SCHOOL

OF

MECHANICAL SCIENCES

Code No.	Subject Name	Credit
ME101	Basic Mechanical Engineering	3:0:0
ME102	Engineering Drawing	2:0:2
ME103	Computer Aided Graphics	1:0:2
ME104	Workshop Practice	0:0:2
ME201	Engineering Thermodynamics	4:0:0
ME202	Thermal Engineering	3:1:0
ME203	Thermal Engineering Lab	0:0:1
ME204	Heat and Mass Transfer	4:0:0
ME205	Heat Transfer & Internal Combustion Engines Laboratory	0:0:2
ME206	Internal Combustion Engines Laboratory	0:0:1
ME207	Mechanics of Machines I	4:0:0
ME208	Mechanics of Machines II	4:0:0
ME209	Dynamics Lab	0:0:1
ME210	Machine Design & Drawing	3:1:0
ME211	Design of Mechanical Transmission Systems	3:1:0
ME212	Special Machines Lab	0:0:2
ME213	Metrology and Quality Control	4:0:0
ME214	Metrology	4:0:0
ME215	Metrology Lab	0:0:1
ME216	Engineering Economics and Cost Analysis	3:1:0
ME217	Gas Dynamics & Jet propulsion	3:1:0
ME218	Software Lab	0:0:2
ME219	Heat Transfer & Internal Combustion Engines Lab	0:0:1
ME220	Mechanics of Machines – I	2:1:0
ME221	Mechanics of Machines – II	2:1:0
ME222	Special Machines Lab	0:0:1
ME223	Heat Engines and Fluid Machinery	3:1:0
ME224	Heat Engineering	3:1:0
ME225	Heat Engineering Laboratory	0:0:1
ME226	Design of Machine Elements	3:1:0
ME227	Machining Lab - II	0:0:1
ME301	Advanced Thermodynamics	3:1:0
ME302	Advanced Heat Transfer	3:1:0
ME303	Advanced Thermal Laboratory	0:0:2
ME304	Advanced Fluid Mechanics	3:1:0
ME305	Advanced Refrigeration and Air-conditioning Systems	3:1:0
ME306	Automatic Controls in Thermal Equipments	3:1:0
ME307	Advanced Instrumentation in Thermal Engineering	3:1:0
ME308	Design of Thermal Power Equipments	3:1:0
ME309	Design and Analysis of Heat Exchangers	4:0:0
ME310	Technology Forecasting	4:0:0

Code No.	Subject Name	Credit
ME311	Computational Fluid Dynamics	3:1:0
ME312	Finite Element Methods in Engineering	3:1:0
ME313	Energy Conservation & Management	3:1:0
ME314	Advanced Turbo Machinery	4:0:0
ME315	Two Phase Flow and Heat Transfer	4:0:0
ME316	Cryogenic Engineering	3:1:0
ME317	Software Lab	0:0:2
ME318	Energy Technology Forecasting	3:1:0
ME319	Combustion in Engines	3:1:0

ME101 BASIC MECHANICAL ENGINEERING

Credit: 3:0:0
Marks: 40 + 60

Unit I
Steam boilers and turbines: Boiler mountings and accessories – Cochran boiler – locomotive boiler – Babcock and Wilcox boiler – fire and water tube boilers – main parts of steam turbine – single stage impulse turbine – Parson's reaction turbine – difference between impulse and reaction turbines.

Unit II
Power plants and IC engine: Classification of power plants – steam, nuclear, diesel and hydro power plants – IC engines – components – working of four stroke petrol and diesel engines.

Unit III
Alternate sources of energy: Solar energy – wind mills – tidal power geothermal power – ocean thermal energy conversion.

Unit IV
Metal casting and forming process: Advantages of casting – patterns – moulding – melting of cast iron – fettling – casting defects – forging – rolling – extrusion – drawing.

Unit V
Metal joining and Machining process: Introduction – welding - arc welding – gas welding – brazing – soldering – lathe – drilling machines – shaping machine – milling machine. Introduction to Heat treatment & Heat Treatment processes.

Text Book
1. Shanmugam G., "Basic Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi 1997.

Reference Books

1. Shanmugam G. and Palanichamy M.S., “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Publishing Co., New Delhi 1996.
2. Venugopal K., “Basic Mechanical Engineering”, Anuradha Publication

ME102 ENGINEERING DRAWING

Credit: 2:0:2
Marks 50 + 50

Unit I
Standard code of practice for Engineering Drawing – lettering – dimensioning – methods of drawing simple figures – ellipse, hyperbola, parabola, regular polygons.

Unit II
Introduction to orthographic projections – projection of points, projection of straight lines in the first quadrant (line parallel to both planes, inclined to one plane and parallel to other, inclined to both planes).

Unit III
Projections of simple solids in simple positions – prism, pyramid, cylinder and cone. Conversion of pictorial views into orthographic views of simple machine members.

Unit IV
Development of surface of solids – prism, pyramid, cylinder and cone. Isometric views of solids.

Unit V
Plan, Elevation and Section of single storied residential/office building with flat RCC roof and brick masonry walls having not more than three rooms. (Planning/Designing is not expected in this course)

Text Books

1. Venugopal K, “Engineering Drawing and Graphics”, 3rd Edition, New Age International Publishers, 1999.
2. Natarajan K.V., “A Text Book of Engineering Drawing”, 12th Edition, 1998.

Reference Books

1. Bhatt N.D., ‘Elementary Engineering Drawing’, 26th Ed., Chartor Publishing House, Anand, 1987.
2. Sekkilar S.M., Tamarai Selvi S., ‘Engineering Drawing’, Anuradha Agencies, Kumabkonam, 1987.
3. Software which demonstrates concepts of 1st angle and 3rd angle projections.

ME103 COMPUTER AIDED GRAPHICS

Credit 1:0:2
Marks: 50 + 50

Unit I
Introduction to Computers and Computer Aided Graphics – Workstations – Display Technology – Input and Output Devices – Graphics standards.

Unit II
Introduction to Computer Aided Design and Drafting – Applications – Various CAD Packages – Study of AUTOCAD 2000 software – Hardware requirements.

Unit III
Simple Exercises using various Drawing and Editing commands of AUTOCAD 2000

Unit IV
Simple Exercises using various formatting commands – Basic Dimensioning practice using AUTOCAD 2000.

Unit V
Simple Exercises using Layers and Blocks – Introduction to Isometric Drawings – Basic Plotting practice.

Text Book

1. George Omura, 'AUTOCAD 2000', BPP Publications, New Delhi, 2000

Reference Books

1. Shyam Tickoo, 'AUTOCAD 2000 BIBLE', BPP Publications, New Delhi, 2000
2. K.V. Natarajan, "Engineering Drawing and Graphics", 15^{th} Ed. 2001

ME104 WORKSHOP PRACTICE

Credit: 0:0:2
Marks: 50 + 50

A.Carpentry:
Handling of carpentry tools: Practice in marking, sawing, plaining and chieselling to size – making simple joints such as half-lap, dovetail, mortise, joints.
Use of modern materials such as plywood, chip board, novapan, laminated sheets etc. (demonstration only).
B. Fitting:
Use of fitting tools: practice in marking, fitting to size and drilling, making of simple mating profiles such as vee, square, dovetail, half round joints.
C. Smithy:
Demonstration of hand forging of round rod into square.
D. Miscellaneous
Demonstration of metal joing processes like weldong, brazing soldering and operation of Lathe, Milling machine and NC machines.

ME201 ENGINEERING THERMODYNAMICS

Credit 4:0:0
Marks: 40+60

Unit : I

Basic concepts – concept of continuum, macroscopic approach, thermodynamic systems – closed, open or control volume. Thermodynamic properties and equilibrium state of a system, state diagram, path and process, quasi-static process, work, modes of work, zeroth law of thermodynamics – concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities C_v and C_p, enthalpy, steady flow process with reference to various thermal equipments.

Unit : II

Second law of thermodynamics – Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Carnot cycle, reversed Carnot cycle, efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy – reversibility and irreversibility – Carnot theorem, entropy and reversibility, absolute entropy availability

Unit : III

Properties of pure substances – Thermodynamic properties of pure substances in solid liquid and vapour phases, phase rule P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non flow and flow processes.

Unit : IV

Gas mixtures – Properties of ideal and real gases, equation of state, Avagadro's law, Gay Lussac's law Graham's law of diffusion, kinetic theory of gases, RMS and average velocity, ideal gas and deviation from it, Vander Wall's equation of states compressibility, compressibility chart, expansivity. Dalton's law of partial pressure. Psychrometry and psychrometric charts, property calculations of air vapour mixtures

Unit : V

Air standard cycles – Otto, Diesel, Dual, Brayton cycles – calculation of mean effective pressure and air standard efficiency. Rankine cycle – efficiency calculation

Text Books

1. Vanwylen and Sontag, Classical Thermodymics, Wiley Eastern, 1997
2. Nag P.K., Engineering Thermodynamics, TMH, New Delhi, 1998

Reference Books:

1. Holman. J.P., Thermodynamics, 3rd edition, McGraw Hill, 1985
2. Roy choudhury T., Basic Engineering Thermodynamics, TMH, 1988

ME202 THERMAL ENGINEERING

Credit 3:1:0
Marks: 40+60

(Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant, property tables are permitted.)

Unit : I

Classification of IC engine, IC engine components and functions. Actual and theoretical p-v diagram of four stroke and two stroke engines. Valve timing diagram and port timing diagram. Comparison of two stroke and four stroke engines. Fuel supply systems, Ignition systems, testing and performance of I.C. Engine. Knocking and Detonation. Lubrication system and cooling system. Exhaust gas analysis, pollution control norms

Unit II : Steam Turbine

Steam nozzles – flow through nozzles – General relation for adiabatic flow – effect of friction – Diffusers. Steam turbines – Advantages of turbines – impulse and reaction turbines – 50% reaction – compounding of turbines, Reheating of Regeneration cycle.

Unit III : Gas Dynamics

Compressible fluid flow through nozzle and diffusers – stagnation properties – Mach number, sonic velocity – Isentropic flow – flow through constant area ducts. Fanno and Raleigh flow – normal shock, simple problems using gas tables.

Unit IV : Air Compressor

Classification and working principle, work of compression with and without clearance. Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating air compressors. Multistage air compressor and intercooling – work of multistage air compressor. Problems in air compressor.

Unit : V

Vapour compression Refrigeration cycle – super heat, sub cooling, performance calculations. Working principle of vapour absorption system. Ammonia-water, Lithium bromide- water systems (Description only). Comparison between vapour compression and absorption systems.

Unit : V

Psychrometry, Psychrometric chart, Psychrometric processes – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling, problems. Cooling load calculations. Concept of RSHF, GSHF, ESHF. Simple problems, Air conditioning systems.

Text books:

1. Kothandaraman, C.P, Domkundwar S., Engineering Thermodynamics, Dhanpat Rai & Sons, 2^{nd} edition, 1988.
2. Holman, J.P., Thermodynamics, Mc Graw Hill, 1985.

Reference Books:

1. Zill Smith, Zurich, Fundamentals of I.C. Engines, Oxford, 1992.
2. Rogers, Mayhew, Engineering Thermodynamics, ELBS, 1992.
3. Arora, C.P., Refrigeration and Air conditioning, TMH, 1994.

ME203 THERMAL ENGINEERING LABORATORY

Credit: 0:0:1
Marks: 25+25

1. Boiler study and trial
2. Flue gas analysis by Orsat apparatus.
3. Study and performance characteristics of Steam turbine
4. Dryness fraction of steam using Calorimeters
5. Performance characteristics of a constant speed air blower
6. Verification of fan laws and static efficiency of air blower.
7. Test on reciprocating compressor.
8. Coefficient of performance of a Vapour compression Refrigeration plant.
9. Performance test on Air Conditioning Plant.
10. Wind tunnel – drag and lift measurements

ME204 HEAT AND MASS TRANSFER

Credit: 4:0:0
Marks: 40+60

Unit : I

Introduction to conduction heat transfer, Fourier's law of conduction, thermal conduction equation – derivation in Cartesian, Cylindrical and Spherical coordinates. One dimensional steady state conduction in plane wall and composite wall. Thermal contact resistance variable conductivity, thermal resistance, electrical analogy, radial systems – cylinder, sphere. Overall heat transfer coefficients, critical thickness of insulation. Heat generation in plane wall, cylinder and sphere.

Unit : II

Steady state conduction in two dimensions, conduction shape factor, numerical method of analysis. Unsteady state conduction – lumped heat capacity systems, significance of Biot and Fourier numbers, transient heat flow in a semi-infinite solid, use of Heisler and Grober charts.

Unit : III

Review of hydro dynamics and thermal boundary layers. Significance of non-dimensional numbers in connection. Dimensional analysis for free and forced convection. Forced Convection – heat transfer over a flat plate, flow through pipes, use of empirical relations. Free Convection – heat transfer from vertical, horizontal and inclined surfaces. Conduction and Convection systems – fins with different boundary conditions

Unit : IV

Types of heat exchangers, overall heat transfer coefficients, LMTD and NTU methods, fouling factor. Design factors – problems in heat exchangers, effectiveness.

Unit : V

Condensation and Boiling processes. Radiation – nature of thermal radiation, black body concepts, gray body, radiation shape factor, relation between shape factors, radiation heat transfer between two surfaces. Electrical analogy, Re-radiationg surface, radiation shields. Mass transfer – Fick's law of diffusion, equi-molal counter diffusion, Stephen's law, Mass transfer coefficient, non-dimensional number in mass transfer, evaporation process in the atmosphere

Text Books

1. Holman J.P., 'Heat Transfer', SI Metric Ed., Mc Graw Hill, ISE, 1972.
2. Sachdeva, 'Heat and Mass Transfer', Wiley Eastern, 1986.

Reference Books

1. Chapman., 'Heat Transfer', Maxwell Mcmillan, ISE, 1986.
2. Bijhon., 'Convective Heat Transfer', John Wiley, 1971.
3. Schaum Sereis., 'Heat Transfer', McGraw Hill, 1967.
4. Beyazitogly Yildiz., Ozisik, M.Necati., 'Elements of Heat Transfer', McGraw Hill, 1956.

ME205 HEAT TRANSFER & INTERNAL COMBUSTION ENGINES LAB

Credit: 0:0:2
Marks: 50+50

1. Thermal conductivity of insulating powder.
2. Thermal conductivity of insulating material by guarded hot plate method.
3. Heat transfer through composite wall.
4. Heat transfer by free and forced convection/
5. Heat exchanger test – parallel and counter flow
6. Emissivity measurement apparatus.
7. Heat transfer from fins – natural and forced convection.
8. Stefan – Boltzman apparatus.
9. Performance of condensers and Coolers.

10. Valve timing diagram of a four – stroke engine, Port timing diagram of a two-stroke engine
11. Performance test on a multi-cylinder diesel engine fitted with hydraulic/electric dynamometer
12. Mechanical efficiency using Retardation test.
13. Performance test on a four-stroke single cylinder diesel engine

14. Heat balance test on multi cylinder diesel engine.
15. Determination of optimum cooling water rate in single cylinder diesel engine
16. Performance characteristics of a multi-cylinder petrol engine – Morse test
17. Analysis of engine exhaust gas

ME206 INTERNAL COMBUSTION ENGINES LABORATORY

Credit:0:0:1

Marks: 25+25

1. Valve timing diagram of a four – stroke engine, Port timing diagram of a two-stroke engine
2. Performance test on a multi-cylinder diesel engine fitted with hydraulic/electric dynamometer
3. Mechanical efficiency using Retardation test.
4. Performance test on a four-stroke single cylinder diesel engine
5. Heat balance test on multi cylinder diesel engine.
6. Determination of optimum cooling water rate in single cylinder diesel engine
7. Performance characteristics of a multi-cylinder petrol engine – Morse test
8. Analysis of engine exhaust gas

ME207 MECHANICS OF MACHINES I

Credit : 4:0:0
Marks:40+60

Unit : I
Links, Pairs, chain, Mechanism, inversion of machines, structure, degree of freedom, inversion, four bar chains. Velocity and acceleration: Velocity and acceleration of simple mechanism by relative velocity method. Klein's construction for slider - crank chain,. Analytical methods and solution for mechanisms.

Unit : lI
Belt and rope drives, single plate, multiple plate cones clutches, power transmitted brakes. Lubrication: Theory of lubrication, hydrostatic and hydrodynamic bearings, fractional loss power in bearing.

Unit : III
Cams; Types of cams and followers displacement, velocity and acceleration curves for uniform velocity, uniform acceleration and retardation, SHM, Cyclodial curves. Layout of profile of plate cams of the above types with reciprocating and oscillating followers-knife-edge, Rollers and flat faced followers. Cylindrical and face cams, polynomial cams, cams with special contours.

Unit : IV

Theory of gearing, gear nomenclature, law of gearing, tooth forms of gears, minimum number of teeth. Length of arc of contact, interface. Gear trains: Types, velocity ratio and torque calculation in epicyclic gear trains.

Unit : V

Function of Governors - Porter, Proell and spring loaded governors, sensitivity, stability, hunting and isochronisms. Effect of friction. Calculation of equilibrium speeds and ranges of speed of governors. Gyroscope-couple and effects in ship, motor cycle, car, aircraft and space vehicles, gyroscope stabilization.

Text Books

1. Amitabha Ghosh and Asok Kumar Mallik. "Theory of Mechanisms and Machines" - 2nd Edition, Affiliated East and West Press Limited, 1988.
2. Khurmi R.S. "Theory of Machines" Khanna Pub. Delhi, 1979.

Reference Books

1. Ballaney P.L. "Theory of Machines" Khanna Pub. Delhi, 1979
2. Shigley J.E and Uicker J.J "Theory of Machines and Mechanisms," .McGraw Hill ISE, 1981.

ME208 MECHANICS OF MACHINES – II

Credit: 4:0:0
Marks: 40+60

Unit : I

Static force analysis, free body diagrams, conditions of two, three and four force members. Effect of friction. Inertia forces, and D' Alembert's principle, Dynamic force analysis of mechanisms including slider crank mechanisms. Computer aided dynamic analysis, Computer Aided Synthesis of Mechanisms.

Unit : II

Flywheels – turning moment diagrams and fluctuation of energy of reciprocating engine mechanisms, coefficient of fluctuation of energy and speed, weight of flywheel required.

Unit : III

Static and dynamic balancing of rotating masses in single and different planes, primary and secondary forces and couples, partial balancing of reciprocating masses of in-line V W and radial engines. Direct and reverse crank method.

Unit : IV

Undamped free vibration of single degree system, simple pendulum, compound pendulum, springs in series, springs in parallel and combinations. Damped free vibration of single degree freedom systems, types of damping, free vibrations with viscous damping, critically damped system. Under damped system - Logarithmic decrement. Forced vibration of single degree of freedom systems. Constant Harmonic excitation, steady state vibration, magnification factor versus frequency ratio for various damping ratios. Transverse vibrations of beams – natural frequency of energy method, Dunkerly's method – vibration isolation and transmissibility, critical speed – whirling of shafts – industrial noise controls.

Unit : V
Torsional vibrations – torsional vibration of single and multiple rotor systems, equivalent shafts, geared systems, Holzer's method and signature analysis.

Text Books

1. Shigley, J.E. and Uicker, J.J., 'Theory of Machines and Mechanisms', TMH ND, 1998.
2. Ballaney, P.L., 'Theory of Mechines', Khanna Publishers, 1990.

Reference Books

1. Beer, and Jhonston, 'Vector Mechanics for Engineers', 5^{th} Ed., TMH, ISE, 1998.
2. Amithabha Ghosh, and Ashok Kumar Malik., 'Theory of Mechanisms and Machines', 2^{nd} Ed., Affiliated East and West Press Limited, 1998.

ME209 DYNAMICS LAB

Credit: 0:0:1
Marks: 25+25

1. Study of cutting forces using lathe / drilling dynamometer.
2. Dynamic balancing of rotors.
3. Determination of critical speed of whirling shafts.
4. Study of undamped free vibration of equivalent spring mass system.
5. Study of undamped torsional vibration of a single rotor system.
6. Measurement of strain using strain gauge and strain meter.
7. Determination of amplitude and frequency of forced vibration using vibration exciter and vibrometer.
8. Determination of Radius of Gyration of Machine elements – connection rods, flywheel.

ME210 MACHINE DESIGN AND DRAWING

Credit: 3:1:0
Marks: 40+60

Unit : I
Introduction to the design process – factors influencing the machine design, selection of materials based on its physical and mechanical properties. Direct, bending torsional and combined stress equations, impact, and shock loading. Criteria of failure, stress concentration factor, size factor, surface finish factor – factor of safety, design stress, theories of failures – simple problems.

Unit : II
Variable and cyclic loads – fatigue strength and fatigue limit – S-N- curve, combined cyclic stress, Soderberg and Goodman equations – Design of helical, leaf, disc and torsional springs under constant loads and varying loads.

Unit : III
Design of solid and hollow shaft based on strength, rigidity and critical speed. Design and drawing of keys, keyways, couplings, rigid and flexible couplings.

Unit : IV
Design and drawings of welded joints, reverted joints of pressure vessels and structures. Threaded fasteners, Cotter joints knuckle joints and pipe joints.

Unit : V
Design and drawing of piston, connecting rod, crankshaft, and flywheel.

Text Books

1. Sundarrajamoorthy, T.V. and Shanmugam, 'Machine Design', Khanna Publishers, 1989.
2. Goseph Edward Shighley, 'Mechanical Engineering Design', McGraw Hill, 1992.

Reference Books

1. Dobrovolsky, V., 'Machine Elements', MIR Publications, 1978.
2. Hall, A.S., Holowenko, A.R. and Laughlin, HIG., Theory and Problems in Machine Design,Schaums series.

Hand Book

Design Data Book, PSG College of Technology, Coimbatore
Use of approved data books are permitted. The examination shall be of four hours duration.

ME211 DESIGN OF MECHANICAL TRANSMISSION SYSTEMS
(Pre-requisite ME210)

Credit: 3:1:0
Marks: 40+60

Unit : I
Design of bearings – sliding contact and rolling contact types. Design of drives – flat belt, V-belt chains and design of ropes, Variable speed drives- Mechanical, Hydraulic.

Unit : II
Design of gears – spur gear, helical gear and herring bone gears.

Unit : III
Design of bevel gears – straight and spiral bevel types. Design of worm gears and power screws.

Unit : IV
Design of gear box – speed reducers – speed diagrams, Stepped pulley.

Unit V
Design of a Ratchet & pawl mechanism, Geneva mechanism, Design of cams, skew gears.

Text Books

1. Sundarajamoorthy T.V. and Shanmugam, 'Machine Design', Khanna, 1995.
2. Sen G. C. & Bhattacharyya A, 'Principles of Machine Tools', New Central Book Agency (P) Ltd., 1999.
3. Prabhu.T.J., Design of Transmission elements,1998.

Reference Books

1. V. Dobrovolsky, 'Machine Elements', MIR, 1978.
2. Hall A.S. Holowenko A.R. and Laughlin H.G., 'Theory and Problems in Machine Design', Schaum's Series, 1978.
3. Hall and Allen, ' Machine Design', S.Schaum's Series, 1980.
4. Joseph Edward Shighley, 'Mechanical Engineering', McGraw Hill, 1980.

Hand Book

1. PSG College of Technology, 'Design Data Book', Coimbatore.
   Use of approved data books are permitted in the examination.

ME212 SPECIAL MACHINES LAB

Credit: 0:0:2
Marks: 25+25

1. Shaping machine:
   Making a square from a round rod, grooving, V-grooving, dovetail – male and female
2. Plain milling and gang milling exercises
3. Universal milling machine:
   Spur gear cutting, helical gear cutting, bevel gear cutting, polygonal surface milling, and pocket milling
4. Grooving and letter sinking -Vertical milling machine
5. Eccentric turning and multi- start thread cutting on lathe.
6. Grinding exercises to required accuracy:
   Universal cylindrical grinder, vertical spindle surface grinder, horizontal spindle surface grinder
7. Grinding a single point cutting tool in tool and cutter grinder.
8. Slotting and key-way cutting in vertical slotting machine.
9. Determination of cutting forces in turning – lathe tool dynamometer
10. Determination of cutting forces in milling / drilling tool dynamometer.
11. Determination of tool wear using toolmaker's microscope

ME213 METROLOGY AND QUALITY CONTROL

Credit: 4:0:0
Marks: 40+60

Unit : I

Quality control – introduction – statistical techniques in quality control – economics of quality control – control chart for variable – control charts for attributes – Acceptance sampling procedures – single, double, multiple and sequential sampling – OC curves for sampling plan – AOQL and its importance

Unit : II

Total quality system : systems approach to quality, establishing the quality system . Quality costs and economics, Organising for quality, achieving for total commitment to quality, Total quality management in a company – New design control –incoming material control And Product control – ISO 9000 – A case study in a company

Unit : III

Metrology – Introduction – general measurements – concepts – standards of measurement – line and end standards – wavelength standards – reliability – sensitivity, precision, accuracy, and errors in measurements – interchangeability – limit gauges

Unit : IV

Instruments to measure geometric shape, straightness testing and flatness, optical flat, interferometer, optical projectors, comparators, mechanical, pneumatic, electropneumatic and electrical – LVDT (Linear Variable Differential Transformer)

Unit : V

Measurement of surface finish – direct and indirect methods – tool makers microscope – introduction to coordinate measuring machine – Measurement of gear and thread – Dovetail measurement – measurement of center line of hole and hole size – autocollimator
Computer aided inspection – machine vision – opto electric sensors – applications – microprocessor applications in metrology -

Text Books

1. 1.ASTME Handbook of Industrial Metrology , prentice hall of India , ND , 1988
2. 2.Jerry Banks , Principles of quality control , John Wiley , 1989

Reference books

1. Eugene .L.Grant and Others , Statistical Quality Control , McGraw Hill , 1988
2. Armand V Feihenbaum , Total quality control 3rd edition , McGraw Hill international,1993
3. Jain R.K ,Engineering metrology , Khanna publications , 1985
4. Parson S A J , Metrology and gauging , McDonald and Evans
5. ISO – 9000 manual

ME214 METROLOGY

Credit:4:0:0
Marks: 40+60

Unit : I

Metrology – Introduction – general measurements – concepts – standards of measurement – line and end standards – wavelength standards – reliability – sensitivity, precision, accuracy, and errors in measurements – interchangeability

Unit : II

Instruments to measure geometric shape , straightness testing and flatness, optical flat, interferometer, optical projectors, – limit gauges

Unit : III

Comparators, mechanical, pneumatic, electro pneumatic, and electrical – LVDT (Linear Variable Differential Transformer). Measurement of surface finish – direct and indirect methods – tool makers microscope

Unit : IV

Control charts-X,R,P introduction to coordinate measuring machine – Measurement of gear and thread – Dovetail measurement – measurement of center line of hole and hole size

Unit : V

Autocollimator Computer aided inspection – machine vision – optic electric sensors – applications – microprocessor applications in metrology.

Text Books:

1. ASTME Handbook of Industrial Metrology, prentice hall of India, ND, 1988
2. Jerry Banks, Principles of quality control, John Wiley, 1989

Reference books

1. Eugene .L.Grant and Others , Statistical Quality Control , McGraw Hill , 1988
2. Armand V Feihenbaum , Total quality control 3rd edition , McGraw Hill international,1993
3. Jain R.K ,Engineering metrology , Khanna publications , 1985
4. Parson S A J , Metrology and gauging , McDonald and Evans
5. ISO – 9000 manual

ME215 METROLOGY LAB

Credit: 0:0:1
Marks: 25+25

1. Use of precision measuring instruments like micrometer, Vernier, height and depth gauges, surface plate, height master, etc.
2. Checking dimensions of machined parts and squareness of try square using slip gauges

3. Use of sine bar for measuring angles and tapers
4. Measurement of tooth thickness by gear tooth vernier; concentricity tester for measurement of PCD run-out
5. Calibration of plug and dial gauges
6. Taper and bore measurement using spheres.
7. Fundamental dimensions of a gear using optical profile projector
8. Checking straightness of a surface plate using auto-collimator
9. Measurement of angle between Centre lines of holes drilled radially on a shaft.
10. Measurement of thread parameters using floating carriage micrometer
11. Use of pneumatic comparator` and mechanical comparator.
12. Micro hardness measurement and surface finish measurement

ME216 ENGINEERING ECONOMICS AND COST ANALYSIS

Credit: 3:1:0
Marks: 40+60

Unit : I

Nature and scope of Engineering Economics – definition and scope of study of the subject – significance of economic analysis in business decisions. Demand and Supply analysis – determinants of demand – Law of Demand – elasticity of demand – demand forecasting – law of supply elasticity of supply – market price

Unit : II

Cost analysis: fixed cost – variable cost – marginal cost – cost output relationship in the short run and in the long run – equilibrium of the firm. Pricing decisions – situations demand pricing decisions, pricing in practice – full cost pricing – marginal cost pricing – going rate pricing – bid pricing – pricing for a rate of return, statutory price fixation in India.

Unit : III

Money and banking: value of money – inflation – deflation – banking – commercial bank and its functions, central bank and its functions. New economic environment: economic systems, economic liberalization, privatization and globalization

Unit : IV

Capital budgeting: need for Capital budgeting – method of appraising project profitability – rate of return – pay back period – present value comparison – cost benefits analysis, preparation of feasibility report, appraisal process – economic and commercial feasibility – financial feasibility – technical feasibility.

Unit : V

Depreciation: Causes for depreciation – objectives – method of computing depreciation – simple problem,. Break even analysis: Break even point – basic assumptions – break even chart – managerial uses of break even analysis, simple problems. Projected financial statements: cash flow statement, profit and loss account, balance sheet and evaluation of projected financial statements with the help of ratios.

Text Book

1. Varshney. R.L. and Maheshwari K.L., 'Managerial Economics', S. Chand & Co., 1993

Reference Books

1. Samuelson P.A. and Nordhaus W.D., 'Economics', Mc Graw Hill, 1992
2. Harold Preierman J.R. and Seymour., 'The Capital Budgeting Decision', Smidt Maxwell Mac Milan Intl., 1990.

ME217 GAS DYNAMICS AND JET PROPULSION

Credit : 3:1:0
Marks: 40+60

UNIT I

Gas dynamics – Energy equation for flow processes, stagnation state, velocity of sound, critical states, various regions of flow, Mach number, critical Mach number, Mach cone, Crocco number. Effect of Mach number on compressibility, T-S diagram and h-s diagrams showing nozzle and diffuser process.

UNIT II

Isentropic flow – Isentropic flow with variable area – Mach number variation Hugoniot equation, area ratio as a function of Mach number, Impulse function, mass flow rate, flow through nozzles, flow through diffusers.

UNIT III

Flow through constant area ducts. Flow in constant area ducts with friction, Fanno curves and Fanno flow equation, solution of Fanno equation, variation of flow properties, variation of Mach number with duct length, Isothermal flow with friction. Flow in constant area ducts with heat transfer, Raleigh line, Raleigh flow equation, variation of flow properties and maximum heat transfer.

UNIT IV

Flow with normal shock waves, governing equations, Prandtl-Meyer equations, impossibility of Rarefaction shock, Mach number in the down stream, of the normal shock, static pressure ratio, temperature ratio, density ratio and stagnation pressure ratio across the shock, entropy change, characteristic of flow through convergent and divergent nozzle with various back pressures. Normal shocks in Fanno and Rayleigh flow. Flow with oblique shock wages (qualitative treatment).

UNIT V

Propulsion – Air craft propulsion – types of jet engines, energy flow through jet engines, thrust power and propulsive efficiency, turbo jet components – diffuser, compressor, combustion chamber, turbines, exhaust systems. Performance of jet engine, thrust augmentation, performance of turbo prop engines, ram jet and pulse jet engines. Rocket propulsion – rocket engines, basic theory of equations, thrust equations, effective jet velocity, specific impulse, rocket engine performance, solid and liquid propellant rockets. Comparison of various propulsion systems.

Text Books

1. Yahya, S.M., 'Fundamentals of Compressible flow with aircraft and rocket propulsion', 2nd En,. Wiley Eastern, 1991

Reference Books:

1. Dr. Somasundaram S.L., 'Gas Dynamics and Jet Propulsion', Newnes – Butterworths & Co Publishers Ltd 1996.
2. Shapiro H. Ascher., 'Dynamics and Thermo Dynamics of Compressive Fluid Flow', Vol I & II, Ronald press Co., NY, 1955.
3. Anderson, D. John Jr., 'Introduction to Flights', 3rd Ex., Mc Graw Hill, ISE, 1989.
4. Chapman A.J. Walker H.F., 'Introductory Gas Dynamics', Holt Rinrhart and Winston Inc., 1971.

ME218 SOFTWARE LAB

Credits 0:0:2
Marks: 50+50

Introduction to Softwares- FLUENT - Pro-Engineer - I-DEAS - UNIGRAPHICS - CATIA - ANSYS - AUTOCAD – 2000.

Modelling of Small Machine Components using softwares.

Assembly modelling of machine parts.

ME219 HEAT TRANSFER & INTERNAL COMBUSTION ENGINES LABORATORY

Credit: 0:0:1
Marks: 25+25

1. Thermal conductivity of insulating powder.
2. Heat transfer through composite wall.
3. Heat transfer by free and forced convection/
4. Heat exchanger test – parallel and counter flow
5. Emissivity measurement apparatus.
6. Heat transfer from fins – natural and forced convection.
7. Valve timing diagram of a four – stroke engine, Port timing diagram of a two-stroke engine
8. Mechanical efficiency using Retardation test.
9. Performance test on a four-stroke single cylinder diesel engine
10. Heat balance test on multi cylinder diesel engine.

11. Performance characteristics of a multi-cylinder petrol engine – Morse test

ME220 MECHANICS OF MACHINES I

Credit: 2:1:0
Marks: 40+60

UNIT I
Links, Pairs, chain, Mechanism, inversion of machines, structure, degree of freedom, inversion, four bar chains. Velocity and acceleration: Velocity and acceleration of simple mechanism by relative velocity method.

UNIT II
Single plate, multiple plate cones clutches, power transmitted brakes. Lubrication: Theory of lubrication, fractional loss power in bearing.

UNIT III
Cams; Types of cams and followers displacement, velocity and acceleration curves for uniform velocity, uniform acceleration and retardation, SHM, Cycloidal curves. Layout of profile of plate cams of the above types with reciprocating and oscillating followers-knife-edge, Rollers and flat faced followers.

UNIT IV
Theory of gearing, gear nomenclature, law of gearing, tooth forms of gears, minimum number of teeth. Length of arc of contact, interference. Gear trains: Types, velocity ratio and torque calculation in epicyclic gear trains.

UNIT V
Function of Governors - Porter, Proell governors, sensitivity, stability, hunting and isochronisms. Ranges of speed of governors. Gyroscope-couple and effects in ship and aircraft.

Text Books

1. Amitabha Ghosh and Asok Kumar Mallik. "Theory of Mechanisms and Machines" - 2nd Edition, Affiliated East and West Press Limited, 1988.
2. Khurmi R.S. "Theory of Machines" Khanna Pub. Delhi, 1979.

Reference Books

1. Ballaney P.L. "Theory of Machines" Khanna Pub. Delhi, 1979
2. Shigley J.E and Uicker J.J "Theory of Machines and Mechanisms," .McGraw Hill ISE, 1981.

ME221 MECHANICS OF MACHINES – II

Credit: 2:1:0
Marks: 40+60

UNIT I

Static force analysis, free body diagrams, conditions of two, three and four force members. Effect of friction. Inertia forces, and D' Alembert's principle, Dynamic force analysis of mechanisms including slider crank mechanisms.

UNIT II

Flywheels – turning moment diagrams and fluctuation of energy of reciprocating engine mechanisms, coefficient of fluctuation of energy and speed, weight of flywheel required.

UNIT III

Static and dynamic balancing of rotating masses in single and different planes, primary and secondary forces and couples, Direct and reverse crank method.

UNIT IV

Undamped free vibration of single degree system, simple pendulum, compound pendulum, springs in series, springs in parallel and combinations. Damped free vibration of single degree freedom systems, types of damping, free vibrations with viscous damping, critically damped system. Forced vibration of single degree of freedom systems. Transverse vibrations of beams – natural frequency of energy method, Dunkerly's method – vibration isolation and transmissibility.

UNIT V

Torsional vibrations – torsional vibration of single and multiple rotor systems, equivalent shafts, geared systems, Holzer's method.

Text Books:

3. Shigley, J.E. and Uicker, J.J., 'Theory of Machines and Mechanisms', TMH ND, 1998.
4. Ballaney, P.L., 'Theory of Machines', Khanna Publishers, 1990.

Reference Books:

1. Beer, and Jhonston, 'Vector Mechanics for Engineers', 5th Ed., TMH, ISE, 1998.
2. Amithabha Ghosh, and Ashok Kumar Malik., 'Theory of Mechanisms and Machines', 2nd Ed., Affiliated East and West Press Limited, 1998.

ME222 SPECIAL MACHINES LAB

Credit: 0:0:1
Marks: 25+25

1. Shaping machine
2. Making a square from a round rod, grooving, V-grooving, dovetail – male and female
3. Plain milling and gang milling exercises
4. Universal milling machine:

5. Spur gear cutting, helical gear cutting,
6. Grooving and letter sinking -Vertical milling machine
7. Eccentric turning and multi- start thread cutting on lathe.
8. Grinding exercises to required accuracy:
9. Universal cylindrical grinder, vertical spindle surface grinder, horizontal spindle surface grinder
10. Grinding a single point cutting tool in tool and cutter grinder.
11. Slotting and key-way cutting in vertical slotting machine.

ME 223 HEAT ENGINES AND FLUID MACHINERY

Credits 3:1:0
Marks 40+60

UNIT-I: Fluid Properties

Fluid density-specific weight-specific gravity - viscosity surface tension - capillary - compressibility - vapor pressure – Manometers – Simple problems.

PUMPS: Positive displacement pumps and reciprocating pumps - operating principles -slip - indicator diagram - separation- air vessels centrifugal pumps - operation - overall performance curves-cavitation -multi staging -selection of pumps - jet pump - compressor pump - submersible pump - gear oil pump -construction and principle of operation. – working principle of air compressor.

UNIT-II: Turbines

Impulse momentum equation- moment of momentum equation (theory only) - turbine classification-working principles -pelton wheel, Francis, Kaplan turbines - velocity triangles -draft tube- similarity laws - specific speed - governing of turbines- surge tanks.

UNIT-III

Basic concepts - thermodynamic system - properties - processes - cycle - equilibrium - first law of thermodynamics - application of first law to non flow and flow process - second law of thermodynamics - Kelvin Planck's statement -Clausius statement - reversibility - Carnot theorem - heat engine - reversed heat engine - entropy.

UNIT-IV

I.C.Engine - air standard cycles - air standard efficiency - Otto, Diesel and Brayton - testing of IC Engines - performance curves, FHP determination, heat balance.

UNIT-V

Heat transfer - modes of heat transfer - steady state heat conduction - heat conduction with internal heat generation - extended surfaces - fin - convection - empirical relations - radiation - laws of radiation - radiant heat transfer between two surfaces.

Text Books

1. Modi, P.N. & Seth, S.M., "Hydraulics and Fluid Mechanics", (Including hydraulic machines) Standard Book House, New Delhi, 10th Edition, 1991.
2. Kothandaraman,C,P., etal, "A course in heat engines and thermodynamics", Dhanpat Rai & Sons, 3rd Edition, 1993.

Reference Books

1. Som,S.R, & Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, 1998.
2. Holman, "Heat Transfer", McGraw Hill International, 7th, Edition, 1992.
3. Cengel,. A., "Introduction to Thermodynamics and Heat Transfer", Tata McGraw Hill, New Delhi, 1997.

ME 224 HEAT ENGINEERING

Credit: 3:1:0
Marks: 40+60

UNIT-I Introduction to Thermodynamics

Systems, Zeroth Law, First Law - Heat and work transfer in flow and non-flow processes, Second law, Kelvin-Planck statement - Clausius statement - concept of entropy - Clausius inequality - entropy change in non-flow processes.

UNIT-II Gas Laws & Air Cycles

Properties of gases and vapours - Otto, Diesel, Dual combustion and Brayton combustion cycles – Air Standard efficiency - Cycle comparisons - Mean effective pressure - Engine performance parameters.

UNIT-III Compressors

Air compressor: Classification and working principle, work of compression with and without clearance. Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating air compressors. Multistage air compressor and intercooling – work of multistage air compressor. Problems in air compressor.

UNIT-IV Refrigeration

Vapour compression Refrigeration cycle – super heat, sub cooling, performance calculations. Working principle of vapour absorption system. Ammonia-water, Lithium bromide- water systems (Description only). Comparison between vapour compression and absorption systems.

UNIT-V Air Conditioning

Psychrometry, Psychrometric chart, Psychrometric processes – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling, problems. Cooling load calculations. Concept of RSHF, GSHF, ESHF. Simple problems, Air-conditioning systems.

Text Books

1. Kothandaraman,C.P, Domkundwar S., "Thermal Engineering", Dhanpat Rai & Sons, 2nd edition, 1988.
2. Nag. P.K., " Engineering Thermodynamics ",Tata McGraw Hill Co., Ltd., Seventh Edn., 1993

Reference Books

1. Holman, J.P., Thermodynamics, Mc Graw Hill, 1985.
2. Rogers, Mayhew, Engineering Thermodynamics, ELBS, 1992.
3. Arora, C.P., Refrigeration and Air conditioning, TMH, 1994.

ME 225 HEAT ENGINEERING LABORATORY

Credit :0:0:1
Marks 25+25

List of Experiments:

1. Test on reciprocating compressor.
2. Coefficient of performance of a Vapour Compression Refrigeration plant.
3. Performance test on Air Conditioning Plant.
4. Valve timing diagram of a four – stroke engine, Port timing diagram of a two-stroke engine
5. Performance test on a multi-cylinder diesel engine fitted with hydraulic/electric dynamometer

6. Mechanical efficiency using Retardation test.
7. Performance test on a four-stroke single cylinder diesel engine
8. Heat balance test on multi cylinder diesel engine.

ME 226 DESIGN OF MACHINE ELEMENTS

Credit: 3:1:0
Marks: 40+60

UNIT I

Introduction to the design process – factors influencing the machine design, selection of materials based on its physical and mechanical properties. Direct, bending torsional and combined stress equations, impact, and shock loading. Criteria of failure, stress concentration factor, size factor, surface finish factor – factor of safety, design stress, theories of failures – simple problems.

UNIT II

Variable and cyclic loads – fatigue strength and fatigue limit – S-N- curve, combined cyclic stress, Soderberg and Goodman equations – Design of helical, leaf, disc and torsional springs under constant loads and varying loads.

UNIT III
Design of solid and hollow shaft based on strength, rigidity and critical speed. Design and drawing of keys, keyways, couplings, rigid and flexible couplings.

UNIT IV
Design and drawings of riveted joints - pressure vessels and structures,Screw joints,Cotter joints knuckle joints and pipe joints.

UNIT V
Design and drawing of piston, connecting rod, crankshaft, and flywheel.

Text Books:

1. Sundarrajamoorthy, T.V. and Shanmugam, 'Machine Design', Khanna Publishers, 1989.
2. Goseph Edward Shighley, 'Mechanical Engineering Design', McGraw Hill, 1992.

Reference Books:

1. Dobrovolsky, V., 'Machine Elements', MIR Publications, 1978.
2. Hall, A.S., Holowenko, A.R. and Laughlin, HIG., Theory and Problems in Machine Design,Schaums series.

Hand Book
Design Data Book, PSG College of Technology, Coimbatore
Use of approved data books are permitted. The examination shall be of four hours duration.

ME 227 MACHINING LAB – II

Credit: 0:0:1
Marks: 25+25

1. Shaping machine:
   Making a square from a round rod, grooving, V-grooving, dovetail – male and female
2. Milling Exercise:
   Plain milling and gang milling exercises
3. Gear cutting in Milling:
   Spur gear cutting using Indexing unit.
4. Advanced Turning Exercises
   Eccentric turning and multi- start thread cutting on lathe.
5. Grinding exercises to required accuracy:
   Cylindrical grinder, Surface grinder
6. Slotting and key-way cutting in vertical slotting machine.
7. Gear cutting exercises using Gear Hobber- Spur and Helical gear.

ME301 ADVANCED THERMODYNAMICS

Credits 3:1:0
Marks 40+60

Unit I : Review Of Basics

First law and Second law analysis – concept of entropy – principle of increase of entropy – entropy generation – Availability – concept of exergy – exergy analysis of combustion processes. Helm Holtz function – Gibb's function – OnSagar reciprocity relation.

Unit : II

Thermodynamic relations, Maxwell's relations, T-ds equations – specific heat relations – energy equation – Joule Thomson effect – Clausius Claperyon Equation. Criteria for Equilibrium – Gibb's phase rule – Conditions for stability.

Unit : III

Compressibility factor, fugacity and activity, computation from the generalized charts, dependence of fugacity and activity on pressure and temperature, chemical – equilibrium. Phase rule – ideal and real solution of gases, liquids, equilibrium system.

Unit IV : Statistical Thermodynamics

Thermodynamics probability, Maxwell statistics, Fermi Dirac and Bose – Einstein statistics, Entropy and probability, Degeneracy of energy levels, Partition functions.

Unit V : Kinetic Theory of Gases

Perfect gas model, Distribution of translational velocities distribution function, molecular collisions and mean free path, equipartition of energy.

Text Books

1. Michael A Sadd., 'Thermodynamic for Engineers', Prentice Hall, 1972.
2. P.K. Nag., 'Engineering Thermodynamics', II Ed., McGraw Hill, 1995.

Reference Books

1. G.J. Van Wylen & R.E. Sonntag., 'Fundamentals of Classical Thermodynamics', Willy Eastern Ltd., 1989 (Unit I, II & III)
2. J.P. Holman., 'Thermodynamics', 4th Ed., McGraw Hill, 1988.
3. Juisheng Hsieg., 'Principles of Thermodynamics', McGraw Hill, 1978.
4. Lee and Sears., 'Statistical Thermodynamics', Addition Wesley, 1976.
5. Samuel Glasstne., 'Thermodynamics for Chemists', Van Nastrand, 1974.
6. Burghardt M.D., 'Engineering Thermodynamics for Engineers', Harper and Row, NY, 1987.
7. Wark K., 'Advanced Thermodynamics for Engineers', McGraw Hill, NY, 1987.
8. Smith K. Van Ness H.C., 'Introduction to Chemical Engineering Thermodynamics'. McGraw Hill, NY, 1987.

ME302 ADVANCED HEAT TRANSFER

Credits:3:1:0
Marks: 40+60

Unit I : Conduction
The heat diffusion equation. One dimensional steady state conduction with and without heat generation. The plane wall – Radial system. Heat Transfer from extended surfaces – effectiveness – efficiency. Insulation – critical thickness. Transient conduction – the lumped capacitance method – semi infinite solid.

Unit II : Convection
Energy equation – thermal boundary layer. Forced convection – Practical correlations – flow over surfaces – internal flow. Natural convection, combined forced and free convection – combined convection and radiation in flows.

