surface finish
- [3] Measurement tools
- [4] Engineering materials
- [5] Wear mechanisms
- [6] Maintenance softwares
- [7] Industrial safety norms and regulations
- [8] Motivation