Unit III : Radiation and Boiling – Condensation
Radiative heat exchange between surfaces – radiation shape factor – reradiating surfaces. Radiation in gases. Boiling – Pool and flow boiling, correlations. Condensation – modes and mechanisms – correlations and problems.

Unit IV
Heat Exchanger and Mass Transfer -Heat exchanger: types – LMTD method and the effectiveness – NTU method. Mass Transfer: types – Fick's law of diffusion – mass diffusion equation, Equimolar counter diffusion – convective mass transfer. Evaporation of water into air.

Unit : V
Analytical method for two dimensional heat equation (The method of separation of variables). Finite difference method – formulation of nodal equation – solutions for two dimensional conduction problems.

Text Books

1. Holman J.P., 'Heat and Mass Transfer', Tata McGraw Hill, 8th Ed., 1989.
2. Kern D.D., 'Extended Surface Heat Transfer', New Age International Ltd., 1985.

Reference Books

1. Frank P. Incropera and David P. Dewit T., 'Fundamentals of Heat and Mass Transfer', 4th Ed., John Wiley & Sons, 1998.
2. C.P. Kothandaraman., 'Fundamentals of Heat and Mass Transfer', 2nd Ed., New Age International, 1997.
3. Eckert E.R.D. and Drake R.M., 'Analysis of Heat and Mass Transfer', McGraw Hill, 1980.
4. Kays, W.M. and Crawford W., 'Convective Heat and Mass Transfer', McGraw Hill Inc., 1993.
5. Burmister L.C., 'Convective Heat Transfer', John Wiley and Sons, 1983.
6. Segerlind L.J., 'Applied Finite Elements Analysis', John Wiley, 1976.

ME303 ADVANCED THERMAL LABORATORY

Credits 0:0:2
Marks 50+50

1. Thermal conductivity of insulating materials.
2. Performance analysis of heat exchangers
3. Performance Analysis of Solar Pump
4. Performance Analysis of Solar Air Heaters.
5. Performance characteristic of steam boilers.
6. Performance Test on Refrigeration Unit
7. Performance Analysis of Air conditioning Unit
8. Performance Analysis of Fuel Burners
9. Emission Analysis of I.C. Engines.
10. Pressure Vs Crank angle diagram of I.C. Engines.
11. Variable compression ratio test on I.C. Engines; CFR engines with pressure Vs Crank angle diagram – combustion process and emission control studies.
12. Performance tests on multicylinder CI engines with bi-fuel operation and head recovery system of exhaust gas.

ME304 ADVANCED FLUID MECHANICS

Credits 3:1:0
Marks 40+60

Unit : I
Standard pattern of flow: velocity potential and stream, uniform flow source, sink, doublet and combinations. Flow past cylinder with and without circulation, flow past Rankine body.

Unit II : Conformal Transformation
Analytic functions, Simple transformation, flow at a wall angle, flow past a cylinder, flow parallel and normal to a flat plate, flow past a streamlined structure Schwartz Christroffel Theorem simple applications.

Unit III : Flow of Real Fluid
Laminar and turbulent flows, Navier-Stokes equations exact solutions for simple cases, boundary layer principles, flat plate, conducts, curved solid bodies, Prandt mixing length turbulent theory, universal velocity profile, momentum eddy concept – simple applications.

Unit IV : Compressible Fluid Flow Basics
One dimensional compressible flow through ducts and nozzles, isentropic flow with friction, heat transfer, plane shock. Use of stagnation properties from gas table in application.

Unit V : Compressible Fluid Flow Basics
Normal and oblique shocks, Prandt – Mayer Expansion, Property ratio's across the shock waves Rankine, Huguinot equation, strength of shock wave – Methods of characteristics applied to two dimensional flow cases.

Text Books

1. Streeter V.L., 'Fluid Dynamics', Mc Graw-Hill 1971.
2. Shapin A.H., 'The dynamics and thermodynamics of compressible fluid flow', Vol. I and II, The Ronald Press Co., 1955.

Reference Books

1. Yuan S.W., 'Foundations of Fluid Mechanics', Prentice Hall of India, 1976.
2. Robertson., 'Hydrodynamics Theory and Application', Prentice Hall of India, 1965.
3. Zucrwo M.J. and Hoffman J.D., 'Gas dynamics', Vol. I and II, John Wiley and Sons Inc., 1977.
4. Fox R.N. and McDonald A.T., 'Fluid Mechanics', John Wiley & Sons, 1994.
5. Dr. J.K Goyal I K.P. Gupta., 'Fluid Dynamics', 3rd revised Ed., Pragathiprakasam, Meerut, 1989.

ME305 ADVANCED REFRIGERATION AND AIRCONDITIONING SYSTEMS

Credits 3:1:0
Marks 40+60

Unit I : Review Of Thermodynamic Principles Of Refrigeration

Vapour compression cycle, actual vapour compression cycle, multistage, multi evaporator system, cascade system, gas cycle refrigeration, aircraft refrigeration.

Unit II : Refrigeration

Estimation of thermal load, selection and matching of components compressors, evaporators, condensers, expansion devices, cyclic controls requirements of refrigerants, lubricants in refrigeration, Secondary refrigerants, mixed refrigerants.

Unit III : Vapour absorption systems

Theory of mixtures, enthalpy composition diagrams, absorption system calculation, aqua ammonia systems, LiBr water system, Three fluid absorption systems, solar refrigeration system.

Unit IV : A.C. System and Control

Review of psychometric process, air washer, water/stream injection and sensible heat factor and by-pass factor, comfort air conditioning, factors affecting human comfort, comfort chart, year-round air conditioning system, A.C. control, by pass reheat, volume control, noise and vibration.

Unit V : Air Distribution

Air distribution pattern, outlet friction in ducts – thermal insulation, duct design, equal distribution methods, fan arrangements.

Text Books

1. Stocker W.F. and Jones J.W., 'Refrigeration and Air-conditioning Data', McGraw Hill, 1985.

2. Manohar Prasad., 'Refrigeration and Air Conditioning', Wiley Eastern Ltd., 1990.

Reference Books

1. Jordan and Priester., 'Refrigeration and Air conditioning', Prentice Hall of India, 1974.
2. 'Ashrae Hand Book', 4 Vol., Current Ed.,
3. Carrier Air Conditioning Co., 'Hand Book of Air Conditioning', Prentice Hall of India, 1974.
4. Lanqley Billy., 'Refrigeration and Air Conditioning', 3rd Ed., Englewood Cliffs (NJ), Prentice Hall, 1989.
5. Jones., 'Air-conditioning Engineering', Edward Arnold Pub., 1987.

ME306 AUTOMATIC CONTROLS IN THERMAL EQUIPMENTS

Credits 3:1:0
Marks 40+60

Unit : I

Introduction to Automatic controls – Engineering of controls for Engines – Fuel pumps – governors – carburetor butterfly valve & links.

Unit II : Refrigeration & Air conditioning – Expansion system:

Constant Pressure and Superheat (Thermostat expansion value) – HP & LP cutouts combination controls – high current relay – high side and low side float system – evaporator regulating valve. Temperature controlled suction pressure valve. Thermostats Humidity control. Damper motors – Pneumatic control for room temperature.

Unit III : Boiler

Water level – air flow – furnace pressure – steam temperature – combustion control – master controller – Burner management Pulverizer control – mixed fuel control, PLC application.

Unit IV : Turbine

Governor – over speed cut off.
Controls in combined cycle plants and PLC application
Controls in co-generation plants.

Unit : V

Microprocessor based applications in measurement and control. Digital transducers – Interface systems and standards – computer automated measurement and control (CAMAC) standards – IEEE 488 standard interface – remote monitoring and control of boiler houses. DDAC (Distributed data acquisition and control sytem) – Microprocessor based temperature control system.

Text Books

1. Althours A.D., Turnquist C.H., Braceioano A.F., 'Modern Refrigeration & Air Conditioning', Galgotia Book House, 1982.
2. David Lindsley., 'Boiler Control Systems', McGraw International, London, 1992.

Reference Books

1. R. Munton and J.R. Stott., 'Refrigeration at Sea', Applied Science Publishers Ltd., London, 1978.
2. LRD Lilly (ed)., 'Diesel Engine – Reference Book', Butter Worths, London, 1985.
3. National Seminar on 'Steam and Gas based cogeneration system', Indian Institute of Plant Engineers, Radient Publication Pvt. Ltd., Secunderabad, 1987.
4. Doughlas, M. Considine & Glenn D. Considine (eds)., 'Process Instruments and Controls Hand Book', 3rd Ed., McGraw Hill, 1985.
5. George C. Barney, 'Intelligent instrumentation microprocessor applications in measurement and control', 2nd Ed., Prentice Hall of India Pvt. Ltd. New Delhi, 1992.

ME307 ADVANCED INSTRUMENTATION IN THERMAL ENGINEERING

Credits 3:1:0
Marks 40+60

Unit : I

Review of static and dynamic measurements – kinds of errors and uncertainty – Their analysis – Planning the experiments from error analysis. Pressure cells – Dynamic characteristic LVDT, piezo Electric pressure gauge.

Unit : II

Flow Measurements Pitot tubes – magnetic flow visualization methods – shadowgraph – schlieren and interferometry – smoke methods – impact of pressure in supersonic flow – Hot wire anemometer – Laser Bopler anemometer – Holographic flow motors, NMR flow meter.

Unit : III

Temperature measurements – measurement by Mechanical effect and by electrical effects-Thermocouples, pyrometry, transient response of thermal systems – calibration methods. Thermo electric effect instruments – varying resistance device quartz Thermometers. Thermal property measurements: measurement of Thermal conductivity. Emissivity – Gas composition analysis gas chromography – Infrared analyzer and Mass spectrometer.

Unit : IV

Data acquisition and processing – analysis of experimental Data – Measurement of Heat flow by Electrical analog – use of computers. Digital transducers intelligent temperature measuring instruments an application of program logic controllers in boilers and turbines.

Unit : V

Solar radiation measurement: Definition – Pyrhekuimeters and phyrheliometric scales. Pyranometers – Measurement of duration – sun shine recorder. Instrumentation of I.C. Engines, Gas and Steam Turbines and Boilers.

Text Books:

1. Doebelin O.E., ‘Measurement Systems and Design’, McGraw Hill Co., 1998.
2. Holman J.P., ‘Experimental Methods for Engineers’, McGraw Hill, 1971.

Reference Books:

1. Beckwit T.G. and Buck M.L., ‘Mechanical Measurements’, Addition Welsly, 1986.
2. Rangan, C.S., Sharma G.S. and Mani V.S., ‘Instrumentation Devices and Systems’, Tata McGraw Hill Pub. Co., 1993.
3. Johnson C.D., ‘Process Central Instrumentation Technology’, John Willey & Sons Inc., 1988.
4. R.S. Sirohi & H.C. Radhakrishanan., ‘Mechanical Measurements’, Willey Eastern Ltd., 1983.

ME308 DESIGN OF THERMAL POWER EQUIPMENTS

Credits 3:1:0
Marks 40+60

Unit : I

Design considerations – Services – requirements - parameters to be considered in Boiler Design - IBR Code Furnace Design: Heat Transfer in Furnace – heat balance – types of refractory walls – Furnace – Water wall arrangements. Heat release rates – furnace bottoms – Slag removal – Cold primary air system – wind box assembly Different types of furnaces for solids and liquids.

Unit : II

Water Side Design – Circulations – Positive and Natural circulation – ratio drum size stream space and water contact – Steam generator configuration – Design or condensers – Economic selection of condensers. Super Heater Design. Economy of super heat limit of super heat – super heater performance, steam mass flow gas mass flow and pressure drop in super heater. Tube design – Super heat temperature control.

Unit : III

Evaporators – Single effect and multiple effect evaporator steam requirements.

Unit : IV

Water & Steam purification – chemical treatment mechanical carry over – Silica carry over gravity separation – drum internals – steam washing typical arrangements of boiler drum internal in H.P. boilers – Economizers: Types of Economizers integral – Separate Design of an economizer suitable for a power plant.

Unit : V

Types of Air heater, recuperative and regenerative – Design considerations – Higher temperature and low temperature applications – Draft system design: Power requirement for draft fans, Pressure losses – Diameter and height of the chimney Design – Forced, induced, balanced drafts – Ash separators by ESP Electrostatic precipitators.

Text Books

1. P.K. Nag., 'Power Plant Engineering (Steam and Nuclear)', Tata McGraw Hill, New Delhi, 1998.
2. C.D. Shields., 'Boilers', McGraw Hill, 1982.

Reference Books

1. Homi, P. Serval., 'Boilers & Pressure Vessels', Multitech Publishing Company, Bombay, 1989.
2. Carl Shields., 'Boilers – Type characteristics & function', McGraw Hill, 1982.
3. Skrotzki & W.A. Vepot., Power Station Engg. Economy, Tata McGraw Hill, New Delhi, 1987.
4. Morse, T.F., ' Power Plant Engineering', Van Nostrand East West Press, revised Edn., 1983.
5. David Sunn, Robert Houston., 'Industrial Boilers', Longman Science & Technology, 1986.
6. 'Modern Power Station Practice', Vol. 8, Central Electricity Generatio Board, UK, 1980.

ME309 DESIGN AND ANALYSIS OF HEAT EXCHANGERS

Credits 4:0:0
Marks 40+60

Unit I : Constructional Details

Types, Fluid flow arrangements, parallel, counter and cross flow, shell and tube heat exchanger, Regenerators and recuperator. Condensers – Industrial applications.

Unit II : Heat Transfer

Modes of Heat Transfer, Overall heat transfer coefficient, Thermal resistance, Efficiency. Temperature Distribution and its implications, LMTD, effectiveness.

Unit III : Flow Distribution

Effect of Turbulence, Friction Factor, Pressure Loss, Orifice, Flow nozzle, Diffusers, Bends, Baffles, Effect of Channei Divergence, Manifolds.

Unit IV : Stress in tubes, Headers sets and Pressure vessels

Differential Thermal Expansion, Thermal stresses, Shear stresses, Thermal sleeves, Vibration, Noise, types of failures.

Unit : V

Design Aspects: Heat transfer and pressure loss flow configuration effect of baffles. Effect of deviations from ideality. Design of typical liquid-liquid, gas-gas-liquid heat exchangers. Design of cooling towers.

Text Books

1. Kays, W.M. and London A.L., 'Compact Heat Exchangers', 3rd Ed., McGraw Hill, 1984.
2. Frass, A.P. and Ozisik, M.N., 'Heat Exchanger Design', John Wiley and Sons Inc., 1965.
3. Walker G., 'Industrial Heat Exchangers', A basic guide, McGraw Hill V Book Co., 1980.

Reference Books

1. 'Standards of the Turbular Exchanger Manufacturer Association', 6th Ed., Tubular Exchanger Manufacturers Association, New York, 1978.
2. Donold Q Kern., 'Process Heat Transfer', McGraw Hill Book Co., 1984.
3. E.A.D. Saunders., 'Heat Exchangers', Longman Scientific and Technical, New York, 1988.

ME310 TECHNOLOGY FORECASTING

Credits 4:0:0
Marks 40+60

Unit : I

Technology Forecasting : Normative approach technology forecasting for strategic decision - technology forecasting for research and development planning. Extrapolation methods. Intentive methods such as Delhi. Surveys and sceneries, analytical techniques

Unit : II

Energy Planning: Energy as a resource for technology development – Centralized and decentralized – Energy inflow and outflow analysis – Energy forecast – Ways of bridging the gap between supply and demand.

Unit : III

Energy Audit: Energy Audit Energy Accounts and Analysis - Audit in heating – ventilation – air conditioning in building system – Electric utility, process system energy audit – case studies in industries.

Unit : IV

Energy conservation – cost of energy – reception – storage – handling of fuel – Measurement of energy – controls– Conservation in industries – boilers – New Technologies – Waste reutilization – Case studies.

Unit : V

Application of forecasting techniques in energy and environmental impacts studies – Risk Assessment – Future energy sources – Hydrogen economy – Nuclear Fusion and MHD – case studies.

Text Books:

1. Raymond E. Willies., 'A guide of forecasting for planers and managers', Prentice Hall.
2. P.K. Roghatgi., Kalpara Roghatgi and B. Bowonder,, 'Technological forecasting', TMH, 1979.

Reference Books:

1. Willis Golden, 'Technological Forecasting', Penguin Books, 1972.
2. Albert Thumanson., 'Handbook of Energy Audit', The Fairmount Press Inc., 1979.
3. Gorden R. Payme., 'Managing of Energy in commerce and industry', Butterworth, 1984.
4. Kydes A.S., 'Energy Modelling and simulation', IMACS North Holland Pub. Co., 1983.
5. Industrial Energy Conservation, 'Case Studies Survey', TERI, Delhi, 1994.
6. Nagrath., 'Systems Modelling and Analysis', Tata McGraw Hill, 1982.

ME311 COMPUTATIONAL FLUID DYNAMICS (CFD)

Credits 3:1:0
Marks 40+60

Unit : I

Hydrodynamics, shearing stress, viscosity – Lagrangian method, Eulerian Method – Local and individual time rates of change, acceleration, - Eulerian and lagrangian equation of continuity – Symmetrical forms of the equation of continuity – solved problems related to liquid motion, related to equation of continuity, related to boundary surface.

Unit : II

Equations of motion – pressure equation – Lagrangian equation of motion – Helmholtz vorticity equation – Cauchy's integral – equations for impulsive actions – Kelvin's circulation theorem and solved problems.

Unit : III

Irrotational motion in two dimension, Complex potential due to a source, due to a doublet, Images with respect to straight line, Logramgian stream function, circle theorem of Milne – Thomson, Blasius theorem, solved problem.

Unit IV : Motion of Cylinders

Circular cylinders, Elliptic cylinders, sphere, solution of Laplace equation, Joukowshi transformation, liquid streaming past a fixed sphere and solved problems.

Unit V : Stoke's Stream Function

Stoke's function, property of stoke's function, irrotational motion, solution of ψ, Kelvin's minimum energy theorem. Analysis of Joukowshi transformation, Kutta – Joukowlin's theorem, schwarz – Christoffel theorem, Transformation of infinite and semi – infinite strip and solved problems, Karman – Pohlhausen method for boundary layer flow. Complex potential due to vortex of strength +k, Routh's theorem, Karman's vortex sheet and solved problem.

Text Books

1. Streeter, 'Fluid Dynamics', 3rd Ed., McGraw Hill, 1976.
2. Goyal and Gupta, 'Fluid Dynamics', 2nd Ed., Prentice Hall, New Delhi, 1987.

Reference Books

1. 'Computational fluid dynamics', Conference proceedings chapter IV & V (in IIT, Chennai, Library)
2. Goyal and Gupta, 'Kinematics of Fluids', 3rd Ed., McGraw Hill, 1984.

ME312 FINITE ELEMENT METHODS IN ENGINEERING

Credits 3:1:0
Marks 40+60

Unit : I

Introduction – Variational formulation – General field problems, discrete and continuous models, solution difficulties, the relevance and place FEM, basic concepts. Boundary and initial value problems, gradient and divergence theorems, variational calculus and application to BVP, method of weighted residuals, the Ritz method.

Unit II : One Dimensional Problems

FEM analysis of one dimensional problems, discretisation of domain, element equations and assembly, imposition of bc, solution of equations, Cholesky method, Post processing examples from hat and fluid flow problems.

Unit III : Two Dimensional Problems

Second order equation involving a scalar –valued function – model equation, variational formulation, FE formulation through generalized co-ordinate approach, Triangular and quadrilateral elements, convergence interpolation functions, elements matrices and vector, assembly matrices, boundary conditions, solution techniques.

Unit IV : Isoparametric Elements And Formulations

Natural coordinates in 1,2 and 3 dimensions, use of areas coordinated for triangular elements in two dimensional problems, isoparametric elements in 1,2, and 3 dimensions, use of areas coordinated for triangular elements in two dimensional problems, isoparametric elements in 1,2 & 3 dimensions, lagrangean and serendipity elements, formulation of element equations, numerical integration.

Unit V : Application To Field Problems
Auxisymmetric problems in elasticity, head and fluid flow problems, time dependent problems, use of standard software packages, in FEM-ANSYS, NASTRAN in solving the field problems.

Text Books

1. Rao S.S., 'Finite Element Methods in Engineering', Pergamon Press, 1989.
2. Hubner K.H. and Thornton E.A., 'The Finite Element Method for Engineers', Wiley & Sons, 1982.

Reference Books

1. Reddy, J.N., 'An Introduction to Finite Element Method', McGraw Hill Instl. Student Ed., 1994.
2. Zienkwicz D.C., 'Finite Element Methods in Engineering', Pergamon Press, 1989.
3. Desai, C.S. and Abel J.F., 'Introduction to Finite Element Method', Affiliated East West Press, 1982.
4. Hinton and Owen., 'Finite Element Programming', Academic Press London, 1977.

ME313 ENERGY CONSERVATION AND MANAGEMENT

Credits: 3:1:0
Marks: 40+60

Unit : I
Energy resources, energy use patterns and scope for conservation, world energy supply and demand, national energy systems, policies, programmes and decisions.

Unit : II
Energy Auditing in engineering and process industry, identification of areas for energy conservation, review of conservation technologies, conservation through maintenance, lubrication and tribological innovations, predictive and preventive maintenance.

Unit : III
Energy conservation in buildings: heating, cooling, lighting and ventilation, electrical energy conservation, energy efficient electric motors and power factor improvement in power systems. Energy conservation in thermal systems: combustion systems, refrigeration and airconditioning system, furnaces and boilers.

Unit : IV
Energy Management principles, need for organization and goal setting, Basic discounting, life cycle costing and other methods, factors affecting economics, energy pricing and incentives for conservation, financial management.

Unit : V
Policies regarding non-conventional energy system, energy resource management, availability, needs and cost benefits of energy sources. Conflicting goals and decision under uncertainty, energy technology assessment.

Text Books:

1. David H.U., Handbook of Industrial Energy Conservation Van Nostrand Reinhold Company, 1983.
2. W.R. Murphy and G.Mc Kay, Energy Management, Butterworths, London.
3. Raikhy P.S. and Parmindar Singh., Energy Consumption in India, Deep and Deep Publication, 1990.

Reference books:

1. Vogt F., Energy Conservation and use of renewable sources of Energy in the Bio-Industries, Pergamon Press, 1981.
2. Albert Thumann, Plant Engineers and Managers Guidee to Energy Conservation, Ffairmount Press, 1987.
3. Ray D.A., Industrial Energy Conservation, Pergamon Press, 1980.
4. Kreith F. and West R.E (Eds), Economics of Solar Energy Consservaation Systems, Vol. I and III CRC Press, 1980.
5. Shinskey E.G., Energy Conservation through Control, Academic Press, 1980.

ME314 ADVANCED TURBO MACHINERY

Credit 4:0:0
Marks 40+60

UNIT I

Introduction – Classification of turbo machinery. Application of TT – theorem in turbo machinery. Incompressible fluid in turbomachines – Effects of Reynolds Number and Mach number.

Energy transfer between a fluid and a rotor - Euler turbine equation – components of energy transfer – impulse and Reaction – Efficiencies.

UNIT II

Radial flow pumps and compressors – head capacity relationship – Axial flow pumps and compressors – Degree of reaction dimensionless parameters – Efficiency and utilization factor in Turbo Machinery.

UNIT III

Thermodynamics of Turbo machine processes – Compression and expansion efficiencies – Stage efficiency – Infinitesimal stage and finite stage efficiencies.

Flow of fluids in Turbo machines – flow and pressure distribution over an airfoil section – Effect of compressibility cavitations – Blade terminology- Cascades of blades – fluid deviation – Energy transfer of blades – Degree of reaction and blade spacing – Radial pressure gradient – Free vortex flow – losses in turbo machines.

UNIT IV

Centrifugal pumps and compressors – Inlet section – Cavitation – NPSH - flow in the impller channel – flow in the discharge casing pump and compressor characteristic.

UNIT V
Radial flow turbines – inward flow turbines for compressible fluids – inward flow hydraulic – velocity and flow coefficients – gas turbine blading – Performance & analysis of Kaplan turbine – pelton wheels.

Text Books:
1. Lee., 'Theory and Design of Steam and Gas Turbine', McGraw Hill, 1954.
2. Yahya., 'Turbines, Compressions & Fans', Tata McGraw Hill, 1983.
3. D.G. Stephard, 'Principles of Turbo machines', Macmillan Co., 1984.

Reference Books:
1. William J Kerten, 'Steam Turbine Theory and Practice', CBS Publisher & Distributors, 1988.
2. Cohen Rogers., 'Saravana Muttoo, 'Gas Turbine Theory', Long man, 1988.
3. Bathe W N., 'Fundamentals of Gas Turbines', Willey & Sons, 1994.
4. Steffmoff, 'Design of Pumps', Willey & Sons, 1997.

ME315 TWO PHASE FLOW & HEAT TRANSFER

Credit 4:0:0
Marks 40+60

UNIT I
Two phase flow – simultaneous flow of liquids and gases, horizontal two phase flow lockhart and Martenelli procedure flow factor method – vertical two phase flow – Two phase flow through inclined pipes

UNIT II
Circulation in boiler – natural and forced – effective pressure head in boiler tubes variation of major parameters of drum during transient conditions - The hydrodynamics stability of vapour – liquid system – simultaneous flow of fluids and solids, dynamics of particles submerged in fluids – flow through packed bed.

UNIT III
Fluidization, calculation of pressure drop in fixed bed-determination of minimum fluidization velocity, Expanded bed, dilute phase, moving solids fluidization - Elutriation in fluidized bed – Semi fluidization – applications. Pulsating column – oscillating fluidized beds.

UNIT IV
Heat Transfer with change of phase: Film wise condensation of pure vapours – Drop wise condensation in plated surfaces – condensation in presence of non condensable gas – pool boiling – Boiling in forced flow inside tubing.

UNIT V
Gas – Liquid Fluidization: Gas liquid particle process, Gas liquid particle operation – Gas liquid fluidization. Flow of Gas - Bubble formation, bubble growth gas hold up – Gas mixing liquid holdup – liquid mixing – flow of liquid mixing – Gas liquid mass transfer.

Text Books:

1. Ginou J.N., 'Two Phase Flow & Heat Transfer', McGraw Hill, New York, 1978.
2. Mc Adams., 'Heat Transmission', McGraw Hill, 1963.

Reference Books:

1. Daugherty and Franzini., 'Fluid Mechanics with Engineering Applications', McGraw Hill, 1985.
2. S.C. Kutateladeze., 'Problems of Heat Transfer and Hydraulics of Two Phase Media', Pergamon Press, 1982.
3. Davidson J.F and Harrison D., 'Fluidization', Prentice Hall, 1976.
4. L.S. Tong., 'Boiling Heat Transfer and Two Phase Flow', Wiley, New York, 1965.

ME316 CRYOGENIC ENGINEERING

Credit 3:1:0
Marks 40+60

UNIT I

Introduction: Historical development – present areas involving cryogenic engineering. Basic thermodynamic as applied to liquefaction and refrigeration process – isothermal, adiabatic and Joule Thomson expansion process – adiabatic demagnetization – pay off functions – Figure of Merrit.

UNIT II

Low temperature properties of engineering materials: mechanical properties – thermal properties – electrical and magnetic properties. Properties of cryogenic fluids – materials of constructions for cryogenics applications.

UNIT III

Gas liquefaction systems: Production of low temperatures - general liquefaction systems – liquefaction systems for neon, hydrogen, nitrogen, and helium.

UNIT IV

Cryogenic refrigeration systems: ideal refrigeration systems – refrigerators using liquids and gases as refrigerants – refrigerators using solids as working media.

UNIT V

Cryogenic storage and transfer systems – Cryogenic fluid storage vessels, cryogenic fluid transfer systems. Application of cryogenics – cryopumping – superconductivity and super fluidity – cryogenics in space technology – cryogenics in biology and medicine.

Text Books:

1. Randall F. Barron., 'Cryogenic Systems', McGraw Hill, 1985.
2. Klaus D. Timmerhaus and Thomas M. Flynn., 'Cryogenic Process Engineering', Plenum Press, New York, 1989.

Reference Books:

1. Herald Weinstock., ‘Cryogenic Technology’, 1969.
2. Scott R.B., ‘Cryogenics Engineering’, Van Nostrand & Co., 1962.
3. Robert W. Vance., ‘Cryogenic Technology’, John Wiley & Sons Inc., New York, London, 1971.
4. Sengapatha, Bose A., ‘Cryogenics – Progress and Applications’, Tata McGraw Hill, 1987.

ME 317 SOFTWARE LAB

Credit 0:0:2
Marks 40 + 60

Introduction to Software - Pro-Engineer - ANSYS – FLUENT (CFD), NISA

Mini project using these software

ME318 ENERGY TECHNOLOGY FORECASTING

Credit 3:1:0
Marks 40+60

UNIT I

Technology Forecasting: definition – structure, essential features, normative approach, technology forecasting for strategic decision - technology forecasting for research and development planning. Explorative methods, dynamics forecasting, Extrapolation methods, intuitive methods such as Delphi. Surveys and scenarios, analytical techniques

UNIT II

Energy Planning: Energy as a resource for technology development –global and national scenario, issues and concerns, centralized and decentralized – Energy inflow and outflow analysis – Energy forecast – Ways of bridging the gap between supply and demand.

UNIT III

Energy Audit: Energy Audit, types- walk through, intermediate & comprehensive. Energy Accounts and Analysis - Audit in heating – ventilation – air conditioning in building system – Electric utility, process system energy audit – case studies in industries.

UNIT IV

Energy conservation – cost of energy – Energy conservation opportunities and Energy conservation measures – storage of energy, characteristics of a storage system – handling of fuel – Measurement of energy – controls– Conservation in industries – boilers – New Technologies – Waste reutilization – recycling from wastes, waste heat recovery resources, application of waste heat barriers of Energy conservation Case studies.

UNIT V

Energy and Environment Application of forecasting techniques in energy and environmental impacts studies effect on climatic, integrative assessment of climate change – Risk Assessment – Future energy sources – Hydrogen economy – Nuclear Fusion and MHD – case studies.

Text Books:

3. Raymond E. Willies., 'A guide of forecasting for planers and managers', Prentice Hall.
4. P.K. Roghatgi., Kalpara Roghatgi and B. Bowonder,, 'Technological forecasting', TMH, 1979.
5. David Hus. " Hand Book of Industrial Energy Conservation",

Reference Books:

7. Willis Golden, 'Technological Forecasting', Penguin Books, 1972.
8. Albert Thumanson., 'Handbook of Energy Audit', The Fairmount Press Inc., 1979.
9. Gorden R. Payme., 'Managing of Energy in commerce and industry', Butterworth, 1984.
10. Kydes A.S., 'Energy Modelling and simulation', IMACS North Holland Pub. Co., 1983.
11. Industrial Energy Conservation, 'Case Studies Survey', TERI, Delhi, 1994.
12. RaoS,Porubekar.B.B ' Energy Technology" Khanna Publishers. 1999.
13. Teddy year books.

ME 319 COMBUSTION IN ENGINES

Credit : 3:1:0
40 + 60

UNIT I

Combustion Principles: Thermodynamics concepts of combustion. First law and second law of thermodynamics applied to combustion process – heat of combustion – Adiabatic flame temperature – stoichiometry and excess air – combustion calculations – minimum air required for complete combustion of fuel – chemical equilibrium and dissociation.

UNIT II

Chemical Kinetics: Theories of combustion homogeneous mixture – heterogeneous mixture – Laminar and Turbulent flame propagation in engines – Combustion generated Pollutants – monitoring and control.

UNIT III

Combustion in SI engines: Initiation of combustion stages of combustion flame front propagation – Factors influencing the flame speed – knocking in SI Engines – Effect of engine variables on knock – combustion chambers for SI engine stratified charge engine. Heat balance for SI engine.

UNIT IV

Combustion in CI engines: Various stages of combustion in CI engines – air fuel ratio in CI engines – delay period (or) ignition lag – variables affecting delay period – Diesel knock – Air swirl – General functions and characteristics of the combustion chamber – comparison of some Basic Design of CI Engine combustion chambers – Heat balance for CI engine.

UNIT V

Combustion in Gas Turbine: Flame stabilization re-circulation – requirements of the combustion chamber – combustion process – combustible fuels for gas turbines – configuration of combustion chamber.

Text Books:

1. John B. Heywood., 'Internal Combustion Engine Fundamentals', McGraw Hill, International Editions, 1989 (III, IV unit)
2. Edward E. Obert., 'Internal Combustion Engines and Air Pollution', Internal Educational Publishers, New York, 1973, (I. II, III, IV Unit)

Reference Books:

1. Cohen H. Rogers, GEC and Saravanamutto, 'HIM Fan Turbine Theory', Longman Group Ltd., 1980.
2. Treager, 'Air Craft Gas Turbine Engine Technology', Tata McGraw Hill, 3rd Ed., 1997 (V unit).
3. J.K. Jain,, 'Gas Dynamics and Jet Propulsion', Khanna Publishers, 1989 (V unit).
4. Mathur M.L. and Sharma., 'A Course in Internal Combustion Engines', R.P. Dhanpat Rai Publications, 1997 (I, II, III & IV)
5. Paul W. Gill, James H. Smith., 'Fundamentals of Internal Combustion Engines', Oxford and IBH Publishing Co., 1962 (III & IV Unit).
6. V. Ganesan., 'Internal Combustion Engines', Tata McGraw Hill Publishing Company Ltd., 1995 (III & IV Unit).

DEPARTMENT

OF

MECHANICAL SCIENCES

ADDITIONAL SUBJECTS

Code No.	Subject Name	Credit
ME105	Basic Mechanical Engineering	2:0:0
ME228	Engineering Thermodynamics	3:1:0
ME229	Thermal Engineering	3:1:0
ME230	Heat and Mass Transfer	3:1:0
ME231	Design of Mechanical Transmission Systems	3:1:0
ME232	Heat Transfer & Internal Combustion Engines Lab	0:0:1
ME233	Production Processes	4:0:0
ME234	Statistical Quality Control & Reliability in Manufacturing	3:1:0
ME235	Computer Application in Design and Analysis	4:0:0
ME236	Machine Drawing	4:0:0
ME237	Fluid Power Control Engineering	4:0:0
ME238	Fluid Power Control Lab	0:0:2
ME239	Refrigeration & Air Conditioning	3:1:0
ME240	Power Plant Engineering	4:0:0
ME241	Automobile Engineering	4:0:0
ME242	Internal Combustion Engines	3:1:0
ME243	Principles of Resource and Quality Management	3:1:0
ME311	Computational Fluid Dynamics	3:1:0
ME320	Advanced Heat and Mass Transfer	3:1:0
ME321	Advanced Fluid Mechanics	3:1:0
ME322	Advanced Refrigeration and Air-Conditioning Systems	3:1:0
ME323	Design of Thermal Power Equipments	3:1:0
ME324	Design and Analysis of Heat Exchangers	3:1:0
ME325	Power Plant Management	4:0:0
ME326	Energy Conservation and Forecasting Techniques	4:0:0
ME327	Instrumentation and Controls in Thermal Engineering	4:0:0
ME328	Combustion of Fuels and Pollution Control	4:0:0
ME329	Vacuum Technology	3:1:0
ME330	Nuclear Power Engineering	4:0:0
ME331	Two Phase Flow	4:0:0

ME105 BASIC MECHANICAL ENGINEERING

Credit: 2:0:0 **Marks: 40+60**

Unit I : Introduction to Mechanical Engineering
Historical Development - Speed as a parameter, Development history of cycles, motorbikes, automobiles, locomotives, ships, aircrafts, rockets and spacecrafts – India in space.

Unit II : Energy Systems & Power packs
Basic parameters – Units & dimensions – Effects of pressure and temperature – External combustion engine (steam engine and steam turbine) - Internal combustion engine (petrol & diesel engines) – Components of gas turbine engine and jet engine.

Unit III : Power Plants
Conventional power plants - Hydro, Thermal, Nuclear power plants – DG power plants - Non-conventional power plants - Solar, wind, tidal, geothermal power plants, Ocean Thermal Energy Conversion.

Unit IV
Manufacturing processes: Metal casting and forming processes, metal joining and machining processes.

Unit V
Introduction to modern design and manufacturing software: AutoCAD, Pro-Engineer, I-Deas, Unigraphics, MasterCAM, ANSYS, NISO, FLUENT – Applications. Introduction to Rapid Proto-typing.

Text Book
1. Dr.Nicholas., M.T, ‘Karunya class notes on Elements of Mechanical Engineering’, 2004

Reference books

1. Shanmugam.G., ‘Basic Mechanical Engineering’ Tata Mc Graw Hill publishing Co., new delhi, 1997.
2. Shanthakumar,S.R.J., ‘Basic Mechanical Engineering’ Hi-Tech Publications, Mayiladuthurai, T.N., 1999
3. Venugopal .K and Prabhu Raj.V, “Basic Mechanical Engineering”, Vidayal Karuppur, Kumbakonam, 1993
4. www.Inventorsabout.com
5. User manuals of various software and hardware

ME228 ENGINEERING THERMODYNAMICS

Credit 3:1:0 **Marks: 40+60**

UNIT I
Basic concepts – concept of continuum, microscopic and macroscopic approach, thermodynamic systems – closed, open, isolated, control volume. Thermodynamic properties and equilibrium state of a system, state diagram, path and process, quasi-static process, work, modes of work, zeroth law of thermodynamics – concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities C_v and C_p, enthalpy, steady flow process with reference to various thermal equipments.

UNIT II

Second law of thermodynamics – Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Carnot cycle, reversed Carnot cycle, efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy – Carnot theorem, entropy and reversibility, absolute entropy availability, irreversibility

UNIT III

Properties of pure substances – Thermodynamic properties of pure substances in solid liquid and vapour phases, phase rule P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non flow and flow processes -simple problem.

UNIT IV

Gas mixtures – Properties of ideal and real gases, equation of state, Avagadro's law, Gay Lussac's law Graham's law of diffusion, kinetic theory of gases, RMS and average velocity, ideal gas and deviation from it, Vander Wall's equation of states compressibility, compressibility chart,Expansivity

Types of fuels-HCV,LCV, Determination of Calorific value -Bomb-calorimeter,Junker's calorimeter, Stochiometric Mixture.

UNIT V

Air standard cycles – Otto, Diesel, Dual, Brayton Rankine cycles – calculation of mean effective pressure and air standard efficiency.

Text Books

1. Vanwylen and Sontag, Classical Thermodynamics, Wiley Eastern, 1997
2. Nag P.K., Engineering Thermodynamics, TMH, New Delhi, 2002

Reference Books

1. Holman. J.P., Thermodynamics, 3rd edition, McGraw Hill, 1985
2. Roy choudhury T., Basic Engineering Thermodynamics, TMH, 1988
3. Yunus Ccngel 'Thermodynamics', TMH, 1998

ME229 THERMAL ENGINEERING

(Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant, property tables are permitted.)

Credit 3:1:0 **Marks: 40+60**

UNIT I

Classification of IC engine, IC engine components and functions. Actual and theoretical p-v diagram of four stroke and two stroke engines. Valve timing diagram and port timing diagram. Comparison of two stroke and four stroke engines. Fuel supply systems, Ignition systems, testing and performance of I.C. Engine. Knocking and Detonation. Lubrication system and cooling system. Exhaust gas analysis, pollution control norms

UNIT II

Steam Turbine: Steam nozzles – flow through nozzles – General relation for adiabatic flow – effect of friction – Diffusers. Steam turbines – Advantages of turbines – impulse and reaction turbines – 50% reaction – compounding of turbines, Reheating and Regeneration cycle – Performance evaluation.

UNIT III

Air compressor: Classification and working principle, work of compression with and without clearance. Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating air compressors. Concept of positive displacement – Rotary pump. Multistage air compressor and intercooling – work of multistage air compressor. Problems in air compressor.

UNIT IV

Vapour compression Refrigeration cycle – super heat, sub cooling, performance calculations. Working principle of vapour absorption system. Ammonia-water, Lithium bromide- water systems (Description only). Comparison between vapour compression and absorption systems.

UNIT V

Psychrometry, Psychrometric chart, Psychrometric processes – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling, problems. Concept of RSHF, GSHF, ESHF. Simple problems, Air conditioning systems- window and split units.

Text books:

1. Kothandaraman, C.P, Domkundwar S., Engineering Thermodynamics, Dhanpat Rai & Sons, 2nd edition, 1988.
2. Holman, J.P., Thermodynamics, Mc Graw Hill, 1985.

Reference Books:

1. Zill Smith, Zurich, Fundamentals of I.C. Engines, Oxford, 1992.
2. Rogers, Mayhew, Engineering Thermodynamics, ELBS, 1992.
3. Arora, C.P., Refrigeration and Air conditioning, TMH, 1994.
4. Nay P.K., “Engineering Thermodynamics”, TMH 2002

ME230 HEAT AND MASS TRANSFER

Credits: 3:1:0 **Marks: 40+60**

UNIT I

Introduction to conduction heat transfer, Fourier’s law of conduction, thermal conduction equation – derivation in Cartesian, Cylindrical and Spherical coordinates. One dimensional steady state conduction in plane wall and composite wall. Thermal contact resistance variable conductivity, thermal resistance, electrical analogy, radial systems – cylinder, sphere. Overall heat transfer coefficients, critical thickness of insulation. Heat generation in plane wall, cylinder and sphere.

UNIT II

Steady state conduction in two dimensions, conduction shape factor, numerical method of analysis. Unsteady state conduction – lumped heat capacity systems, significance of Biot and Fourier numbers, use of Heisler and Grober charts.

UNIT III

Concept of hydro dynamics and thermal boundary layers. Significance of non-dimensional numbers in connection. Dimensional analysis for free and forced convection. Forced Convection – heat transfer over a flat plate, flow through pipes, use of empirical relations. Free Convection – heat transfer from vertical, horizontal and inclined surfaces. Conduction and Convection systems – fins with different boundary conditions

UNIT IV

Types of heat exchangers, overall heat transfer coefficients, LMTD and NTU methods, fouling factor. Design factors – problems in heat exchangers, effectiveness.
Mass transfer – Fick's law of diffusion, equi-molal counter diffusion, Stephen's law, Mass transfer coefficient, non-dimensional number in mass transfer, evaporation process in the atmosphere

UNIT V

Condensation and Boiling processes. Radiation – nature of thermal radiation, black body concepts, gray body, radiation shape factor, relation between shape factors, radiation heat transfer between two surfaces. Electrical analogy, Re-radiating surface, radiation shields.

Text Books:

1. Holman J.P., 'Heat Transfer', SI Metric 8th Ed., Mc Graw Hill, ISE, 1986
2. Sachdeva, 'Heat and Mass Transfer', Wiley Eastern, 1986

Reference Books:

1. Chapman., 'Heat Transfer', Maxwell McMillan, ISE, 1986.
2. Bijhon., 'Convective Heat Transfer', John Wiley, 1971.
3. Schaum Series., 'Heat Transfer', McGraw Hill, 1967.
4. Beyazitogly Yildiz., Ozisik, M.Necati., 'Elements of Heat Transfer', McGraw Hill, 1956.

ME231 DESIGN OF MECHANICAL TRANSMISSION SYSTEMS

Credit: 3:1:0 **Marks: 40+60**

UNIT I
Selection of bearings based on loads - Design of Jurnal bearings – sliding contact and rolling contact types – Design of flat belt, V-belt

UNIT II
Design and selection of Chains, ropes. Design of gears – spur gear, helical gear and herring bone gears.

UNIT III
Design of bevel gears – straight and spiral bevel types. Design of worm gears, skew gears.

UNIT IV
Design of gearbox – speed reducers – speed diagrams, Stepped pulley.

UNIT V
Design of a Ratchet & pawl mechanism, Geneva mechanism, Design of cams-Contact stress and Torque calculation, power screws.

Text Books:

1. Sundarajamoorthy T.V. and Shanmugam, 'Machine Design', Khanna, 1995.
2. Sen G. C. & Bhattacharyya A, 'Principles of Machine Tools', New Central Book Agency (P) Ltd., 1999.
3. Prabhu.T.J., Design of Transmission elements,1998.

Reference Books:

1. V. Dobrovolsky, 'Machine Elements', MIR, 1978.
2. Hall A.S. Holowenko A.R. and Laughlin H.G., 'Theory and Problems in Machine Design', Schaum's Series, 1978.
3. Hall and Allen, ' Machine Design', S.Schaum's Series, 1980.
4. Joseph Edward Shighley, 'Mechanical Engineering', McGraw Hill, 1980.

Hand Book

1. PSG College of Technology, 'Design Data Book', Coimbatore.

Use of approved data books are permitted in the examination.

ME232 HEAT TRANSFER & INTERNAL COMBUSTION ENGINES LABORATORY

Credit: 0:0:1 **Marks: 25+25**

6 experiments will be notified by HOD from time to time

ME233 PRODUCTION PROCESSES

Credits:4:0: 0 **Marks 40 + 60**

UNIT – I

Lathe – Types, specification, lathe operations – attachment for various operations, type of tools, capstan and turret lathe, Automatic lathes milling: types, specification, milling tool nomenclatures and its specifications, indexing types – simple, compounding and differential.

UNIT – II

Drilling, Boring, Broaching: Specification Tools, Nomenclature and its specification, shaper, planer. Grinding – types grinding, grinding wheel. Specification, Grinding wheel shapes and sizes mounting, dressing, truing and balancing of grinding wheel. Gear shaping, gear hobbing and gear finishing.

UNIT – III

Non-Traditional Machining:- Classification, Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electron beam machining, Laser beam machining, Ion beam machining, Electro chemical machining.

UNIT – IV

Metal forming: Rolling principle, rolling load, rolling variables, Forging classification, Extrusion – Principle, Classification, Defects in rolled, forged and extruded components. Un conventional Forming – HERF process, explosive forming, hydroelectric forming. Electro magnetic forming. Introduction to powder metallurgy.

UNIT - V

Moulding and casting: – Pattern, pattern allowance, and types, moulding sand preparation, types of core. Special casting process – Shell moulding, permanent moulding, precision moulding, investment casting,. Die casting, centrifugal casting, and continuous casting.
Welding: - Classification, Gas welding, Arc Welding - TIG, MIG, resistance welding, Laser beam welding, Forge Welding, Explosion Welding, Thermit welding. Introduction to Electron Beam welding, submerged welding of friction welding processes.

Text Books:

1. S.K. Hajra Choudhray, S.K. Bose, ‘Elements of Workshop Technology, Vol. II, Machine Tools’, Media promoters & Publishers (P) Ltd, 2000.
2. P.N. Rao, ‘Manufacturing Technology’, 2nd Ed. Tata McGraw Hill Publishing Ltd., 1999.

References

1. HMT, ‘Production Technology’, TMH (India), 1996.
2. Heine, Richard, Carl R Loper and Philip Rosenthal, ‘Principles of Metal Casting’, Tata McGraw Hill Publishing Ltd., 2000.

ME234 STATISTICAL QUALITY CONTROL AND RELIABILITY IN MANUFACTURING

Credits 3:1:0 **Marks 40+60**

UNIT 1

Introduction, definition of quality, method of control chance, causes, assignable causes, SQC benefits and limitations, Quality assurance, quality management, total quality control, quality circles, Total Quality Management**,** Six sigma fundamental concepts, normal curve, measure of dispersion. Distributions – Binomial, Poisson, Geometric, Hyper geometric, Gamma distribution. Poisson as an approximation to the binomial distribution, normal approximation to the binomial. Preview of probability theorems

UNIT II

Theory of control charts, sample as an estimate of universe process control, control cahrt for variables X bar and R charts, standard deviation charts, run up and run down, process capability studies, control charts for attributes, fraction defectives and number of defective charts. Chart sensitivity, control chart for non- conformities- C and U charts. Process capability – Definition and analysis.

UNIT III

Acceptance sampling- fundamental concepts and terms, OC curves, AQL,LTPD,AOQL sampling plans, simple, double, multiple and sequential sampling plans, stratified example for variables, Dodge Romig sampling plans, Bulk sampling- problems using Dodge romig and BIS code books. ISO 9000 – a simple case study in an industry. Taguchi methods-Introduction to offline Quality control methods. Case studies-Online quality control methods-loss function applications – Problems, failure mode effect analysis, quality function deployment.

UNIT IV

Reliability : definition, mean failure rate, mean time for failure, mean time between failure, hazard rate, hazard models. Constant hazard, linearly increasing hazard, weibull’s model. System reliability, series parallel and mixed configuration – simple problems, failure mode effect analysis, quality function deployment, Environmental testing.

UNIT V

Reliability improvement redundancy, element, unit and stand by redundancy, reliability allocation for a series system. Maintainability and availability. System downtime, reliability and maintainability. Trade off, simple problems.

Text books

1. Grantt, ‘Statistical Quality Control’ , Mc Graw Hill, ISE 1990
2. Srinath.L.S, ‘Reliability Engineering ‘ Affiliated East west press, New delhi 1973
3. Tapan.P.Bagchi, ‘Taguchi methods explained – Practical steps to robust design’ Prentice Hall of India 1993

Reference books

1. Jerry Banks, ‘ Principles of Quality Control’ , John wiley 1990
2. Douglas. C. Montgomery, ‘Principles of quality control’ , John wiley, 1991
3. Taguchi et al- ‘Quality Engineering in production systems TMH 1989

ME235 COMPTUTER APPLICATION IN DESIGN AND ANALYSIS

Credit 4:0:0 **Marks 40 + 60**

UNIT-I

Introduction- Reasons for implementing CAD-Historical Development-Design process-Benefits of CAD

Conventional design representation –representation of form using drawings, represenation of structure using diagrams-strength and weaknesses of conventional representations.

Computer representation of drawing and diagrams- computer aided draughting; computer aided schematic drawing –3D modeling schemes-types of geometric modeling.

UNIT-II

Standardization in Graphics-Graphical Kernel System-Other Graphic standards-Exchange of modeling data.

2D transformation -scaling, translation & rotation-Homogeneous transformations-combination transformations clipping –3D Transformation –scaling, translation & rotation.

UNIT-III

Introduction-application –Types of Analysis- general procedure of FEA-element types and characteristics-concept of element assembly-local and global co-ordinate systems-bandwidth and its effects-boundary conditions-aspect ratio-boundary value and initial problem-Pascal’s triangle-stiffness matrix-shape function-bar element-Beam element-2D rectangular element-triangular element.

UNIT-IV

Higher order elements-isoparametric elements-1D Quadratic and cubic elements-continuous and convergence requirement-use of natural co-ordinate system and Area co-ordinate system. -Various analysis softwares.

UNIT-V

Reverse engineering-Re-engineering-concepts of Rapid prototyping-concurrent engineering and design methodology-product data management and application-World wide web and developments in www.

Text Book

1. CAD / CAM, Principles, Practice and Manufacturing Management by Chris McMahon, Jimmy Browne, Pearson Education, 2002
2. Finite Element methods in Engineering by S S Rao, Pergamon Press, 1989

References

1. P.N.Rao, CAD/CAM Principles And Applications, Tata Mcraw-Hill, 2002
2. Computer Graphics and design by Radhakrishnan and C P Kothandaraman, DhanpatRai Publications, 2002.

ME236 MACHINE DRAWING

Credit 4:0:0 **Marks 50+50**

UNIT I

Conventional representation of threaded parts, springs, gear. Abbreviations and symbols for use in technical drawings. Conventions for sectioning and dimensioning.

UNIT II

Limits, fits, tolerances - selection. Maximum material principle. Surface finish - Selection welding symbols, methods of indicating, Preparation of Joints for welding.

UNIT III

Drawings of Cotter Joints & Knuckle joints, connecting rod, plummer block, Screw jack, swivel bearing, types of flange couplings – protected, unprotected flexible couplings.

UNIT IV

Preparation of Assembly drawing of machine parts- vice, lathe tailstock, junction stop valve, Safety valves - dead weight, rams bottom – steam relief valves – non-return valves.

UNIT V

Computer Aided Drafting of machine parts- Lathe tailstock, unprotected type flange coupling, dead weight safety valve, machine vice using AUTOCAD.

Text Book

1. Goplalkrishnan, " Machine Drawing", Subash publishers, 1998

Reference books

1. Bhatt.N.D, Machine drawing", charotar publishing house, Anand, 2003
2. Siddheshwar , N.P.Kannaiah & V.V.S. Satry " Machine Drawing" , Tata Mcgraw Hill, 1980
3. Revised IS Codes 10711,10713,10714,9609,1165,10712,10712,10715,10716,10717, 11663,11668,10968,11669,8043,8000
4. Auto Cad 2000 Manual.

ME237 FLUID POWER CONTROL ENGINEERING

Credit:4:0:0 **Marks:40+60**

UNIT-I

Pumps and motors: Introduction to fluid power control-Properties of hydraulic fluids-Pumps: Gear pumps, Spiral pumps Vane pumps, Radial and Axial pumps, Piston pumps,

characteristics, Motors-fixed and variable displacement motors
Cylinders and power packs: Different types of cylinders for controls-construction details, computations of force, flow requirements, selection of reservoir capacity, and power packs.

UNIT-II
Valves: Direction control valves-Methods of actuation, Flow control valves, Temperature and pressure compensation, Meter-in, Meter- out, and bypass circuits, Pressure control valves, relief valves, sequence valves, pressure reducing valves, unloading valves, counter-balancing valves, Hydraulic fuses, seals, selection of pipe lines.

UNIT-III
Control and use of pneumatic power. Comparison of pneumatic and hydraulic controls, Pneumatic control valves, filters, regulators, lubricators, mufflers, basic designs of pneumatic direction control valves, solenoid valves, rotary air motors, vane type air motors.

UNIT-IV
Accumulator systems, servo valves-Mechanical, Electro hydraulic servo valves, Flow control valve, valves with coil armatures, electro hydraulic servo mechanisms, proportional valves, Dual cylinder sequence circuit using pressure and limit switches, electro pneumatic circuit, regenerative circuit, basic concepts of programmable logical control. Application of PLC in sequencing circuits.

UNIT-V
Typical industrial applications: speed control circuit, Deceleration circuit, intensifier circuits, pneumo-hydraulic circuits, synchronizing circuits, hydrostatics transmission circuits, control circuits for reciprocating drives in machine tools, Material handling equipments, Fluid power circuits-Failures and trouble shooting.

Text books

1. Harry.L.Stewart D.B., ‘Practical Guide to Fluid Power’ Taraorevala Sons & Co. Pvt. Ltd. Bombay, 1976
2. Anthony Esposito, “Fluid power with Applications”, PHI, 1980

Reference books

1. Herbert.E.Marrit, ‘Hydraulic Control Systems’, John Wiley, 1967
2. StringerJ.D., ‘Hydraulic Systems Analysis’, Macmillan Press London, 1976.
3. Dudley a pease, ‘Basic Fluid Power’, PHI London, 1967.

ME238 FLUID POWER CONTROL LABORATORY

Credit 0:0:2 **Marks: 50 + 50**

12 experiments will be notified by HOD from time to time

ME239 REFRIGERATION AND AIR CONDITIONING

Credit:3:1:0 **Marks: 40+60**

UNIT I

Review of thermodynamic principles – refrigeration. Air refrigeration – Bell-Coleman cycle and Bootstrap cycle – cycle analysis and performance calculations. Aircraft refrigeration system. Vapour compression refrigeration cycle – use of P-H charts – multistage multiple evaporator systems – cascade system – COP comparison. Vapour absorption refrigeration system. Ammonia water and Lithium Bromide water systems. Steam jet refrigeration system. Performance analysis

UNIT II

Compressors – reciprocating & rotary (element treatment) – condensers – evaporators. Refrigerants – properties – selection of refrigerants – refrigeration plant controls – testing and charging of refrigeration units. Applications to refrigeration systems – ice plant – food storage plants – milk –chilling plants – refrigerated cargo ships – cryogenic in medicine and biological uses.

UNIT III

Review of fundamental properties of psychometric – use of psychometric charts – psychometric processes – Grand and Room Sensible Heat Factors – by pass factor – requirements of comfort air conditioning – comfort charts –factors governing optimum effective temperature, recommended design conditions and ventilation standards.

UNIT IV

Types of load – design of space cooling load – Heat transmission through building. Solar radiation – infiltration – internal heat sources (sensible and latent) – outside air and fresh air load – estimation of total load – design of air conditioning cycles

UNIT V

Domestic, commercial and industrial systems – central air conditioning systems – applications: car, industry, stores, and public buildings. Air conditioning equipments – air cleaning and air filters – humidifiers – dehumidifiers – air washers – condenser – cooling tower and spray ponds – elementary treatment of duct design – air distribution system. Thermal insulation of air conditioning systems – factors affecting thermal conductivity – types of materials

Text Books

1. Arora. C.P., ‘Refrigeration and Air Conditioning’, TMH, New Delhi, 1988.
2. N.F. Stoecker and Jones, ‘Refrigeration and Air Conditioning’, TMH, New Delhi, 1981.

Reference Books

1. Manohar Prasad, ‘Refrigeration and Air Conditioning’, Wiley Eastern Ltd., 1983.

2. Jordon and Prister., 'Refrigeration and Air Conditioning', Prentice Hall of India PVT Ltd., New Delhi, 1985.
3. Raj. J. Dossat, 'Principles of Refrigeration', SI Version, Wiley Eastern Ltd., 1985.

ME240 POWER PLANT ENGINEERING

Credit: 4:0:0 **Marks: 40+60**

UNIT I

Simple Rankine Cycle modified Rankine cycle – Re heating – Regeneration, analysis, pressure and temperature limits. Binary vapour cycle and combined cycle.

UNIT II

Steam power plant – various components, layout, Modern high pressure boilers – sub critical and super critical – Stoker type and Pulverized type combustion systems. Economizer and Air pre heater. Ash handling and dust collectors. Draught systems. Water treatment. Condensers and cooling towers.

UNIT III

Nuclear power plant – Basic nuclear physics and nuclear reactions related to nuclear reactors, nuclear reactor materials, types of reactors, radiation shielding, waste disposal. Gas turbine power plant – components and layouts. Open and closed cycle plants – combined gas turbines and steam power plants.

UNIT IV

Diesel Engine Power Plant – components and lay-outs, selection of engine type. Environmental hazards of various power plants. Hydro-electric Power Plants – runoff, storage and pumped storage type – draft tube. Lay-out and selection of water turbine.

UNIT V

Load curve – definition – fixed and operating costs – comparison of economics of different types of power plants. Unconventional power plants – Solar, Wind, Ocean thermal Tidal, Wave and Geothermal power plants. MHD concepts of energy conversion and energy audit.

Text Books

1. Verma. M., 'Power Plant Engineering', Methuen & Co., Ltd., 1968.
2. Archie W, Culp Jr., 'Principles of Energy Conversion', McGraw Hill, 1985.

Reference Books

1. Domkundwar., 'Power Plant Engineering', Dhanpat Rai & Sons, 1988
2. Wakil, M.M.E.l, 'Power Plant Technology', Mc Graw Hill, 1985.
3. Roy Eckart and Joel Weisman., 'Modern Power Plant Engineering', PHI, 1985.
4. Wakil M.M.El., 'Nuclear Heat Transport, International text book company', London, 1977.

ME241 AUTOMOBILE ENGINEERING

Credit:4:0:0 **Marks: 40+60**

UNIT I

Types of automobile – engine location – chassis layout – construction types, engine cylinder arrangements – position rings – cylinder liners – valves and operating mechanisms – inlet and exhaust manifolds. Design considerations – materials and their properties. Review of fuel, cooling lubrication systems – filters, fuel economy devices, water pumps, radiators – thermostats, anti freezing compounds.

UNIT II

Steering system – principle of steering – centre point steering – steering linkages – steering geometry and wheel alignment – power steering – wheels and tyres. Types and places of use – tyre construction, specification – tyre wear and cause – wheel balancing. Suspension system – need, types – independent suspension – coil and leaf springs – suspension systems for multiaxle vehicles.

UNIT III

Clutches – need, types – single and multiple clutches, diaphragm clutch, centrifugal clutch, over running clutch, fluid coupling, torque converters. Brakes – need, types – mechanical, hydraulic and pneumatic brakes – disc and drum types, their relative merits – details of components – brake adjustments and defects – power brake

UNIT IV

Need of gearboxes – types of gear transmission – sliding mesh, constant mesh and synchromesh gearboxes – shift mechanisms – epicyclic and hydromatic transmission. Transmission universal joint – constant velocity joint – propeller shaft – Hotchkiss drive – torque tube drive, front and rear axles types – stub axles – differential need and types – four wheel drive.

UNIT V

Electrical system – construction, operation and maintenance of lead aced batteries – battery charging system – principle and operation of cutout and regulators – starter motor – bendix drive – solenoid drive – magneto coil and solid stage ignition systems – ignition timing – lighting and electrical accessories – automobile air conditioning – panel board instruments. Maintenance – trouble shooting and service procedure – over hauling – engine tune up, tools and equipment for repair and overhaul – organization and management of service station – testing equipments. Automobile pollution standards.

Text Books

1. Ramalingam K.K., ‘Automobile Engineering’ SciTech Publications Pvt. Ltd., 2002
2. Crouse W.H. and Anglin D.L., ‘Automotive Engines’, 9th Edition, 1994, McGraw Hill

Reference Books
1. Newton., K, Steeds.W, Garret.T.K. and Butterworth., 'Motor Vehicle', IE, 1989.
2. Martin. W.Stockel, 'Auto Service and Repair', Good heart Willcox Publishers, Illinois, 1978.
3. Joseph Heitner, 'Automotive Mechanics', 2nd Edition, Affiliated Eastern Law House, 1967
4. Dolan J.A., 'Motor Vehicle Technology and Practical Work', ELBS, 1978

ME242 INTERNAL COMBUSTION ENGINES

Credit: 3:1:0 **Marks: 40+60**

UNIT I

Classification of IC engines – analysis of engine cycles. Two stroke and Four stroke engines – petrol and diesel engines. Construction details. Engine performance parameters.

UNIT II

Fuels – chemical structure – important qualities of fuels – rating of fuels. Combustion in SI engine – flame propagation – factors influencing combustion – knock ion SI engines – combustion chambers for SI engines. Combustion in CI engines – factors influencing knock in CI engines – combustion chambers for CI engines.

UNIT III

Carburetion – Air-fuel mixture requirements – calculation of Air-fuel ratio – essential p[arts of modern carburetor. Types of carburetor. Fuel injection systems – classification, fuel injection pump – nozzle. Injection in SI engines – Ignition systems – Battery and Magneto types – firing order – ignition timing and spark advance

UNIT IV

Lubrication – lubrication systems – types – properties of lubricants – additives for lubricants. Heat rejection and cooling – Theory of engine heat transfer. Types of cooling systems – Air and liquid systems.

UNIT V

Testing of IC engines – Dynamometers, Fuel and Air consumption measurements. Exhaust and coolant temperature, Emission and Noise. Causes for emission and its control - Engine power – engine efficiencies – performance characteristics – variables affecting performance characteristics, Heat balance.

Text Books
1. Ganesan. V., 'Internal Combustion Engines', Tata Mc Graw Hill, New Delhi, 1998.

Reference Books
1. Colin, Ferguson. R., 'Internal Combustion Engines', John Wiley and Sons, 1989.
2. Edward. F. Obert., 'Internal Combustion Engines', Inter-Science Publishers, 1971.

ME243 PRINCIPLES OF RESOURCE AND QUALITY MANAGEMENT

Credit: 3:1:0 **Marks 40 + 60**

UNIT – I : Linear Programming
Linear Programming-Formation of the problem-Graphical Method-Simplex method-Primal dual Problems-Dual Simplex method – Two Phase Method – assignment models – transportation models – degeneracy in transportation models.

UNIT – II : Network Analysis
Resource scheduling – Sequencing in jobs through two machines and three machines, network analysis: PERT and CPM – Network Diagram – Probability of achieving completion date – Crash time – Cost analysis.

UNIT – III : Queuing and Game Theory
Queuing theory: Characteristics of Queuing model – Single channel models with Poisson arrival and exponential service (To be illustrated with engineering application – No derivation)
Game Theory: Two persons – Zero sum games – Pure Strategies and Mixed Strategy – Saddle point method – Graphical method – Concept of Dominance.

UNIT – IV : Introduction to Quality Management
Definition of quality – Dimensions of Quality – Basic Concept of Total Quality Management – Historical review – Principles of TQM – Seven tools of quality – Deming philosophy – Barriers to TQM implementation – Benchmarking definition – Reasons to Benchmark – Procedure, Quality function Deployment - definition – Benefits – Procedure – 5S Kaizen concepts of Six Sigma and its overview.

UNIT – V : Quality Systems
Need for ISO 9000 and Other quality systems – ISO 9000, 2000 Quality Systems – Elements - Implementation of Quality systems – Documentation – Quality Auditing – QS 9000 - ISO 14000 – Concept, Requirements and benefits.

Text Books

1. S.Bhaskar, *Operations Research*, Anuradha Agencies, 1999. (Chapters 2, 3, 4.1 – 4.8, 4.12 – 4.13, 6.1 – 7.6, 8, 9.2, 11, 13.1 – 13.5)
2. Dale H. Besterfied, *Total Quality Management*, Pearson Education Asia, 2002. (Chapters 1, 9, 10, 11)
3. J.M.Juran, *Quality Planning and Analysis*, Fifth Edition, Tata McGraw Hill Publishers, 1998.(Chapter 17)

(RESTORED)

ME311 COMPUTATIONAL FLUID DYNAMICS

Credits: 3:1:0 **Marks: 40+60**

Unit I

Introduction: General equations of fluid flows and heat transfer Navier Stoke's equation for a Newtonian Fluid, governing equations of fluid flow. Differential and integral forms. Classification of physical systems and integral forms. Classification of physical systems Equilibrium problems – classification of fluid flow equations.

Unit II

Transition from laminar to turbulent flow, effect of turbulence on time averaged Navier Stoke's equations, characteristics of simple turbulent flows, free turbulent flows, flat plate boundary layer and pipe flow. Turbulence models, mixing length model, the K-e model.

Unit III

Finite Volume Method for one dimensional, two-dimensional and three dimensional steady state diffusion. Steady state one dimensional convection and diffusion. The central differencing scheme. Assessment of the central differencing scheme for convection diffusion, problems. The upwind differencing scheme. Higher order differencing schemes for convection diffusion problems. Quadratic upwind differencing scheme the quick scheme. The staggered grid. The momentum equations, the SIMPLE algorithm.

Unit IV

One dimensional unsteady heat conduction. Explicit scheme, Crank Nicolson scheme. Solution procedure for unsteady flow calculations, Transient SIMPLE. Inlet Boundary conditions, outlet boundary conditions, wall boundary conditions. The constant pressure boundary condition, symmetry boundary condition, periodic or cyclic boundary condition.

Unit V

Applications of CFD – Combustion modeling. The simple chemical reacting system (SCRS), Eddy break-up of model of combustion.

Calculation of buoyant flows and flows inside buildings.

Overall view of CFD in Material processing, mold flow, fuel flow, acoustics, aero dynamics, bio-fluids, modeling of a fire in a test room.

Text Book

1. Versteeg. H.K. & Malalasakera W., "An Introduction to Computational Fluid Dynamics – The Finite Volume Method", Addison Wesley Longman Limited, England, 1999
2. Gerritsma M.T., & Koren B., "Introduction to Computational Fluid Dynamics", Lecture Notes 2000

References

1. Patankar S.V., "Numerical Heat Transfer and Fluid Flow", Heimisphere Publishing Corporation, Taylor Francis Group, New York, 1980.
2. Anderson D.A., "Tannehill J.C. and Pletcher R.H., "Computational Fluid Mechanics and Heat Transfer", Hemispher Publishing Corporation, Taylor & Francis Groupd, New York, 1984
3. Ozisik M.N., "Heat Transfer – A Basic Approach", McGraw Hill, New York, 1985
4. Schlichting H., "Boundary Layer Theory", 7th Edition, McGraw Hill, New York, 1979
5. Johnson M.W., "Computational Fluid Dynamics", I & II Lecture Notes, 2000

ME320 ADVANCED HEAT AND MASS TRANSFER

Credits: 3:1:0 **Marks: 40+60**

UNIT I : Conduction

Conduction equation in rectangular, cylindrical and spherical coordinate. One dimensional steady state conduction with and without heat generation. The plane wall – Radial system – critical thickness. Analytical method for two dimensional heat equation (The method of separation of variables). Transient conduction – lumped capacitance method – semi infinite solid.

UNIT II : Numerical Methods in Heat Conduction

Numerical Methods in Heat Conduction - Finite difference formulation of differential Equations, one dimensional Steady Heat Conduction, two dimensional Steady Heat Conduction,Transient Heat conduction .

UNIT III: Convection

Convection: Energy equation – thermal boundary layer. Forced convection – Practical correlations – flow over surfaces – internal flow. Natural convection, combined forced and free convection – combined convection and radiation in flows.

UNIT IV: Radiation heat transfer

Radiation- Radiative heat exchange between surfaces – radiation shape factor – reradiating surfaces. Radiation shield, Radiation exchange with emitting and absorbing gases.

UNIT V: Mass Transfer:

Mass Transfer: types – Fick's law of diffusion – mass diffusion equation, Equimolar counter diffusion – Transient Mass Diffusion – Diffusion in moving medium. Convective mass transfer. Evaporation of water into air. Simultaneous Heat and Mass transfer.

Text Books

1. Yunus.A Cengel., 'Heat Transfer a Practical Approach', Tata McGraw Hill, 2nd Ed., 2003
2. Holman J.P., 'Heat and Mass Transfer', Tata McGraw Hill, 8th Ed., 1989.

Reference Books

1. Kern D.D., ‘Extended Surface Heat Transfer’, New Age International Ltd., 1985.
2. Frank P. Incropera and David P. Dewit T., ‘Fundamentals of Heat and Mass Transfer’, 4th Ed., John Wiley & Sons, 1998.
3. Eckert E.R.D. and Drake R.M., ‘Analysis of Heat and Mass Transfer’, McGraw Hill, 1980.
4. Kays, W.M. and Crawford W., ‘Convective Heat and Mass Transfer’, McGraw Hill Inc., 1993.
5. Segerlind L.J., ‘Applied Finite Elements Analysis’, John Willey, 1976.

ME321 ADVANCED FLUID MECHANICS

Credits 3:1:0 **Marks 40+60**

UNIT I

Method of describing fluid motion– Lagrangian, Eulerian Method – Local and individual time rates of change, acceleration, - Eulerian and lagrangian equation of continuity.Bernoulli’s equation from Euler’s equation– solved problems related to liquid motion, related to equation of continuity.

UNIT II

Forces and stress acting on fluid particles. Differental momentum equation. Navier Stoke Equations of Motion for simple cases in rectangular, cylindrical and spherical coordinate. Energy Equation

UNIT III

Irrotational motion in two dimensions, sources and sink Complex potential due to a source, due to a doublet, Images with respect to straight line, solved problem.
Vortex motion-Vortex tube, Helmohltz’s vorticity theorem, velocity potential and stream function.

UNIT IV

Flow over Circular cylinders, sphere, solution of Laplace equation, Joukowshi transformation, Flow past cylinder with and without circulation, flow past Rankine body. Liquid streaming past a fixed sphere and solved problems.
Analytic function Conformal Transformation of infinite and semi – infinite strip

UNITV

Boundary layer principles, flat plate, conduits, curved solid bodies, Prandtl mixing length turbulent theory, universal velocity profile, and momentum eddy concept – simple applications.Von Karman integral equation to Boundary layer –with and without pressure gradient.

Text Books

1. Streeter, ‘Fluid Dynamics’, 3rd Ed., McGraw Hill, 1976.

2. Raisinghania.M.D, ‘Fluid Dynamics’, 4th Ed., S.Chand & Company Ltd, 2002.

Reference Books

1. Yuan S.W., ‘Foundations of Fluid Mechanics’, Prentice Hall of India, 1976.
2. Robertson., ‘Hydrodynamics Theory and Application’, Prentice Hall of India, 1965.
3. Fox R.N. and McDonald A.T., ‘Fluid Mechanics’, John Wiley & Sons, 1994.
4. Dr. J.K Goyal I K.P. Gupta., ‘Fluid Dynamics’, 3rd revised Ed., Pragathiprakasam, Meerut, 1989.
5. Schlichting.H., ‘Boundary layer Theory’ ,7th Ed.,McGraw Hill, New york,1979

ME322 ADVANCED REFRIGERATION AND AIR CONDITIONING SYSTEMS

Credits 3:1:0 **Marks 40+60**

UNIT I : Principles

Review of thermodynamic principles of refrigeration, Vapour compression cycle, actual vapour compression cycle, cascade system, Bell colemen cycle refrigeration, Thermo electric refrigeration, Vortex refrigeriation, steam jet refrigeration, pulse tube refrigeration, acoustic refrigeriation.

UNIT II:Industrial Applications of Refrigeration

Study of air conditioning systems in –Automobiles, trains, ships, aircraft.
Study of refrigeration systems in cold storages, ice plants, Departmental stores, Dairy and beverage plants.
Lubricants in refrigeration, refrigerants, Secondary refrigerants, mixed refrigerants.Eco-friendly refrigerant, Effect on ozone layer.

UNIT III: Vapour absorption systems

Theory of mixtures, enthalpy composition diagrams, absorption system calculation, aqua ammonia systems, LiBr water system, three fluid absorption systems, solar refrigeration system.

UNIT IV: Airconditioning system

Review of psychometric process, air washer, water/stream injection and sensible heat factor and by-pass factor, RSHF, GSHF, ESHF-problems. Comfort air conditioning, factors affecting human comfort, comfort chart – cooling load calculations.

UNIT V: Air Distribution system

Air Distribution: Air distribution systems, duct design-equivalent diameter- equal distribution method and static regain method. Ventilation systems-fan arrangements-characteristics of fan.

Text Books

1. Stocker W.F. and Jones J.W., ‘Refrigeration and Air-conditioning Data’, McGraw Hill, 1985.
2. Manohar Prasad., ‘Refrigeration and Air Conditioning’, Willey Eastern Ltd., 1990.

Reference Books

1. Jordan and Priester., ‘Refrigeration and Air conditioning’, Prentice Hall of India, 1974.
2. ‘Ashrae Hand Book’, 4 Vol., Current Ed.,
3. Carrier Air Conditioning Co., ‘Hand Book of Air Conditioning’, Prentice Hall of India, 1974.
4. Lanqley Billy., ‘Refrigeration and Air Conditioning’, 3rd Ed., Englewood Cliffs (NJ), Prentice Hall, 1989.
5. Jones., ‘Air-conditioning Engineering’, Edward Arnold Pub., 1987.

ME323 DESIGN OF THERMAL POWER EQUIPMENTS

Credits 3:1:0 **Marks 40+60**

UNIT I

Design considerations – Services – requirements - parameters to be considered in Boiler Design - IBR Code Furnace Design: Heat Transfer in Furnace – heat balance – types of refractory walls – Furnace – Water wall arrangements. Heat release rates – furnace bottoms – Slag removal – Cold primary air system – wind box assembly Different types of furnaces for solids and liquids.

UNIT II

Water Side Design – Circulation-natural, forced-circulation ratio.
Design of condensers – Economic selection of condensers. Types-Direct contect, surface condensers. Vacuum efficiency –Air leakage into the condenser-air removal-dry, wet pumps.
Cooling tower-Types and design for power plant application.

UNIT III

Performance of boiler – Equivalent evaporation-Boiler efficiency-boiler trail-heat losses in boiler. Economiser-types, design. Super Heater –Design, Economy of super heat limit of super heat, super heater performance, steam mass flow gas mass flow and pressure drop in super heater. Super heat temperature control. Desuperheater-design. Design of Reheater.

UNIT IV

Water & Steam purification – chemical treatment mechanical carry over – Silica carry over gravity separation – drum internals – steam washing typical arrangements of boiler drum internal in H.P. boilers

UNIT V

Air Pre-Heaters: Types of Air heater, recuperative and regenerative – Design considerations – Higher temperature and low temperature applications.

Draft system design: Power requirement for draft fans, Pressure losses – Diameter and height of the chimney Design – Forced, induced, balanced drafts – Ash separators by ESP Electrostatic precipitators.

Text Books:

1. P.K. Nag., 'Power Plant Engineering (Steam and Nuclear)', Tata McGraw Hill, New Delhi, 1998.
2. C.D. Shields., 'Boilers', McGraw Hill, 1982.

Reference Books:

1. Homi, P. Serval., 'Boilers & Pressure Vessels', Multitech Publishing Company, Bombay, 1989.
2. Skrotzki & W.A. Vepot., Power Station Engg. Economy, Tata McGraw Hill, New Delhi, 1987.
3. Morse, T.F., ' Power Plant Engineering', Van Nostrand East West Press, revised Edn., 1983.
4. David Sunn, Robert Houston., 'Industrial Boilers', Longman Science & Technology, 1986.
5. 'Modern Power Station Practice', Vol. 8, Central Electricity Generating Board, UK, Pergamon Press, 1971.

ME324 DESIGN AND ANALYSIS OF HEAT EXCHANGERS

Credits 3:1:0 **Marks 40+60**

UNIT I

Classification – Regenerators and recuperator, Transfer Process, geometry, flow arrangements – Industrial applications.

UNIT II

Overall heat transfer coefficient, Thermal resistance, Fouling Factor,LMTD method, effectiveness.-NTU method

Preliminary analysis - estimantion of unit size.

UNIT III

Effect of Turbulence, Friction Factor, Pressure drop in bends, and fittings, pressure drop for abrupt contraction, expansion and momentum change- pumping power.

Effect of fouling, Design of Heat exchanger subject to fouling- Techniques to control fouling.

UNIT IV

Differential Thermal Expansion, Thermal stresses,effect of baffles.

Condensation and boiling heat transfer – effect of non condensable gaseous in condensors.

UNIT V
Design Aspects: Geometric calculation, Heat transfer correlations and pressure loss equations for shell and tube heat exchangers, double pipe heat exchangers with bare inner tube and finned inner tube Compact Heat Exchangers.

Text Books

1. Kays, W.M. and London A.L., 'Compact Heat Exchangers', 3rd Ed., McGraw Hill, 1984.
2. Frass, A.P. and Ozisik, M.N., 'Heat Exchanger Design', John Wiley and Sons Inc., 1965.
3. Wlker G., 'Industrial Heat Exchangers', A basic guide, McGraw Hill V Book Co., 1980.

Reference Books:

1. 'Standards of the Tubular Exchanger Manufacturer Association', 6th Ed., Tubular Exchanger Manufacturers Association, New York, 1978.
2. Donold Q Kern., 'Process Heat Transfer', McGraw Hill Book Co., 1984.
3. E.A.D. Saunders., 'Heat Exchangers', Longman Scientific and Technical, New York, 1988.

ME325 POWER PLANT MANAGEMENT

Credits 4:0:0 **Marks 40+60**

Unit I
Managerial Economics – Concept of cost – Nature of Profit measurement – Profit forecasting – Depreciation – Depreciation calculation – Value time function – straight line method – sinking fund method – sum of the years method – fixed percentages method and service output method – Calculation of Capital recovered plus return in the above methods – Depletion.

Unit II : Replacement Studies
Types of replacement studies – Annual cost percent worth – Rate of return – MAPI approach to replacement studies.
Budgetary Control: Various Steps in Budgetary Control – Basic concepts – Break even charts – setting targets for profits, sales – manufacturing – variable cost budgeting.

Unit III : Plant Economics
Energy demand management energy cost and crisis – investors profits – types of tariffs – plant performance and operating characteristics – Input curve – Efficiency curve.

Unit IV : Personnel Management
Purposes of Training – Training Techniques and aids – Guide for selecting a trainer – Training by induction.

Unit V : Maintenance Management
Function and responsibilities of maintenance engineering department – preventive maintenance. Equipment records and check lists – maintenance of power plant equipment –

coal bunkers chutes. Pulverizing equipment – stokers – fuel oil equipment. Material management and inventory management. The Indian Boiler Act, 1923 – The Indian Electricity Act, 1910 – the Indian Electricity rules, 1956.

Text Books

1. Thusun & Farbricky., 'Engineering Economy', 6th Ed., Tata McGrw Hill,1986.
2. C.R. Nagpal, 'Power Plant Engineering', Khanna Publishers, 8th Ed., 1984.

Reference Books

1. Robert Henderson Emrick., 'Power Plant Management', McGraw Hill, 1976.
2. Casonat., 'Production Hand Book', 3rd Ed., John Wiley & Sons, 1986.
3. Taru Chand., 'Engineering Economics', 17th Ed., New Chand Bros, Roorkee, 1988.
4. Murthy P.S.R., 'Power System Operation and Control', Tata McGraw Hill, 1984.
5. 'Hand Book of Training and Development', Jaico Publishing House, 1986.

ME326 ENERGY CONSERVATION AND FORECASTING TECHNIQUES

Credit: 4:0:0 **Marks: 40+60**

Unit : I

Energy resources, world energy supply and demand, scope for conservation, Energy inflow and outflow analysis. Energy as a source of technology development, National energy resources systems, policies, programmes and decisions.Policies regarding Non Conventional energy system.

UNIT:II

Energy Auditing, Methods of auditing,Energy accounts and analysis, Auditing of heating, ventilating and Air Conditioning systems, Electrical utilities, Process system energy audit, Case studies in Industries.

UNIT:III

Review of conservation Technologies, Energy Conservation in buildings, heating , cooling and ventilation. Electrical energy conservation, Energy efficient electrical motors, power factor improvement.

Energy conservation in thermal systems, combustion, refrigeration & A.C Systems, Furnaces & boilers, Cost of energy reception, storage and handling of fuels, measurements of Energy control – Case studies.

UNIT:IV

Principles of Energy management, Life cycle costing, financial Management, factors affecting economics, normative approach tech forecasting for strategies decision. Technology forecasting for R & D planning. Extrapolation methods, intensive methods such as Delphi. Present and future Energy situation in India

Unit : V

Energy resource Management, Energy technology assessment, Application of forecasting techniques in Energy and Environment impact studies, Future energy resources hydrogen economy, nuclear fission and MHD case studies.

Text Books

1. Murphy. W.R., 'Energy Management', Butter Worth, 1982.
2. S. Rao, B.B. Parulekar, "Energy Technology', Khana Publishers, 1999
3. Raymond.e.willms – A guide of forecasting for planers and managers, Prentice Hall, 1987
4. Rohatgi, Kalpana Rohatgi, Bowonder- Technology Forecasting, TMH, 1984

Reference Books:

1. Albert Thumann, plant Engineers & Managers Guid eto Energy Conservation, Fairmount Press, 1987
2. Ray D.A., 'Industrial Energy Conservation', Pergamon Press, 1980.
3. Albert Thumamon. ' Hand bookkof Energy audit' Fairmount press 1929.
4. Industrial Energy Conservation – case studies Survey Teri 1994
5. Hand Book on Energy Audits and management , Anil Kumar Tyagi, Teri,2000
6. Teddy Year Books
7. David H Hand book of Industrial Energy Conservation, Van Nostrand Reinhold Company, 1983
8. Energy Technology – S Rao & Pamlekar, Khanna Publishers, 3rd Edition, 1999.

ME327 INSTRUMENTATION AND CONTROLS IN THERMAL ENGINEERING

Credits 4:0:0 **Marks 40+60**

UNIT I : Introduction

Static and dynamic measurements – kinds of errors and uncertainty – Their analysis – Planning the experiments from error analysis. Pressure cells – Dynamic characteristic LVDT, piezo Electric pressure gauge.

UNIT II: Flow and temperature measurement

Flow Measurements- Pitot tube – magnetic flow visualization methods – shadowgraph – schlieren and interferometry – smoke methods – impact of pressure in supersonic flow – Hot wire anemometer – Laser Bopler anemometer.

Temperature measurements – measurement by Mechanical effect and by electrical effects- Thermocouples, pyrometry, transient response of thermal systems – calibration methods. Varying resistance device- quartz Thermometers.

UNIT III: Radiation measurement

Solar radiation measurement: Pyranometers – Measurement of duration – sun shine recorder. Instrumentation of I.C. Engines, Gas and Steam Turbines.

UNIT IV: Data acquisition and processing
Data acquisition and processing – analysis of experimental Data – Measurement of Heat flow by Electrical analog – use of computers. Digital transducers intelligent temperature measuring instruments an application of program logic controllers in boilers and turbines.

UNIT V Introduction to Automatic controls
Controls in Refrigeration & Air conditioning systems – Expansion devices- Constant Pressure and Superheat (Thermostat expansion value) – HP & LP cut-outs combination controls – high current relay – high side and low side float system. Temperature controlled suction pressure valve.
Boiler control: Water level – air flow – furnace pressure – steam temperature – combustion control – master controller – Burner management Pulverizer control – mixed fuel control, PLC application.

Text Books

1. Doebelin O.E., 'Measurement Systems and Design', McGraw Hill Co., 1998.
2. Holman J.P., 'Experimental Methods for Engineers', McGraw Hill, 1971.

Reference Books

1. David Lindsley., 'Boiler Control Systems', McGraw International, London, 1992.
2. Beckwit T.G. and Buck M.L., 'Mechanical Measurements', Addition Welsly, 1986.
3. Rangan, C.S., Sharma G.S. and Mani V.S., 'Instrumentation Devices and Systems', Tata McGraw Hill Pub. Co., 1993.
4. Althours A.D., Turnquist C.H., Braceioano A.F., 'Modern Refrigeration & Air Conditioning', Galgotia Book House, 1982.

ME328 COMBUSTION OF FUELS AND POLLUTION CONTROL

Credits 4:0:0 **Marks 40+60**

UNIT I
Conventional fuels, potential alternate fuels – Ethanol, Methanol. DEE/DME – Hydrogen, LPG, Natural Gas, Producer Gas, Bio Gas and Vegetable Oils-Properties of fuels, merits and demerits of various fuels.

UNIT II
Requirement of an ignition system and injection systems-Multi point injection – Electronic injection system-modern ignition system. Tranistorised coil ignition system, capacitive discharge ignition system – special design engines – dual fuel engine – spark assisted diesel engine – surface ignition engines – ignition accelerator.

UNIT III
Combustion Principles: Thermodynamic concepts of combustion. First law and second law of thermodynamics applied to combustion processes – heat of combustion – Adiabatic flame

temperature – stoichiometry and excess air – combustion calculations – minimum air required for complete combustion of fuel – chemical equilibrium and dissociation.

UNIT IV
Chemical Kinetics: Theories of combustion homogeneous mixture – heterogeneous mixture – Laminar and Turbulent flame propagation in engines. Air swirl – General functions and characteristics of the combustion chamber – comparison of some Basic Design of CI Engine combustion chambers.

UNIT V
Combustion generated Pollutants – Effect of pollution on environment and health. Global warming. Methods of controlling the emission-additives-Treatment of exhaust gas. Fuel modification, and Evaporative emission control, EGR, Catalytic converters. National and International Emission Standards

Text Books

1. Edward E. Obert., 'Internal Combustion Engines and Air Pollution', Internal Educational Publishers, New York, 1973.
2. Osamu Hirao and Richard K. Pefley, Present and Future Automotive Fuels, John Wiley and Sons, 1988.

Reference Books

1. Mathur M.L. and Sharma., 'A Course in Internal Combustion Engines', R.P. Dhanpat Rai Publications, 1997
2. Paul W. Gill, James H. Smith., 'Fundamentals of Internal Combustion Engines', Oxford and IBH Publishing Co., 1962.
3. V. Ganesan., 'Internal Combustion Engines', Tata McGraw Hill Publishing Company Ltd., 1995 .
4. Crouse William, Automotive Emission Control, Gregg Division / McGraw – Hill.

ME329 VACUUM TECHNOLOGY

Credit: 3:1:0 **Marks: 40+60**

UNIT-I
Introduction, Ideal and real gas laws, Kinetic theory of gases, Mean free path, Transport proprieties in-viscous state, molecular state. Thermal diffusion and energy transport. Gas flow at low pressure-Flow regimes, Conductance and throughput. Pumping speed. Viscous and turbulent flow, molecular flow and Intermediate flow, Conductance of pipelines, fittings.

UNIT-II
Calculation of vacuum systems-Pumping speed, pump down time in viscous and molecular range. Evaluation of the gas load and pumping requirements. Vapors in vacuum system, Vapour pressure and rate of evaporation. Out gassing, out gassing rates, Factors influencing out gassing.Gettering-principles,methods,materials.

UNIT-III

Production of Low pressures- Principles of pumping, selection of pumps. Rough and medium range pumps-Oil sealed rotary pump, Dry pumps, Roots Pumps. High vacuum pumps- Diffusion pumps, Cryopumps.Sealing techniques-classification, permanent seals, demountable seals.

Ejectors-working principle-water jet ejector, steam ejectors, air ejectors. Single and multistage ejectors, advantages of multi-stage ejectors.

UNIT-IV

Measurements of low pressures: classification and selection of vacuum gauges, Total pressure measurement –Direct measurement, indirect measurement. Partial pressure measurement. Calibration of vacuum gauges. Leak rate, Leakage measurement, Leak detectors, Design of vacuum chamber- cylindrical chamber.

UNIT-V

Application of vacuum Technology for Space and Cryogenic applications. Application in chemical and process industries-Vacuum drying-Food preservation-Distillation units.

Textbooks

1. A. Roth, Vacuum Technology, North-Holland, 3rd Ed., 1998.
2. Gehard Lewin, Fundamentals of vacuum science and Technology, McGraw Hill, 1965.

Reference Books

1. J.F. O'Hanlon, A users guide to vacuum technology, Wiley-Interscience, 2nd Ed., 1989.
2. D.M.Hoffman, B.Singh and J.H.Thomas (Eds), Handbook of vacuum science and technology, Academic Press, 1997.
3. L.Holland ,W.Steckelmacher, J.Yarwood , Vacuum Manual, Halsted Press, 1974 (Division of J. Wiley and Sons).

ME330 NUCLEAR POWER ENGINEERING

Credit: 4:0:0 **Marks: 40+60**

Unit-I

Review of Nuclear physics - Nuclear Equations – Energy from Nuclear Reactions and Fission – Thermal neutrons – Nuclear Cross Sections – Neutron Flux distribution in cores, slowing down – Neutron life cycle – Thermal Reaction Equation – Buckling Factors – Reactivity and Reactor Period – Void and Pressure coefficient of Reactivity – Effect of pressure and temperature on Reactivity.

UNIT-II

Reactor Heat generation and Removal – Volumetric Thermal source Strength – Heat flow in and out of solid fuel element – Temperature variations across Fuel elements – Coolant channel orificing – Hot spot factors – Absorption of Core radiation – Total heat generated in the core.

UNIT-III
Heat removal in solids Subject to radiation – Thermal Shield quality and void fractions in flow and non-flow systems – Boiling water reactor hydraulics-Change of Phase reactor.

UNIT-IV
Fluidized Bed Reactor, Gas Cooled Reactor steam Cycle- Simple and Dual Pressure Cycle, Pebble Bed Reactors, Fluid Fuelled Reactors – Types – Corrosion and Erosion Characteristics.

UNIT-V
Energy From Nuclear fusion, Thermonuclear Fusion, D-T Reaction, P-P Reaction, Fuel Cycle, Conditions for Fusion, Plasma confinement and Heating- Magnetic Confinement fusion, Inertial Confinement Fusion, Various Heating Mechanism of Plasma. Schematic of a Fusion Reactor, Major Controlled Fusion Experiments.

Text Books

1. M.M.Ei.Wakil, 'Nuclear power Engineering', McGraw hill book Company, Newyork, 1987.
2. Samuel Glasstone and Alexander Setonske, 'Nuclear reactors Engineering', 3rd Edition, CBS Publishers and Distributors, 1992.

Reference Books

1. Suresh Sarg- eral., 'Physics of Nuclear Reactors' TataMcGraw hill Publishing Company Limited, 1985.
2. Thomas J.Connoly., 'Fundamentals of Nuclear Energy', John Wiley, 1978

ME 331 TWO PHASE FLOW

Credits 4:0:0 **Marks 40+60**

UNIT – I
T1: Introduction to two phase flow-Flow patterns-Vertical co-current flow-Vertical heated channel-Horizontal co-current flow-Flow pattern maps and transitions.

UNIT - II
T1: Basic equations of two phase flow-Conservation of mass, momentum, energy-The homogeneous model-The two-phase friction factor-The separated flow model-the evaluation of two-phase multiplier and the void fraction-Use of models to evaluate pressure loss-The Lockhart-martinelli equations.
Pressure losses in two phase flow-Sudden enlargement, contraction, orifices, bends and valves.

UNIT - III

T1: Convective boiling-Thermodynamics of vapour/liquid systems-The basic processes of boiling-vapour formation-Simple bubble dynamics.
Pool boiling-various stages of pool boiling-Convective boiling-Regimes of heat transfer, boiling map.

UNIT - IV

T1: Basic processes of condensation-Liquid formation-Mechanism of evaporation and condensation at a plane liquid-Vapour interface-Crude theory-influence of non-condensable on interfacial resistance.
T2: Film condensation-Condensation on a vertical surface-Laminar film condensation.

UNIT - V

T3: Oscillatory two-phase flows-Classification of flow instabilities-Critical considerations on flow oscillations-acoustic oscillations and thermal oscillations-Density wave oscillations-Pressure drop oscillations-analysis of flow oscillations

Text Book

T1: John. G. Collier, Convective boiling and condensation, Mc Graw Hill, 1972.
T2: D.Butterworth and G.F.Hewitt, Two-phase flow and heat transfer, Oxford University Press, 1977.
T3: Jean. J. Ginoux, Two-phase flows and heat transfer with application to nuclear reactor design problems, Hemisphere Publishing Corporation, 1978.

DEPARTMENT
OF
MECHANICAL SCIENCES

ADDITIONAL SUBJECTS

Code No.	Subject Name	Credit
ME106	Basic Mechanical Engineering	2:0:0
ME244	Smithy, Welding & Sheet Metal Lab	0:0:2
ME245	Metallurgy & Foundry Lab	0:0:2
ME246	Engineering Thermodynamics	3:1:0
ME247	Analysis Lab	0:0:2
ME248	Design of Material Handling Equipment.	3:1:0
ME249	Plant Layout and material Handling.	4:0:0
ME250	Energy Management	4:0:0
ME332	Energy Conservation And Forecasting Techniques	4:0:0
ME333	Solar Energy Utilization	3:1:0
ME334	Experimental Stress Analysis	4:0:0
ME335	Engineering Materials	4:0:0
ME336	Computer Application in Design	4:0:0
ME337	Instrumentation and Control	4:0:0
ME338	Advanced Mechanical Vibrations	3:1:0
ME339	Engineering Economics	4:0:0
ME340	Concepts in Engineering Design and Optimization	4:0:0
ME341	Design of Mechanical System elements	3:1:0
ME342	Advanced Modelling Lab	0:0:2
ME343	Advanced Analysis Lab	0:0:2
ME344	Vibration Lab	0:0:2

ME106 BASIC MECHANICAL ENGINEERING

Credit 2:0:0 **Marks 40+60**

Unit – I : Introduction to Mechanical Engineering

Historical development - speed as a parameter- development of History of cycles, motorbikes, automobiles, locomotives, ships, Aircrafts, Rockets and spacecrafts- India in space.

Unit II : Energy Systems and power packs

Units and dimensions- Effects of pressure and temperature- Energy systems- External combustion Engine- Steam Engine and Steam turbine: internal Combustion Engine, Petrol Engine and Diesel Engine- components of Gas turbine engine and Jet engine.

Unit III : Power Plants

Conventional power plants- Hydro plants- Hydro , thermal, Nuclear power plants- Diesel and Gas turbine power plants; Non- conventional power plants – solar , wind and Tidal power plants- Geothermal power plant- ocean thermal Energy conversion power plants.

Unit IV

Manufacturing processes- Metal casting and forming processes-foundry process, melting or metals, forging process- metal joining process- Welding, soldering and Brazing.

Unit V

Production process : machining process- turning machine, Radial Drilling, Machine, shaping machine and milling machine- NC and CNC machines.

Introduction to modern desing and manufacturing software: auto CAD, PRO-E, ANSYS, CFD- FLUENT, MASTERCAM, ARENA, ADAMS, RAPID PROTOTYPING.

Text Book.

1. Dr. Nicholas M. T., & Mr. Mohan Gift " Karunya Class notes on Elements of Mechanical Engg.", 2004.
2. G. Shanmugam. "Basic Mechanical Engineering", 3rd Edition, Tata Mc Graw Hill, 2001

Reference

1. Sidhartan . P, ' Invention that changed the world' SISO books, Thiruvananthapuram, Dec. 2003.
2. www.inventorsabout.com
3. Shanmugam, G. 'Basic Mechanical Engg." TataMcGraw Hill Pub. Co., New Delhi. 1997.
4. Shanthakumar, S.R.J. , ' Basic Mechanical Engineering' Hi-Tech Publications, Mayiladuthurai, TN, 1999.
5. User Manual and websites of various softwares and hardwares.
6. Tizzard, A ' An Introduction to Computer Aided Engineering', McGRaw Hill 2000.

ME244 SMITHY, WELDING & SHEET METAL LAB

Credit : 0:0:2 **Marks : 50 + 50**

12 experiments will be notified by the HOD from time to time

ME245 METALLURGY & FOUNDRY LAB

Credit : 0:0:2 **Marks : 50 + 50**

12 experiments will be notified by the HOD from time to time

ME246 ENGINEERING THERMODYNAMICS

Credit 3:1:0 **Marks: 40+60**

UNIT I

Basic concepts – concept of continuum, macroscopic approach, thermodynamic systems – closed, open or control volume. Thermodynamic properties and equilibrium state of a system, state diagram, path and process, quasi-static process, work, modes of work, zeroth law of thermodynamics – concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities C_v and C_p, enthalpy, steady flow process with reference to various thermal equipments.

UNIT II

Second law of thermodynamics – Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Carnot cycle, reversed Carnot cycle, efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy – reversibility and irreversibility – Carnot theorem, entropy and reversibility, absolute entropy availability – 3rd law of thermodynamics.

UNIT III

Properties of pure substances – Thermodynamic properties of pure substances in solid liquid and vapour phases, phase rule P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculation of work done and heat transfer in non flow and flow processes – simple problems.

UNIT IV

Gas mixtures – Properties of ideal and real gases, equation of state, Avagadro's law, Gay Lussac's law Graham's law of diffusion, kinetic theory of gases, RMS and average velocity, ideal gas and deviation from it, Vander Wall's equation of states compressibility, compressibility chart, expansivity. Dalton's law of partial pressure. Psychrometry and psychrometric charts, property calculations of air vapour mixtures

UNIT V

Air standard cycles – Otto, Diesel, Dual, Brayton cycles – calculation of mean effective pressure and air standard efficiency. Types of fuels- HCV, LCV, determination of calorific value- Bomb- calorimeter, Junker's calorimeter stochiornetic mixture.

Text Books:

1. Vanwylen and Sontag, Classical Thermodynamics, Wiley Eastern, 1997
2. Nag P.K., Engineering Thermodynamics, TMH, New Delhi, 2004

Reference Books:

1. Holman. J.P., Thermodynamics, 3rd edition, McGraw Hill, 1985
2. Yunus Cengel 'Thermodynamics', TMH, 1998.

ME247 ANALYSIS LAB

Credit : 0:0:2 **Marks : 50 + 50**

12 experiments will be notified by the HOD from time to time

ME248 DESIGN OF MATERIAL HANDLING EQUIPMENT

(Use of approved Data Book is permitted)

Credit: 3:1:0 **Marks: 40+60**

UNIT – I

Material Handling Equipment: Introduction, types, selection and application Design of components of handling equipments, safety concept in design of Material handling Equipments.

UNIT – II

Design of Hoists: Design of hoisting elements: Welded and roller chains – Hemp and wire ropes – Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments: Design of forged hooks and eye hooks – crane grabs – lifting magnets – Grabbing attachments – Design of arresting gear – Brakes: Shoe, band and cone types-Safety issue

UNIT – III

Drives of Hoisting Gear: Hand and power drives – Traveling gear – Rail traveling mechanism – cantilever and monorail cranes – slewing, jib and luffing gear –cogwheel drive – selecting the motor ratings- Safety issue

UNIT – IV

Conveyors: Types p description – design and applications of Belt conveyors, Apron conveyors and escalators, Pneumatic conveyors, Screw conveyors and vibratory conveyors-Safety issue

UNIT – V

Elevators: Bucket elevators: Design – loading and bucket arrangements – Cage elevators – shaft way, guides, counter weights, hoisting machine, safety devices – Design of fork lift trucks.

Text Books:

1. Rudenko N, ‘Materials Handling Equipment’, Envee Publishers, 1970.
2. Spivokovsy. A.O. and Dyachkov. V.K., ‘Conveying Machine’, Vol. I & II, MIR Publishers, 1985.

Reference Books:

1. Alexandrov. M. ‘Materials Handling Equipments’, MIR Publishers, 1981.
2. Boltz Harol. A, ‘Materials Handling Hand book’, The Ronald Press Company, 1959.

ME249 PLANT LAYOUT AND MATERIAL HANDLING

Credit: 4:0:0 **Marks: 40+60**

UNIT I
Plant location - factors to be considered - influence of location on plant layout - selection of plant site. Consideration in facilities planning and layout. Physical facilities - equipments required for plant operation. Capacity, serviceability and flexibility and analysis in selection of equipments space requirements, man power requirements.

UNIT II
Plant layout - need for layout, types of layout, factors influencing product, process, fixed and combination layout; tools and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models - machine data. Layout planning procedure. Visualization of layout revision and improving existing layout, balancing of fabricating and assembly lines.

UNIT III
Material handling - Importance and scope. Principles of material handling. Planning, operation and costing principles - types of material handling systems, factors influencing their choice.

UNIT IV
Industrial buildings and utilities - centralized electrical pneumatic water line systems. Types of building, lighting heating, air-conditioning and ventilation utilities. Planning and maintenance, waste handling statutory requirements. Packing and storage of materials - Importance of packaging, layout for packaging - packaging machinery - wrapping and packing of materials, cushion materials.

UNIT V
Analysis of material handling - Factors involved, motion analysis, flow analysis, graphic analysis, safety analysis, equipment cost analysis, analysis of operation material handling surveys.

Text books:
1. James, M. Apple., 'Plant Layout and Material Handling', John Wiley & Sons, INC, 3rd Ed., 1977.

Reference Books:
1. James, M. Moore, 'Plant Layout and Design', Macmillan Company, NY, 1963
2. Muther, R., 'Practical Plant Layout', Mc Graw Hill Book Company, NY, 1955

ME250 ENERGY MANAGEMENT

Credit: 4:0:0 **Marks: 40+60**

UNIT I
Energy resources, energy use patterns, scope for conservation, world energy supply and demand, national systems and policies, programmes and decisions.

UNIT II
Energy Management principles, need for organisation and goal setting, energy audit in plants, review of conservation technologies.

UNIT III
Basic discounting life cycle costing and other methods, factors affecting economics, energy pricing and incentives for conservation, financial management.

UNIT IV
Policies regarding non-conventional energy system, energy resource management, availability, need and cost benefits of energy source.

UNIT V
Conflicting goals and decision under uncertainty energy technology assessment, waste elimination.

Text books

1. Ray D.A., 'Industrial Energy Conservation', Pergamon Press, 1980.
2. Joe Goldemerg, Etal., Energy for Sustainable World, Wiley Eastern Ltd, 1990.

Reference Books:

1. Kreith. F. and West R.E.(Eds)., 'Economics for Solar Energy Conservation Systems', Vol I. And III, CRC Press, 1980.
2. Shinkey. E.G., 'Energy Conservation through Control', Academic Press, 1980
3. Lav. B. Etal., 'Analytical Techniques for Energy Planning', North Holland, 1984.
4. Murphy. W.R., 'Energy Management', Butter Worth, 1982.
5. Lavry. C. etal., 'Industrial Energy Management and utilization', Hemisphere publishing cooperation, 1988.
6. Guru. D.D. and Qamar Ashan., 'Energy and Economic Development', Amar Prakashan, 1987.

ME332 ENERGY CONSERVATION AND FORECASTING TECHNIQUES

Credit: 4:0:0 **Marks: 40+60**

UNIT I
Energy resources, world energy supply and demand , scope for conservation, energy inflow and outflow analysis. Energy is a source of technology development. National Energy resources systems, Policies, program's and decisions. Policies regarding Non Conventional energy system.

UNIT II
Energy Auditing – Method of auditing, Energy Accounts and analysis, Auditing of heating, ventilating and air Conditioning systems, Electrical Utilities , process system energy audit Case studies in Industries.

UNIT III

Energy conservation - Definition - Principles – thermodynamic efficiency in energy use, Max test effectiveness, Economics of energy conservation- energy conservation in buildings: heating, cooling, lighting and ventilation, electrical energy conservation, energy efficient electric motors and power factor improvement.

Energy conservation in thermal systems: combustion systems, refrigeration and air-conditioning system, furnaces and boilers. Cost of energy reception, storage and handling of fuels, measurements of Energy control- Case studies.

UNIT IV

Energy Management principles,- supply and demand side management policies and energy planning , life cycle costing , Financial Management, factors affecting economics , normative approach tech forecasting for strategies decision . Technology forecasting for R & D Planning, Extrapolation methods, intensive methods such as Delphi Techniques, Present and future Energy situation in India.

UNIT V

Energy Resource management, Energy technology assessment, Application of forecasting techniques in Energy and Environment impact studies, future energy resources, hydrogen economy, nuclear fission and MHD case studies.

Text Books:

1. David Hu., S. Handbook of Industrial Energy Conservation Van Nostrand Reinhold Company, 2002
2. Energy Technology, - S. Rao & Parulkar, Khanna Publishers, 1999.
3. Rohatgi, Kalpana Rohatgi,Bowonder- technology forecasting, TMH, 1986.

Reference books:

1. Murphy W.R, Energy Management, Butterworths, London. 1982.
2. Albert Thumann, Hand book of Energy Audit, Fairmount Press, 1929.
3. Ray D.A., Industrial Energy Conservation, Pergamon Press, 1980.
4. Industrial Energy Conservation - case studies Survey teri 1994.
5. Hand book on Energy Audits and Management, Anil Kumar Tyagi, Teri 2000 Teddy year book

ME333 SOLAR ENERGY UTILIZATION

Credit: 3:1:0 **Marks: 40+60**

UNIT I

Introduction – Energy alternatives – New energy technologies – Solar thermal process – heat transfer devices. Solar Radiation – Solar constant – extra terrestrial radiation – clear sky irradiation – solar radiation measurement – estimation of average solar radiation – solar radiation on titled surface – synthesized radiation data.

UNIT II

Flat plate collectors – cover plates – collectors plate surfaces energy balances equation and collectors efficiency – collector performance – collector improvements effect of incident angle, dust and shading – Thermal analysis of flat plate collector and useful heat gained by the fluid – collector design – Heat transfer factors.

UNIT III

Concentration collectors and reflectors – Parabolic concentrators, nonimaging concentrators, other forms of concentrating collectors. Tracking – receiver shape and orientation – performance analysis – reflectors – reflectors orientation – performance analysis.

UNIT IV

Solar energy storage – stratified storage – well mixed storage – comparison – Hot water system – practical consideration – solar ponds – principle of operation and description of Non-convective solar pond – extraction of thermal energy application of solar ponds.

UNIT V

Solar Electric power generation, photo voltaic cells. Design of swimming pool, heaters – power generation system. Tower concept – solar refrigeration system, thermo electric refrigeration system.

Text Books:

1. Suhatme, S.P., 'Solar Energy Principle of Thermal Collection and Storage', Tata McGraw Hill, 1990.
2. Kriender, J.M., 'Principles of Solar Engineering', McGraw Hill, 1987.

Reference Books:

1. Mangal, V.S., 'Solar Engineering', Tata McGraw Hill, 1992.
2. Bansal, N.K., 'Renewable Energy Source and Conversion Technology', Tata McGraw Hill, 1989.
3. Peter J. Lunde., 'Solar Thermal Engineering', John Willey & Sons, New York, 1988.
4. Duffie, J.A and Beckman W.A., 'Solar Engineering of Thermal Processes', Willey & Sons, 1990.

ME334 EXPERIMENTAL STRESS ANALYSIS

Credit: 4:0:0 **Marks: 40+60**

Unit I : Elementary Elasticity

Stress. Stress equations of equilibrium, principle stress, max. Shear stress, two-dimensional state of stress, stress-strain relations, principal strains.

Unit II : Strain Measurement Methods

Electrical resistance strain gauges, semiconductor gauges, single element, two and multi element configuration, rosettes, two element rectangular, three element rosettes, rect, star, delta configuration, 4 element rectangular rosettes , strain gauge circuits, quarter, half triangle circuits, whit stone bridge, constant current bridge, temperature configuration, effect of contact resistance, lead wires.

Unit III : Photo Elasticity

Background optics-plane and circular polarization-stress optic law-photo elastic materials-casting and modeling techniques-calibration methods-isoclines, isochromatics and stress trajectories-stress separation methods, Fringe sharpening – stress freezing – three dimensional analysis from model slicing – axis symmetric stresses – torsion problem, 2D and 3D Photo elasticity.

Unit IV : Bi-Refrigerant Coating Techniques

Reflection plariscope – sensitivity of the method – principal stress – separation – comparison of brittle coating and bi-refrigerant coating techniques.

Brittle Coating Method

Introduction – Relation between the state of stress in coating and that on the model – Isostatics and isoentactuies – Types of brittle – coating materials – Relative merits of stress – coat and all – temp coatings – crack detection techniques – Variables influencing accuracy of brittle coating application - Modeling – surface preparation and application of coating – calibration of brittle coating materials – Brittle coating technique applied to a specific problem.

Unit V : Moire Methods:

Mechanism of formation of moiré fringes, geometrical approach to moiré fringe analysis, displacement field approach to moiré fringe analysis, out of plain measurements experimental procedure.

Holography:

Plain and spherical waves – coherence - holography setup – Inter ferometry – Displacement measurement – obtaining isopachics.

Text Books:

1. James W Dally & William F Riley. " Experimental stress analysis". International student edition. MCGraw hill, Kogakusha limited, 1985
2. Srinath, L.S. Experimental stress Analysis, TATA Mcgraw Hill, New delhi 1984

Reference Books:

1. Dally and Riley, Experimental stress analysis, Mcgraw hill co., 1978
2. Dove and adams, Experimental stress analysis and motion measerument, Prentice hall of India., 1965
3. Sadhu sing, Experimental stress analysis, Khanna publishers, 1990

ME335 ENGINEERING MATERIALS

Credit: 4:0:0 **Marks: 40+60**

Unit I

Elastic & Plastic Behaviour. :- Elasticity in metals and polymers- mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals – Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviour- Super plasticity- Deformation of non-crystalline material.

Unit II

Fracture behaviour:-Griffith's theory, intensity factor fracture toughness- toughening mechanism- Ductile brittle transition in steel - High temperature fracture, creep- Larson-miller para meter- Deformation and fracture mechanism maps- Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanism and Paris law – Effect of surface and metallurgical parameters on fatigue- fracture of non metallic materials - Failure analysis, sources of failure, procedure of failure analysis.

Unit III

Modern metallic materials.:- Dual phase steels, Micro alloyed, High strength low alloy (HSLA) steel, transformation induced plasticity (TRIP) steel, Maraging Steel- intermetallics, Ni and Ti aluminides- smart materials, shape memory alloys- Metallic glass- Quasi crystal and nano crystalline materials. Applications, selection criteria, Nano structures.

Unit IV

Non metallic materials.:-Polymeric materials- Formation of polymer structure- Production techniques of fibres, foams, adhesives and coatings- structure, properties and applications of engineering polymers- advanced structural ceramics, WC, TIC, TaC, AI_2O_3, SiC, Si_3N_4 CBN and diamond- properties, processing and applications. Selection criteria

Unit V

Composite Materials. :-Fibres- glass carbon, boron, ceramic, Aramid. MATRIX materials Polymer, graphite, Bolted and bonded joints metal, ceramics processing, PMC, applications selection criteria

Text Books:

1. Thomas H. Courtney, Mechanical Behaviour of Materials, (2^{nd} Edn.) McGraw Hill, 2000.
2. Charles, J. A. Crane, F. A. A and Fumess, J. A. S, Selection and use of engineering materials.(3^{rd} Edition), Butter worth- Heiremann, 1997.

References:

1. Flinn R. A. and Torjan , P.K. Engineering Materials and their Applications, (4^{th} Edition) Jaico,1999.
2. George E. Dieter, Mechanical Metallurgy, McGraw Hill (10th Edition),1994.
3. Mattiall. P.K. Fibre Reinforce composites" Manual deletur Inc. 1993.
4. www.astm.org/labs/pages/131350.htm.
5. www.applied materials.com/carrers/agu-ei-html.

ME336 COMPUTER APPLICATION IN DESIGN

Credit: 4:0:0 **Marks: 40+60**

Unit I : Introduction to Computer Graphics Fundamentals

output primitive-(points, Lines, curves, etc) 2-D Transformation (**2-D** Translation, scaling rotators) Windowing and clipping transformation

Unit II : Introduction to CAD Software's

Writing interactive programs to solve design problems and production of drawings using any languages like Auto LISP/C/ FORTRAN etc. Creation of surfaces, solids etc., using solid modeling pack (prismatic and revolved parts)

Unit III : Visual Realism

Hidden line- surface- Solid removal algorithms shading- coloring . Introduction to parametric and variational geometry based on software's and their principles creation of prismatic and lofted parts using these packages.

Unit IV : Assembly of Parts

Assembly of parts , tolerance analysis and mass property calculations, mechanism simulation.

Unit -V

Solid Modeling – Rapid prototyping – data exchange- Documentation- Customizing- solid modeling system.

Textbooks

1. Donald Hearn and M Pauline Baker " Computer Graphics Printice Hall Inc. 1992.

References:

1. Mikell. P. Grooves and emory, W. Zimmers Jr. " CAD/CAM Computer aided Design and Manufacturing " prentice Hall of Inc., 1995.
2. IBRAHIM ZEID " CAD/CAM- Theory and Practice" McGraw Hill, International Edition, 1998.

ME337 INSTRUMENTATION AND CONTROL

Credit: 4:0:0 **Marks: 40+60**

Unit I : Science of Measurement

Units and standards-calibration of techniques-classification of errors-error analysis-statistical methods-odds and uncertainty-static and dynamic characteristics of transducers-response of transducers to different time varying inputs

Unit II : SENSORS AND TRANSDUCERS FOR MEASUREMENTS

Classification of transducers-absolute and incremental transducers- transducer with frequency output-potentiometer-strain gauge-LVDT &RVDT-RTD-direct digital transducers - sensors-thermistor-thermocouples-variable reluctance transducers-capacitive transducers-opto electronic transducers- piezo electronic transducers- fibre optic transducers-magneto strictive transducers-hall effect-load cells-manufacturing of semiconductor transducers

Unit III : Signal Conditioning Methods
need for signal conditioning-modulated and unmodulated signals-resistance and reactance bridges-wheat stone bridge circuits amplification- differentiation and integration –computer based signal conditioning – PC based data acquisition system-shielding and grounding-filters

Unit IV : Mechanical Measurements and Mechanical Chains
Measurement of mechanical quantities –force, torque, temperature, flow ,pressure , liquid level ,linear angular motion –acceleration ,vibration –displacement ,velocity and acceleration –shock, acoustics.

Unit V : Digital Methods of Measurements
Introduction – Conversion of analog signal to digital signal –Analysis of round of errors –Parameter round off –Limit cycles and dither –Sampling theorem limit-Time response and smoothness –Sensitivity to parameter variations-measurement of noise-autialiasiure filter-Multirate sampling
Digital meters-multimeter-phasemeter-digital frequency-period-time measurements-low frequency measurements-automatic time frequency scaling –sources of errors -noise

Text Books

1. S.Reganathan “Transducers Engineering”, Allied publishers Limited,1999

Reference Books

1. E.O. Deobline, “Measurement systems, application and design” McGraw-hill, 4th edition, 1990.
2. Beckwith, Marangoni & Lienhard, “ Mechanical measurements”, Addison-Wesley, 5th edition, 2000.
3. CS Rangan, VSV Mani, G.R. Sharma, instrumentation devices and systems, Tata McGraw hill 1983.
4. A.K SAWHNEY, “a course in electrical and electronics measurement and instrumentation” , Dhanpat Rai & Co.,2000

ME338 ADVANCED MECHANICAL VIBRATIONS

Credit: 3:1:0 **Marks: 40+60**

Unit – I : Single Degree of Freedom System.
Introduction –equation of motion – frequency and period – free vibration- forced vibration – damping - resonance solutions of problems by Newton’s law of motion Solutions of problems by digital computer s for one degree of freedom systems for transient and harmonic response. Energy methods – Raleigh’s method – mechanical impedance method - isolation of vibrations and transmissibility – Seismic instruments.

Unit –II : Two Degree of freedom systems.

Vibration absorber – LaGrange's equation, influence coefficients- mode of vibration-principle modes-principle of orthogonality generalized coordinates – dynamic vibration absorber – semi definite systems.

Unit III

Methods of finding natural frequencies for problems including on torsional vibrations-matrices- matrix iteration –stodola's method holzer's method -mechanical impedance method – solutions of problems by digital computer for multi degree of freedom systems for harmonic response, undamped discrete systems (Matrix iteration technique).

Unit –IV : Vibration of multi degree and continuous systems.

Systems governed by wave equations- vibration of strings- vibration of rods- Beams, Euler's equation for beams – effect of Rotary inertia and shear deformation- Vibration of plates. Normal mode of vibration- Flexibility matrix and stiffness matrix- Eigen value and eigen vector- Orthogonal properties – Modal analysis-– Modal damping in forced vibration - numerical methods in vibration problem.

Unit V : Experimental methods in vibration analysis.

Vibration instruments- vibration exciters, measuring devices- analyisi- vibration Tests-Free, forced environmental vibration tests. Example of vibrations test & analysis– Industrial case studies.

Text Books

1. Tsc, Francis, S., Morse, Ivan, E., Hinkle Rolland, T., "mechanical Vibration", CBS Publishing and Distributors, 1983.
2. William, W. Seeto., "Mechanical Vibrations" schum publishing Company,1996.

References

1. Thompson, W. T., " theory of Vibration with applications", Prentice Hall of India, 1972.
2. Srinivasan, P., "Mechanical Vibration Analysis", Tata Mc Graw Hill Publishing company Ltd., 1982.

ME339 ENGINEERING ECONOMICS

Credit: 4:0:0 **Marks: 40+60**

Unit 1 : Introduction

Economics- Engineering economics – Element of product design and development – concept of concurrent engineering – Plant design and capacity planning – Equipment solution process flowing line balancing makes vs buy decisions – Productivity analysis – Production cost - pricing method

Unit II : Project Feasibility Analysis

Case study – Report preparation – Depreciation – Reasons – Depreciation account – Cases of declining value – Depreciation method – Cost – Volume – Profit analysis: Review of conventional approach – Analysis with time value – Linear – Non linear – Multi product analysis.

Unit III : Method for Evaluation of Tangible Alternatives and Replacement Analysis:
Present worth comparison – Equal, unequal lived assets – Study period – Capitalist cost bond valuation. Equivalent uniform annual cost comparison rate of return comparisons.

Replacement Analysis
Review of conventional approach – Analysis with time value accounting – Current salvage value of the defender – Defender and challenger with different lives – Additional one year assessment – review of project management – PERT – CPM – Crashing – Cost system.

Unit – IV : Marketing and Financial Feasibility
Types of market – Identification of investment opportunities – Market and demand analysis – Forecasting – Demand (review) – forecast control – secondary sources of information – Means of financing – Financial institution – All India – state level – profitability – Cash flows of a project – Financial leverage of a business. Tax factor in investment analysis – Direct – Indirect-advance tax – Tax rates – Incentives for new industries in backward areas.

Unit –V :Risk Analysis and Decision Trees
Recognizing risk – Including risk in economic analysis – Expected value – pay off table – decision Tree – discounted decision tree. Present economic policy – liberalization – privatization – globalisation – Scope of industrial growth.

Text Books:

1. James L. Riggs. "Engineering Economics". Mc Graw Hill Book Company. 1997.
2. Prasanna Chandra. "Projects – Preparation. Appraisal and implementation". Tata McGraw Hill, New Delhi. 1998.

References:

1. Norman N Barish " Economic Analysis for Engineering and Manegrial Decision Making". McGraw Hill Book Company. 1983.
2. Leland T Blank. Anthony J. Tarquin. "Engineering EconoPmy". Mc Graw Hill Book Company.1998.
3. John A.White al. "principles of Engineering Economic Analysis". John Wiley & Sons, New York.1998.

ME340 CONCEPTS IN ENGINEERING DESIGN AND OPTIMIZATION

Credit: 4:0:0 **Marks: 40+60**

Unit I : Design Process and Methods
The Design process-morphology of Design-Design Drawings-Computer Aided Engineering-Designing of Standards- Concurrent Engineering- Product design lifecycle - Product Life Cycle-Technological Forecasting-Market Identification-Competition Bench Marking-Systems Engineering-Life Cycle Engineering-Human Factors in Design-Industrial Design
Creativity and Problem solving-Product Design Specifications-Conceptual Design-Decision theory-Embodiment Design-Detail Design - Reverse Engineering.

Unit II : Optimization Techniques

Single variable and Multivariable optimization-Techniques of unconstrained minimization Golden section-Random pattern and gradient search methods- optimization with equality and inequality constraints-Direct methods-In direct methods using penalty functions-Lagrange's Multipliers-Geometric programming and stochastic programming-Multi objective optimization-Genetic Algorithms and simulated Annealing Techniques

Unit III : Engineering Statistics and Reliability

Probability-Distributions-Test of Hypothesis-Design of Experiments-Reliability theory-Design of reliability-Reliability centered Maintenance

Unit IV : Quality Engineering

Total Quality concept-Quality Assurance-Statistics process control-Taguchi methods-Robust Design-Failure model Effect Analysis

Unit V : Engineering Applications

Structural Applications-Design of simple Truss members-Design Applications-Design of simple axial, transverse load members for minimum cost, maximum weight-Design of shaft and Torsionally loaded members-Design of Springs-Dynamic Applications-Optimum design single, two degrees of freedom-vibration absorbers-Application in mechanisms-Optimum design of simple linkage mechanisms

Text Books:

1. Dieter George.E., engineering Design-"A Materials and Processing Approach", McGraw Hill,International Edition Mechanical Engg.,series,1991.
2. Kalyanamoy Deeb. "Optimization for Engineering Design algorithms and Examples", Prentice Hall of India Pvt. Ltd.1995

References:

1. Path.G. And Beitz.W. "Engineering Design", Springer-Verlag.N.Y.1985
2. Goldberg.D.E, "genetic Algorithms ion ser=arch,Optimization and Machine", Barnen,Addison-Wesley, New Delhi,1989.

ME341 DESIGN OF MECHANICAL SYSTEM ELEMENTS

Credit: 3:1:0 **Marks: 40+60**

Unit-I : Material Handling Equipments

Types, Selection and applications.

Method for determining stresses-Terminology and ligament efficiency-Application.

Unit-II : Stresses In Pressure Vessels

Introduction: Stresses in a circular ring, cylinder-Membrane stress analysis of vessels shell components-Cylinder shells, to spherical heads, conical heads-Thermal stresses-Discontinuity stresses in pressure vessels.

Design Of Vessels:

Design of tall cylinder self supporting process columns-Supports for short vertical vessels-Stress concentration at a variable thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of reinforcement-Pressure vessel design.

Unit III

Design of automotive transmission system – clutches – power transmitted brake – Cams – gear box.

UNIT-IV : Design of hoisting elements:

Welded and roller chains-Hemp and wire ropes. –Design of ropes, pulleys, pulley system, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks-crane grabs-lifting magnets-Grabbing attachments-Design of arresting gear-Brakes: Shoe, band and cone types.

Unit-V : Conveyors

Types-description-Design and applications of belt conveyors, apron conveyors and escalators pneumatic conveyors, screw conveyors and vibratory conveyors.

Text Books

1. John.F.Harvey, "Theory & Design of Pressure Vessels", "CBS Distributors", 1987.
2. Rudenko.N, "Materials Handling Equipments", Elnvee Publishers, 1970.
3. Prabhu T.J., 'Design of Transmission elements', 2003

References

1. Alexandrov.M. "Materials HandlingEquipmets", MIR publishers, 1981.
2. Henry.H.Bedner "Pressure Vessels", Design HandBook, CBS Publishers & Distributors, 1987.
3. Joseph Edward Sighley , "Mechanical Engineering Design", McGraw Hill, 1980

ME342 ADVANCED MODELLING LAB

Credit: 0:0:2 **Marks: 50+50**

12 experiments will be notified by the HOD from time to time

ME343 ADVANCED ANALYSIS LAB

Credit: 0:0:2 **Marks: 50+50**

12 experiments will be notified by the HOD from time to time

ME344 VIBRATION LAB

Credit: 0:0:2 **Marks: 50+50**

12 experiments will be notified by the HOD from time to time

ADDITIONAL SUBJECTS

Code No.	Subject Name	Credit
PE237	Operations Research	3:1:0
PE238	Nano Technology and Smart Materials	4:0:0
PE239	Precision Engineering	4:0:0
PE328	Industrial Robotics	3:1:0
PE329	Computer Integrated Manufacturing Systems	4:0:0
PE330	Design for Manufacturing and Assembly	3:1:0
PE331	Manufacturing Information System	3:1:0
PE332	Manufacturing System and Simulation	3:1:0

PE237 OPERATRIONS RESEARCH

Credit : 3 : 1: 0 **Marks: 40 + 60**

Unit I : Linear Models
The phases of operations research study – Linear programming – Graphical method – Simplex algorithm – Duality – Transportation problems – Assignment problems.

Unit II : Network Models
Network models - Shortest route – Minimal spanning tree – Maximum flow models – Project network – CPM and PERT networks – Critical path scheduling – Sequencing models-n jobs through 2 machines, n jobs through m machines

Unit III : Inventory Models
Inventory models – Economic order quantity models – Techniques in inventory Management –ABC Analysis – formation of ABC graph from the data – Two Bin Methods.

Unit IV : Queuing Models
Queuing models (No derivation) – Queuing systems and structures – Notation – parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation – Monte Carlo Technique – inventory and queuing application.

Unit V : Decision Models
Decision models – Game theory – Two person zero sum games – Graphical solution – Algebric solution – Linear programming solution – Replacement models – Models based on service life – Economic life – Single / Multivariable search technique.

Text Books:

1. H.A. Taha, "Operations Research", Prentice Hall of India, 1999 6th Edn.
2. S. Bhaskar, "Operations Research", Anuradha Pub., Tamil Nadu 1999.
3. Gupta and Hira, "Operations Research", Dhanpat rai and Co.

Reference Books:

1. Shennoy, Srivastava, “Operations Research for Management”, Wiley Eastern, 1994
2. M.J. Bazara, Jarvis H. Sherali, “Linear Programming and Network Flows”, John Wiley, 1990
3. Philip and Ravindran, “Operations Research” , John Wiley, 1992
4. Hiller and Lieberman, “Operations Research”, Holden Day , 1986
5. Frank, S. Budnick, Dennis, McLeavy, “Principles of Operation Research for Management”.

PE238 NANO TECHNOLOGY AND SMART MATERIALS

Credit: 4:0:0 **Marks: 40+60**

Unit I : Introduction Nano – Definition – Measure – Nanosize – Moore’s Law:
Fundamental Science behind nanotechnology (Electrons – atom and iron – Molecules – metals – other materials – Biosystem – molecular recognition – Electrical conduction and Ohm’s Law – Quantum mechanics and quantum ideas – Optics).

Unit II : Measuring and Making Nanostructures
Scanning Probe instruments – Spectroscopy – Electrochemistry – Electron microscopy. Tools to make Nanostructures – Scanning Prope Instruments – Nanoscale Lithography – Dip pen Nanolithography – E-Beam Lithography – Nanosphere lift off lithography – Molecular synthesis – Self assembly – Nanoscale crystal growth – Polymerisation - Nano CAD.

Unit III : Smart Materials – Sensors
Introduction to smart materials – Self – healing structures – Recognition – Seperation – Catalysis – Heterogeneous nanostructures and composites – Encapsulation - consumer goods – Nanoscale sensors – Electromagnetic sensor – Biosensors – Electronic noses.

Unit IV : Biomedical Applications
Drugs – Drug delivery – Photodynamic theraphy – Molecular motors – neuro-electronic interfaces – protein engineering – Nanoluminescent tags.

Unit V : Optics & Electronics
Light energy – Photo voltaics – Light production – Light transmission – Light control and manipulation - Electronics – Carbon nanotubes – soft molecule electronics - memories – Gates and switches – Architectures.

Text Book:

1. Mark Ratner & Daniel Ratner, “Nano Technology”, Pearson Education (Singapore) Pvt.Ltd., 482, F.I.E. Patparganj, 2003, Delhi –110 092.

References:
1. Michelle Simmons, “NanoTechnology: Basic Science and Emerging Technologies”, Chapman and Hall/CRC, June 2002.
2. Bharat Bhushan, “ Springer Handbook of Nanotechnology”, Springer, February 2004.
3. Frank J. Owens, “Introduction to Nanotechnology”, Willey –Interscience, May 2003.

PE239 PRECISION ENGINEERING

Credit: 4:0:0 **Marks: 40+60**

Unit I : Concepts Of Accuracy

Introduction – Part accuracy – errors – general concept spindle rotation accuracy principle – Test methods for radial spindle rotation error in boring and lathe significance of spindle – rotation error for machine tools – Displacement accuracy – influence of displacement on machined work pieces in basic machine tools.

Unit II : Accuracy of Numerical Control Systems

Introduction – Errors due to Numerical interpolation – errors due to displacement measurement systems – Definition of a accuracy of a Numerical control system Various position feedback schemes – NMTSA accuracy test – VDI accuracy test – Deviation with and without backlash – errors due to velocity lags – Definition of Transient response – slide way friction and zero stability.

Unit III : Limits, Tolerances and Fits and Computer Integrated QA.

Introduction – basic size deviation, limits and tolerances – Zero line and sign convention types of fits – basic hole and shaft systems – computation of IT tolerance with simple problem – selection of tolerance Zone computing fundamental deviation with simple example – Total Quality control – Definition of quality assurance and Zero defect with simple example – Evaluation – Environment control.

Unit IV : Acceptance Test for Machine Tools

Introduction - basic types of test – Testing methods and use of checking instruments – measuring instruments used for testing of machine tools – Alignment tests – straightness – Measurement of flatness, parallelism, equidistance, and coincides – rotation – measuring run-out, axial play – camming – Geometrical checking of Lathe, milling, drilling and boring machine – process capability.

Unit V : Fundamentals of nano Technology, Measuring System and Applications

Definition of nanotechnology – Processisng system of nanometer – Atom cluster processing with free fine abrasive – Atomic bit processing using elementary high energy particles – nano-machining as atom – cluster processing – In-process or in situ measurement of position of processing point – Applications – Situ machining of soft metal mirrors with diamond turning – mirror grinding of ceramics – production of curved mirror.

Text Books:
1. Murthy,R.L., - " Precision Engineering in Manufacturing ", New age

2. International(P) Limited,publishers,1996.
3. Norio Taniguchi,- " Nano Technology ", Oxford university,Press,1996.
4. H.P. Garg, “Introduction maintenance”, S.Chand & Co. New Delhi, 1980
5. John Bank, “Essence of TQM”, Prentice Hallof India, Pvt.Ltd., 1990

Reference Book:

1. James D. Medows, “Geometri dimensioning and tolerance”, Marcel Dekker Inc. 1995.

PE328 INDUSTRIAL ROBOTICS

Credit: 3:1: 0 **Marks:40 + 60**

Unit – I : INTRODUCTION

Basic concepts - Robot anatomy - Robot configurations - Basic robot motions - Types of drives – Robot Cell design & Control - Applications -Material handling - processing - Assembly and Inspection - safety considerations.

Unit – II : TRANSFORMATIONS AND KINEMATICS

Vector operations - Translational transformations and Rotational transformations - Properties of transformation matrices-Homogeneous transformations and Manipulator - Forward solution - Inverse solution.

Unit-III : CONTROLS AND END EFFECTORS

Control system concepts - Analysis - control of joints - Adaptive and optimal control - End effectors - classification - Mechanical - Magnetic -Vacuum - Adhesive - Drive systems - Force analysis and Gripper design.

Unit-IV: ROBOT PROGRAMMING , ARTIFICIAL INTELLIGENCE

Methods - Languages -Computer control and Robot Software - VAL system and Language - AI – Basics – Goals-AI Techniques – AI & Robotics

Unit –V : SENSORY DEVICES

Non optical and optical position sensors - Velocity and Acceleration - Range - Proximity - touch - Slip - Force -Torque - Machine vision - Image components - Representation - Hardware - Picture coding - Object recognition and categorization - Software consideration.

Text Books :

1. Klafter R.D., Chmielewski T.A. and Negin M., " Robot Engineering An Intergrated approach ",Prentice Hall of India, New Delhi, 1994.
2. Groover M.P., " Industrial robotics Technology, programming and applications ", McGraw-Hill Book Co., 1995.

References:

1. Fu K.S., Gonzalez R.C.., and Lee C.S.G., " Robotics control, sensing, vision, and intelligence ",McGraw-Hill Book Co., 1987.
2. Deb S.R., " Robotics Technology and Flexible Automation ", Tata McGraw-Hill Publishing Co., Ltd., 1994.

3. Craig J.J., " Introduction to Robotics Mechanics and Control ", Addison-Wesley, 1999.

Reference:
1. http://www.robotics.com
2. Timothy Jordanides etal, “ Expert Systems and Robotics”, Springer- Velag, New York May1991.

PE329 COMPUTER INTEGRATED MANUFACTURING SYSTEMS

Credit: 4:0: 0 **Marks:40 + 60**

Unit – 1 Introduction
Objectives of a manufacturing system-identifying business opportunities and problems classification production - systems-linking manufacturing strategy and systems-analysis of manufacturing operations.

Unit II - Group Technology And Computer Aided Process Planning
Introduction-part families-parts classification and cooling - group technology machine cells-benefits of group - technology. Process planning function CAPP - Computer generated time standards.

Unit III Computer Aided Planning And Control
Production planning and control-cost planning and control-inventory management-Material requirements planning - (ERP)-shop floor control-Factory data collection system-Automatic identification system-barcode technology automated data collection system.

Unit –IV Computer Monitoring
Types of production monitoring systems-structure model of manufacturing process-process control & strategies direct digital control-supervisory computer control-computer in QC - contact inspection methods non-contact inspection method - computer-aided testing - integration of CAQC with CAD/CAM.

Unit – V Integrated Manufacturing System
Definition - application - features - types of manufacturing systems-machine tools-materials handling system computer control system - DNC systems manufacturing cell. Flexible manufacturing systems (FMS) - the FMS concept-transfer systems - head changing FMS – variable mission manufacturing system - CAD/CAM system - human labour in the manufacturing system-computer integrated manufacturing system benefits.
Rapid prototyping - Artificial Intelligence and Expert system in CIM.

Text Books:
1. Groover, M.P., "Automation, Produ tion System and CIM", Prentice-Hall of India, 1998.

References:
1. David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New

Delhi, 1998.
2. Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill, 1983.
3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International 1986.
4. R.W. Yeomamas, A. Choudry and P.J.W. Ten Hagen, "Design rules for a CIM system", North Holland Amsterdam, 1985.

PE330 DESIGN FOR MANUFACTURING AND ASSEMBLY

Credit:3:1:0 **Marks: 40+60**

Unit I :Introduction
General Design principles for manufacturing – strength and mechanical factors, mechanisms selection, Process capability – Feature tolerances – Geometric tolerances – assembly limits – Datum Features – Tolerances stacks.

Unit II : Factors Influencing Form Design
Working Principle, Material, Manufacture Design – Possible solutions – Materials choice – Influence of materials on form design – form design of welded members, forgings and castings.

Unit III : Component Design – Machining Consideration
Design features to facilitate machining – drills – milling cutters – keyways – Doweling procedures, counter sunk screws – Reduction of machined area - simplification by separation – simplification by amalgamation – Design for machinability – Design for economy – Design for clampability – Design for Accessibility – Design for Assembly.

Unit IV : Component Design – Casting Considerations
Redesign of castings based on parting line considerations – minimizing core requirements, machined holes, Redesign of cast members to obviate cores.

Unit V : Redesign for manufacture and case studies
Identification of uneconomical design – Modifying the design – group technology – Computer Application for DFMA.

Text Books.

1. Harry Peck, " Designing for Manufacture", Pitman Publications, 1983.
2. Robert Matousek, " Engineering Design- A Systematic Approach" Blackie & Son Ltd., London.1963

References:

1. James G,. Bralla, " Hand Book of Product design for Manufacturing", Mc Graw Hill publications, 1998.
2. Swift K.G., "Knowledge based design for manufacture", Kogan page Ltd., 1987.

PE331 MANUFACTURING INFORMATION SYSTEMS

Credit : 4:0:0 **Marks:40+60**

Unit – 1 : INTRODUCTION

The evolution of order policies, from MRP to MRP II, the role of Production organization, Operations control.

Unit – 1I : DATABASE

Terminologies - Entities and attributes - Data models, schema and subschema - Data Independence – ER - Diagram - Trends in database.

Unit – III : DESIGNING DATABASE

Hierarchical model - Network approach - Relational Data model -concepts, principles, keys, relational operations - functional dependence -Normalisation, types - Query languages.

Unit – IV : MANUFACTURING CONSIDERATION

The product and its structure, Inventory and process flow - Shop floor control - Data structure and procedure -various model - the order scheduling module, input / output analysis module the stock status database – the complete IOM database - Tracebility.

Unit – V : INFORMATION SYSTEM FOR MANUFACTURING

Parts oriented production information system - concepts and structure-computerised production scheduling, online production control systems, Computer based production management system, computerised manufacturing - information system - case study.

Text Book:

1. Luca G. Sartori, " Manufacturing Information Systems ", Addison-Wesley Publishing Company, 1988.

References:

1. Date.C.J., " An Introduction to Database systems ", Narosa Publishing House, 1997.
2. Orlicky.G., " Material Requirements Planning ", McGraw-Hill Publishing Co., 1975.
3. Kerr.R, " Knowledge based Manufacturing Management ", Addison-wesley, 1991.

Web Reference:

1. www.ist.psu.edu

PE332 MANUFACTURING SYSTEM AND SIMULATION

Credit : 3:1:0 **Marks:40+60**

Unit – I : Introduction

Monte Carlo simulation-nature of computer modelling and simulation.limitations of simulation, areas of application -Components of a system.discrete and continuous systems.models of a system- a variety of modeling approaches

Unit – II : Random Numbers Generation & Tests

Techniques for generating random numbers- mid square method-the mid product method-constant multiplier technique-additive congruential method linear congruential method-tests for random numbers-the Kolmogorov-Smirnov test-the Chi-Square test

Unit – III : Random Variable Generation

Inverse transform technique-exponential distribution-uniform distribution - Weibull distribution. Emprical continuous distribution - Generate approximate normal variates - Erlang distribution

Unit – IV : Distribution and Evaluation of Experiments

Discrete Uniform distribution - Poisson distribution - Geometric distribution - Acceptance rejection technique for Poisson distribution - Gamma distribution - Simulation Experiments - Variance reduction techniques - Antithetic variables -Verification and validation of simulation models.

Unit - V : Discrete –Event System Simulation

concepts in discrete event simulation, Manual simulation using event scheduling, single channel queue, two server queue simulation of inventory problems.

Programming for discrete event systems in GPSS-Case studies

Text books:

1. 1 Jerry Banks and John S. Carson, " Discrete –Event System Simulation", Prentice Hall Inc,1984
2. 2.Gordon G, "systems simulation", Prentice Hall of India Ltd,1991

Reference Books:

1. Narsing deo , " Systems simulation with digital computer", Prentice Hall of India Ltd,1991
2. Francis Neelamkovil, "computer simulation and modeling", John Wiley&Sons1987
3. Ruth M Davis M.O Keefe, " simulation and modeling with pascal", prentice Hall Inc,1984

SCHOOL

OF

MECHANICAL SCIENCES

ADDITIONAL SUBJECTS

Code	Subject Name	Credit
ME107	Basic Mechanical Engineering	2:0:0
ME251	Fluid Mechanics	3:1:0
ME252	CAD Lab	0:0:1
ME253	CAM Lab	0:0:1
ME254	Mechanics of Machines I	4:0:0
ME255	Mechanics of Machines II	4:0:0
ME256	Instrumentation & Control Systems	4:0:0
ME257	Design of Machine Elements	3:1:0
ME258	Manufacturing Technology	4:0:0
ME259	Advanced Manufacturing Technology	4:0:0
ME260	Machine Drawing	0:0:2
ME261	Design of Heat Exchangers and Pressure Vessels for Food Processing	3:1:0
ME262	Mechanical Systems for Food Processing	3:1:0
ME263	Turbomachines	3:1:0
ME345	Advanced Mechanism Design	3:1:0
ME346	Finite Element Analysis	4:0:0
ME347	Experimental Stress Analysis	4:0:0
ME348	Applied Engineering Materials	4:0:0
ME349	Instrumentation and Control	4:0:0
ME350	Principles of Mechanical Vibrations	3:1:0
ME351	Advanced Modeling lab	0:0:1
ME352	Advanced Analysis lab	0:0:1
ME353	Advanced Strength of Materials	4:0:0
ME354	Industrial Vibration Noise Engineering	4:0:0
ME355	Micro Electro Mechanical System	4:0:0

ME107 BASIC MECHANICAL ENGINEERING

Credits : 2:0:0 **Marks : 40 + 60**

UNIT - I

Engine-External combustion engine – Working of Steam Engine – Steam Turbine – Impulse turbine & reaction turbine – Boilers fire tube and water tube boiler – Cochran boiler – Babcock & Wilcox boiler – Internal Combustion Engine – Working of petrol and Diesel Engine – Difference between two stroke and four stroke engines – Working principle of refrigerator and air-conditioner – C.O.P., Vapour compression refrigeration system – Window air conditioner - Desirable properties of refrigerant.

UNIT - II

Conventional power plants – Hydro, Thermal, Nuclear power plants – Diesel and Gas Turbine power plants; Non-conventional power plants – Solar, wind and tidal power plants – Geothermal power plant – Ocean Thermal Energy conversion power plant.

UNIT - III

Load – Types of load – Mechanical load bearing elements bars, beams and shafts - stress and strain – Types of stresses and strains – Elasticity – Three Modulli of Elasticity – Stress strain curve of ductile materials & brittle material – centroid and moment of inertia for specific cases like rectangle, triangle, trapezoid, circle, T-section , L-section & I-section - Computer Aided Design - Advantages of CAD – Applications of CAD – Technical Features of softwares like Auto CAD – Pro Engineer – Ansys – Fluent. Robots – Principle of Robot - Advantages of Robot – Application of Robots in industries.

UNIT – IV

Metal casting and forming process – introduction – advantages of casting – patterns – moulding – melting of cast iron – forging – rolling – extrusion – drawing. Metal joining Process: Introduction - welding – arc welding, gas welding - brazing – soldering. Metal machining: lathe – drilling machine – milling machine – shaping machine – introduction to CNC machining.

UNIT - V

Basic Engineering Materials: Properties of materials – ferrous metals and alloys – nonferrous metals and alloys – light metals and alloys – non-metallic materials – plastics, Elastomers – ceramics and composites – insulating materials – semi conductors – applications.

Text Books:

1. I.E. Paul Degarmo, J.T. Black, Ronald A. Kosher, " Material and Processes in Manufacturing", 8^{th} Edition , John Wiley and sons, inc., 1999.
2. Dr. O.P. Khanna, "A Text Book of Materials Sciences and Metallurgy", Dhanpat Rai & Sons, Delhi, 2001.
3. V.Remesh Babu, "A Text Book on Basic Civil Engineering", Anuradha Agencies, 2000
4. S.R.J.Shantha Kumar, "Basic Mechanical Engineering", HiTech Publications, 2001.
5. G. Shunmagam, "Basic Mechanical Engineering", Tata McGraw Hill,2001.

ME251 FLUID MECHANICS

Credtis: 3:1:0 **Marks:40+60**

UNIT - I : Incompressible Flow

Pressure Relation, Pascal's law – derivation. Different types of pressure, Measurements of pressure gauges, Manometrers - types, Forces on Plane Surface, Problems Forces on Curved Surfaces, Total Pressure & Centre of Pressure. Euler's Eqn., 1-dimensional form –Bernoulli's equation. Flow Measurements - Venturimeter, Orificemeter, Pitot tube.

UNIT – II

Equations of Fluid Flow - Types of flow, Streamline, Stream-tube - continuity eqn, one dimensional & three dimensional flow, velocity potential & stream function, free & forced vortex flow, Flow through Pipes: - Loss of energy in pipes, Major Energy loss, Minor Energy losses, Pipes in Series & Parallel, Power transmission through pipes, Syphon, Water hammer.

UNIT - III

Classification of pumps:-centrifugal pumps- velocity triangles – priming-head loss efficiencies- specific speed – selection of pumps. Positive displacement pumps- reciprocating pumps- working principles – slip indicated diagram- air vessels.

UNIT IV : Compressible Flow

Energy Equation for flow processes, Stagnation properties, Mach number-various regions of flow, Isentropic flow with variable area, Impulse function, convergent-divergent nozzle characteristics.

Flow through constant area duct, Fanno curve and Fanno flow equation, Rayleigh line and flow equation, simple problems.

UNIT V

Flow with normal shock, Prandtl-Meyer equation, Impossibility of rarefaction shock, static pressure ratio, temperature ratio, stagnation pressure ratio across the shock, Flow with oblique shock waves (Qualitative Treatment).

Introduction to propulsion, Aircraft propulsion Turbojet components, Rocket propulsion, Thrust equations, Solid and liquid propellant rockets. Comparison of various propulsion systems.

Text Books:

1. R.K. Rajput,"A Text book of fluid Mechanics & Hydraulic Machines", S.Chand & Co, (1998).
2. R.K. Bansal, "A Text book of fluid Mechanics & Hydraulic Machines", Laxmi Publications (1992).
3. S.Ramamurtham, "A Text book of fluid mechanics and Hydraulics Machines", Dhanpat Rai and sons, (1996).
4. S.M.Yahya, "Fundamentals of Compressible flow with aircraft and rocket propulsion", 2nd edition, wiley eastern (1991).

Reference Books:

1. Dr. P.N. Modi & S.M.,"Hydraulics & Fluid Mechanics" 2001 edition, Standard Book House, (2001).
2. V.I. Streeter, "Fluid mechanics", McGraw-Hill College, (1998).

ME252 CAD Lab

Credit 0:0:1 **Marks 50+50**

6 experiments will be notified by the HOD from time to time

ME253 CAM Lab

Credit 0:0:1 **Marks 50+50**

6 experiments will be notified by the HOD from time to time

ME254 MECHANICS OF MACHINES I

Credit : 4:0:0 **Marks: 40+60**

Unit : I

Links, Pairs, chain, Mechanism, inversion of machines, structure, degree of freedom, inversion, four bar chains. Velocity and acceleration: Velocity and acceleration of simple mechanism by relative velocity method. Klein's construction for slider - crank chain. Analytical methods and solution for mechanisms.

Unit : II

Single plate, multiple plate, cone clutches, power transmitted brakes. Gyroscope-couple and effects in ship, motorcycle, car, aircraft, and space vehicles, gyroscope stabilization.

Unit :III

Cams: Types of cams and followers displacement, velocity and acceleration curves for uniform velocity, uniform acceleration and retardation, SHM, Cycloidal curves. Layout of profile of plate cams of the above types with reciprocating and oscillating followers-knife-edge, Rollers and flat faced followers. Cylindrical and face cams, polynomial cams, cams with special contours.

Unit : IV

Theory of gearing, gear nomenclature, law of gearing, tooth forms of gears, minimum number of teeth. Length of arc of contact, interface. Gear trains: Types, velocity ratio and torque calculation in epicyclic gear trains.

Unit : V

Function of Governors - Porter, Proell and spring loaded governors, sensitivity, stability, hunting and isochronisms, Effect of friction, Calculation of equilibrium speeds and ranges of speed of governors.

Text Books

1. Amitabha Ghosh and Ashok Kumar Mallik. "Theory of Mechanisms and Machines" - 2nd Edition, Affiliated East and West Press Limited, 1988.
2. Thomas Bevan, " Theory of Machines ", CBS Publishers and Distributors, 1984.

Reference Books

1. Rattan S.S "Theory of Machines" 2nd edition, Tata McGraw Hill NewDelhi.
2. Shigley J.E and Uicker J. J. "Theory of Machines and Mechanisms", .McGraw Hill ISE, 1981.

ME255 MECHANICS OF MACHINES – II

Credit: 4:0:0 **Marks : 40+ 60**

Unit-I

Static force analysis, free body diagrams, conditions of two, three and four force members. Effect of friction. Inertia forces, and D' Alembert's principle, Dynamic force analysis of mechanisms including slider crank mechanisms, Computer Aided Analysis of slider crank mechanisms.

Unit-II
Flywheels – turning moment diagrams and fluctuation of energy of reciprocating engine mechanisms, coefficient of fluctuation of energy and speed, weight of flywheel required.

Unit-III
Static and dynamic balancing of rotating masses in single and different planes, primary and secondary forces and couples, partial balancing of reciprocating masses of in-line, V, W and radial engines. Direct and reverse crank method.

Unit-IV
Undamped free vibration of single degree system, simple pendulum, compound pendulum, springs in series, springs in parallel and combinations. Damped free vibration of single degree freedom systems, types of damping, free vibrations with viscous damping, critically damped system. Under damped system - Logarithmic decrement. Forced vibration of single degree of freedom systems. Constant Harmonic excitation, steady state vibration, magnification factor versus frequency ratio for various damping ratios. Transverse vibrations of beams – natural frequency of energy method, Dunkerly's method – vibration isolation and transmissibility, critical speed – whirling of shafts – industrial noise controls.

Unit-V
Torsional vibrations – Torsional vibration of single and multiple rotor systems, equivalent shafts, geared systems, Holzer's method and signature analysis.

Text Books:

1. Shigley, J.E. and Uicker, J.J., "Theory of Machines and Mechanisms", TMH ND, 1998.
2. Thomas Bevan, " Theory of Machines ", CBS Publishers and Distributors, 1984.

Reference Books:

1. Beer, and Johnson, "Vector Mechanics for Engineers", 5th Ed., TMH, ISE, 1998.
2. Amithabha Ghosh, and Ashok Kumar Malik., "Theory of Mechanisms and Machines", 2nd Ed., Affiliated East and West Press Limited, 1998.

ME256 INSTRUMENTATION AND CONTROL SYSTEMS

Credit 4:0:0 **Marks 40+60**

Unit –1
General concepts of Mechanical Instrumentation generalized measurement system. Classification of instruments as indicators, recorders and integrators- their working principles, Precision and accuracy: measurement error and calibration.

Unit -II
Measurement of displacement, time, speed, frequency, acceleration - vibrometer, accelerometer etc. Pressure measurement: gravitational, Bourdon, elastic transducers, strain gauge, pressure cells, and measurement of high and low pressure. Temperature

measurement: bi-metallic, resistance thermometer, thermocouples, pyrometer, thermistors. Hot-wire anemometer, magnetic flow meter , ultrasonic flow meter.

Unit -III

Viscosity: Capillary tube viscometer, efflux viscometer, Humidity: absorption hydrometer, Dew point meter. Strain: strain gauges, types, gauge rosettes calibration. Force measurement: scales and torque measurement: Mechanical torsion meter, electrical torsion meter, fibre optic & piezo electric transducer.

Unit -IV

Control systems: Wheatstone bridge circuits. Open and closed systems, servomechanisms, transfer functions, signal flow graphs, block diagram algebra and hydraulic and pneumatic control systems. Two –way control, proportional control, differential and integral control. Simple problems.

Unit –V

Time response of first order and second order systems, concept of stability, necessary condition for stability, routh stability criterion, Polar and Bode plots, Nyquist stability criterion. Simple problems.

Text Books

1. Sawheny, A.K. “Electrical and Electronics Measurements & Instrumentation”, Dhanpat Rai & Co., 1993.
2. Nagoor Kani. A., ‘Control Systems’, RBA Publications, 1998 (for units IV & V)

Reference Books

1. Thomas G. Beckwith, Lewis buck N. Ray D. Maragoni, ‘Mechanical Measurements, Narosa Publishing House new Delhi, 1989.
2. Collet. C. V. and Hope. A.D. ‘Engineering Measurements’ 2nd Edition ELBS.
3. Nagrath. M. and Gopal. I.J. Control systems Engineering, Wiley eastern Ltd., 1991.

ME257 DESIGN OF MACHINE ELEMENTS

Credit: 3:1:0 **Marks: 40+60**

UNIT I

Introduction to the design process – factors influencing the machine design, selection of materials based on its physical and mechanical properties. Direct bending, torsional and combined stress equations, impact, and shock loading. Criteria of failure, stress concentration factor, size factor, surface finish factor – factor of safety, design stress, theories of failures – simple problems.

UNIT II

Variable and cyclic loads – fatigue strength and fatigue limit – S-N- curve, combined cyclic stress, Soderberg and Goodman equations – Design of helical, leaf, disc and torsional springs under constant loads and varying loads.

UNIT III
Design of solid and hollow shaft based on strength, rigidity and critical speed. Design and drawing of keys, keyways, couplings, rigid and flexible couplings.

UNIT IV
Design of riveted joints - pressure vessels and structures, Screw joints, Cotter joints, knuckle joints and pipe joints.

UNIT V
Design of piston, connecting rod, crankshaft, and flywheel.

Text Books:

1. Sundarrajamoorthy T.V. and Shanmugam, "Machine Design", Khanna Publishers, 1989.
2. Goseph Edward Shighley, "Mechanical Engineering Design", McGraw Hill, 1992.

Reference Books:

1. Dobrovolsky V., "Machine Elements", MIR Publications, 1978.
2. Hall A.S., Holowenko, A.R. and Laughlin, HIG., "Theory and Problems in Machine Design" , Schaums series.

Hand Book

1. Design Data Book, PSG College of Technology, Coimbatore, Use of approved data books are permitted.

ME258 MANUFACTURING TECHNOLOGY

Credit : 4:0:0 **Marks : 40+60**

Unit – I
Introduction – What is manufacturing – History –selection of manufacturing process – **Metal Casting Processes**-introduction – solidification of Metals – fluid flow - fluidity of molten metal- Gating and Risering-Casting Design consideration–Cleaning and finishing-defects- metal casting processes –sand casting-types of pattern-pattern allowance – Pattern manufacturing (solid moulding), rapid prototyping – core-sand types- Expendable mould casting- investment casting, shell mould casting, Co_2 mould casting, plaster mould casting, Multiple use mould casting-permanent mould casting, die casting-hot and cold chamber, centrifugal casting-types – high pressure moulding.

UNIT – II
Metal Forming processes: Hot working and cold working of metals-Bulk deformation processes- Rolling of metals –flat rolling – rolling mills – shape rolling operation – Production of seamless tubing and pipe – Defects in rolled parts –Forging of metals – open die forging – impression die and closed die forging – related forging operation – Rotary swaging– forging machines-Extrusion and Drawing of Metals– the extrusion process types-hot and cold extrusion – extrusion defects – extrusion equipment – drawing process – wire, rod drawing - Sheet Metal Forming Processes- -shearing operations-bending operations- stretch forming-deep drawing-spinning

UNIT – III

Metal Joining Processes- Joining Processing and Equipment-introduction-Fusion Welding-oxyfuel welding-arc welding processing:consumable electrode-electrodes-arc welding processes:non-consumable electrode –laser beam welding-cutting-welding safety-solid state welding processing-ultrasonic welding-friction welding-resistance welding-The welded joint-weld quality-testing welded joints-brazing-soldering

UNIT – IV

Metal Machining Processes : Orthogonal cutting, oblique cutting, forces in cutting, chip formation-types-cutting fluids-action-application of cutting fluids-tool life-tool wear-tool life criteria-cutting tools-tool materials

Single Point machining : Turning- boring-facing-forming-automatic lathe-turret lathe-shaping and planning

UNIT-V

Multipoint Machining : Drilling-Milling:horizontal and vertical mills-milling machines-broaching and thread cutting-gear production:gear making and gear finishing-Abrasive machining-the process of abrasive machininig- abrasives-grinding-grinding wheels-process variables-grinding processes-other grinding processes-coated abrasives-honing-lapping

Text Book:

1. Serope Kalpakjam, Steven.R.Schmid, "Manufacturing Engineering and Technology", Fourth Edition. Pearson Education, 2002
2. John.A.Schey, "Introduction to Manufacturing Processes", Mcgrawhill, Second Edition, 1987

Reference:

1. S. K. Hajra Choudhruy, S. K.Bose, Elements of work shop Technology, Vol I Machine tools, media Promoters & Publishers (P) Ltd., Bombay 10th Edition, 2000.
2. HMT, 'Production Technology", TMH(India), 1996.

ME259 ADVANCED MANUFACTURING TECHNOLOGY

Credit : 4:0:0 **Marks : 40+60**

Unit – I

Processing of Powder Metals, Ceramics, Glass and super conductors-introduction-production of metal powders-compaction of metal powders-sintering-secondary and finishing operations-design considerations of powder metallurgy-process capabilities-shaping ceramics-forming and shaping of glass- Design consideration for ceramics and glass- metal injection moulding.

Unit-II

Processing of superconductors-Forming and Shaping Plastics and Composite Materials – introduction – extrusion – injection moulding – Blow moulding – Casting – processing of reinforced plastics – processing metal-matrix composites – processing ceramic composites – Design consideration and economics of forging and shaping plastics.

Unit – III

Advanced Machining Processes and Nanofabrication-introduction-chemical machining-electrochemical machining-electrical discharge machining-wire EDM-laser beam machining-water jet machining-abrasive jet machining-nano fabrication-micro machining-the economics of advanced machining processes.

Unit-IV

Fabrication of Microelectronic Devices-introduction-semiconductors and silicon-crystal growing and wafer preparation-film deposition-oxidation-lithography-etching-diffusion and ion implantation-metallization and testing-bonding and packaging-yield and reliability-printed circuit boards

Unit – V

Numerical Control and Robotics: Background of Numerical Control, basics of numerical control, motion control: point to point and contouring, linear interpolation and circular interpolation, contouring control, positioning system: absolute and incremental-Control loops: open and closed loop control-cartesian coordinate conventions: left and right hand-programming numerically controlled machines-G and M codes-Basic concepts of robotics-programming of robots, initial robot specification-introduction to rapid prototyping

Text Book

1. Serope Kalpakjam Steven. R. Schmid, "Manufacturing Engineering and Technology", Fourth Edition.Pearson Education, 2002
2. Benjamin W Niebel, Alan B Draper, Richard A Wysk, "Modern Manufacturing Process Engineering", Mcgrawhill, International edition, 1989

References

1. S. K. Hajra Choudhruy, S. K.Bose, "Elements of Work Shop Technology", Vol II Machine tools, media Promoters & Publishers (P) Ltd., Bombay 10th Edition, 2000.
2. HMT, 'Production Technology", TMH(India), 1996.

ME260 MACHINE DRAWING

Credit 0:0:2 **Marks 50+50**

UNIT – I

Conventional representation of threaded parts, springs, gear. Abbreviations and symbols for use in technical drawings. Conventions for sectioning and dimensioning.

UNIT- II

Limits, fits, tolerances - selection. Maximum material principle. Surface finish - Selection welding symbols, methods of indicating, Preparation of Joints for welding.

UNIT – III

Drawings of Cotter Joints & Knuckle joints, connecting rod, plummer block, Screw jack, swivel bearing, protected flange couplings – unprotected flange coupling, flexible couplings.

UNIT IV

Assembly drawing of vice, assembly drawing of lathe tailstock, assembly drawing of junction stop valve, assembly drawing of dead weight Safety valves - assembly drawing of Rams Bottom safety valve, assembly drawing of Steam Relief Valves , assembly drawing of non return valves

UNIT- V

Computer Aided Drawing (AutoCAD): Team Assignment: differential gear train, geyser (instant hot water) Bicycle rear wheel, ceiling fan, hand pump, toilet flush, water tanker, four wheeler engine assembly.

Text Book

1. Goplalkrishnan, " Machine Drawing" , Subash publishers, 1998

Reference Books

1. Bhatt.N.D, Machine drawing", Charotar Publishing House, Anand, 2003
2. Siddheshwar, N.P.Kannaiah & V.V.S. Satry " Machine Drawing", Tata McGraw Hill, 1998

ME261 DESIGN OF HEAT EXCHANGERS AND PRESSURE VESSELS FOR FOOD PROCESSING

Credits 3:1:0 **Marks: 40+60**

UNIT I

Introduction, classification of heat exchangers, Arithmetic mean temperature difference(AMTD), logarithmic mean temperature difference(LMTD)-parallel flow and counter flow, overall heat transfer coefficient, fouling in heat exchangers-fouling effect calculations. Effectiveness in heat exchangers- parallel flow and counter flow .Number of transfer unit (NTU).

UNIT II

Multi pass heat exchangers-correction factor for LMTD.

Design of double pipe heat exchangers- Design considerations, tube side heat transfer coefficient, shell side heat transfer coefficient, overall heat transfer coefficient.

Design of shell and tube heat exchangers - Design considerations, overall heat transfer coefficient Baffles in heat exchangers –types, baffle spacing. Shell types, tube bundle, pitch.

UNIT III

Pressure drop and pumping power calculations in double pipe and shell and tube heat exchangers. Design of condensers .Cooling tower-Types and design; Simple problems.

UNIT IV

Air Pre-Heaters: Types of Air heater, recuperative and regenerative – Design considerations – High temperature and low temperature applications; Simple problems
Heat exchanger sizing for heating or cooling of a batch of liquid in agitated vessel, batch cooling with external heat exchanging, jacketed batch reactor heating; Simple problems

UNIT V
Evaporators –classification-horizontal and vertical. Single effect and multi effect evaporator criteria for selecting evaporator. [Only theory].

Text Books:

1. S.D.Dawande; "*Principles of Heat Transfer and Mass Transfer*", Central Techno Publications, 2000.
2. Arora, S.Domkundwar; "*A Course in Heat and Mass Transfe*", Dhanpat Rai & Co. Ltd, 2002.

Reference Books:

1. J.M.Coulson and J.F.Richardson: *Chemical Engineering VoI 1. Fluid flow, Heat Transfer and Mass Transfer*. Butterworth-Heinemann, an imprint of Elservier, Sixth Edition, Indian Reprint, 2006
2. Homi, P. Serval., '*Boilers & Pressure Vessels*', Multitech Publishing Company, Bombay, 1989.
3. P.K. Nag., '*Power Plant Engineering (Steam and Nuclear)*', Tata McGraw Hill, New Delhi, 1998.

ME262 MECHANICAL SYSTEMS FOR FOOD PROCESING

Credit : 3:1:0 **Marks: 40+60**

Unit I
Food Plant Pumps: Pumping theory, NPSH, different heads, Pressure and head conversion.
Types of pumps employed-Centrifugal pumps, Reciprocating pumps, Rotary gear pumps, vane pumps, peristaltic pumps, and diaphragm pumps. Their construction, working principles and applications. (Simple problems)

Unit II
Mechanical power transmission systems- Relation between torque, power speed, Basics of mechanical design of shafts, hollow shafts, different coupling types, belt and gear drives. Velocity ratio- (Simple problems).

Unit III
Steam generation and distribution. IBR and non IBR systems of steam generation and distribution. Water tube and smoke tube boilers. Boiler capacity, boiler specifications, automatic boilers, Boiler mountings. Steam pipe grades, wall thickness, fittings, valves and gauges. Need for pressure reduction and pressure reducing valve. Thermic fluid and hot air generators and distribution. Relative merits and demerits of steam, hot air and thermic fulid heating of foods. [Only theory].

Unit IV
Chilled water and ice, their production, types of chilled water generators, types of ice generators. Storage and instant water chillers- (Simple problems).

Unit V
Material handling in Food plants. Importance of electro-mechanical handling. Types of elevators. Bucket, Slat, pneumatic and screw elevators, inclined elevators – Design configuration, power requirement and specific applications. Handling of wet products. SS and plastic conveyors and elevators- [Only theory].

Text Books

1. T.C.Robberts: *Food Plant Engineering Systems*, CRC Press Ltd. Washington, USA,1989.
2. P.C.Smith, *"Introduction to Food Process Engineering"*, Springer international Edition, 2005

Reference

1. R.Paul Singh,Dennis R.Heldman; *"Introductin to Food Engineering"* (3rd edition), Academic press, Elsevier, 2001.
2. Arthur W Farral: *"Food Engineering Systems Vol-1"*, AVI Publications, 1990.
3. R.K.Bansal; *"Fluid Mechanics and Hydraulic Machines"*, Laxmi publications (P) Ltd, 2004

ME263 TURBOMACHINES

Credits 3:1:0 **Marks 40+60**

UNIT I : Principles of Turbo machinery
Definition of turbo machineries, Euler's turbine equation, classification. Static and stagnation states, Application of first and second laws to Turbo machines. Efficiency of turbo machines. Problems

UNIT II : Cascade theory
Blade terminology, cascade of blades, flow angles, flow deviation, lift and drag, losses in cascades, velocity diagrams, degree of reaction
Flow through Nozzles and Blade passages
Introduction, Steady flow through nozzles, Area changes and one-dimensional isentropic flow, Effects of friction in flow passages, Characteristics of Converging and Diverging Nozzles, Flow of Wet steam through nozzles, Diffusers Problems

UNIT III : Rotary Fans and Blowers
Introduction, Centrifugal blower, types of vane shapes, Size and speed of Machine, Vane shape: efficiency, stresses, and characteristics. Actual performance characteristics, The slip co-efficient, Fan laws and characteristics,

UNIT IV : Axial and Centrifugal Compressors
Axial Compressors: Stage velocity triangles, enthalpy – entropy diagrams, flow through blade rows, stage losses and efficiency, work done factor, low hub-tip ratio stages, super sonic and trans sonic stages, performance characteristics, problems

Centrifugal Compressors: Elements of centrifugal compressor stage, stage velocity diagrams, enthalpy-entropy diagram, nature of impeller flow, slip factor, diffuser, volute casing, stage losses, performance characteristics, problems.

UNIT V : Hydraulic Turbines

Classification, Euler's equation for turbines, velocity triangle for single stage axial and radial machines, Impulse and reaction turbines, Pelton, Francis & Kaplan turbine. Power and efficiency calculations, draft tube, cavitation, water turbine governing.

Text Books

1) V. Kadambi and Manohar Prasad: "An Introduction to Energy Conversion Vol. III", 2002
2) S M Yahya: "Turbines, Compressors and Fans", Second Edition.
3) V Ganesan: "Gas Turbines", 2002

Reference Books:

1) Hill P G and Peterson C R , Mechanics and Thermodynamics of Propulsion, Addison Wesley, 1965.
2) Kerrebrock, J L , Aircraft Engines and Gas Turbines, MIT Press, 1977
3) Mattongly, J D, Elements of Gas Turbine Propulsion, McGraw Hill 1996

ME345 ADVANCED MECHANISM DESIGN

Credit : 3:1:0 **Marks 40 + 60**

Unit I : Introduction

Review of fundamentals of kinematics- mobility analysis- formation of one D.O.F. Multiloop kinematic chains, Network formula- Gross motion concepts.

Unit II : Kinematic Analysis

Position Analysis- Vector loop equations for four bar, slider crank, inverted slidercrank, geared five bar and six bar linkages. Analytical methods for velocity and acceleration. Analysis - four bar linkage - Jerk analysis. Plane Complex mechanisms. Path Curvature theory. Fixed and moving centrodes, inflection points and inflection circle. Euler Savary Equation, graphical constructions- Cubic of stationary curvature.

Unit III : Synthesis of Mechanisms

Type synthesis- Number synthesis- Associated Linkage concept. Dimensional synthesis- function generation, path generation, motion generation, Graphical methods. Cognate linkage- coupler curve synthesis, Design of six-bar mechanisms. Algebraic methods. Application of instant centre in linkage design. Cam Mechanisms- determination of optimum size of Cams.

Unit IV : Dynamics of Mechanisms

Static force analysis with friction – inertia force analysis- combined static and inertia force analysis, shaking force, kinetostatic analysis. Introduction to force and moment balancing of linkages.

Unit V Spatial Mechanism and Robotics

Kinematic Analysis of spatial RSSR mechanism- Denavait- Hartenberg parameters forward and inverse kinematic of Robotic manipulators.

Text Book

1. Sandor G. N. and Erdman. A. G., " Advanced mechanism Design analysis and synthesis", Prentice Hall, 1984.

References

1. Singhley , J. E. and uicker J.J., " Theory of Mechanics and Mechanism", McGraw Hill 2003.
2. Amitabha Ghosh and Ahsok Kumar Mallik, "Theory of mechanism and Machines", EWLP, Delhi, 1999.
3. Nortorn R. L. " Design of Machinery", Mc Graw Hill, 1999.
4. Kenneth J. Waldron, Gary L Kinzel, "Kinematics, Dynamics and Design of Machinery", John wiley- sons 1999.

ME346 FINITE ELEMENTS ANALYSIS

Credit : 4:0:0 **Marks 40 + 60**

Unit I : Introduction:
Basic concepts- General applicability of the method to structural analysis, heat transfer and fluid flow problems- general approach of finite element method with case studies in stress analysis, classical analysis techniques-finite element packages - Solution of Finite Equations: Solution of equilibrium problems- Gauss elimination techniques, Choleski method solution of Eigen value problem , Jacobi method, power method, subspace interaction method- Solution of propagation problems, numerical solutions.

Unit II: General Procedure:
Discretization of Domain- basic element shapes- interpolation polynomials- natural coordinates- formulation of element characterstic matrices and vectors- direct approach-variational approach and weighted residual approach. Formulation of one dimensional, two-dimensional, three-dimensional elements, continuity conditions- isoparametric elements- curve sided elements- numerical integration.

Unit III : Solid and structural mechanics:
Basic equations of solid mechanis- Static analysis- formulation of quilibrium equations-analysis of trusses and frames- analysis of plates- Solid of revolution. Dynamic analysis –dynamic equations of motion- consistent and lump mass matrices- Free vibration analysis – dynamic response calculation.

Unit IV : Field problems:
Two dimensional field equation- governing differential equations- Integral Equations for the element matrices- Element matrices- Triangular element, Rectangular element problems. Torsion of Non circular sections: General theory- Twisting of a square bar-shear stress components- Evaluation of the twisting torque- Computer solutions for the square bar problems.

Unit V: Heat Transfer Problems.

Basic equations of heat transfer derivation using finite element Method for 1D problems.

Fluid mechanics problems: Basic equations- Solutions procedure- compressible flows- Galerkin approach.

Boundary Element Method (BEM): Introduction, Types, Advantages & Disadvantages of BEM-Types of Boundary Elements-Infinite Boundary Element

Text Book

1. Rao. S.S. "The Finite element method in Engineering", IInd Ed., Pergamon Press, Oxford, 2003
2. J.Ramachandran, "Boundary and Finite Element Theory and Problems", Narosa Publishing House, 2000.

Reference Books

1. K.J. Bathe, ' Finite Element Procedures in Engineering Analysis", Prentice hall, Engle Wood chiffs, 1981.
2. C.S. Desai and J.P. Abel. " Introduction to Finite Element Method" Affiliated East West Press, 1972.
3. Belagundu, "Finite Element Methods in Engineering", PHI, 2002

ME347 EXPERIMENTAL STRESS ANALYSIS

Credits : 4:0:0 **Marks : 40+60**

UNIT I :Elementry Elasticity

Stress. Stress equations of equilibrium, principal stress, Max. shear stress, two-dimensional state of stress, stress-strain relations, principal strains.

UNIT II : Strain Measurement Methods

Electrical resistance strain gauges, semiconductor gauges, single element, two and multi element configuration, rosettes , two element rectangular, three element rosettes, rect, star, delta configuration, 4 element rectangular rosettes, strain gauge circuits, quarter, half triangle circuits, wheatstone bridge, constant current bridge, temperature configuration, effect of contact resistance, lead wires.

UNIT III : Photo Elasticity

Background optics-plane and circular polarization-stress optic law-photo elastic materials-casting and modeling techniques-calibration methods-isoclines, isochromatics and stress trajectories-stress separation methods, Fringe sharpening – stress freezing – three dimensional analysis from model slicing – axis symmetric stresses – torsion problem, 2D and 3D Photo elasticity.

UNIT IV : Bi-Refrigerant Coating Techniques

Reflection plariscope – sensitivity of the method – principal stress – separation – comparison of brittle coating and bi-refrigerant coating techniques.

Brittle Coating Method

Introduction – Relation between the state of stress in coating and that on the model – Isostatics and isoentactuies – Types of brittle – coating materials – Relative merits of stress – coat and all – temp coatings – crack detection techniques – Variables influencing accuracy of brittle coating application - Modeling – surface preparation and application of coating – calibration of brittle coating materials – Brittle coating technique applied to a specific problem.

UNIT – V : Moire Methods and Image Processing

Mechanism of formation of moiré fringes, geometrical approach to moiré fringe analysis, displacement field approach to moiré fringe analysis, out of plane measurements experimental procedure.

Digital image processing. Introduction, image sampling and quantization. Uniform sampling and quantization.video standards. Image sensors. Image display. Image storage. Some basic relationships and mathematical operations between pixels basic steps in image processing. Typical image processing systems for digital photoelasticity. Image acquisition. Tools for image understanding.

Text books:

1. James W Dally & William F Riley. " Experimental stress analysis". International student edition. MCGraw hill, Kogakusha limited. 1978.
2. Srinath, L.S., "Experimental Stress Analysis", TATA Mcgraw Hill, New Delhi 1984
3. K.Ramesah, "Digital Photoelasticity: Advanced Technologies and Applications", Springer-Verlag Berlin and Heidelberg GmbH & Co. K

Reference book:

1. Dove and Adams, Experimental Stress Analysis and Motion Measurement", Prentice hall of India, 1965

ME348 APPLIED ENGINEERING MATERIALS

Credit 4:0:0 **Marks 40+60**

Unit I : Elastic & Plastic Behaviour.

Elasticity in metals and polymers- mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals – Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviour- Super plasticity- Deformation of non-crystalline material.

Unit II : Fracture behaviour.

Griffith's theory, intensity factor fracture toughness- toughening mechanism- Ductile brittle transition in steel - High temperature fracture, creep- Larson- Miller parameter-Deformation and fracture mechanism maps- Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanism and Paris law – Effect of surface and metallurgical parameters on fatigue- fracture of non metallic materials.-Failure analysis sources of failure, procedure of failure analysis.

Unit III : Modern metallic materials.

Dual phase steels, Micro alloyed, High strength low alloy (HSLA) steel, transformation induced plasticity (TRIP) steel, Maraging Steel- intermetallics, Ni and Ti aluminidessmart materials, shape memory alloys- Metallic glass- Quasi crystal and nano crystalline materials. Applications, selection criteria, Nano structures.

Unit IV : Non metallic materials.

Polymeric materials- Formation of polymer structure- Production techniques of fibres, foams, adhesives and coatings- structure, properties and applications of engineering polymers- advanced structural ceramics, WC, TIC, TaC, AI_2O_3, SiC, Si_3N_4 CBN and diamond- properties, processing and applications. Selection criteria.

Unit V : Composite Materials.

Fibres- glass carbon, boron, ceramic, Aramid. MATRIX materials Polymer, graphite, Bolted and bonded joints metal, ceramics processing, PMC, applications selection criteria

Text Books:

1. Thomas H. Courtney, “Mechanical Behaviour of Materials”, (2^{nd} Edn.) McGraw Hill, 2000.
2. Charles, J. A. Crane, F. A. A and Fumess, J. A. S, “Selection and Use of Engineering Materials”, (3^{rd} Edition), Butter worth- Heiremann, 1997.

References:

1. Flinn R. A. and Torjan , P.K., “Engineering Materials and their Applications”, (4^{th} Edition) Jaico,1999.
2. George E. Dieter, “Mechanical Metallurgy”, McGraw Hill (10th Edition),1994.
3. Mattiall. P.K., “Fibre Reinforce Composites”, Manual deletur Inc. 1993.
4. www.astm.org/labs/pages/131350.htm.
5. www.applied materials.com/carrers/agu-ei-html.

ME349 INSTRUMENTATION AND CONTROL

Credits : 4:0:0 **Marks:40+60**

Unit – I : Science of Measurement

Units and standards-calibration of techniques-classification of errors-errors analysis statistical methods-odds and uncertainty-static and dynamic characteristics of transducers response of transducers to different time varying inputs

Unit –II : Sensors and Transducers for Measurements

Potentiometer-strain gauge-LVDT & RVDT-RTD—sensors –thermistor-thermocouples-variable reluctance transducers –capacitive transducers-opto electronic transducers –piezo electronic transducers-fibre optic transducers-magneto strictive transducers-hall effect-load cells.

Unit – III : Signal Conditioning Methods

Need for signal conditioning-modulated and unmodulated signals-resistance and reactance bridges-wheat stone bridge circuits amplification-differentiation and integration-computer based signal conditioning-PC based data acquistion system-shielding and grounding-filters.

Unit – IV : Mechanical measurements

Measurement of mechanical quantities-force, torque, temperature flow pressure, liquid level, linear angular motion-acceleration, vibration-displacement, velocity and acceleration – shock, acoustics.

Unit – V : Digital Methods of Measurements

Introduction-Conversion of analog signal to digital signal - measurement of noise - Digital meters-multimeter-phasemeter-digital frequency – period-time measurements-low frequency measurements-automatic time frequency scaling-sources of errors-noise.

Text Book:

1. E.O. Deobline, “Measurement Systems, application and design”, McGraw-hill, 4th Edition, 1990.
2. Thomas G. Beckwith, “Mechanical Measurements”, Narosa Publishing house, 2000.

Reference Books:

1. S. Renganathan, “Transducers engineering”, Allied Publishers Ltd., 1999.
2. A.K. Sawhney, “A course in electrical and electronics measurement and Instrumentation”, Dhanpat Rai & Co.2000.

ME350 PRINCIPLES OF MECHANICAL VIBRATIONS

Credits : 3:1:0 **Marks:40+60**

UNIT -I : Vibration of Single Degree Of Freedom System

Introduction –equation of motion – frequency and period – free vibration- forced vibration – damping - resonance solutions of problems by Newton’s law of motion-Solutions of problems for one degree of freedom systems for transient and harmonic response. Energy methods – Raleigh’s method – mechanical impedance method - isolation of vibrations and transmissibility – Seismic instruments.

UNIT -II : Vibration of two - Multi degree Freedom systems

Equations of motion of Two Degree of freedom systems.

Vibration absorber – LaGrange’s equation, influence coefficients- mode of vibration-principle modes-principle of orthogonal generalized coordinates – dynamic vibration absorber – semi definite systems. Vibration of multi degree freedom systems.

UNIT - III : Vibration of continuous systems

Vibration of strings- vibration of rods- Vibration equation for beams

Normal mode of vibration- Flexibility matrix and stiffness matrix- Eigen value and eigenvector- Orthogonal properties – Modal analysis-– Modal damping in forced vibration - numerical methods in vibration problems

UNIT -IV

Methods of finding natural frequencies for problems including on torsional vibrations-matrices- matrix iteration –Stodola’s method, Holzer’s method -mechanical impedance method – solutions of problems by digital computer for multi degree of freedom systems for harmonic response, undamped discrete systems --Matrix iteration technique.

UNIT -V : Experimental methods in vibration testing and analysis.

Vibration instruments- vibration exciters - measuring devices- analysis- vibration Tests- Free, forced environmental vibration tests. Example of vibrations test-data acquisition – Modal and FFT analysis– Industrial case studies.

Text Books.

1. Benson H Tongue, " Principles of vibration"(2^{nd} edition)Oxford University Press, 2002
2. Tsc, Francis, S., Morse, Ivan, E., Hinkle Rolland, T., "Mechanical Vibration", CBS Publishing and Distributors, 1983.
3. William, W. Seeto., "Mechanical Vibrations", Schaum publishing Company,1996.

Reference Books:

1. Thompson, W. T., " Theory of Vibration with applications", Prentice Hall of India, 1982.
2. Den Hartog, " Mechanical Vibrations", McGraw Hill, 1985.
3. Srinivasan, P., " Mechanical Vibration Analysis", Tata McGraw Hill Publishing company Ltd., 1982.

ME351 ADVANCED MODELING LAB

Credits : 0:0:1 **Marks:50+50**

6 experiments will be notified by the HOD from time to time

ME352 ADVANCED ANALYSIS LAB

Credits : 0:0:1 **Marks:50+50**

6 experiments will be notified by the HOD from time to time

ME353 ADVANCED STRENGTH OF MATERIALS

Credits: 4:0:0 **Marks :40+60**

Unit I : Basic Concepts of Force, Stress, Strain and Displacement, Transformations

Introduction – force diagrams- free body diagrams- force Distributions- stress- strain relations. Displacements, Strain –Displacement relations, problems. Coordinate systems - 3D Stress Transformation- Strain transformations- Generalized 3D stress –strain relations- the equilibrium equations – Compatibility.

Unit II : Strength, Failure Modes, and Design Considerations

Strength- The Design Factor-Strength -failure theories. – Basic- Tresca, Von Mises theories and comparison of theories - Plasticity and limit design concepts- Inelastic Behavior- Engineering Approximations used in Statically Indeterminate Problems - Typical design problems involving these theories with Axial loading- Beams in bending- bending of symmetric beams in Two planes.-problems

UNIT –III : Energy Techniques

Work- Strain Energy, total Strain Energy in Bars with Simple Loading Conditions- Castigliano's first Theorem- Castigliano's Second Theorem- Deflections of Thick-Walled Curved Beams - Castigliano's Second Theorem Applied to Statically - Determinate problems - The Virtual Load Method, the Virtual Load Method applied to Statically Indeterminate Problems - Raleigh's Method applied to Beams in Bending. Straight Beams undergoing the combined effects of Axial and Transverse loading.

Unit - IV : **Torsion of structures**

Prandtl's stress function for torsion - Membrane theory - Torsion of non circular sections-rectangular and steel rolled sections- Torsion strain energy – Closed thin - walled tubes shear - open thin – walled beams- shear flow - torsion of single cell multiple cell sections - Shear Center with one axis of symmetry- Shear center for open and unsymmetrical sections - Stresses due to combined bending and torsion of symmetric and unsymmetrical sections.

Unit V Concepts from the theory of Elasticity

Plane Elastic problems - The Airy Stress Function- Bending of Unsymmetrical Beams-Transverse Shear stresses- Thin- walled beams- - Composite beams in bending- Curved beams – Bending of thin – flat rectangular and circular plates- shell structures - Thick-walled cylinder and rotating disks- Contact stresses - stress concentrations.

Text Book:

1. Richard G Budynas., "Advanced Strength And Stress Analysis" (2^{nd} Edition) by, McGraw - Hill International Edition, 1999.
2. LS Srinath, Tata., "Advanced mechanics of solids", (2^{nd} Edition) by McGraw-Hill PCL, 2003

Reference Books:

1. S.Timoshenko and SW Krieger ., "Theory of plates and shells" , by, McGraw - Hill International Edition 1999, Engineering mechanics series
2. S.Timoshenko and D.H.Young , "Elements of strength of Materials", by. D Van Nostrand Co., 1968

ME354 INDUSTRIAL VIBRATION AND NOISE ENGINEERING

Credits: 4:0:0 **Marks: 40 + 60**

UNIT – I :- Introduction to Engineering acoustics

Basic physical acoustics- acoustic levels and spectra- decibels, sound power, Sound pressure, power and intensity -- Character of noise – Addition of two noise sources - Noise source identification. Noise radiation from vibrating bodies sound- properties of the various sources that create noise - Noise in machines and machine elements. Fan and flow noise. Combustion noise. Noise in piping systems. Industrial noise... Characteristics of Duct and Cabin Noise. Stationary modes. Random noise.

Unit –II : Industrial noise problems Noise control methods

Basic source of machine noise character - Fans and blowers- gas- jet noise- gear noise-

Jet noise Response of structures -Noise control methods -Acoustic materials- sound silencers mufflers and active noise control Noise absorber design. Acoustic enclosures - Design of silencers, mufflers. Importance of reverberations time -Acoustic Design of Buildings. Environmental acoustics Sound Intensity Mapping Noise isolation design Human factors in noise engineering

Unit -III : Industrial vibration problems

Vibrations and their manifestations in real life systems. Experimental and theoretical routes to vibration engineering. Applications of numerical procedures to determine natural frequencies and mode shapes – Harmful effects of mechanical vibrations - Dynamic instability control - Introduction to Modal testing, model updating and structural dynamic modification to improve dynamic design of machine structures.. Vibration Reduction Measures, Unconstrained and constrained layer damping treatment, add on dampers, and stiffeners.

Unit -IV : Vibration control

Vibration control strategies- Application of damping treatment for vibration control in machines and structures. Review of Design of a Vibration Absorber -Vibration control solutions -- Active control of vibrations. Design of vibration isolators. Auxiliary mass systems including tuned dampers for vibration control - Changing the dynamic characteristics of a structure, Structural dynamics modification. Predicting the modification (dynamic design) Design of Isolators in machine foundations. Role of materials damping. Balancing of rotating machinery. Rigid and flexible rotor balancing. Active Vibrations control.

Unit –V : Vibration and noise measurements, Testing and analysis

Acoustic / Noise sensors, instrumentation measurement and noise control instruments and noise propagation -Various types of acoustic testing chambers reverberation control- vibration control -Vibration sensors – vibration instrumentation, measurement and analysis -Vibration Testing. Spatial, Modal and Response models of vibrating systems. Balancing of rotating and reciprocating machines..

Text Books:

1. Leo N Bernak, Istvan L., “Noise and Vibration control Engineering”, Ver J & W Publication, 2006
2. Luis H Bell, Douglas H Bell, “Industrial Noise Control – Fundamentals and Application”, 2nd edition, Marcel Decker INC, 1994

Reference Books:

1. Clarence W De Silva, “Vibration Fundamentals and Practice”, CRC Press, 2000
2. Denis Karczub M.P. Norton., Fundamentals of Vibration and Noise Analysis for Engineers”, Cambridge University Press, 2003
3. Prof . Engrg, “Vehicle Vibration and noise Pep.”, Publishers -2004

ME355 MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)

CREDIT 4:0:0 **Marks 40 + 60**

UNIT I: Overview of MEMS and Microsystems.
MEMS and Microsystems – Evolution of Micro Fabrication – Micro Systems and Microelectronics. Application of MEMS in Various Fields. Micro System – Working Principle – Micro Sensors, Micro Actuators, Micro Accelerometer, Micro Fluidics.
Scaling Laws in Miniaturization: Introduction to Scaling – Scaling In Geometry, Scaling In Rigid Body Dynamics, Scaling In Electrostatic Forces, Scaling In Electromagnetic Forces, Scaling In Electricity, Scaling In Fluid Mechanics, Scaling In Heat Transfer.

UNIT II: Micro Systems Design
Engineering science for microsystems design – atomic structure of matter, ions and ionization, molecular theory, doping of semiconductors, diffusion process, and quantum physics, plasma physics, electrochemistry.
Engineering mechanics for micro system design – static thin plates, mechanical vibration, thermodynamics, fracture mechanics, thin film mechanics, overview of finite element stress analysis.

UNIT III: Materials for MEMS and Microsystems
Introduction – Substrate And Wafer, Active Substrate Material. Silicon as a substrate material, Silicon Compounds, Silicon Piezo Resistors, Gallium Arsenide, Quartz, Piezo Electric Crystals, Polymers, Packaging Materials.

UNIT IV: Micro Systems Fabrication
Introduction – Photolithography, Ion Implantation, and Diffusion – Oxidation, CVD, PVD, Deposition by Epitaxy, Etching.
Overview of Micro Machining – Bulk Micro Machining, Surface Micro Machining, LIGA Process.

UNIT V: Micro Systems Packaging
Overview of mechanical packaging of microelectronics, microsystems packaging. Essential packaging techniques, 3D packaging, assembly of micro systems – signal mapping and transduction.

Case Study – Design a Model of a Pressure Sensor with Packaging.

Text Books:

1. Tai-Ran Hsu," MEMS & Micro Systems – Design and Manufacture", Tata McGraw Hill, 2002.

Reference Books:

1. Naldim Maluf," An Introduction to Micro Electro Mechanical Systems", Artech House, 1999.
2. Sergey Edward Lyshevski," MEMS & NEMS, Devices and Structures", CRC Press, 2002.

SCHOOL
OF
MECHANICAL SCIENCES

ADDITIONAL SUBJECTS

Code No.	Subject Name	Credits
ME264	Micro Electro Mechanical Systems	4:0:0
ME265	Computational Fluid Dynamics	3:1:0
ME266	Renewable Sources of Energy	4:0:0
ME267	Design & Analysis of Heat Exchangers	3:1:0
ME268	Computer Aided Design	4:0:0
ME269	Finite Element analysis	3:1:0
ME270	Mechanical Vibrations	3:1:0
ME271	Product Design and Development Strategies	4:0:0
ME272	Tribology in Design	4:0:0
ME273	Design Lab	0:0:1
ME274	Advanced Thermal Engineering Lab	0:0:1
ME356	Bio-Mechanics	4:0:0
ME357	Advanced Modeling Lab	0:0:2
ME358	Advanced Analysis Lab	0:0:2
ME359	Thermochemical Conversion of Biomass	4:0:0
ME360	Modelling and Simulation	4:0:0
ME361	Chemical Kinetics and Reactor Design	4:0:0
ME362	Introduction to Fuel Cells	4:0:0
ME363	Materials Characterization	4:0:0

ME264 MICRO ELECTRO MECHANICAL SYSTEMS

Credit: 4: 0: 0 **Marks: 40+60**

Unit I: Introduction:
MEMS and Microsystems – Evolution of Micro Fabrication – Micro Systems and Microelectronics. Application of MEMS in Various Fields. Working Principle – Micro Sensors, Micro Actuators, Micro Accelerometer, Micro Fluidics.

Unit II: Materials for MEMS:
Introduction – Substrate and Wafer, Active Substrate Material. Silicon as a substrate material, Silicon Compounds, Silicon Piezo Resistors, Gallium Arsenide, Quartz, Piezo Electric Crystals, Polymers.

Unit III: Scaling Laws in Miniaturization:
Introduction to Scaling – Scaling in Geometry, Scaling in Rigid Body Dynamics, Scaling in Electrostatic Forces, Scaling in Electromagnetic Forces, Scaling in Electricity, Scaling in Fluid Mechanics, Scaling in Heat Transfer.

Unit IV: MEMS Fabrication Techniques:
Introduction – Photolithography, Ion Implantation, and Diffusion – Oxidation, CVD, PVD, Deposition by Epitaxy, Etching. Overview of Micro Machining – Bulk Micro Machining, Surface Micro Machining, LIGA Process.

Unit V: MEMS Packaging:
Introduction to MEMS packaging. Essential packaging technologies, Packaging Materials and selection criteria, 3D packaging, Case study on pressure sensor packaging.

Text Books:
1. Tai-Ran Hsu, "MEMS & Microsystems – Design and Manufacture," Tata McGraw Hill, 2002.

Reference Books:
1. Naldim Maluf," An Introduction to Micro Electro Mechanical Systems", Artech House, 1999.
2. Sergey Edward Lyshevski," MEMS & NEMS, Devices and Structures", CRC Press, 2002.
3. Sami Franssila," Introduction to Micro Fabrication", Wiley, 2004.

ME265 COMPUTATIONAL FLUID DYNAMICS

Credits 3: 1: 0 **Marks 40+60**

Unit I: Governing Equations And Boundary Conditions
Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Physical boundary conditions – Time-averaged equations for Turbulent flow - Turbulence -Kinetic -Energy Equations – mathematical behavior of PDEs on CFD: Elliptic, Parabolic and Hyperbolic equations.

Unit II: Discretization And Solution Methodologies
Methods of Deriving the Discretization Equations - Taylor Series formulation – Finite difference method – Control volume Formulation - Solution methodologies: Direct and iterative methods, Relaxation method, Alternating Direction Implicit method.

Unit III: Heat Conduction
Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problems

Unit IV : Convection And Diffusion
Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, upwind, hybrid and power-law schemes - Discretization equations for two dimensional convection and diffusion.

Unit V: Calculation Of Flow Field
Representation of the pressure - Gradient term and continuity equation - Staggered grid - Momentum equations - Pressure and velocity corrections - Pressure - Correction equation,

SIMPLE algorithm and its variants. Turbulence models: mixing length model, Two equation (k-E) models.

Text Book:

1.. Versteeg, H.K, and Malalasekera, W., “An Introduction to Computational Fluid Dynamics: The Finite Volume Method”, Longman, 1998

Reference Book:

1. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw-Hill Publishing Company Ltd., 1998.
2. Patankar, S.V., “Numerical Heat Transfer and Fluid Flow”, McGraw-Hill, 1980. Ane-Books2004 Indian Edition.
3. Muralidhar, K and Sundarajan .T., “Computational Fluid Flow and Heat Transfer”, Narosa Publishing House, New Delhi, 1995.
4. Bose, T.K., “Numerical Fluid Dynamics”, Narosa publishing House, 1997.
5. Muralidhar, K and Biswas “Advanced Engineering Fluid Mechanics”, Narosa Publishing House, New Delhi, 1996.
6. Anderson, J.D., “Computational fluid dynamics – the basics with applications”, 1995.

ME266 RENEWABLE SOURCES OF ENERGY

Credit 4:0:0 **Marks 40+60**

Unit I: Energy And Environment

Primary energy sources - world energy resources-Indian energy scenario-energy cycle of the earth –environmental aspects of energy utilisation, CO_2 emissions and Global warming– renewable energy resources and their importance. Potential impacts of harnessing the different renewable energy resources.

Unit II: Solar Energy

Principles of solar energy collection -.solar radiation - measurements - instruments - data and estimation- types of collectors - characteristics and design principles of different type of collectors - performance of collectors - testing of collectors. Solar thermal applications - water heaters and air heaters - performance and applications - simple calculations - solar cooling - solar drying - solar ponds - solar tower concept - solar furnace.

Unit III: Wind, Tidal And Geo Thermal Energy

Energy from the wind - general theory of windmills - types of windmills - design aspects of horizontal axis windmills - applications. Energy from tides and waves – working principles of tidal plants and ocean thermal energy conversion plants - power from geothermal energy - principle of working of geothermal power plants.

Unit IV: Bio Energy

Energy from bio mass & bio gas plants -various types - design principles of biogas plants - applications. Energy from wastes - waste burning power plants - utilization of industrial and municipal wastes - energy from the agricultural wastes.

Unit V: Other Renewable Energy Sources
Direct energy conversion (Description, principle of working and basic design aspects only) – Magneto hydrodynamic systems (MHD) - thermoelectric generators – thermionic generators - fuel cells - solar cells - types, Emf generated, power output, losses and efficiency and applications. Hydrogen conversion and storage systems

Text Books:

1. Rai G.D, “Non conventional Energy sources” (1999) Khanna Publishers, New Delhi

Reference Books:

1. Sukhatme, S.P., Solar Energy, 2nd edition, TMH, 2003
2. Sulton, “Direct Energy Conversion”, McGraw-Hill, 1966.
3. Duffie and Beckmann, “Solar Energy Thermal Processes, John Wiley, 1974.
4. Garg. H. P and Prakash. J., “Solar Energy - Fundamentals and applications”, TMH, New Delhi,1997.
5. Ashok V Desai, “Non-conventional Energy”, Wiley Eastern Ltd, New Delhi, 1990

ME267 DESIGN AND ANALYSIS OF HEAT EXCHANGERS

Credits 3:1:0 **Marks: 40+60**

Unit I:
Introduction ,classification of heat exchangers, Arithmetic mean temperature difference(AMTD),logarithmic mean temperature difference(LMTD)-parallel flow and counter flow, overall heat transfer coefficient, fouling in heat exchangers-fouling effect calculations. Effectiveness in heat exchangers- parallel flow and counter flow .Number of transfer unit (NTU).

Unit II:
Multi pass heat exchangers-correction factor for LMTD. Design of double pipe heat exchangers- Design considerations, tube side heat transfer coefficient, shell side heat transfer coefficient, overall heat transfer coefficient. Design of shell and tube heat exchangers - Design considerations, overall heat transfer coefficient Baffles in heat exchangers –types, baffle spacing. Shell types, tube bundle, pitch.

Unit III:
Pressure drop and pumping power calculations in double pipe and shell and tube heat exchangers. Design of condensers .Cooling tower-Types and design.

Unit IV:
Air Pre-Heaters: Types of Air pre heater, recuperative and regenerative – Design considerations – Higher temperature and low temperature applications; Simple problems - Heat exchanger sizing for heating or cooling of a batch of liquid in agitated vessel, batch cooling with external heat exchanging, jacketed batch reactor heating.

Unit V:
Evaporators –classification-horizontal and vertical. Single effect and multi effect evaporator criteria for selecting evaporator.

Text Books:

1. S.D.Dawande; Principles of heat transfer and mass transfer –Central techno publications, 2000.

Reference Books:

1. J.M.Coulson and J.F.Richardson: Chemical Engineering VoI 1. Fluid flow, Heat Transfer and Mass Transfer. Butterworth-Heinemann, an imprint of Elservier, Sixth Edition, Indian Reprint, 2006
2. Homi, P. Serval., 'Boilers & Pressure Vessels', Multitech Publishing Company, Bombay, 1989.
3. P.K. Nag., 'Power Plant Engineering (Steam and Nuclear)', Tata McGraw Hill, New Delhi, 1998.

ME268 COMPUTER AIDED DESIGN

Credit 4:0:0 **Marks 40+60**

Unit I: Design Process
Introduction to CAD-Benefits of CAD-Reasons for Implementing CAD-Historical development-Design Process-Conventional and Computer representations of Drawings and Diagrams, its strength and weaknesses-Product cycle - Sequential and concurrent engineering

Unit-II: Computer Graphics, Basic Concepts And Systems.
Origin of computer Graphics, Fundamentals of Computer Hardware- interactive graphic display- Graphic systems. Display devices- Hard copy devices- interactive graphic input & output devices display processors. Introduction and study of various Operating systems like Unix ,Windows ,MS-DOS .

Unit-III: Transformation
2D , 3D transformations - Translation , Rotation , Scaling - Concatenation
Solid Modeling
Geometric Modeling - Wireframe, Surface and Solid models - CSG and B-REP Techniques - Features of Soild Modeling Packages - Parametric and features - Interfaces to drafting, Design Analysis.

Unit-IV: Techniques for Geometric Modeling
Representation of curves - Bezier curves - Cubic spline curve - B-Spline curves - Rational curves – Surface Modeling techniques - surface patch - Coons patch - bi-cubic patch - Bezier and B-spline surfaces

Unit-V: Graphics Standards for CAD
Need of Graphics and computer standards -Standardization in Graphics-Graphics Kernel System, OGL- Data Exchange standards-STL - IGES-STEP-CALS-DXF- Network fundamentals -WAN, LAN

Emerging Trends In CAD

Reverse Engineering -Re-engineering -Rapid prototyping-Concurrent engineering and design methodology-Product Data Management & application

Text Book:

1. Ibrahim Zeid, " CAD - CAM Theory and Practice ", Tata McGraw Hill Publishing Co. Ltd., 2005.
2. Sadhu Singh, " Computer Aided Design and Manufacturing ", Khanna Publishers, New Delhi, 1998.

References:

1. P.Radhakrishnan and C.P.Kothandaraman, " Computer Graphics and Design ", Dhanpat Rai and Sons, New Delhi, 2003.
2. Groover and Zimmers, " CAD / CAM : Computer Aided Design and Manufacturing Prentice Hall of India, New Delhi, 2002.
3. V.Ramamurthi, " Computer Aided Mechanical Design and Analysis ", Tata McGraw Hill Publishing Co Ltd., 1998.
4. Kunwoo Lee, "Principles of CAD/CAM/CAE Systems", Addison Wesley, 2005

ME269 FINITE ELEMENT ANALYSIS

Credit 3:1:0 **Marks 40+60**

Unit I:

Introduction: Basic concepts- General applicability of the method to structural analysis, heat transfer and fluid flow problems-Historical Background -finite element packages- Boundary Value and Initial Value Problem-Weighted Residual Methods.

Unit II:

General Procedure of FEA-Element Types and its Characteristics-Concept of Element Assembly -Bandwidth and its effects- Boundary conditions-Aspect Ratio- Pascal's Triangle-Stiffness matrix for Spar element, Beam element-Shape Function for Spar element, Beam element.

Unit III:

Convergence and Continuous criteria- Local, Global and Natural Co-ordinate System- Shape Function for Rectangular, Triangular Elements-

Unit IV:

Introduction to Higher Order Elements-Shape Function for Quadratic Element, Cubic Element- Area Co-ordinate system-, LaGrangean and serendipity elements.

Unit V: Applications To Field Problems

Heat Transfer Problems. One Dimensional Basic equation of heat transfer derivation of finite element equation- Structural Problems: Equations of elasticity- plane elasticity problems - Bending of elastic plates - Fluid Mechanics Problems: incompressible fluid flow.

Text Book.

1. Rao. S.S. ' The Finite Element Method in Engineering', IInd Ed., Pergamon Press, Oxford, 2001.
2. Tirupathi.R.Chandrupatla, Ashok.D.Belegundu. 'Introduction to Finite Elementsin Engineering', Prentice Hall of India, 2004.

Reference Books:

1. C.S. Desai and J.P. Abel. " Introduction to Finite Element Method" Affiliated East West Press, 2002..
2. J.N.Reddy, "An Introduction to Finite Element Method", Mc Graw Hill, 1993.

ME270 MECHANICAL VIBRATIONS

Credit 3:1:0 **Marks 40+60**

Unit I:
Relevance of and need for vibrational analysis - Mathematical modelling of vibrating systems - Discretes and continuous systems - review of single-degree of freedom systems - free and forced vibrations, Various damping models.

Unit II:
General solution to free vibration problem - damped free vibration - Forced vibration of undamped system -dynamic vibration absorbers - Technical applications.

Unit III:
Free and forced vibrations of multi-degree of freedom systems in longitudinal torsional and lateral modes -Matrix methods of solution-normal modes - Orthogonality principle-Energy methods

Unit IV:
Torsional vibrations - Longitudinal vibration of rods - transverse vibrations of beams - Governing equations of motion - Natural frequencies and normal modes - Energy methods

Unit V:
Vibration instruments - Vibration exciters Measuring Devices - Analysis - Vibration Tests - Free and Forced Vibration tests.

Text Books:

1. Singiresu.S.Rao., "Mechanical Vibrations", Addison Wesley Longman ,2003.
2. Thomson, W.T.,--"Theory of Vibration with Applications" CBS Publishers and Distributers,NewDelhi,2002

Reference Book:

1. Rao, J. S . , & Gupta K.--"Ind. Course on Theory and Practice Mechanical Vibration", NewAge International (P) Ltd.,2005.
2. Kelly, "Fundamentals of Mechanical Vibrations", Mc Graw Hill Publications, 2000.
3. P.Srinivasan, " Mechanical Vibration Analysis ", Tata-Mc Graw Hill, New Delhi, 1982.

Web References:

1. http://www.ecgcorp.com/velav/
2. http://www.auburn.edu/isvd/
3. http://www.vibetech.com/techpaper.htm

ME271 PRODUCT DESIGN AND DEVELOPMENT STRATEGIES

Credit 4:0:0 **Marks 40+60**

Unit I:
Nature and scope of product engineering - creative thinking and organizing for product innovation criteria for product success in life cycle of a product.

Unit II:
Modeling and simulation - the role of models in product design mathematical modeling similitude relations -weighted property index.

Unit III:
Material selection - problems of material selection-performance characteristics of materials - the materials selection process-economics of materials-cost versus perforamance relations-weighted property index.

Unit IV:
Functional and production design-form design-influence of basic design, mechanical loading and material on form design - form design of gray castings, malleable iron castings, aluminium castings, pressure die castings, plastic mouldings, welded fabrications, forging and manufacture by machining methods. Influence of space, size, weight, etc., on form design, aesthetic and ergonomic considerations.

Unit V:
Dimensioning and tolerancing a product-functional production and inspection datum-tolerance analysis.

Text Books:

1. Dieter, G.E., "Engineering Design", McGraw Hill, 2000..
2. Kevin Otto & Kristin Wood, "Product Design", Pearson Educational Inc. 2004.

References:.

1. Niebel, B.W. & Draper, A.B., "Product Design and Process Engineering, McGraw Hill, 1974.
2. Karl T Ulrich, Steven D Eppinger, " Product Design & Development", Irwin Homeward Boston Publishers, 2004.
3. Robert Matouseek, "Engineering Design", Blackie & Sons Ltd., 1963.

ME272 TRIBOLOGY IN DESIGN

Credit 4:0:0 **Marks 40+60**

Unit I: Surfaces And Friction

Topography of Engineering surfaces- Contact between surfaces - Sources of sliding Friction – Adhesion Ploughint- Energy dissipation mechanisms Friction Characteristics of metals - Friction of non metals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction - Source of Rolling Friction – Stick slip motion - Measurement of Friction.

Unit II: Wear

Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear – Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture wear - Wear of Ceramics and Polymers - Wear Measurements.

Unit III: Lubricants And Lubrication Types

Types and properties of Lubricants - Testing methods - Hydrodynamic Lubrication - Elasto hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication Hydrostatic Lubrication.

Unit IV: Design Of Fluid Film Bearings

Design and performance analysis of thrust and journal bearings - Full, partial, fixed and pivoted journal bearings design - Lubricant flow and delivery - power loss, Heat and temperature rotating loads and dynamic loads in journal bearings - special bearings - Hydrostatic Bearing design.

Unit V: Surface Engineering And Materials For Bearings

Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes – Surface coatings - Plating and anodizing - Fusion Processes - Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings

Text Book:

1. Prasanta Sahoo. , “ Engineering Tribology”,Prentice Hall of India, 2005.
2. Sushil Kumar Srivastava, “ Tribology in Industries” , S.Chand Publishers, 2005.

References:

1. Cameron, A. "Basic Lubricaton Theory”, Ellis Herward Ltd., UK, 1981.
2. Kragelsky, “ Friction Wear & Lubrication”, Mir Publications, 1981.

Web References:

1. http://www.csetr.org/link.htm
2. http://www.me.psu.edu/research/tribology.htm

ME273 DESIGN LAB

Credits 0:0:1 **Marks 50+50**

6 experiments will be notified by the HOD from time to time

ME274 ADVANCED THERMAL ENGINEERING LAB

Credits 0:0:1 **Marks 50+50**

6 experiments will be notified by the HOD from time to time

ME356 BIOMECHANICS

Credit 4:0:0 **Marks : 40 + 60**

Unit I:
Introduction and Overview fields of biomechanics, body protection, historical background, anatomical concepts and terminology
Whole Body Biomechanical Characteristics
Anthropometry, analysis of muscle and joint loads, modeling body segments, solving indeterminate problems: reduction and optimization techniques

Unit II: Musculoskeletal Dynamics
kinematics of a rigid body, dynamics of a rigid body, joint moments, solving indeterminate problems, illustrative cases: the hip, knee and ankle
Biomechanics of Bone
bone composition and structure, biomechanical properties of bone, bone behavior under various loading modes, bone remodeling, Wolff's law, biomechanical compatibility, changes in bone with aging

Unit III:
Biomechanics of Articular Cartilage
Composition and structure of articular cartilage, biomechanical behavior of articular cartilage, cartilage lubrication, cartilage wear, biomechanics of pathologic degeneration of cartilage
Biomechanics of Tendons and Ligaments
Composition and structure of tendons and ligaments, mechanical behavior of tendons and ligaments, mathematical characterization and modeling, factors effecting biomechanical properties of tendons and ligaments
Biomechanics of Skeletal Muscle
Composition and structure of skeletal muscle, mechanics of muscle contraction, force production in muscle, Hill's functional model of the muscle, muscle remodeling

Unit IV: Joint Mechanics
Kinetics and kinematics of joints, lubrication of joints analysis of force in orthopaedic implants.

Unit V: Biomechanics of the Spine
Anatomy of the spine, functional unit of the spine, kinematics of the spine, dynamics of the spine, structural stability of the spine

Text Books:
1. Mow, V.C. Basic Orthopedic Biomechanics, Raven Press, NY, 1991.
2. Nigg, B.M. and Herzog, W. Biomechanics of the Musculo-Skeletal System, John Wiley & Sons, NY, 1994.

References:
1. Nordin and Frankel, Basic Biomechanics of the Musckuloskeletal System, 3rd Ed
2. White and Panjabi, Clinical Biomechanics, 2nd Ed

ME357 ADVANCED MODELLING LAB

Credits 0:0:2 **Marks 50+50**

12 experiments will be notified by the HOD from time to time

ME358 ADVANCED ANALYSIS LAB

Credits 0:0:2 **Marks 50+50**

12 experiments will be notified by the HOD from time to time

ME359 THERMOCHEMICAL CONVERSION OF BIOMASS

Credit 4:0:0 **Marks : 40+60**

Unit I - Biomass Energy
Biomass –definition- biomass resource – types of sources - municipal and industrial wastes - agricultural crop residues – energy plantations - conversion technology - method for obtaining energy from biomass – some examples for thermochemical conversion of biomass - environmental impacts – biomass based fuel reduce the potential for global warming – control of CO_X and NO_X emissions using biomass menergy. Biochemical Conversion - - Anaerobic Digestion - Biogas Production - Types of Biogas Plant-Thermochemical Conversion -Gasification - Types - Briquetting - Industrial Applications of Gasifiers - Environment Benefits

Unit II - Energy Plantations
Energy plantations - Size reduction, Briquetting - Drying, Storage and handling of biomass. Feedstock for biogas - Microbial and biochemical aspects- operating parameters for biogas production. Kinetics and mechanism- High rate digesters for industrial waster water treatment.

Unit III - Thermochemical Methods
Thermo chemical conversion of lignocelluloses biomass - Incineration, Processing for liquid fuel production. Pyrolysis -Effect of particle size, temperature, and products obtained.

Thermo chemical Principles: Effect of pressure, temperature , steam and oxygen - Fixed and fluidized bed Gasifiers- Partial gasification of biomass by CFB.
Combustion of woody biomass-Design of equipment - Cogeneration using bagasse- Case studies: Combustion of rice husk.

Unit IV - Thermal Energy Auditing
Energy Audit-Purpose, Methodology with respect to process Industries - Power plants, Boilers etc., - Characteristic method Employed in Certain Energy Intensive Industries - Various Energy Conservation Measures - Steam System - Losses in Boiler, Methodology of Upgrading Boiler Performance - Energy conservation in pumps, Fans & Compressors, Air conditioning and refrigeration systems, Steam Traps- - Types, Function, Necessity

Unit V - Availability Analysis And Thermodynamic Property Relations
Reversible work, Availability, Irreversibility and Second-Law Efficiency for a closed System and steady-State Control Volume. Availability Analysis of Simple Cycles. Thermodynamic Potentials, Maxwell relations, - Generalised relations for changes in Entropy, Internal Energy and Enthalpy, Generalised Relations for Cp and - Cv Clausius Clayperon Equation, Joule-Thomson Coefficient, Bridgman Tables for Thermodynamic relations.

Text Books

1. Ruth Howes & Anthony Fainberg, “The Energy Sourcebook: A Guide to Technology, Resources and Policy”, American Institute of Physics, 1991.
2. D.O. Hall, "Biomass Energy", Energy Policy, october 1991.

Reference books:

1. Chakraverthy A, “Biotechnology and Alternative Technologies for Utilisation of Biomass or Agricultural Wastes”, Oxford & IBH publishing Co, 1989.
2. Mital K.M, “Biogas Systems: Principles and Applications”, ISBN –81-224-0947-New Age International publishers (P) Ltd., 1996.
3. Venkata Ramana P and Srinivas S.N, “Biomass Energy Systems”,ISBN 81-85419-25-6, Tata Energy Research Institute, 1996.
4. Khandelwal. K.C.and Mahdi(SS), “Bio-Gas Tecnology”, Tata McGraw-Hill Pub. Co. Ltd , 1986.
5. O.P.Chawls , “Advances in Bio-gas Technology” I.C.A.R., New Delhi, 1970.

ME360 MODELLING AND SIMULATION

Credit 4:0:0 **Marks : 40+60**

Unit I - Basic Modelling
Introduction to modelling, Application and scope of coverage, Formulation, Review of algebraic equators, Ordinary and partial differential equation. Analytical and numerical techniques, Smoothing techniques, Spline function approximations

Unit II - Modelling of Heat, Mass And Momentum Transfer Operations
Review of heat, mass and momentum transfer operations, Modelling ar exchangers, Evaporators, Absorption columns, Extractors, Distillation columns, Membrance processes.

Unit III - Model Discrimination And Parameter Estimation
Rate equations, Linear and non-linear regression analysis, Design of experiments, Factorial, Central, fractional design, Evolutionary operation techniques, Case studies.

Unit IV - SIMULAITON SOFTWARE
History- selection process – simulation in high level language – simulation packages – interpreted Vs simulators – future trends.
Statistical models -- terminology and concepts – useful statistical models - distributors.
Queuing models -- characteristics – performance measures – steady state behaviour – networks of qurues.

Unit V - Optimization Techniques & Application Of Optimization
Function, Analysis and numerical methods for single variable and multivariable system, Constrained optimization problems.
Application Of Optimization
Heat transfer and energy conservation, Separation techniques, Fluid flow systems, Chemical Reactor design.

Text Books

1. Edgar, T.F. and D.M. Himmelblau - " Optimization of Chemical Processes ", McGraw Hill Book Co., New York, 1989.
2. Sherwood T.K., Pighord, and C.R.Wilke, " Mass Transfer ", McGraw-Hill Kogukusha Ltd., 1975.
3. Cheremisioniff, N.P. (Edr.) - " Hand Book of Heat and Mass Transfer ", Vol.II. Mass Transfer and Reactor Design, Gulf publishing Company, Houston, 1986.

References Books

1. Lubeyn W.L. " Process Modelling, Simulation and Control Engineering ", McGraw Hill Book Co., New York, 1990.
2. "Chemical Engineering Tutorial Numerical methods, Chemical Engineering ", August 17, October 26, 1987 Feb. 15, April 25, July 18, Nov. 21, 1988, July 14, 1989.

ME361 CHEMICAL KINETICS AND REACTOR DESIGN

Credit 4:0:0 **Marks : 40+60**

Unit I - Chemical kinetics
Chemical kinetics – overview of first ,second and third order reactions- rate law - complex reactions – mechanism – steady state approximation - effect of temperature – Arrhenius treatment – theories of reaction rate – collision – absolute reaction rate – competing – and parallel reactions – chain reactions – transition state theory – opposing reactions – consecutive reaction – deduction of rate laws – kinetics of fast reaction.

Unit II - Kinetics Of Heterogeneous Reactions
Catalyic Reactions, Rate controlling steps, Langmuir - Hinshelwood model, Rideal - Eiley Mechanism, Steady State approximation, Noncatalytic fluid - soild reactions, Shrinking and unreacted core model.

Unit III - Design Of Heterogeneous Catalytic Reactors & Adiabatic Reactors
Isothermal and adiabatic fixed bed reactors, Non-isothermal and nonadiabatic fixed bed reactors. Two phase fludized bed model, slurry reactor model, Trickle bed reactor model.

Design Of Adiabatic Reactors:
Design of fixed bed units (Exo reactions). Cooling in reactions in Chemical industry Catalyst regeneration, case studies.

Unit IV - Reactor In Spray Regine
Power dissipation concepts, Choice of fast reactors, Process design, Process reactor safety, Stability, Design for high severity, testing , Design of novel reactors and case studies, short cuts.

Unit V - Design Of Multicomponent Operations
Design of multicomponent absorption and distillation units, Design for poison control.
Calculation for design of upstream and down stream Processing equipments in chemical processes:
Aspects, System Analysis, Maintenance, Cost Analysis, Energy conservation, Simulation of separation technologies, Design of purifiers.

Text Books:

1. Smith J.M. - " Chemical Engineering Kinetics ", McGraw-Hill, 1981.
2. Fogler H.S - " Elements of Chemical Reaction Engineering ", Prentice - Hall 1986.

Reference books :

1. Rase, H.F., " Chemical Reactor Design for Process Plants ", Vol.21, Wiley, 1977.
2. Trehan, M. - " Catalytic Reactor Design " McGraw Hill, 1983.
3. Austin D.G. and G.V. Jeffeys - " A worked out solution to problem in Chemical engineeing design ", I.I. C.H.E. London, 1986.
4. Perry J.H. - " Chemical Engineer's Hand Book " 7th Edition., 1988.
5. Cooper A.P. and G.V.Jefferys - " Chemical Kinetics and Reactor Design ", Prentice Hall – USA, 1973.
6. Bischoff and Froment - " Chemical Reactor Design and Analysis ", Addision - Wesley, 1982.
7. C.Kalidas, “Chemical kinetic methods”: Principles of Relaxations Techniques and application”, Hew Agw International (P) Ltd,CChennai,1996.
8. P.W.Atkins, “Physical Chemistry” fifth edition, Oxford university Press,1995

ME362 INTRODUCTION TO FUEL CELLS

Credit 4:0:0 **Marks : 40+60**

Unit I - Introduction to Fuel Cell
A simple Fuel cell – Advantage and disadvantage – Fuel cell types – Basic Fuel Cell operation – Fuel cell performance –Environment Impact of Fuel Cell : Life Cycle assessment – Emissions related to Global warming – Emissions related to air pollution

Unit II - Overview of fuel cell types and systems:
Construction and operation of Fuel cells : Phosphoric-Polymer Electrolyte Membrane-Alkaline- Molten Carbonate-Solid oxide Fuel cells – Fuel cell stack – Thermal management subsystem – Fuel delivery/processing system-Power electronics subsystem

Unit III Fuel Cell Thermodynamics
Heat potential of a Fuel : Enthalpy of Reactions – Work Potential of a Fuel :Gibbs Free energy – Predicting Reversible Voltage of a Fuel Cell under Non-standard state Conditions-Fuel Cell Efficiency

Unit IV - Charge and Mass Transport:
Charge transport - in response to Forces , Voltage loss factor , Resistance - Physical Meaning of Conductivity – Classes of Fuel cell electrolytes - Transport in Electrodes Vs Flow structure – Diffusive Transport – Convective Transport

Unit V - Essential Electrochemical Characterization Techniques for a Fuel cell:
Insitu: Fundamentals Electrochemical Variables: Voltage, Current and Time – Basic Fuel Cell test station Requirements – Electrochemical Impedance Spectroscopy- Current Interrupt Measurement – Cyclic Voltammetry
Exsitu: Porosity Determination- BET surface area determination – Gas permeability – Structure Determinations – Chemical Determinations

Text Books:

1. Ryan O'Hayre, Suk-won Cha, Whitney Colella and Fritz B Prinz," Fuel Cell Fundamentals", ISBN : 978-0-471-74148-0, John Wiley & Sons, New Jersey, 2005
2. Supramaniam Srinivasan, "Fuel Cell : From Fundamentals to Applications", ISBN-10:0-387-25116-2, ISBN-13:978-0387-25116-5 Springer, NY, 2006

Reference:

1. Allen.J.Bard and Larry.R.Faulkner, "Electrochemical Methods : Fundamentals and Applications", 2nd Ed., ISBN: 0-471-04372-9, John Wiley & Sons NY, 2001
2. Geoffrey A Prentice, "Electrochemical Engineering Principles", ISBN:0132490382 Prentice-Hall,U.S.A., 1991
3. Gregor Hoogers, "Fuel Cell Technology Handbook (Mechanical Engineering Series)", ISBN 0-8493-0877.1, CRC Press LLC, Florida, 2003

ME363 MATERIALS CHARACTERIZATION

Credit 4:0:0 **Marks : 40+60**

Unit I - Structural Analysis
X-Ray Diffraction methods: Rotating Crystal Method – Powder Method- Scherrer Formula for estimation of particle size- Debye-Scerrer Camera- structure factor- structure factor Calculations- Instrumentation and result analysis

Unit II - Morphology
Electron Spectroscopy for chemical analysis (ESCA)- X-ray photoelectron spectroscopy (XPS)- Auger electron spectroscopy (AES)- Secondary ion mass spectrometry (SIMS)-

Transmission Electron Microscopy (TEM)- Scanning Transmission Electron Microscopy (STEM)- Rutherford backscattering spectrometry (RBS)- Atomic Force Microscopy (AFM)- Instrumentation and result analysis

Unit III - Optical Characterization
UV-Visible-IR spectrometry- FTIR-Raman-NMR-Sample Handling techniques – Instrumentation and result analysis

Unit IV - Thermal Analytical Techniques
Principles of differential Thermal Analysis (DTA)- Differential Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TG) – Instrumentation- Determination of Transition temperature, Heats of transition of plastics, metals and alloys and other materials

Unit V - Electrochemical Methods:
Electrical Conductivity of liquids – Determination of pH – Principle of liquid and gas chromatography – Mechanical and Magnetic analysis : Vicker's Hardness test – Vibrating Sample Magnetometer – Working Principle of VSM – Instrumentation.

Text Books:

1. Cullity Addision, "Elements of X-ray diffraction", Wesley Publishing Co., 1967
2. Prutton, M., "Surface Physics" Clarenden Press, Oxford, 1975
3. Treatise on Materials and Technology, Volume 27,"Analytical Techniques for Thin Films", Academic Press Inc., New York, 1991

ADDITIONAL SUBJECTS

Code No.	Subject Name	Credits
PE240	Production Processes	4:0:0
PE241	Material Science & Engineering	4:0:0
PE334	Metrology & Measurement Systems	4:0:0
PE335	Composite Materials	4:0:0
PE336	Metal Cutting Theory and Practice	4:0:0

PE240 PRODUCTION PROCESSES

Credit: 4:0:0 **Marks: 40+60**

Unit I:
Lathe – Types, specification, lathe operations – attachment for various operations, type of tools, capstan and turret lathe, Automatic lathes milling: types, specification, milling tool nomenclatures and its specifications, indexing types – simple, compounding and differential.

Unit II:
Drilling, Boring, Broaching: Specification Tools, Nomenclature and its specification, shaper, planer. Grinding – types grinding, grinding wheel. Specification, Grinding wheel shapes and sizes mounting, dressing, truing and balancing of grinding wheel. Gear shaping, gear hobbing and gear finishing.

Unit III:
Non-Traditional Machining:- Classification, Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Laser beam machining, Numerical Control Machine Tool: Classification of Numerical Control systems, Manual part Programming, CNC/DNC system, Numerical Control Machines: Turning Center, Machining Centrer

Unit IV:
Metal forming: Rolling principle, rolling load, rolling variables, Forging classification, Extrusion – Principle, Classification, Defects in rolled, forged and extruded components. Un conventional Forming – HERF process, explosive forming, hydroelectric forming. Electro magnetic forming. Introduction to powder metallurgy, Metal Injection Moulding.

Unit V:
Moulding and casting: – Pattern, pattern allowance, and types, moulding sand preparation, types of core. Special casting process – Shell moulding, permanent moulding, precision moulding, investment casting,. Die casting, centrifugal casting, and continuous casting. Welding: - Classification, Gas welding, Arc Welding - TIG, MIG, resistance welding, Laser beam welding, Forge Welding, Explosion Welding, Thermit welding. Introduction to Electron Beam welding, submerged welding of friction welding processes.

Text Books:

1. S.K. Hajra Choudhray, S.K. Bose, 'Elements of Workshop Technology, Vol. II, Machine Tools', Media promoters & Publishers (P) Ltd, 2004, 11th Edition.

2. P.N. Rao, 'Manufacturing Technology', 2nd Ed. Tata McGraw Hill Publishing Ltd., 1999.

References:

1. HMT, 'Production Technology', TMH (India), 1996.
2. **2.** Heine, Richard, Carl R Loper and Philip Rosenthal, 'Principles of Metal Casting', Tata McGraw Hill Publishing Ltd., 2000.
3. **3.** Randal M. German, 'Metal Injection Moulding'

PE241 MATERIAL SCIENCE AND ENGINEERING

Credit: 4:0:0 **Marks: 40+60**

Unit I: Structure of materials and alloys:

Crystal systems, space lattices, miller indices of atomic planes and directions, allotropy. Crystal defects – point, line and surface defects, X-ray diffraction – Bragg's law. Metallography – preparation of specimen, micro and macro examination, metallurgical and electron microscopes.

Unit II: Mechanical behaviors of materials:

Stress – strain curve, elastic deformation, characteristic of elastic deformations,. Anelastic deformation, strain-time curves, damping capacity, Viscous deformation, Plastic deformation, mechanism of plastic deformation – slip and twinning. Strengthening mechanism – work hardening.

Unit III: Mechanical testing and fracture of materials

Tensile test – stress strain curves for ductile and brittle materials – mild steel, copper, concrete, cast iron, proof stress, yield point phenomenon, Luder's bands. Compression test, Hardness test – various hardness tests. Impact test – fatigue – stress cycles for fatigue testing, endurance limit, fatigue limit S-N curve, Creep – creep curve, primary creep, secondary creep, tertiary creep. Fracture – ideal fracture stress, brittle fracture – Griffith's theory – ductile failure, cup and cone type fracture. Fatigue failure.

Unit IV: Phase diagram and Heat treatment of steel

Solid solution, inter metallic compound, cooling curves, non-equilibrium cooling, phase rule, Ferrous and non-ferrous alloys – Fe-C diagram, effect of alloying elements on properties of steel, tool steel, heat resisting and die steel, Grey CI, White CI, Malleable iron and SG iron.

Critical temperature on heating, annealing, spheroidizing, normalizing, hardening, isothermal transformation – TTT diagram, tempering, martempering and ausforming. Hardenability and its testing. Surface hardening processes.

Unit V: Miscellaneous Engineering Materials

Ceramic Materials- structures-properties of ceramic Materials – abrasives- Glasses-composition- properties-manufacture of Glasses-polymers- polymerization, Thermo plastics and thermosets. Composites –metrix and reinforcement materials

Text Books

1. Khanna .O.P " A text book of Materials Science and Metallurgy" Dhanpat Rai and Sons Delhi, 1995.

Reference Books

1. Anderson, J.C., Leaver. K.D., Rawlings, R.D., Alexander, J.M., "Material Science", ELBS, 1985.
2. Robert, E. Reed Hill, "Physical Metallurgy Principles", Affiliated East West Press, 1973.
3. Williams D, " Material Science and Engineering" John wiley & sons inc. 1997.

PE334 METROLOGY AND MEASUREMENT SYSTEMS

Credit 4:0:0 **Mark (40+60)**

Unit: I Science of Measurement

Mechanical measurement – direct comparison and indirect comparison – the generalized measurement system – types of input quantities – measurement standards – calibration – uncertainty – systematic and random errors – common types of errors – classifications of errors – terms used in rating instrument performance – introduction to uncertainty – propagating uncertainty – zero, first and second order instruments – methods of correcting for spurious inputs – inherent insensitivity – high gain feed back –signal filtering and opposing inputs.

Unit II : Sensors and Transducers for Measurement

Sensors – loading error – primary and secondary transducers – compatibility of mechano electric transducer combination - variable resistance transducers – sliding contact devices – variable inductance elements – self inductance and mutual inductance elements – differential transformer – construction and characteristics – rotary differential transformer – variable reluctance transducer – capacitance transducers – active and passive transducers – piezo electric transducers – photo electric sensors –Hall effect transducers – resistance wire strain gages – types – theory of metallic strain gauges – selection and installation – strain gauge circuits – ballast circuit – bridge circuit – bridge with two and four arm sensitivity - calibration of strain gauges – application of strain gauges – load cells – measurement of strain in rotating shafts – measurement of pressure – standards of pressure – measurement of high pressure – bulk modules gauge –measurement of low pressure – the Mc Leod Gauge – thermal conductivity gauges.

Unit – III Measurement of Temperature and Flow

Measurement of temperature – liquid in glass thermometer – complete partial and total immersion thermometers – resistance thermometers – constructional details – resistance thermometer circuits – lead wire compensation for resistance thermometers – thermistors – constructional details – measuring circuits for thermistors – thermo electric thermo meters – laws of thermocouples – industrial thermocouples and their ranges – making of thermocouple junctions – ambient temperature compensation – use of extension heads – pyrometers – optical total radiation and photo electric pyrometers – linear quartz thermometer – measurement of flow – need for flow metering – rotameter – theory and constructional details – magnetic flow meters – hotwire anemometers - drag force flow meter.

Unit – IV Linear and Angular measurements

Slip gauges - stack of slip gauge – method of selecting slip gauges – adjustable slip gauge – measurement of angles – sine bar checking unknown angles – sine center – sources of error – angle gauges - optical instruments for angular measurement – auto collimator – applications – straightness and square ness – angledekkor – precision spirit levels – clinometers

Unit – V Miscellaneous measurements

Measurement of surface roughness – surface texture – primary texture – secondary texture and the lay specification for surface textures – methods for measuring surface finish – the Talysurf instrument – the profilograph – Tomlinson surface meter – Tracer type profilograph – measurement of screw thread profiles – errors in pitch – microscopic method – measurement of internal thread – measurement of effective diameter – two wire and three wire method – measurement of root diameter – gear tooth measurement- measurement of gear profile – tooth thickness – tooth spacing – pitch circle diameter – Parkinson's gear tester – the coordinate measuring machine constriction – operation and programming.

Text Books:

1. Ernest O Doeblin, "Measurement systems", McGraw Hill Publishers, 2003.
2. Beckwith, Marangoni; Lienhard "Mechanical Measurements", Pearson Education, 2004.

References:

1. I.C Gupta, "Engineering Metrology", Danpat Rai Publications, 2004.
2. R. K . Jain, "Engineering Metrology", Khanna Publishers, New Delhi, 2003.
3. Mickell. P. Groover, "Automation, Production systems and computer Integrated Manufacturing", Pearson Education, 2004.

PE335 COMPOSITE MATERIALS

Credits 4:0:0 **Marks 40+60**

Unit I: Introduction.

Definition – need- General Characteristics, applications, Fibers- Glass, Carbon, Ceramic and Aramid fibers. Matrices- polymer, Graphite, Ceramic and Metal Matrices- Characteristics of fibers and matrices, Smart Materials- type and Characteristics.

Unit II: Mechanics and Performance

Characteristics of fiber-reinforced lamina-laminates-interlaminar stresses – Static Mechanical properties- Fatigue and Impact properties- Environmental Effects - Fracture behaviour and Damage Tolerance.

Unit III: Manufacturing

Bag Moudling- compression Moulding – Pultrusion- Filament Winding- other Manufacturing Processes- quality inspection methods.

Unit IV: Analysis

Stress analysis of laminated Composite beams, plates, shells- vibration and stability analysis – reliability of composites- equivalent orthographic/layered Finite Elements- finite element method of analysis of composites- analysis of sandwich structures.

Unit V: Design and Testing
Characterization of composite products – laminate design consideration- bolted and bonded joints design examples- non-destructive testing- failure mode Predictions.

Text Book:

1. Mallick, P.K., Fiber- Reinforced composites: Materials, Manufacturing and Design" Maneel Dekker inc. 1993.
2. Agarwal, B.D., and Broutman L.J., " Analysis and Performance of fiber composites", John Wiley and Sons, New York, 1990.

References:

1. Halpin, J. C., "Primer on Composite Materials, Analysis" Techomic Publishing Co., 1984.
2. Mallick, P.K. and Newman, S., " Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.

PE336 METAL CUTTING THEORY AND PRACTICE

Credit 4:0:0 **Mark (40+60)**

Unit 1: Introduction
Basic mechanism of chip formation-types of chips-Chip breaker-Orthogonal Vs Oblique cutting- force and velocity relationship and expression for shear plane angle in orthogonal cutting-Energy Consideration in machining-Modern theories in Mechanics of cutting - Review of Merchant and Lee Shaffer Theories- critical comparison.

Unit II: Tool Nomenclature and Cutting Forces
Nomenclature of single point tool - Systems of tool Nomenclature and Conversion of rake angles - Nomenclature of multi point tools like drills, milling cutters and broaches. Forces in turning, drilling and milling - specific cutting pressure- measurement of cutting forces.

Unit III: Thermal Aspects of Machining
Thermodynamics of chip formation - Heat distributions in machining-Effects of various parameters on temperature - Method of temperature measurement in machining - Hot machining - cutting fluids.

Unit IV: Tool Materials, Tool Life and Tool Wear
Essential requirements of tool materials - Developments in tool materials-ISO specifications for inserts and tool holders-Tool life- optimum tool life - Conventional and accelerated tool life tests- Concepts of machinability and machinability index - Economics of machining

Unit V: Wear Mechanisms and Chatter in Machining:
Reasons for failure of cutting tools and forms of wear-mechanisms of wear - chatter in machining - Factors effecting chatter in machining - types of chatters-Mechanism of chatter based on Force Vs Speed graph, Mechanism of grinding - Various parameters affecting grinding process.

Text Books:

1. Shaw .M.C., " Metal cutting Principles ",Oxford clarendon Press,1984.
2. Juneja.B.L and Sekhon.G.S- " Fundamentals of metal cutting and machine tools", New Age International(p) Ltd., 1995.
3. Bhattacharya. - " Metal Cutting Theory and Practice ", New central Book Agency pvt. Ltd., Calcutta1984.

References:

1. Venkatesh .V.C. & Chandrasekharan.H. “Experimental Techniques in Metal cutting", Prentice Hall of India, 1982.
2. Xing Sheng LI & Low I.M., Editors Advanced Ceramic Transtech Publications, 1994.
3. Kuppuswamy.G.- "Principles of metal cutting", Universities Press(India)Ltd., 1996
4. Boothroy.D.G. and Knight. W.A "Fundamentals of Machining and Machine tools", Marcel Dekker, New York, 1989.

SCHOOL OF

MECHANICAL SCIENCES

ADDITIONAL SUBJECTS

Sub. Code	Subject Name	Credit
ME108	Engineering Drawing	0:0:4
ME109	Computer Aided Graphics	0:0:2
ME110	Basic Engineering Drawing	0:0:2
ME275	Material Science	3:0:0
ME276	Modern Vehicle Technology	4:0:0
ME277	Design and Drawing of Machine Elements	2:0:2
ME278	Kinematics of Machine Elements	4:0:0
ME279	Basics of Mechanical Engineering	3:0:0
ME280	Personnel Management & Industrial Relations	3:0:0
ME281	Metrology and Computer Aided Inspection	3:0:0
ME282	Production Processes	3:0:0
ME283	Material Science and Engineering	3:0:0
ME284	Special Machines Lab	0:0:2
ME285	Lathe Shop	0:0:1
ME364	Mechatronics and Machine Controls	4:0:0
ME365	Engineering Materials and Applications	4:0:0
ME366	Modelling Lab I	0:0:2
ME367	Analysis Lab	0:0:2
ME368	Modelling Lab II	0:0:2
ME369	CFD Lab	0:0:2

ME108 ENGINEERING DRAWING

Credit : 0:0:4

Unit - I
Standard code of practice for Engineering Drawing: Lettering – Dimensioning – Methods of drawing simple figures – Ellipse, hyperbola, parabola, regular polygons.

Unit - II
Introduction to orthographic projections, projection of points, projection of straight lines in the first quadrant (Line parallel to both planes, inclined to one plane and parallel to other, parallel to one plane and perpendicular to other plane, inclined to both the planes)

Unit - III
Projections of simple solids in simple positions – prism, pyramid, cylinder and cone. Conversion of pictorial views into orthographic views of simple machine members.

Unit - IV
Development of surface of solids – prism, pyramid, cylinder and cone. Isometric views of solids.

Unit - V
Plan, Elevation and Section of single storied residential / office building with flat RCC roof and brick masonry walls having not more than three rooms. (Planning / Designing is not expected in this course)

Text Books:

1. Venugopal K. "Engineering Drawing and Graphics", 8th Edition, New Age International Publishers, 2007.
2. Narayana K.V, Kannaiah. P, "Text Book of Engineering Drawing (Engineering Graphics)", 2nd Edition, 2006.

Reference Books:

1. Bhatt N.D., "Elementary Engineering Drawing", 26th Edition. Chartor Publishing House, Anand, 1987.
2. Sekkilar S.M. Tamarai Selvi S., "Engineering Drawing" Anuradha Agencies, Kumbakonam, 1987.

ME109 COMPUTER AIDED GRAPHICS

Credit : 0:0:2

Unit - I
Introduction to Computers and Computer Aided Graphics – Workstations Display Technology – Input and Output Devices – Graphics standards.

Unit - II
Introduction to Computer Aided Design and Drafting – Applications – Various CAD Packages – Study of AUTOCAD 2007 Software – Hardware requirements.

Unit - III
Simple Exercise using various Drawing and Editing commands of AUTOCAD 2007.

Unit - IV
Simple Exercise using various Formating commands – Basic Dimensioning practice using AUTOCAD 2007.

Unit - V
Simple exercises using Layers and Blocks – Introduction to Isometric Drawings – Basic Plotting practice.

Text Book
Shyam Tickoo, 'AUTOCAD 2007 for Engineers and Designers ' Dreamtech India (P) Ltd. , 2007

Reference Book
V. Natarajan, 'Engineering Drawings and Graphics', 15^{th} Edition 2001

ME110 BASIC ENGINEERING DRAWING

Credit: 0:0:2

Unit - I
Standard code of practice for Engineering Drawing: Lettering – Dimensioning – Methods of drawing simple figures – regular polygons.

Unit - II
Introduction to orthographic projections: Projection of points, projection of straight lines in the first quadrant (line parallel to both planes, inclined to one plane and parallel to other, parallel to one plane and perpendicular to other plane).

Unit - III
Projections of simple solids in simple positions – prism, pyramid, cylinder and cone. (solid parallel to both planes, parallel to one plane and perpendicular to other plane)

Unit - IV
Development of surface of solids in simple positions – prism, pyramid, cylinder and cone. (uncut views only), Isometric view of basic solids.

Unit - V
Plan, Elevation and Section of single storied residential / office building with flat RCC roof and brick masonry walls having not more than two rooms. (Planning/ Designing is not expected in this course)

Text Books:
1. Venugopal K. "Engineering Drawing and Graphics", 8th Edition, New Age International Publishers, 2007.
2. Narayana K.V, Kannaiah. P, "Text Book of Engineering Drawing (Engineering Graphics)", 2nd Edition, 2006.

Reference Books:
1. Bhatt N.D., "Elementary Engineering Drawing", 26th Edition. Chartor Publishing House, Anand, 1987.
2. Sekkilar S.M. Tamarai Selvi S., "Engineering Drawing" Anuradha Agencies, Kumbakonam, 1987.

ME275 MATERIAL SCIENCE

Credit 3 : 0: 0

Unit - I Structure of materials and alloys:

Crystal systems, space lattices, miller indices of atomic planes and directions, allotropy. Crystal defects – point, line and surface defects, X-ray diffraction – Bragg's law. Metallography – preparation of specimen, micro and macro examination, metallurgical and electron microscopes.

Unit - II Mechanical behaviors of materials:

Stress – strain curve, elastic deformation, characteristic of elastic deformations,. Anelastic deformation, strain-time curves, damping capacity, Viscous deformation.

Unit - III Mechanical testing

Tensile test – stress strain curves for ductile and brittle materials – mild steel, copper, concrete, cast iron, proof stress, yield point phenomenon, Luder's bands. Compression test, Hardness test – various hardness tests. Impact test – fatigue – stress cycles for fatigue testing, endurance limit, fatigue limit S-N curve.

Unit - IV Fracture of materials

Plastic deformation, mechanism of plastic deformation – slip and twinning. Strengthening mechanism – work hardening.Fracture – ideal fracture stress, brittle fracture – Griffith's theory – ductile failure, cup and cone type fracture.

Unit - V Phase diagram

Solid solution, inter metallic compound, cooling curves, non-equilibrium cooling, phase rule, Ferrous and non-ferrous alloys – Fe-C diagram, effect of alloying elements on properties of steel

Text Books :

1. Khanna .O.P " A text book of Materials Science and Metallurgy" Dhanpat Rai and Sons Delhi, 1995.

Reference Books:

1. Anderson, J.C., Leaver. K.D., Rawlings, R.D., Alexander, J.M., "Material Science", ELBS, 1985.
2. Robert, E. Reed Hill, "Physical Metallurgy Principles", Affiliated East West Press, 1973.
3. Shanthakumar, S.R.J. , " Metallurgy & Materials Science", Anuradha agencies, Kumbakonam., 1999.

ME276 MODERN VEHICLE TECHNOLOGY

Credit 4 : 0: 0

Unit - 1

Types of automobiles: Engine location – chassis layout – construction types, engine cylinder arrangements – Piston rings – Cylinder liners – Valves and Actuating mechanisms – Inlet and Exhaust manifolds. Review of Fuel, Cooling & Lubrication

Unit - II

Steering system: Principle of Steering – Centre point steering – Steering linkages – Steering geometry and Wheel alignment – Power steering. Wheels and tyres: Types and places of use – tyre construction, specification – tyre wear and causes – wheel balancing. Suspension system – need, types – independent suspension – coil and leaf springs – suspension systems for multi-axle vehicles.

Unit - III

Clutches – need, types – Single and Multiple Disc Clutches, Diaphragm Clutch, Centrifugal Clutch, Overrunning Clutch, Fluid Coupling, Torque Converters. Brakes: Need, Types – Mechanical, Hydraulic and Pneumatic Brakes – disc and drum types, their relative merits – details of components– Power brake**,** Antiskid brake, Antilock Braking System (ABS) & its operation.

Unit - IV

Gear box: Need, types of gear transmission – sliding mesh, constant mesh and synchromesh gearboxes; Gearshift mechanisms; Epicyclic and Hydromatic transmission. Universal joint – constant velocity joint – propeller shaft – Hotchkiss drive – Torque tube drive; Front and Rear axles: Types – stub axle; Differential: need and types; Four wheel drive.

Unit - V

Sensors & Actuators: Types of Sensors; Sensors for Speed, Throttle Position, Exhaust Oxygen Level, Manifold Pressure, Crankshaft Position, Coolant Temperature, Exhaust Temperature, Air-mass flow for engine application. Solenoids, Stepper-Motors, & Relay.
Engine Electronics: Throttle body fuel injection, Multi point fuel injection (MPFI), Gasoline Direct Injection (GDI); Common Rail Direct Injection (CRDI); Variable Timing Ignition (VTI), Distributor-less Ignition; Engine Mapping; On-board Diagnostics. Transmission Electronics: Multiplexing and De-multiplexing; electronically controlled Automatic Transmission System.

Text Books:

1. Ramalingam K.K., ‘Automobile Engineering’ SciTech Publications Pvt. Ltd., 2002
2. Crouse W.H. and Anglin D.L., ‘Automotive Engines’, 9th Edition, 1994, McGraw Hill
3. William B. Riddens, “Understanding Automotive Electronics”, 5th Edition, Butterworth & Heinemann Woburn, 1998

Reference Books:

1. Newton. K, Steeds.W, Garret.T.K. and Butterworth. ‘Motor Vehicle’, IE, 1989.

2. Martin. W.Stockel, ‘Auto Service and Repair’, Good heart Wilcox Publishers, Illinois, 1978.
3. Joseph Heitner, ‘Automotive Mechanics’, 2nd Edition, Affiliated Eastern Law House, 1967
4. Dolan J.A., ‘Motor Vehicle Technology and Practical Work’, ELBS, 1978
5. Robert Bosch, “Automotive Hand Book”, SAE 5th Edition, 2000.
6. Bechhold, “Understanding Automotive Electronics”, SAE, 1998

ME277 DESIGN AND DRAWING OF MACHINE ELEMENTS

Credit 2:0:2

Unit - I Properties of Construction Materials
Mechanical properties of construction materials - simple stresses and strains - Hooks law - stress strain relationship - modulus of elasticity - yield and working stresses - ultimate strength and factor of safety - tension. Compression - shear - bending and torsional stresses - strain energy - impact and fatigue stresses - temperature stresses.

Unit -II Construction Materials for Food Plant
Cast iron- steel- alloy steels-other materials - their composition and applications - mechanical and thermal properties - stainless steels, grades, composition, properties of stainless steels - corrosion in metals - types and preservation - non ferrous metals - brass and aluminium their properties and application - plastic materials - nylon, PVC, teflon and polypropylene - FRP their properties and applications.

Unit -III Machine Drawing
Fundamentals of drawing - sectioning, dimensioning-orthographic drawings-sectional views-isometric views of machine parts-assembly drawing of machine-sub assemblies used in food processing machines.

Unit - IV Design Consideration
Manufacturing considerations in machine design - standard components- gears- pulleys-shaft and other accessories- pipes and pipe joints -riveted joints - welded joints - screwed joints – COTTER and knuckle joints.

Unit - V Design of Food Processing Equipments
Design consideration in cleaning and grading. Design of cleaner grader-design requirement for drying systems and design of drier - design consideration of evaporator and design of evaporator. Pneumatic separator design details.

Text Books :
1. Herman C. Hesse & Henry J. Rushton, "Process Equipment Design" D. Van Nostrand Company, Newyork , 2005
2. Khurmi, R. S. & Gupta, J.K. A “text-book of Machine Design”, Euresia Publishing House (Pvt.) Ltd. ,New Delhi, 2003

3. Hall C. V. & Daire D. C. Processing Equipment for Agricultural Products", AVI Publishing Co, 1972.

Reference Books :

1. Bernard Godan Ed & Calude Willm, "Primary Cereal Processing", VCH Publishing, New York , 1994
2. Spottd M. F., "Design of Machine Elements", Prentice Hall of India Ltd, New Delhi, 2002.
3. John A. Troller "Sanitation in Food Processing", Academic Press, Newyork and London, 1993

ME278 KINEMATICS OF MACHINE ELEMENTS

Credit 4 : 0: 0

Unit - I Mechanisms

Basic concept of machines-Kinematics-links-pairs-chain-machines and mechanisms-structure-degrees of freedom-Different mechanisms and uses-Inversion of mechanisms-Four bar linkage-its inversions.

Unit - II Friction

Friction-pivot and collar friction-bearing-types-loss of power due to friction in bearings-Basic theory of lubrication-viscosity ratings-Antifriction bearings-types-brakes band-shoe-clutches types-single and multiple disc cone and their applications.

Unit -III Power Drives

Power Drives - belt-flat and V belts-Tension ratio-centrifugal tension-creep-chain Drives-Gears-classification-terminology-profile-law of gearing-minimum number of teeth- Length of arc of contact-interference between rack and pinion-efficiency-gear trains-simple-compound-reverted

Unit -IV Governors And Flywheel

Governor-watt and porter governor-sensitivity – hunting and isochronisms, flywheel-function-fluctuation of speed and energy

Unit –V CAM

Cam and follower-types-application-profiles, displacement, velocity and acceleration for uniform velocity, uniform acceleration and retardation, SHM, cycloidal curves.

Text Books :

1. Rattan, S. S. "Theory of Machines", Tata McGrawHill Publishing Company Ltd., New Delhi, 1998.
2. Shigley. J. E. & Nicker. J. J., "Theory of Machines and Mechanisms, McGrawHill Inc., 1995

Reference Books :

1. Ghosh A & Malik A. K., "Theory of Mechanisms and Machines", Affiliated East West Press (P) Ltd., 1988
2. Ballaney, P. L., "Theory of Machines", Khanna Publishers, New Delhi 1994

ME279 BASICS OF MECHANICAL ENGINEERING

Credit 3 : 0: 0

Unit – I Introduction to Thermodynamics

Systems, Zeroth Law, First Law - Heat and work transfer in flow and non-flow processes, Second law, Kelvin-Planck statement - Clausius statement - concept of entropy . Properties of gases and vapours

Unit – II Energy Systems

External combustion Engine- Steam Engine and Steam turbine: internal Combustion Engine, Petrol Engine and Diesel Engine- components of Gas turbine engine.

Unit - III Air and vapour power cycles

Otto, Diesel, Dual and Brayton combustion cycles – Air Standard efficiency - Cycle comparisons.Rankine cycles (simple problems)

Unit – IV Power Plants

Conventional power plants- Hydro plants- Hydro , thermal, Nuclear power plants- Diesel and Gas turbine power plants; Non- conventional power plants – solar , wind and Tidal power plants- Geothermal power plant- ocean thermal energy conversion power plants.

Unit -V Refrigeration and Air conditioning (Only theory)

Principles of Vapour compression Refrigeration system. Working principle of vapour absorption system. Comparison between vapour compression and absorption systems. Winter Air-conditioning systems - summer air conditioning system- year round air conditioning system

Text books:

1. Kothandaraman, C.P, Domkundwar S., Engineering Thermodynamics, Dhanpat Rai & Sons, 2nd edition, 1988.
2. Domkundwar., 'Power Plant Engineering', Dhanpat Rai & Sons, 1988

Reference Books:

1. Arora, C.P., Refrigeration and Air conditioning, TMH, 1994.
2. Nag P.K., Engineering Thermodynamics, TMH, New Delhi, 1998
3. Archie W, Culp Jr., 'Principles of Energy Conversion', McGraw Hill, 1985.

ME280 PERSONNEL MANAGEMENT AND INDUSTRIAL RELATIONS

Credit 3:0:0

Unit -1
Nature, Scope, Changing Role of Personnel Manager, New People management; Manpower Planning: Factors Affecting Manpower Planning, Organizational Structure. Job Design and Job Analysis. Process of Manpower Planning.

Unit -II
Recruitment and Selection: Process and Methods, Induction, Placement, Internal Mobility; Performance Appraisal: Scope and Objectives, Methods of Appraisal, Development of an Effective Appraisal System.

Unit - III
Wage and Salary Administration: Wage Legislation, Factors Affecting Wage and Salary Issues, Wage Level, Structure and Wage Determination, Incentives and Fringe Benefits.

Unit - IV
Trade Unions and Collective Bargaining: Trade Union Act, Federations' Roles and Issues, Process of Collective Bargaining.

Unit - V
Workers Participation in Management: Nature and Purpose, Effective Workers Participation; Grievance Handling: Nature, Causes, and Procedures.

Text Book :

1. Cowling Alan, James Philip, " The Essence of Personnel Management and Industrial Relations".Printice hall of India, 1997

Reference Books:

1. Aswathappa. K. " Human Resources and Personnel Management", Tata MaGraw hill, 1999.
2. Philip Allen " The essence Industrial Relations and Personnel Management" Amazon Publishers, 2006.

ME281 METROLOGY AND COMPUTER AIDED INSPECTION

Credit 3 : 0: 0

Unit - I General Concepts of Measurement
Definition-Standards of measurement-Errors in measurement-Accuracy, precision, sensitivity and readability - calibration of instruments, selection and care of instruments.

Unit - II Linear and Angular Measurements
Length standard-Line and end standard - Slip gauges, micrometers, verniers, dial gauges-comparators, various types-principle and applications-angular measuring instruments-bevel protractor, levels, clinometers-sine bar, angle dekkor- autocollimator.

Unit - III Measurement of Form Errors, Surface Roughness and Measuring Machines
Straightness, flatness, alignment errors-surface texture-various measuring instruments-run out and concentricity, Tool maker's microscope-metro scope

Unit - IV Measurement of Screw Threads and Gears
Various elements of threads-2 wire and 3 wire methods-gears elements -various errors and measurements.

Unit - V Computer Aided and Laser Metrology
Coordinate measuring machine-LASER micrometer- Introduction to Interferometer, optical - LASER interferometers-applications

Text Book :

1. I.C.Gupta, "A Text Book of Engineering Metrology", Dhanpat Rai and Sons, 2000

Reference Books :

1. R.K.Jain and S.C.Gupta, "Engineering Metrology", Dhanpat Rai and Sons, 2000.
2. G.N.Galyer F.W and C.R.Shotbolt, " Metrology for Engineers ", ELBS Edn 1990.
3. "ASTME Handbook of Industries Metrology", Prentice Hall of India Ltd., 1992.
4. Robert.G. Seippel, "Optoelectronics for technology and engineering ", Prentice Hall New Jersey,1989.
5. Parson. S, "Metrology and Gauging", McDonald & Evans, 1970.

ME282 PRODUCTION PROCESSES

Credit 3 : 0: 0

Unit – I
Lathe – Types, specification, lathe operations – attachment for various operations, type of tools, capstan and turret lathe, automatic lathes milling: types, specification, milling tool nomenclatures and its specifications.

Unit – II
Drilling and Boring, tool specification, nomenclature, shaper, planer. Grinding – types of grinding wheels- specifications- mounting- dressing -balancing of grinding wheels. Gear shaping- gear hobbing and gear finishing.

Unit – III
Non-Traditional Machining:- Classification, Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Laser beam machining, Numerical Control Machine Tool: Classification of Numerical Control systems, Manual part Programming.

Unit – IV

Metal forming: Rolling principle, rolling load, rolling variables, forging classification, Extrusion – Principle, Classification, Defects in rolled, forged and extruded components. Un conventional Forming, explosive forming, Electro magnetic forming. Introduction to powder metallurgy.

Unit - V

Moulding and casting: – Pattern, pattern allowance, and types, moulding sand preparation, types of core. Special casting process – Shell moulding, permanent moulding, precision moulding, investment casting,. Die casting, centrifugal casting, and continuous casting. Welding: - Classification, Gas welding, Arc Welding - TIG, MIG, resistance welding, Laser beam welding.

Text Books:

1. S.K. Hajra Choudhray, S.K. Bose, 'Elements of Workshop Technology, Vol. II, Machine Tools', Media promoters & Publishers (P) Ltd, 2004, 11th Edition.
2. P.N. Rao, 'Manufacturing Technology', 2nd Ed. Tata McGraw Hill Publishing Ltd., 1999.

Reference Books:

1. HMT, 'Production Technology', TMH (India), 1996.
2. Heine, Richard, Carl R Loper and Philip Rosenthal, 'Principles of Metal Casting', Tata McGraw Hill Publishing Ltd., 2000.
3. Randal M. German, Metal Injection moulding.

ME283 MATERIAL SCIENCE AND ENGINEERING

Credit 3 : 0: 0

Unit - I Crystallography

Classifications of materials – properties of engineering materials – band energy and activation energy- structure of solid materials -BCC- FCC & HCP structures – atomic packing factor- polymorphism- Miller indices- metallographic analysis- specimen preparation metallurgical and scanning electron microscope.

Unit – II Mechanical Behavior

Defects in crystals -point defects line defect edge and screw dislocations – propagation of dislocation - Frank Read source – surface imperfections - diffusion - mechanisms of diffusion - Fick's Laws of diffusion – plastic , deformation- slip and twinning - recovery re-crystallization and grain growth.- strengthening mechanisms strain hardening- precipitation hardening

Unit – III Failure of materials.

Fracture – ductile and brittle fracture - Griffith's theory of crack propagation protection against fracture- Creep- mechanisms of creep – creep resistant materials- equi cohesive temperature —- fatigue failure SN curve- prevention of fatigue failure.

Unit - IV Phase diagram

Solid solution, Hume Rothery rule - phases- phase diagrams- Gibbs phase rule- cooling curves, types of equilibrium diagrams, lever rule – phase diagrams of Copper-Nickel, Bismuth -Cadmium ,lead-Tin system. Iron Carbide equilibrium diagram - TTT diagram - effect of cooling rates and alloying elements

Unit - V Heat treatment of Steel.

Annealing normalizing - spheroidsing- hardening, tempering - Iso thermal annealing, austempering and mar tempering-hardenability Jomnys test for hardenability- case hardening- carburizing- nitriding—carbonitriding- induction hardening- flame hardening.

Text Books

1. Raymond A Higgins "Engineering Materials (Applied Physical Metallurgy) English Language book society, 2000
2. Khanna .O.P " A text book of Materials Science and Metallurgy" Dhanpat Rai and Sons Delhi, 1995.

Reference Books

1. Anderson, J.C., Leaver. K.D., Rawlings, R.D., Alexander, J.M., "Material Science", ELBS, 1985.
2. Robert, E. Reed Hill, "Physical Metallurgy Principles", Affiliated East West Press, 1973.
3. Williams D, " Material Science and Engineering" John wiley & sons inc. 1997.

ME284 SPECIAL MACHINES LAB

Credit 0:0:2

12 Experiments will be notified by the HOD from time to time

ME285 LATHE SHOP

Credit: 0:0:1

6 Experiments will be notified by the H O D from time to time

ME364 MECHATRONICS AND MACHINE CONTROLS

Credit 4 : 0: 0

Unit - I Introduction

Introduction - multidisciplinary scenario - evolution of mechatronics - scope of Mechatronics - measurement systems - control systems - servomechanisms and regulators - control system fundamentals - block diagrams and block diagram reduction .

Unit - II Control systems and programmable logic controllers
Stability of control systems - Rouths and Hourwitz stability criteria - programmable logic controllers (PLC) - input output processing - programming (fundamentals only) - mnemonics -timers - shift registers - master and jump controls - data handling - selection of PLC.

Unit - III Elements of Mechatronics
Mechartonic elements - data presentation systems - displays - analog and digital indicators - analogous chart recorders - visual display units - CRO - printers - magnetic recorders - light indicators - liquid crystal display units - alarm indicators data loggers - computers with plug in boards-data acquisition systems.

Unit - IV Controls in NC Machines and fluidic control
Controls in NC Machines-hydraulic systems - direct current motors - stepping motors - feedback devices-encoders - resolvers - inductosyn – tachogenerators - principles of fluid logic control -Coanda effect - basic fluidic devices - fluidic logic gates - bistable - flipflop - OR and NOR gates - exclusive OR gates - fludic sensors - backpressure sensor - cone jet proximity sensor -interruptible jet senor.

Unit – V Process control Pneumatics
Process control pneumatics - signals and standards - the flapper nozzle - volume booster - air relay and force balance - pneumatic controllers - proportional pneumatic control - proportional plus integral pneumatic control - proportional plus integral plus derivative pneumatic control - PI and IP convertors.

Text books

1. W Boltson , 'Mechatronics',PearsonEducation third edition 2007.
2. Andrew Parr, 'Hydraulics and Pneumatics', Jico Publishing House ,Mumbai 2006.
3. Kuo, 'Automatic Control Systems', Asian student Edition, Printice Hall of India, 2005.

Reference Books:

1. Mahalik,Nitaigour,Premehand, 'Mechatronics', TataMc.Graw Hill Publishers, New Delhi 2005.
2. Anthony Esposito, 'Fluid Power', Pearson Education, 2005
3. Ogata Katsuhiko , 'Modern Control Engineering', Printice Hall of India , 2005.
4. Yoram Koren, 'Computer control of Manufacturing Systems', TataMc.Graw Hill Publishers, New Delhi, 2005.

ME 365 ENGINEERING MATERIALS AND APPLICATIONS

Credits 4:0:0

Unit: I Elastic and Plastic Behavior.
Elastic behaviour – atomic model of Elastic behaviour – Rubber like Elasticity anelastic behaviour- visco elastic behaviour-plastic deformation- slip- shear strength of perfect and real crystals- movement of dislocation – effect of temperature on dislocation movement-

sources of dislocation – work hardening- effect of grain size solute atoms and precipitate particles on dislocation movement.

Unit II Fracture Behaviour
Ductile and Brittle fracture - Griffiths theory – fracture toughness- Ductile Brittle Transition - protection against fracture – fatigue Failure of ferrous and non ferrous materials- fatigue tests- mechanism of fatigue failure – fatigue strength - Methods to improve fatigue strength- Creep and creep resistant materials.

Unit III Modern Metallic Materials.
Patented Steel wire - Steel martensite- ausformed steels- micro alloyed steels- precipitation hardened aluminium alloys- Maraging steels – metallic glasses – shape memory alloys- smart Materials- TRIP Steels.

Unit IV Ceramics and glasses.
Introduction- Ceramic Structures- silicate ceramics- simple silicates- layered silicates- carbon –diamond- graphite- imperfections and impurities in ceramics –brittle fracture and fractural strength of ceramics - applications and processing of ceramics- glasses- glass properties- glass forming- heat treatment of glass – glass ceramics- clay products- fabrication techniques- refractories – abrasive ceramics and their processing- powder pressing and tape casting-cements- advanced ceramics- heat engine applications.

Unit V: Composite Materials.
Introduction – Particle reinforced composites- fiber reinforced composites- influence of fiber length and orientation-fiber and matrix materials- polymer matrix composites- glass fiber - reinforced polymer composites, carbon fiber- reinforced polymer composites, aramid fiber reinforced composites- metal matrix composites- ceramic - matrix composites- carbon – fiber carbon composites- hybrid composites- processing of FRP- pultrusion – filament winding- structure of composites.

Text Books:

1. Raymond A. Higgin’s “ Engineering Metallurgy Part 1 (Applied Physical Metallurgy) English Language Book Society.2000
2. George. E. Dieter ‘ Mechanical metallurgy” Mc Graw hill Book Company. 1998.
3. Thomas H. Courtney ‘ Mechanical Behaviour of Materials” McGraw Hill International Edition.2000

Reference books:

1. Raymond A. Higgin’s “ Properties of Engineering Materials, English Language Book Society.2000
2. V. Raghavan, “ Materials Science and Engineering – Prentice Hall of India (P) Ltd., New Delhi.1998.
3. Williams D, Callister “ Material Science and Engineering” John Wiley & sons inc. 1996.

ME366 MODELLING LAB I

Credit 0:0:2

12 Experiments will be notified by the HOD from time to time

ME367 ANALYSIS LAB

Credit 0:0:2

12 Experiments will be notified by the HOD from time to time

368 MODELLING LAB II

Credit 0:0:2

12 Experiments will be notified by the HOD from time to time

ME369 CFD LAB

Credit 0:0:2

12 Experiments will be notified by the HOD from time to time

SCHOOL

OF

MECHANICAL SCIENCES

ADDITIONAL SUBJECTS

Code	Subject Name	Credit
09ME101	Basic Mechanical Engineering	2:0:0
09ME102	Engineering System Design	2:0:0
09ME103	Workshop Practice(exercise bank)	0:0:2
09ME201	Engineering Mechanics	3:0:0
09ME202	Engineering Thermodynamics	3:1:0
09ME203	Thermal Engineering	3:1:0
09ME204	Heat and Mass Transfer	3:1:0
09ME205	Mechanics of Machines – I	3:1:0
09ME206	Design of Machine Elements	3:1:0
09ME207	Gas Dynamics and Jet Propulsion	3:1:0
09ME208	Design of Transmission Systems	3:1:0
09ME209	Machine Drawing	0:0:2
09ME210	Thermal Engineering Lab	0:0:1
09ME211	Dynamics Lab	0:0:1
09ME212	Metrology Lab	0:0:1
09ME213	Special Machines Lab	0:0:1
09ME214	Heat Transfer and Internal Combustion Engine Lab	0:0:1
09ME215	Cam Lab	0:0:1
09ME216	Cad Lab	0:0:1
09ME217	Foundry, Smithy, Welding & Sheet Metal Lab	0:0:2
09ME218	Metallurgy Lab	0:0:1
09ME219	Concepts of Engineering Design	4:0:0
09ME220	Composite Materials	4:0:0
09ME221	Human Factors In Engineering and Design	4:0:0
09ME222	Rapid Prototyping	4:0:0
09ME223	Metal Cutting Theory and Practice	4:0:0
09ME224	Mechatronics and Controls	4:0:0
09ME225	Fluid Power Control	4:0:0
09ME226	Welding Technology	4:0:0
09ME227	Foundry Technology	4:0:0
09ME228	Heat Engines and Fluid Machinery	3:1:0
09ME229	Introduction to Nano Technology and Micromanufacturing	4:0:0
09ME230	Computer Simulation of IC Engines Process	4:0:0
09ME231	Alternative Fuels for IC Engines	3:1:0
09ME232	Automotive Air-Conditioning	4:0:0
09ME233	Combustion and Heat Transfer	4:0:0
09ME234	Computer Aided Vehicle Design	4:0:0
09ME235	Microprocessor Application in Automobiles	4:0:0
09ME236	Production Processes for Automotive Components	4:0:0
09ME237	Power Plant Engineering	4:0:0
09ME238	Refrigeration and Air Conditioning	3:1:0
09ME239	Biomass Energy Systems	3:1:0

09ME240	Propulsion Engineering	3:1:0
09ME241	Non-Conventional Energy Systems	3:1:0
09ME242	Introduction to Aerodymanics	3:1:0
09ME243	Flight Dynamics	4:0:0
09ME244	Aerodynamics Testing Facilities & Measurement	4:0:0
09ME245	Aircraft Performance	4:0:0
09ME246	Helicopter Engineering	4:0:0
09ME247	High Speed Aerodynamics	4:0:0
09ME248	Industrial Robotics	3:0:0
09ME249	Computer Aided Inspection and Metrology	3:1:0
09ME250	Computer Integrated Manufacturing	3:0:0
09ME251	IT in Manufacturing	3:0:0
09ME252	Introduction to Micro Electro Mechanical Systems	3:0:0
09ME253	Mechatronics	3:0:0
09ME254	Basic Automobile Engineering	3:0:0
09ME255	Computer Workstation Ergonomics	3:0:0
09ME256	Applied Thermodynamic and Heat Transfer	3:0:0
09ME257	Material Science and Engineering	3:0:0
09ME258	Heat and Mass Transfer Lab:	0:0:2
09ME259	MATLAB	0:0:2
09ME263	Production Management and Quality Systems	3:1:0
09ME264	Fundamentals of Engineering Thermodynamics	4:0:0
09ME265	Fundamentals of Heat and Mass Transfer	4:0:0
09ME266	Industrial Robotics	3:0:0
09ME267	Design of Machine Elements	3:1:0
09ME268	Food Processing Equipment Design	4:0:0
09ME301	Applied Mathematics	3:1:0
09ME302	Advanced Thermodynamics	3:1:0
09ME303	Advanced Fluid Mechanics	3:1:0
09ME304	Computer Integrated Manufacturing Systems	4:0:0
09ME305	Computer Applications in Design	4:0:0
09ME306	Mechanical Measurements	4:0:0
09ME307	Ergonomic Design and Analysis	4:0:0
09ME308	Micro manufacturing and nano technology	4:0:0
09ME309	Instrumentation in Thermal Engineering	3:1:0
09ME310	Fluidised Bed Systems	3:1:0
09ME311	Optimization for Design Of Food Processing Machineries	4:0:0
09ME312	Dimensional Analysis And Similitude	4:0:0
09ME313	Computer Aided Design And Manufacturing Of Food Processing Equipments	4:0:0

09ME101 BASIC MECHANICAL ENGINEERING

Credits: 2:0:0

Objective:
To provide knowledge about IC Engines, External combustion Engines, boilers, power plants, metal forming, metal joining, machining process and materials. To understand about CAD and modern design softwares in the mechanical engineering.

UNIT - I
Engine-External combustion engine – Working of Steam Engine – Steam Turbine – Impulse turbine & reaction turbine – Boilers fire tube and water tube boiler – Cochran boiler – Babcock & Wilcox boiler – Internal Combustion Engine – Working of petrol and Diesel Engine – Difference between two stroke and four stroke engines.

UNIT - II
Conventional power plants – Hydro, Thermal, Nuclear power plants – Diesel and Gas Turbine power plants; Non-conventional power plants – Solar, wind and tidal power plants – Geothermal power plant – Ocean Thermal Energy conversion power plant.

UNIT - III
Load – Types of load –stress and strain – Types of stresses and strains –Stress strain curve of ductile materials- Introduction of Mechanical Engineering Software Packages.

UNIT – IV
Metal casting and forming process – Introduction – advantages of casting – patterns – molding – melting of cast iron – forging. Metal joining Process: Introduction - welding – arc welding, gas welding

UNIT –V
Metal machining: Lathe – Drilling machine – Milling machine – Shaping machine.
Basic Engineering Materials: Properties of materials – ferrous metals and alloys – Nonferrous metals and alloys.

Text Books:
1. S.R.J.Shantha Kumar, "Basic Mechanical Engineering", HiTech Publications,2001.
2. G. Shunmagam, "Basic Mechanical Engineering", Tata McGraw Hill, 2001.

Reference Books:
1. I.E. Paul Degarmo, J.T. Black, Ronald A. Kosher, "Material and Processes in Manufacturing", 8th Edition, John Wiley and sons, inc., 1999.
2. Dr. O.P. Khanna, "A Text Book of Materials Sciences and Metallurgy", Dhanpat Rai & Sons, Delhi, 2001.
3. V.Remesh Babu, "A Text Book on Basic Civil Engineering", Anuradha Agencies,2000
4.K.Venugopal,V.Prabhuraja," Basic Mechanical Engineering", Anuradha Agencies,2000

09ME102 ENGINEERING SYSTEM DESIGN

Credit : 2:0:0

Objective:

- *To learn and demonstrate an understanding of systems analysis and design principles, concepts, and evaluation.*
- *To be familiar with the major phases of the system development life cycle.*
- *To be able to produce a structured system specification for a simple system from system analysis.*
- *To gain an appreciation for the scope of systems analysis and design in a organization context*
- *5. To consider alternative development methodologies and in what situations they may be particularly appropriate.*

UNIT I

Introduction to systems:

Definition of system-common types of systems, Natural systems, Man-made systems, Automated systems- General systems principles. Participants to system Development-users, management, auditors, system analysts, systems designers, programmers, operations personnel-Scope and structure of a system-system requirements-system's requirements, user's requirements, Technical requirements-system survey-Investigation methods-survey report.

UNIT II

System Life Cycle Development

Interviewing and Questionnaires, observation, Recognition of need-Feasibility Study, Analysis, Design, Implementation. Models of System Development Life Cycle. Project Team Roles and skills.

UNIT III

Systems analysis

Overview of system analysis-nature of analysis-importance of analysis in system's life cycle-role and requirements of system analysts-popular methods of system analysis-Analysis Process-Tools supporting analysis: Data flow diagram Functioning diagram, Entity relationship diagram-Business Process Automation-Business Process Improvement- Business Process Re-Engineering-Developing an Analysis Plan.

UNIT – IV

System design

Overall designing Specifications: Overview of structured design, Design goals and objectives, Relationship between system analysis and design, Principles of procedure design, stages of design, Tools and Techniques of design. Developing the Design Plan-Moving from logical to physical models.

UNIT V

User Interface Design

Interface Design -Principles for User Interface Design –user interface design process-Design Analysis for Trade studies-integration and Qualification.

Text books:

1. Alan Dennis & Barbara Haley Wixom, "Systems Analysis and Design", John Wiley & sons,2002
2. D. Buede, "The Engineering design of systems models and methods" ,New York, NY: John Wiley & Sons, 2000.

Reference books:
1. Kenneth E. Kendall and Julie E Kendall, "System Analysis and Design", Prentice-Hall, 2007
2. Garg Vinod Kumar ,S.Srinivasan, "Systems Analysis & Design", PHI 2004.
3. KELKAR. S.A., "STRUCTURED SYSTEMS ANALYSIS AND DESIGN-A CONCISE STUDY", PHI 2004.
4. Igor Haweyszkiewycz, "System Analysis and Design", Prentice-Hall, 2007.

09ME103 WORKSHOP PRACTICE
(Exercise Bank)

Credit:0:0:2

I. Product Study Lab

Study of the following Mechanical Systems by dismantling, identifying different parts and measuring the various dimensions of the parts

a) Pneumatic cylinder
b) Worm Gear Box
c) External Gear Pump

II. Soldering Shop

Soldering of wires
Soldering of Diodes
Soldering on PCB

III. Plumbing Shop

1. Practice of internal and external threading of pipe
2. Practice of pipe fitting using L-bow, Tee and Union joints
3. Practice of pipe fitting using reducer, coupling and tap

IV. Fitting Shop

1. Making of V-fitting and drilling
2. Making of T-fitting

V. Carpentry Shop

1. Middle Lap joint
2. Dove Tail joint

09ME201 ENGINEERING MECHANICS

Credit 3:0:0

Objective

- *To provide the student with a clear and thorough understanding of the theory and applications of engineering mechanics, covering both statics and dynamics*
- *To provide the student with a thorough understanding of the concept, drawing, and the use of free-body diagrams.*
- *To be able to determine the Centre of Gravity and Moments of Inertia of simple geometric shapes and understand the physical applications of these properties.*
- *To understand the use and be able to perform calculations related to friction forces in engineering applications.*

UNIT I
Basics

Introduction - Units and Dimensions - Laws of Mechanics –Lame's Theorem-Parallelogram theorem-Vectors - Vectorial representation of forces and moments - Vector operations.
Statics Of Particles :Coplanar Forces - Resolution and Composition of forces - Equilibrium of a particle - Forces in space -Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility - single equivalent force.

UNIT II
Equilibrium Of Rigid Bodies
Free body diagram - Types of supports and their reactions - requirements of stable equilibrium - Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem -Equilibrium of Rigid bodies in two dimensions.

UNIT III
Properties Of Surfaces And Solids
Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, L section , Hollow section by using standard formula – second and product moments of plane area – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia.

UNIT IV
Dynamics Of Particles
Displacement, Velocity and acceleration their relationship - Relative motion - Curvilinear motion - Newton's Law - Work Energy Equation of particles - Impulse and Momentum - Impact of elastic bodies.

UNIT-V
Friction
Frictional Force - Laws of Coloumb friction - Simple Contact friction - Rolling Resistance - Belt Friction.

Text Book*:*
1. *Palanichamy, M.S., Nagan, S., "Engineering Mechanics – Statics & Dynamics", Tata McGraw-Hill, 2002.*
2. Rajasekaran, S, Sankarasubramanian, G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., 2000.
References Books:
1. *Hibbeller, R.C., "Engineering Mechanics", Vol. 1 Statics, Vol. 2 Dynamics,Pearson Education Asia Pvt. Ltd., 2000.*
2. Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers", Vol. 1 Statics and Vol. 2 Dynamics, McGraw-Hill International Edition, 1997.
3. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", IV Edition – Pearson Education Asia Pvt. Ltd., 2003.

09ME202 ENGINEERING THERMODYNAMICS

Credit: 3:1:0

Objective:

- *To learn about the basic concepts of engineering thermodynamics. To provide knowledge about second law of thermodynamics, properties of pure substances and gas mixtures. To understand about the various air standard cycles.*

UNIT I

Basic concepts

Concept of continuum, microscopic and macroscopic approach, thermodynamic systems – closed, open, isolated, control volume. Thermodynamic properties and equilibrium state of a system, state diagram, path and process, quasi-static process, work, modes of work, zeroth law of thermodynamics – concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities C_v and C_p, enthalpy, steady flow process with reference to various thermal equipments.

UNIT II

Second law of thermodynamics

Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Carnot cycle, reversed Carnot cycle, efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy – Carnot theorem, entropy and reversibility, absolute entropy availability, irreversibility

UNIT III

Properties of pure substances

Thermodynamic properties of pure substances in solid liquid and vapour phases, phase rule P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non flow and flow processes -simple problem.

UNIT IV

Gas mixtures

Properties of ideal and real gases, equation of state, Avagadro's law, Gay Lussac's law Graham's law of diffusion, kinetic theory of gases, RMS and average velocity, ideal gas and deviation from it, Vander Wall's equation of states compressibility, compressibility chart,Expansivity Types of fuels-HCV,LCV, Determination of Calorific value -Bomb-calorimeter,Junker's calorimeter, Stochiometric Mixture.

UNIT V

Air standard cycles

Otto, Diesel, Dual, Brayton , Rankine cycles – calculation of mean effective pressure and air standard efficiency.

Text Books

1. Nag P.K., Engineering Thermodynamics, TMH, New Delhi, 2002.
2. Yunus Ccngel 'Thermodynamics', TMH, 2000

Reference Books

1. Holman. J.P., Thermodynamics, 4th edition, McGraw Hill, 2002
2. Roy choudhury T., Basic Engineering Thermodynamics, TMH, 2000
3. Vanwylen and Sontag, Classical Thermodynamics, Wiley Eastern, 1999

09ME203 THERMAL ENGINEERING

Credit 3:1:0

(Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant, property tables are permitted.)

Objective:

- *To provide knowledge about the various systems, testing and performance of IC Engines .To learn about steam turbine, Air compressors, Refrigeration and Air conditioning systems.*

UNIT I

Classification of IC engine, IC engine components and functions. Actual and theoretical p-v diagram of four stroke and two stroke engines. Valve timing diagram and port timing diagram. Comparison of two stroke and four stroke engines. Fuel supply systems, Ignition systems, testing and performance of I.C. Engine. Knocking and Detonation. Lubrication system and cooling system. Exhaust gas analysis, pollution control norms

UNIT II

Steam Turbine: Steam nozzles – flow through nozzles – General relation for adiabatic flow – effect of friction – Diffusers. Steam turbines – Advantages of turbines – impulse and reaction turbines – 50% reaction – compounding of turbines, Reheating and Regeneration cycle – Performance evaluation.

UNIT III

Air compressor: Classification and working principle, work of compression with and without clearance. Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating air compressors. Concept of positive displacement – Rotary pump. Multistage air compressor and intercooling – work of multistage air compressor. Problems in air compressor.

UNIT IV

Vapour compression Refrigeration cycle – super heat, sub cooling, performance calculations. Working principle of vapour absorption system. Ammonia-water, Lithium bromide- water systems (Description only). Comparison between vapour compression and absorption systems.

UNIT V

Psychrometry, Psychrometric chart, Psychrometric processes – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling, problems. Concept of RSHF, GSHF, ESHF. Simple problems, Air conditioning systemswindow and split units.

Text books:

1. Kothandaraman, C.P, Domkundwar S., Engineering Thermodynamics, Dhanpat Rai & Sons, 2nd edition, 2003
2. Holman, J.P., Thermodynamics, Mc Graw Hill, 4th edition, 2005

Reference Books:

1. Rogers, Mayhew, Engineering Thermodynamics, ELBS, 4th edition, 2003.
2. Arora, C.P., Refrigeration and Air conditioning, TMH, 2nd edition, 2002.
3. Nag P.K., "Engineering Thermodynamics", TMH 2002

09ME204 HEAT AND MASS TRANSFER

Credits:3:1:0

Objective:

- *To provide knowledge about Conduction, convection, radiation, heat transfer during boiling and condensation. To learn about the design of heat exchangers. To understand the principles of mass transfer.*

UNIT I

Introduction to conduction heat transfer, Fourier's law of conduction, thermal conduction equation – derivation in Cartesian, Cylindrical and Spherical coordinates. One dimensional steady state conduction in plane wall and composite wall. Thermal contact resistance variable conductivity, thermal resistance, electrical analogy, radial systems – cylinder, sphere. Overall heat transfer coefficients, critical thickness of insulation. Heat generation in plane wall, cylinder and sphere.

UNIT II

Steady state conduction in two dimensions, conduction shape factor, numerical method of analysis. Unsteady state conduction – lumped heat capacity systems, significance of Biot and Fourier numbers, use of Heisler and Grober charts.

UNIT III

Concept of hydro dynamics and thermal boundary layers. Significance of non-dimensional numbers in connection. Dimensional analysis for free and forced convection. Forced Convection – heat transfer over a flat plate, flow through pipes, use of empirical relations. Free Convection – heat transfer from vertical, horizontal and inclined surfaces. Conduction and Convection systems – fins with different boundary conditions

UNIT IV

Types of heat exchangers, overall heat transfer coefficients, LMTD and NTU methods, fouling factor. Design factors – problems in heat exchangers, effectiveness. Mass transfer – Fick's law of diffusion, equi-molal counter diffusion, Stephen's law, Mass transfer coefficient, non-dimensional number in mass transfer, evaporation process in the atmosphere

UNIT V

Condensation and Boiling processes. Radiation – nature of thermal radiation, black body concepts, gray body, radiation shape factor, relation between shape factors, radiation heat transfer between two surfaces. Electrical analogy, Re-radiating surface, radiation shields.

Text Books:

1. Holman J.P., 'Heat Transfer', SI Metric 8th Ed., Mc Graw Hill, ISE, 2003.
2. Sachdeva, 'Heat and Mass Transfer', Wiley Eastern, 2nd Ed, 2005.

Reference Books:

1. Frank.P.Incropera,David.P.DeWitt 'Heat & Mass Transfer',John Wiley,5Th Edition 2005.
2. P.S.Ghoshdastidar., ' Heat Transfer', Oxford, 2005.
3. Schaum Series., 'Heat Transfer', McGraw Hill, 2004.

4. Yunus.A.Cengal,' Heat Transfer',Tata McGraw Hill,2nd Edition 2003.

09ME205 MECHANICS OF MACHINES - I

Credit: 3:1:0

Objective:

- *To make the students to understand the basic mechanisms and machines of various type s like cams , gears, governors.*

UNIT I

Links, Pairs, chain, Mechanism, inversion of machines, structure, degree of freedom, inversion, four bar chains. Velocity and acceleration: Velocity and acceleration of simple mechanism by relative velocity method. Klein's construction for slider - crank chain, Analytical methods and solution for mechanisms.

UNIT II

Belt and rope drives, single plate, multiple plate cones clutches, power transmitted brakes. Lubrication: Theory of lubrication, hydrostatic and hydrodynamic bearings, fractional loss power in bearing.

Unit III

Cams; Types of cams and followers displacement, velocity and acceleration curves for uniform velocity, uniform acceleration and retardation, SHM, Cyclodial curves. Layout of profile of plate cams of the above types with reciprocating and oscillating followers-knife-edge, Rollers and flat faced followers. Cylindrical and face cams, polynomial cams, cams with special contours.

Unit IV

Theory of gearing, gear nomenclature, law of gearing, tooth forms of gears, minimum number of teeth. Length of arc of contact, interface. Gear trains: Types, velocity ratio and torque calculation in epicyclic gear trains.

UNIT V

Function of Governors - Porter, Proell and spring loaded governors, sensitivity, stability, hunting and isochronisms. Effect of friction. Calculation of equilibrium speeds and ranges of speed of governors. Gyroscope-couple and effects in ship, motor cycle, car, aircraft and space vehicles, gyroscope stabilization.

Text Books

1. Amitabha Ghosh and Asok Kumar Mallik. "Theory of Mechanisms and Machines" -2nd Edition, Affiliated East andWest Press Limited, 2001
2. Khurmi R.S. "Theory of Machines" Khanna Pub. Delhi, 2006.

Reference Books

1. Shigley J.E and Uicker J.J "Theory of Machines and Mechanisms," .McGraw Hill ISE, 2002.
2. Sadhu singh, "Theory of machines", Dhanpath rai& son P.Ltd. 2007.

09ME206 DESIGN OF MACHINE ELEMENTS

Credit: 3:1:0

Objective:

- *To study about various mechanical elements like Cotter joints. And to understand the behavior of elements like springs. And design of pressure vessials.*

UNIT I

Introduction to the design process – factors influencing the machine design, selection of materials based on its physical and mechanical properties. Direct, bending torsional and combined stress equations, impact, and shock loading. Criteria of failure, stress concentration factor, size factor, surface finish factor – factor of safety, design stress, theories of failures – simple problems.

UNIT II

Variable and cyclic loads – fatigue strength and fatigue limit – S-N- curve, combined cyclic stress, Soderberg and Goodman equations – Design of helical, leaf, disc and torsional springs under constant loads and varying loads.

UNIT III

Design of solid and hollow shaft based on strength, rigidity and critical speed. Design and drawing of keys, keyways, couplings, rigid and flexible couplings.

UNIT IV

Design and drawings of riveted joints - pressure vessels and structures, Screw joints, Cotter joints knuckle joints and pipe joints.

UNIT V

Design and drawing of piston, connecting rod, crankshaft, and flywheel.

Text Books:

1. Sundarrajamoorthy, T.V. and Shanmugam, 'Machine Design', Khanna Publishers, 2003.
2. Goseph Edward Shighley, 'Mechanical Engineering Design', McGraw Hill, 2001.

Reference Books:

1. Dobrovolsky, V., 'Machine Elements', MIR Publications, 2000.
2. Hall, A.S., Holowenko, A.R. and Laughlin, HIG., Theory and Problems in Machine Design,Schaums series.

Hand Book

Design Data Book, PSG College of Technology, Coimbatore
Use of approved data books are permitted. The examination shall be of four hours duration.

09ME207 GAS DYNAMICS AND JET PROPULSION

Credit: 3:1:0

Objectives:

- *To learn about the basic concept and importance of Gas dynamics. To understand how the flow takes place in flow and non flow systems. To understand the phenomena of shock, Fanno and Rayleigh flow. To understand the thrust equation and how it used in aircraft and rocket propulsion in an efficient way.*

UNIT I
Gas dynamics – Energy equation for flow processes, stagnation state, velocity of sound, critical states, various regions of flow, Mach number, critical Mach number, Mach cone, Crocco number. Effect of Mach number on compressibility, T-S diagram and h-s diagrams showing nozzle and diffuser process.

UNIT II
Isentropic flow – Isentropic flow with variable area – Mach number variation, area ratio as a function of Mach number, Impulse function, mass flow rate, flow through nozzles, flow through diffusers.

UNIT III
Flow through constant area ducts. Flow in constant area ducts with friction, Fanno curves and Fanno flow equation, solution of Fanno equation, variation of flow properties, variation of Mach number with duct length, Isothermal flow with friction. Flow in constant area ducts with heat transfer, Raleigh line, Raleigh flow equation, variation of flow properties and maximum heat transfer.

UNIT IV
Flow with normal shock waves, governing equations, Prandtl-Meyer equations, impossibility of Rarefaction shock, Mach number in the down stream, of the normal shock, static pressure ratio, temperature ratio, density ratio and stagnation pressure ratio across the shock, entropy change, characteristic of flow through convergent and divergent nozzle with various back pressures. Normal shocks in Fanno and Rayleigh flow. Flow with oblique shock wages (qualitative treatment).

UNIT V
Propulsion – Air craft propulsion – types of jet engines, energy flow through jet engines, thrust power and propulsive efficiency, turbo jet components – diffuser, compressor, combustion chamber, turbines, exhaust systems. Performance of jet engine, thrust augmentation, turbo prop engines, ram jet and pulse jet engines. Rocket propulsion – rocket engines, basic theory of equations, thrust equations, effective jet velocity, specific impulse, rocket engine performance, solid and liquid propellant rockets.

Text Books:
1. Yahya, S.M., 'Fundamentals of Compressible flow with aircraft and rocket propulsion', 3rd Ed,. Wiley Eastern, 2003

Reference Books:
1. Dr. Somasundaram S.L., 'Gas Dynamics and Jet Propulsion', Newnes – Butterworths & Co Publishers Ltd1999.
2. S.Senthil, 'Gas Dynamics and Jet Propulsion',A.R.S.Puublications,3rd Ed,2006.
3. Anderson, D. John Jr., 'Introduction to Flights', Mc Graw Hill, ISE, 2004.

09ME208 DESIGN OF TRANSMISSION SYSTEMS

Credit:3:1:0

Objective:

- *To study about various mechanical transmissions systems and design of bearings, chains and ropes. To have a better understanding of gears and design of spur gears, helical gears, herring bone gears, straight and spiral bevel gears, worm gears and skew gears. To design the gear box, speed reducers, speed diagrams and stepped pulley.*
- *To study the mechanism of ratchet and pawl, cams and power screws.*

UNIT I
Selection of bearings based on loads - Design of Journal bearings – sliding contact and rolling contact types – Design of flat belt, V-belt

UNIT II
Design and selection of Chains, ropes. Design of gears – spur gear, helical gear and herring bone gears.

UNIT III
Design of bevel gears – straight and spiral bevel types. Design of worm gears, skew gears.

UNIT IV
Design of gearbox – speed reducers – speed diagrams, Stepped pulley.

UNIT V
Design of a Ratchet & pawl mechanism, Geneva mechanism, Design of cams-Contact stress and Torque calculation, power screws.

Text Books:
1. *Sundarajamoorthy T.V. and Shanmugam, 'Machine Design', Khanna, II revised edition 2002.*
2. Sen G. C. & Bhattacharyya A, 'Principles of Machine Tools', New Central Book Agency (P) Ltd., IInd edition ,1999.
3. Prabhu.T.J., Design of Transmission elements, 1998. 5th edition ,2002.

Reference Books:
1. V. Dobrovolsky, 'Machine Elements', MIR, IInd edition1999.
2. Hall A.S. Holowenko A.R. and Laughlin H.G., 'Theory and Problems in Machine Design', Schaum's Series,2000.
3. Hall and Allen, 'Machine Design', S.Schaum's Series, .Ist edition 2001
4. Joseph Edward Shighley, 'Mechanical Engineering', McGraw Hill, 2002

Hand Book
1. PSG College of Technology, 'Design Data Book', Coimbatore. Use of approved data books are permitted in the examination.

09ME209 MACHINE DRAWING

Credits : 0:0:2

1. Orthographic projection of simple models and from given isometric drawing of simple blocks and machine parts.
2. Isometric and oblique drawing.
3. Introduction of pictorial, drawing, construction of isometric scale, its use in isometric drawing.
4. Isometric drawing and oblique of simple blocks and machine parts.
5. Conventions used in Machine Drawing.
6. Conventional representation of common features in mechanical drawing like screw threads, rolled sections bearings tension spring, gear and pinion as per IS:696.
7. Conventional representation of materials on per IS:696.
8. Conventional method of representation of full sectional and half sectional views of machine parts as per IS:696.
9. Free hand sketches of bolt and nuts. Locking devices, studs, rivet-heads, keys cotters and simple machine part.
10. Freehand sketches of the following universal coupling.
11. Different joints like socket joints, union joints, expansion joint, bush bearings.
12. Dimensional and sectional drawing of – bench vice, Plummer Block, Machine Parts – Cotter joint, Knuckle joint.

Text Book

1. Gopalakrishnan, "Machine Drawing" , Subash Publishers,2000 .Division of Production Engineering 16
2. Donald Hean and M. Pauline Baker, "Computer Graphics", Printice Hall Inc., 2002

Reference Books

1. Bhatt, N.D. "Machine Drawing", Charotar Publishing House, Anand,2003.
2. Siddheswar, N. P.Kanniah, and V.V.S. Satry, "Machine Drawing", Tata McGraw Hill,2005
3. Revised IS codes; 10711, 10713, 10714,9609, 1165, 10712, 10715, 10716, 10717, 11663, 11668, 10968, 11669, 8043, 8000.

09ME210 THERMAL ENGINEERING LAB

Credits : 0:0:1

1. Boiler study and trial
2. Study and performance characteristics of Steam turbine
3. Dryness fraction of steam using Calorimeters
4. Performance characteristics of a constant speed air blower

5. Verification of fan laws and static efficiency of air blower.
6. Test on reciprocating compressor.
7. Coefficient of performance of a Vapors compression Refrigeration plant.
8. Performance test on Air Conditioning Plant.
9. Performance test on Heat pump.

09ME211 DYNAMICS LAB

Credits:0:0:1

1 Helical Spring
2 Jump speed analysis of Cam and Followers
3 Whirling of Shaft
4 Undamped free vibration of Equivalent Spring Mass System.
5 Undamped free vibration of Single Rotor system.
6 Motorized Gyroscope
7 Measurement of Strain using Strain Gauge Indicator.
8 Dynamic Balancing Machine.
9 Lathe Tool Dynamometer
10 Drill Tool Dynamometer

09ME212 METROLOGY LAB

Credits: 0:0:1

1. Use of precision measuring instruments like micrometer, Vernier, height and depth gauges, surface plate, height master, etc.
2. Checking dimensions of machined parts and squareness of try square using slip gauges
3. Use of sine bar for measuring angles and tapers
4. Measurement of tooth thickness by gear tooth vernier; concentricity tester for measurement of PCD run-out
5. Calibration of plug and dial gauges
6. Taper and bore measurement using spheres.
7. Fundamental dimensions of a gear using optical profile projector
8. Checking straightness of a surface plate using auto-collimator
9. Measurement of angle between Centre lines of holes drilled radially on a shaft.
10.Measurement of thread parameters using floating carriage micrometer
11. Use of pneumatic comparator` and mechanical comparator.
12.Micro hardness measurement and surface finish measurement

09ME213 SPECIAL MACHINES LAB

Credit: 0:0:1

1. Machining Rectangular Block Using Shaper
2. Machining Rectangular Block Using Milling Machine
3. Machining V Block Using Shaper
4. Spur Gear Cutting
5. Key Way Cutting

6. Cylindrical Grinding

09ME214 HEAT TRANSFER AND INTERNAL COMBUSTION ENGINE LAB

Credit: 0:0:1

1. Study of heat Conduction through Composite wall.
2. Thermal Conductivity test for Insulating medium.
3. Heat transfer in Natural Convection.
4. Heat transfer from a Pin-Fin (Forced Convection).
5. Heat balance test on 4-Stroke bi-fuel Single cylinder Diesel Engine.
6. Performance test on 4-Stroke Twin cylinder Vertical Diesel Engine.
7. Valve Timing Diagram for 4-Stroke Diesel Engine.

09ME215 CAM Lab

Credit 0:0:1

1. Study and programming of CNC XL Mill Trainer.
2. Profile cut: Linear interpolation.
3. Profile cut: Circular interpolation.
4. Profile cut: Linear and circular interpolation.
5. Square pocketing and drilling using canned cycles.
6. Mirror programming.
7. Step turning in CNC Trainer lathe.

09ME216 CAD Lab

Credit 0:0:1

1. 3D modeling with Extrude, Round, Mirror commands
2. 3D modeling with Revolve , Hole pattern commands
3. 3D modeling with Rib , Chamfer, Draft commands
4. Assembly of Knuckle Joint
5. Assembly of Plumber block
6. Surface model of a Phone Receiver
7. Advanced modeling commands Sweep and Blend.

09ME217 FOUNDRY, SMITHY, WELDING & SHEET METAL LAB

Credit: 0:0:2

1. Study of Foundry, Smithy, Welding and Sheet Metal tools

Foundry:

2. Sand Moulding using single piece solid circular pattern
3. Sand Moulding using stepped cone pulley pattern
4. Sand Moulding using flange pattern

Welding:

5. Welding Butt Joint
6. Welding Lap Joint
7. Welding T- Joint

Smithy:

8. Making a square from a round rod
9. Making an L-bend
10. Making J- bend

Sheet Metal:

11. Sheet metal working of rectangular office tray
12. Sheet metal working of hopper

09ME218 METALLURGY LAB

Credit: 0:0:1

1. Study and use of metallurgical microscope
2. Strength of foundry sand
3. Permeability of foundry sand
4. Strength of foundry sand
5. Identification of metal specimen
    a) Grey Cast Iron
    b) Spheroidal Cast Iron
    c) Malleable Cast Iron
6. Identification of metal specimen
    a) Normalised Low Carbon Steel
    b) Case Carburised Steel

09ME219 CONCEPTS OF ENGINEERING DESIGN

Credit 4:0:0

Objective:

- *Instill the philosophy that real engineering design is often an open-ended, illstructured process*
- *To Provide students with in-depth practice in design and the use of a structured approach to design*
- *To Develop and practice teamwork, critical thinking, creativity, and independent Learning*
- *To Provide an introductory knowledge of business practices, economic viability, environmental sustainability and the social consequences of technology*
- *To learn the process of design based on the scientific method, to combine creative thinking with engineering principles to turn ideas into robust reality*

UNIT I

The Design Process

The design process - Morphology of Design - Design drawings - Computer Aided Engineering - Designing of standards - Concurrent Engineering - Product life cycle - Technological Forecasting - Market Identification -Competition Bench marking - Systems Engineering - Life Cycle Engineering - Human Factors in Design -Industrial Design.

UNIT II
Design Methods
Creativity and Problem Solving - Product Design Specifications - Conceptual design - Decision theory - Embodiment Design - Detail Design - Mathematical Modeling - Simulation - Geometic Modelling - Finite Element Modelling

UNIT III
Material Selection Processing And Design
Material selection Process - Economics - Cost Vs Performance - Weighted property Index - Value Analysis -Role of Processing and Design - Classification of Manufacturing Process - Design for Manufacture - Design for Assembly - Residual stresses - Fatigue, Fracture and Failure

UNIT-IV
Engineering Statistics And Reliability
Probablity - Distributions - Test of Hypothesis - Design of Experiments - Reliability Theory.

UNIT-V
Quality Engineering
Total Quality Concept - Quality Assurance - Statistics Process Control - Taguchi Methods - Robust Design-Failure Model Effect Analysis.

Text book:
1. *Dieter George E., " Engineering Design -A Materials and Processing Approach", McGrawHill,International Edition Mechanical Engg ., Series ,2000.*

References:
1. Palh .G. and Beitz .W., " Engineering Design ", Springer - Verlag , NY. 2001.
2. Ray .M.S., " Elements of Engg. Design ", Prentice Hall Inc .1985.
3. Karl t. Ulrich and Steven d Eppinger "Product Design and Developement " ,McGraw Hill,Edition 2004.

09ME220 COMPOSITE MATERIALS

Credits: 4:0:0

Objective:
- *To develop an understanding of composite materials*
- *To equip them with knowledge to carry out stiffness and strength analysis of continuous-fiber-reinforced laminated composites*
- *To introduce them to manufacturing methods for composites*
- *To impart the theories governing the bending, buckling and vibration behavior of beam, plate and shell structural elements*
- *To understand the Failure of composite structure and General design considerations in dealing with composite materials*

UNIT I
Introduction.

Definition – need- General Characteristics, applications, Fibers- Glass, Carbon, Ceramic and Aramid fibers. Matrices- polymer, Graphite, Ceramic and Metal Matrices- Characteristics of fibers and matrices, Smart Materials- type and Characteristics.

UNIT II
Mechanics And Performance
Characteristics of fiber-reinforced lamina-laminates-interlaminar stresses – Static Mechanical properties- Fatigue and Impact properties- Environmental Effects - Fracture behaviour and Damage Tolerance.

UNIT III
Manufacturing
Bag Moulding - Compression Moulding - Pultrusion - Filament Winding -Other Manufacturing Processes -Quality Inspection methods.

UNIT IV
Analysis
Stress analysis of laminated Composite beams, plates, shells- vibration and stability analysis – reliability of composites- finite element method of analysis of composites.

UNIT V
Design And Testing
Characterization of composite products – laminate design consideration- bolted and bonded joints design examples- failure mode Predictions.

Text Book:
1. Mallick, P.K., Fiber- Reinforced composites: Materials, Manufacturing and Design" Maneel Dekker inc.2006.
2.William Callister., "Engineering Materials", John Wiley and Sons, New York, 2000.

References:
1. Halpin, J. C., "Primer on Composite Materials, Analysis" Techomic Publishing Co., 2006.
2. Mallick, P.K. and Newman, S., " Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 2006.
3. Sharma.S.C. "Composite Materials", Prentice Hall of India, 2000.

09ME221 HUMAN FACTORS IN ENGINEERING AND DESIGN

Credit 4:0:0
Objective:
- *To introduce the Fundamental terms and concepts of human factors*
- *To discuss anthropometric, biomechanical and physiological principles and how they are used to optimize human well-being and overall performance.*
- *To Identify, Analyze, Setup and implement solutions to a human factors problem*
- *To learn the impact of human factors in workplace design-environment and Productivity and to work with the latest OSHA guidelines and regulations.*

UNIT I
Introduction

Definition, human technological system, multidisciplinary engineering approach, human–machine system, manual, mechanical, automated system, human system reliability, conceptual design, advanced development, detailed design and development, human system modeling.

UNIT II

Human Output And Control

Physical work, manual material handling, motor skill, human control of systems, controls and data entry devices, hand tools and devices.

UNIT III

Workplace Design

Applied anthropometry, workspace design and seating, arrangement of components within a physical space, interpersonal aspects of work place design, design of repetitive task, design of manual handling task, work capacity, stress, fatigue.

Environmental Conditions Illumination, climate, noise, motion, sound, vibration.

UNIT IV

Biomechanics

Biostatic mechanics, statics of rigid bodies, upper extremity of hand, lower extremity and foot, bending, lifting and carrying, biodynamic mechanics, human body kinematics, kinetics, impact and collision.

UNIT V

Biothermodynamics And Bioenergitics

Biothermal fundamentals, human operator heat transfer, human system bioenergetics, thermoregulatory physiology, human operator thermo regularity, passive operator, active operator, heat stress.

Human Factors Applications Human error, accidents, human factors and the automobile, organizational and social aspects, steps according to ISO/DIS6385, OSHA's approach, virtual environments.

Text Book

1. *Karl Kroemer, Henrike Kroemer, Katrin Kroemer-Elbert, "ERGONOMICS" How to Design for Ease & Efficiency, Prentice Hall International Editions, 2001.*

Reference Books

1. *Mark S Sanders, "Human Factors in Engineering and Design", McGraw Hill, New York, 1993.*
2. *Bridger R S, "Introduction to Ergonomics", Taylor and Francis, London, 2003.*
3. *Martin Helander, A Guide to Ergonomics of Manufacturing, TMH, 1996.*
4. *Mccormic,E.J. and Sanders.M.S " Human factors in Engineering and Design ",McGraw Hill, 1992.*

09ME222 RAPID PROTOTYPING

Credit:4:0:0

Objective:

- *To provide knowledge on fundamentals of new techniques in product development and their applications.*

UNIT I
Introduction
Need for the compression in product development, History of RP systems, RP fundamental-basic steps, Applications of RP- prototyping, rapid tooling-direct and indirect and rapid manufacturing, Classification of RP systems.

UNIT II
Liquid Based RP processes
Stereo lithography Systems: Principle, Process parameters, Process details, Data preparation, Data files and Machine details, Applications. Solid Ground Curing: Principle of operation, Machine details, Applications.

UNIT III
Solid Based RP processes
Fusion Deposition Modeling: Principle, Process parameters, Path generation, Applications. Laminated Object Manufacturing (LOM): Principle of operation, materials, Process details, Applications.

UNIT IV
Powder Based RP processes
Selective Laser Sintering: Types of machines, Principle of operation, Process parameters, Data preparation for SLS, Applications. Direct shell production casting- Applications. Three Dimensional (3D) Printing – principle, applications. Laser Engineered Net Shaping (LENS) – principle –applications.

UNIT V
Rapid Tooling
Indirect Rapid Tooling –Room Temperature Vulcanizing Silicone rubber tooling, Spray metal tooling. Direct Rapid Tooling - Direct AIM, Copper polyamide, Direct Metal Laser Sintering

Text Books
1. *Rafique Noorani," Rapid prototyping- Priniciples and Applications" , John Wiley & Sons Inc. New Jersey,2005*
2. *Paul. F. Jacobs, "Stereo lithography and other RP & M Technologies", SME, NY, 1996.*

Reference Books
1. *Pham. D. T. & Dimov. S. S., "Rapid Manufacturing", Verlag, London, 2001.*
2. *Terry Wohlers, "Wohlers Report 2006", Wohlers Associates, 2006.*

09ME223 METAL CUTTING THEORY AND PRACTICE

Credit 4:0:0

Objectives :

- *To learn fundamentals of metal cutting theory, tool nomenclature, tool materials wear mechanisms and thermal aspects of machining*

UNIT I
Introduction
Basic mechanism of chip formation-types of chips-Chip breaker-Orthogonal Vs Oblique cutting- force and velocity relationship and expression for shear plane angle in orthogonal cutting-Energy Consideration in machining-Modern theories in Mechanics of cutting -Review of Merchant and Lee Shaffer Theories-critical comparison.

UNIT II
Tool Nomenclature and Cutting Forces
Nomenclature of single point tool - Systems of tool Nomenclature and Conversion of rake angles - Nomenclature of multi point tools like drills, milling cutters and broaches. Forces in turning, drilling and milling - specific cutting pressure- measurement of cutting forces.

UNIT III
Thermal Aspects of Machining
Thermodynamics of chip formation - Heat distributions in machining-Effects of various parameters on temperature - Method of temperature measurement in machining - Hot machining - cutting fluids.

UNIT IV
Tool Materials, Tool Life and Tool Wear
Essential requirements of tool materials - Developments in tool materials-ISO specifications for inserts and tool holders-Tool life- optimum tool life - Conventional and accelerated tool life tests- Concepts of machinability and machinability index - Economics of machining

UNIT V
Wear Mechanisms and Chatter in Machining:
Reasons for failure of cutting tools and forms of wear-mechanisms of wear - chatter in machining - Factors effecting chatter in machining - types of chatters-Mechanism of chatter based on Force Vs Speed graph, Mechanism of grinding - Various parameters affecting grinding process.

Text Books:
1. *Shaw .M.C., " Metal cutting Principles ",Oxford clarendon Press,1984.*
2. *Juneja.B.L and Sekhon.G.S- " Fundamentals of metal cutting and machine tools", New Age International(p) Ltd., 1995.*
3. *Bhattacharya. - " Metal Cutting Theory and Practice ", New central Book Agency pvt. Ltd., Calcutta1984.*

References:
1. *Venkatesh .V.C. & Chandrasekharan.H. “Experimental Techniques in Metal cutting", Prentice Hall of India, 1982.*
2. *Xing Sheng LI & Low I.M., Editors Advanced Ceramic Transtech Publications, 1994.*
3. *Kuppuswamy.G.- "Principles of metal cutting", Universities Press(India)Ltd., 1996*
4. *Boothroy.D.G. and Knight. W.A "Fundamentals of Machining and Machine tools", Marcel Dekker, New York, 1989.*

09ME224 MECHATRONICS AND CONTROLS

Credit 4: 0: 0

Objective:

- *To learn basics of control systems, programmable logic controls, controls in NC machines and pneumatic controls*

UNIT I

Introduction

Introduction - multidisciplinary scenario - evolution of mechatronics - scope of Mechatronics- measurement systems - control systems - servomechanisms and regulators - control system fundamentals - block diagrams and block diagram reduction.

UNIT II

Control systems and programmable logic controllers

Stability of control systems - Rouths and Hourwitz stability criteria - programmable logic controllers (PLC) - input output processing - programming (fundamentals only) - nemonics-timers - shift registers - master and jump controls - data handling - selection of PLC.

UNIT III

Elements of Mechatronics

Mechartonic elements - data presentation systems - displays - analog and digital indicators -analogous chart recorders - visual display units - CRO - printers - magnetic recorders - lightindicators - liquid crystal display units - alarm indicators data loggers - computers with plugin boards-data acquisition systems.

UNIT IV

Controls in NC Machines and fluidic control

Controls in NC Machines-hydraulic systems - direct current motors - stepping motors - feedback devices-encoders - resolvers - inductosyn – tachogenerators - principles of fluid logic control -Coanda effect - basic fluidic devices - fluidic logic gates - bistable - flipflop -OR and NOR gates - exclusive OR gates - fludic sensors - backpressure sensor - cone jetproximity sensor -interruptible jet senor.

UNIT V

Process control Pneumatics

Process control pneumatics - signals and standards - the flapper nozzle - volume booster – air relay and force balance - pneumatic controllers - proportional pneumatic control - proportional plus integral pneumatic control - proportional plus integral plus derivative pneumatic control - PI and IP convertors.

Text books

1. *W Boltson 'Mechatronics' PearsonEducation third edition 2007.*
2. *Andrew Parr, 'Hydraulics and Pneumatics', Jico Publishing House ,Mumbai 2006.*
3. *Kuo, 'Automatic Control Systems', Asian student Edition, Printice Hall of India,2005.*

Reference Books

1. *Mahalik,Nitaigour,Premehand, 'Mechatronics', TataMc.Graw Hill Publishers, New Delhi 2005.*
2. *Anthony Esposito, 'Fluid Power', Pearson Education, 2005*
3. *Ogata Katsuhiko , 'Modern Control Engineering', Printice Hall of India , 2005.*
4. *Yoram Koren, 'Computer control of Manufacturing Systems', TataMc.Graw Hill Publishers, New Delhi, 2005.*

09ME225 FLUID POWER CONTROL

Credit: 4:0:0

Objective :

- *To learn about fluid power automation, and fundamentals of hydraulic and pneumatic systems*

UNIT I

Fluid power Automation

Need for and development of automation, principles of automation, basic concepts, feasibility of automation, economic considerations. Symbols used for various hydraulic circuit components, Boolean algebra, truth tables.

UNIT II

Elements Of Hydraulic System.

Air and Hydraulic cylinders, pressure accumulators, fluid reservoirs, check valve, flow control valves, directional control valves, restrictors, relief valve, hydraulic servo systems, Fluid power symbols, electrical devices for hydraulic circles.

UNIT III

Transmission Of Hydraulic Drives

Constant and Variable delivery types, gears, vane and piston pumps, design and construction, linear motor cylinder and piston drives, design and construction**.**

UNIT IV

Hydraulic Circuits

Reciprocation, quick return, sequencing, synchronizing clamping and accumulator circuits, press circuits, hydraulic copying machine circuit, fluidic elements.

UNIT V

Pneumatic And Low-cost Automation

Pneumatic circuits, components simple circuit and application, low cost automation circuits for product handling and operation and machine tools and presses. Application of pneumatics and Hydraulics in CNC machining centers.

Text Book

1. *Anthony Esposito, " Fluid power with applications", Prentice Hall,2000.*
2. *Ramakrishnan M. " Industrial Automation", Swathi Publications, 1999.*

Reference Books

1. *Hary C. Steward, " Practical guide to fluid power", D.B. Tarapovevala sons & Co Pvt Ltd. Bombay 1987.*
2. *Steward H.L. " Hydraulic and pneumatic power for production, Industrial press", New York, 1987.*
3. *Andrew par, " Hydraulic and pneumatic", 1993.*
4. *Shearer J. L. " Fluid power control", John wiley, 1989.*
5. *"Electro Hydraulics" FESTO didactic KG D- 73734 Esslingen1994.*

09ME226 WELDING TECHNOLOGY

Credit 4:0:0
Objective :

- *To introduce fundamentals of welding technology.*

UNIT I
Basic Joining Processes and Equipment
Types of welding-gas welding-arc welding-shielded metal arc welding, GTAW, GMAW,SAW – Resistance welding (spot, seam, projection, percussion, flash types)-thermit welding - soldering, brazing and braze welding- Welding power sources and characteristics-welding electrodes- safety aspects in welding

UNIT II
Design of Weldments
Welding symbols-Positions of welding-joint and groove design-weld stress-calculationsdesignof weld size-estimation of weld dilution, preheat and post heat temperature- brief introduction to welding codes & standards (ASME / ASTM / AWS)

UNIT III
Welding Metallurgy
Weldability of cast iron , steel, stainless steel, aluminium alloys , dissimilar metals-effect of gases in welding-residual stresses-distortion-relieving of stresses

UNIT IV
Inspection and Testing
Defects in welding-causes and remedies-destructive testing methods –non destructive testing (visual inspection , liquid penetrant inspection, radiographic inspection, magnetic particle inspection, ultrasonic inspection & pressure and leak testing)- case studies -testing of pipe, plate, boiler drum,

UNITS V
Special welding Processes
Electron beam and Laser beam welding-plasma arc welding-stud welding-friction welding explosive welding-ultrasonic welding-underwater welding-welding of plastics - automation of welding, seam tracking, vision and arc sensing-welding robots

Text Books
1. *Khanna, O.P., "A Text book on Welding Technology", Dhanpet Rai & sons, Delhi, 2002.*
2. *Little, R.L, "Welding and Welding Technology", TMH, Delhi, 2000*

Reference Books
1. *Rao, P.N. "Manufacturing Technology", 2 nd edition ,TMH Publications, New Delhi,1998*
2. *Houldcraft, P.T., "Welding process Technology" ,Cambridge University press, 1990.*
3. *Parmar, R.S., "Welding Process and Technology", Khanna Publishers, Delhi,. 1992.*
4. *AWS. "Welding Hand book", Vol I & II, 1996.*

09ME227 FOUNDRY TECHNOLOGY

Credits :4:0:0

Objective:

- *To introduce to students various foundry process and their application.*

UNIT I
Introduction
Introduction to moulding and casting Processes – Steps involved – advantages, limitations and application of casting process. Patterns – Types, pattern allowances, Pattern materials and pattern making, Cores – Core prints , Core boxes and core making.

UNIT II
Moulding Processes
Manual moulding processes – equipments and tools – Moulding sand ingredients – Moulding sand properties, influence of ingredients on properties – sand preparation and control – sand testing – machine moulding – types of machines, applications – core blowers – core shooters.

UNIT III
Casting Processes
Sand casting processes –permanent mould casting processes-pressure die casting, centrifugal casting – precision/investment casting-shell moulding, CO_2 moulding – continuous casting –squeeze casting – electro slag casting processes, Vacuum process, full mould process, magnetic moulding process.

UNIT IV
Melting, Pouring And Testing
Foundry – remelting, furnaces – selection of furnace – Crucible, oil fired furnace, electric furnaces – Resistance, arc, induction furnaces – cupola steel melting, non-ferrous melting practices, pouring equipments, Inspection of castings, destructive and non destructive, Casting defects – Occurrence, causes and remedies.
UNIT V
Pouring, Feeding And Automation
Gating system – functions-types of gating system-Gating Ratio-Riser – function –types of risers – riser design – foundry layout and automation.

Text Book
1.Jain P.L. "Principles of Foundry Technology", Tata McGraw-Hill, 2003
References
1 *Heine, Lpoer et al "Principles of Metal Casting" McGraw-Hill Publishing Company Ltd 1999.*
2 *Taylor H.F. Fleming M.C. & Wulff.J "Foundry engineering"; Wiley Eastern Ltd.1993.*
3 *Gupta R.B "Foundry Engineering"; Satyaprakashan, New Delhi, 1989.*
4 *Lal,Mand Khanna O.P "A Text Book of Foundry Technology" Dhanpat Rai and Sons, New Delhi 1986.*
5 *Lindberg R. a "Processes and Materials of Manufacture" Prentice Hall of India Pvt., Ltd., 2000*
6 *"ASM Metals Hand Book on casting" 1992.*
7 *Banga T.R. and Agarwal R.L. "Foundry Engineering", Khanna Publishers, 1992.*

09ME228 HEAT ENGINES AND FLUID MACHINERY

Credits 3:1:0

Course Objective:
To provide knowledge about Fluid properties, pumps, turbines, basic concepts and laws of thermodynamics, I.C.Engines, Conduction, convection and radiation heat transfer

UNIT-I:
Fluid Properties: Fluid density-specific weight-specific gravity – viscosity- surface tension - capillary - compressibility - vapor pressure – Manometers – Simple problems.
PUMPS: Positive displacement pumps and reciprocating pumps - operating principles -slip - Indicator diagram - separation- air vessels centrifugal pumps - operation – overall performance curves- cavitation -multi staging -selection of pumps - jet pump - compressor pump - submersible pump - gear oil pump -construction and principle of operation. – working principle of air compressor.

UNIT-II:
Turbine impulse momentum equation- moment of momentum equation (theory only) - turbine Classification-working principles -pelton wheel, Francis, Kaplan turbines - velocity triangles -draft tube- similarity laws - specific speed - governing of turbines- surge tanks.

UNIT-III
Basic concepts - thermodynamic system - properties - processes - cycle - equilibrium - first law of thermodynamics - application of first law to non flow and flow process - second law of thermodynamics - Kelvin Planck's statement -Clausius statement - reversibility - Carnot theorem - heat engine - reversed heat engine - entropy.

UNIT-IV
I.C.Engine - air standard cycles - air standard efficiency - Otto, Diesel and Brayton cycles- testing of IC Engines - performance curves, FHP determination, heat balance.

UNIT-V
Heat transfer - modes of heat transfer - steady state heat conduction - heat conduction with internal heat generation - extended surfaces - fin - convection - empirical relations - Radiation - laws of radiation - radiant heat transfer between two surfaces.

Text Books
1. Modi, P.N. & Seth, S.M., "Hydraulics and Fluid Mechanics", (Including hydraulic machines) Standard Book House, New Delhi, 15th Edition, 2005.
2. Nag P.K., "Basic and applied Thermodynamics" TMH, New Delhi, 2002.

Reference Books
1. Som,S.K, & Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, 2000.
2. Holman, "Heat Transfer", McGraw Hill International, 8th, Edition, 2003.
3. Cengel,. A., "Introduction to Thermodynamics and Heat Transfer", Tata McGraw` Hill, New Delhi, 1997.
4. Kothandaraman,C,P., etal, "A course in heat engines and thermodynamics", Dhanpat Rai & Sons, 5th Edition, 2002.

09ME229 INTRODUCTION TO NANO TECHNOLOGY AND MICROMANUFACTURING

Credits 4:0:0

Objective:
- *To give an introduction to the concepts in micromachining and Nano technology*

UNIT I

Introduction to Nanotechnology and investigating materials in Nano scale
Introduction to Nanotechnology-Experimental methods-Introduction-Electron Microscopy-Scanning probe microscopy-Optical microscopy for Nano science and Technology

UNIT II
Carbon Nan tubes, their production, application and societal implications of Nano Science and Nano Technology
Introduction-Carbon nano tubes-structures-properties-production of carbon Nano tubes-Chemical Vapour deposition-Arc discharging-Laser ablation-Mechanisms of growth-purification-Applications of carbon Nanotubes- Electrical transport of carbon nanotubes-applications in computers biomedical applications-X-ray equipments-Nanomechanical actuators-Societal implications of Nano science and Nanotechnology-

UNIT III
Micro Fabrication and Micro Manufacturing
Introduction-Photo lithography-ion implantation-Diffusion-Oxidation-Chemical vapour deposition-physical vapour deposition-depolition by Epitaxy-Etching-Micro manufacturing-Introduction-Bulk micro manufacturing-Isotropic and Anisotropic Etching-wet etchants-Etch stop-Dry Etching-Surface micromanufacturing-Mechanical problems associated with Surface Micromachining-The LIGA process-general description-Materials for substrates and photoresists-The SLIGA process

UNIT IV
Introduction to principles of Micro Electro Mechanical Systems & Micro Opto Electro Mechanical Systems (MOEMS)

Introduction- Micro Electro Mechanical Systems(MEMS) –microelectronics fabrication methods- Micro instrumentation-Micro instrumentation- Micro Mechatronics-Nano finishing- Optically variable devices-MECS-Micro propulsion-e beam Nano lithography-Nanotechnology-Carbon nanotubes-Molecular Logic Gates- Micro devices-Bio sensors,-Principles of MEMS-introduction-MechanicalMEMS-thermal MEMS-Magnetic MEMS-and MOEMS-

UNIT V
Nano Finishing Techniques
Nano Finishing Techniques-Introduction-Traditional anfd advanced finishing process-Abrasive Flow machining-Magnetic Abrasive finishing-Magnetorheologial Finishing- Magnetorheologial Abrasive Flow Finishing-Magnetic Float Polishing- Elastic Emission Machining-Ion Beam Machining- Chemucal Mechanical Polishing

Text book
1. *N.PMahalik, "Micro manufacturing and Nanotechnology," Springer Verlag, Berlin Heidelberg 2006*
2. *T Pradeep, "NANO The Essentials" Tata McGraw-Hill New Delhi 2007*
3. *Tai-Ran Hsu " MEMS &Microsystems Tata McGraw-Hill New Delhi 2005*

References
1. *V K Jain "Advanced Machining Processes" allied Publishers (P) Ltd. 2008*
2. *Introduction to Nanotechnology, Charles P.Poole, Jr. and Frank J.Owens, Wiley, 2003*
3. *Michael Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and Burkhard Raguse, "Nanotechnology – Basic Science and Emergin Technologies", Chapman & Hall(CRC), 2004*

09ME230 COMPUTER SIMULATION OF IC ENGINES PROCESS

Credits 4:0:0

Objective:

- *This course mainly deals with computer simulation on SI Engine, Combustion of SI Engines and Diesel engines.*

UNIT I
Introduction
Introduction - Heat of reaction - Measurement of URP - Measurement of HRP - Adiabatic flame temperature: Complete combustion in C/H/O/N Systems, Constant volume adiabatic combustion, constant pressure adiabatic combustion. Calculation of adiabatic flame temperature - Isentropic changes of state.

UNIT II
SI Engine Simulation With Air As Working Medium
Deviation between actual and ideal cycle - Problems, SI engine simulation with adiabatic combustion, temperature drop due to fuel vaporization, full throttle operation - efficiency calculation, part-throttle operation, super charged operation.

UNIT III
Simulation Of 2 Stroke SI Engine
Multi zone model for combustion in 2 stroke petrol engines, simulation of engine performance, simulation for pollution estimation

UNIT IV
Progressive Combustion In 4 Stroke SI Engine
4 Stroke SI Engines simulation with progressive combustion with gas exchange process, Heat transfer process, friction calculation, compression of simulated values, validation of the computer code, engine performance simulation, pressure crank angle diagram and other engine performance.

UNIT V
Diesel Engine Simulation
Multi zone model for combustion, different heat transfer models, equilibrium calculations, Simulation of engine performance, simulation for pollution estimation.

Textbooks:
1. Ganesan.V. " Computer Simulation of spark ignition engine process ",Universities Press (I) Ltd, Hyderbad, 2002
2. Ramoss.A.L., " Modelling of Internal Combustion Engines Processes" McGraw Hill Publishing Co,2000.

References:
1. Ashley Campbel, " Thermodynamic analysis of combustion engines ", John Wiley & Sons, New York, 1986.
2. Benson.R.S., whitehouse.N.D., " Internal Combustion Engines ", Pergamon Press, oxford, 1979.

09ME231 ALTERNATIVE FUELS FOR IC ENGINES

Credit: 3:1:0

Objective:

- *This course mainly deals about Alternative Fuels And Energy Systems, various types of fuels and energy, performance of fuels, emission, and specification of various powered vehicles.*

UNIT I
Fuels
Introduction, Structure of petroleum, Refining process, Products of refining process, Fuels for spark ignition, Knock rating of SI engine fuels, Octane number requirement, Diesel fuels and Numerical Properties of Petroleum products ,Specific gravity, Density, Molecular weight , Vapour Pressure, Viscosity, Flash point, Fire point , Cloud Point, Pour point, Freezing Point, Smoke Point and Char value, Anilin point, Octane number, performance number, Cetane number, Emulsification, Oxidation Stability, Acid value/Number, Distillation Range & sulphur content.

UNIT II
Alternative Fuels For IC Engines
Need for alternate fuels such as Ethanol, Methanol, LPG, CNG, Hydrogen, Bio gas and producer gas and the method of manufacturing Single fuel engines. Properties of alternate fuels, use of alternative fuels in SI engines, Engine modification required, performance in emission and emission characteristics of alternative fuels in SI mode of operation v/s Gasoline operation.

UNIT III
Duel Fuel Engine
Need and advantages, The working Principle , Combustion in duel fuel engines, Factors affecting combustion in dual fuel engine, use of alcohols, LPG, CNG, Hydrogen, Bio gas and producer gas in CI engine in dual fuel mode, Engine modification required, performance and emission characteristics of alternative fuels(mentioned above) in dual fuel mode of operation v/s diesel operation.

UNIT IV
Biodiesels
What are biodiesels, Need of biodiesels, Properties of biodiesels v/s Petrol diesel, Performance and emission characteristics of biodiesel v/s petrol diesel operation.

UNIT V
Availability
Suitability & Future prospects of these gaseous fuels in Indian context. Environmental Pollution with convection and alternative fuels, Pollution control methods and packages.

Texts Book :
1) R.P.Sharma and M.L.Mathur : "A course in Internal Combustion Engines", D.Rai & sons. 2002

Reference Books :
1) John B. Heywood : Internal combustion Engines Fndamentals"", McGraw Hill Internation Edition,
2) Osamu Hirao & Richard Pefley : "Present and future Automotive fuels", Wiley Interscience Publication. NY. 1988.
3)O.P.Gupta : "Elements of fuels, furnaces and Refractories", Khanna Publishers 2000
4) Domkundawar V.M : "Internal Combustion Engines", I Edition, Dhanpat Rai & Co., 1999

09ME232 AUTOMOTIVE AIR-CONDITIONING

Credits 4:0:0

Objective:

- *Optimum aim of the course is to achieve optimal usage of available resources to get maximum output. It gives idea about various Air-Condition Systems used in Automobiles.*

UNIT I
Air-conditioning Fundamentals
Basic air conditioning system - Location of air conditioning components in a car - Schematic layout of a refrigeration system. Compressor components - Condenser and high pressure service ports. Thermostatic expansion value - Expansion value calibration - Controlling evaporator temperature - Evaporator pressure regulator - Evaporator temperature regulator.

UNIT II
Air Conditioner - Heating System
Automotive heaters - Manually controlled air conditioner - Heater system - Ford automatically controlled air conditioner and heater systems - Automatic temperature control - Air conditioning protection – Engine protection.

UNIT III
Refrigerant
Containers - Handling refrigerants - Tapping into the refrigerant container - Refrigeration system diagnosis - Diagnostic procedure - Ambient conditions affecting system pressures.

UNIT IV
Air Routing & Temperature Control
Objectives - Evaporator care air flow through the Dash recirculating unit - Automatic temperature control – Duct system - Controlling flow - Vacuum reserve - Testing the air control and handling systems.

UNIT V
Air Conditioning Service
Air conditioner maintenance and service - Servicing heater system Removing and replacing components. Trouble shooting of air controlling system - Compressor service.

Text book:
1. William H Crouse and Donald L Anglin, " Automotive Air conditioning ", McGraw-Hill Inc;2002
References:
1. Mitchell information Services, Inc, " Mitchell Automatic Heating and Air Conditioning Systems ", Prentice Hall Ind., 2001
2. Paul Weiser, " Automotive Air Conditioning ", Reston Publishing Co Inc., 1990.
3. MacDonald, K.L., " Automotive Air Conditioning ", Theodore Audel series2001.
4. Goings. L.F., Automotive Air Conditioning ", American Technical services, 2000

09ME233 COMBUSTION AND HEAT TRANSFER

Credits 4:0:0

Objective:

- *This course mainly deals with combustion of fuels with various effects of engine operating variables on combustion and heat transfer in engines.*

UNIT I
Introduction To Combustion Processes
Combustion in premixed and diffusion flames - Combustion process in IC engines.

UNIT II
Normal, Abnormal Combustion In Si Engines
Stages of combustion - Flame propagation - Rate of pressure rise - Cycle to cycle variation – Abnormal combustion - Theories of detonation - Effect of engine operating variables on combustion.

UNIT III
Combustion And Knock In CI Engines
Droplet and spray combustion theory - stages of combustion - delay period - peak pressure - Heat release – Gas temperature - Diesel knock.

UNIT IV
Heat Transfer In IC Engines
Basic definitions - Convective heat transfer - Radiative heat transfer - Heat transfer, temperature distribution and thermal stresses in piston - Cylinder liner - Cylinder head - fins and values.

UNIT V
Experimental investigation of combustion and Heat Transfer in IC engines
Photographic studies of combustion processes – P-θ diagram in SI and CI engines. Anemometry – Temperature measurement in piston - cylinder liner - cylinder head and engine valves.

Text Books:

1. SPALDING.D.B., " Some fundamental of Combustion ", Butterworth Science Publishcations, London, 2003

References:

1. Lewis.B., Pease.R.N. and Taylor.H.S., " Combustion Process High Speed Gas dynamics and Jet Propulsion Series ", Princeton University Press, Princeton, New Jersey, 2000
2. Taylor.E.F. " The Internal Combustion Engines ", International Text Book Co., Pennsylvania,2000.
3. Ganesan.V. " Internal Combustion Engines ", Tata McGraw Hill Co., 1999

09ME234 COMPUTER AIDED VEHICLE DESIGN

Credits 4:0:0

Objective:

- *This course is mainly deals with Computer Aided Vehicle Design for Passenger and Commercial Vehicle for Suspension, Steering system, Clutch, Gearbox and Design of propeller shaft.*

UNIT I
Vehicle Frame And Suspension
Study of loads - moments and stresses on frame members. Computer aided design of frame for passenger and commercial vehicle - Computer aided design of leaf springs - Coil springs and torsion bar springs.

UNIT II
Front Axle And Steering Systems
Analysis of loads - moments and stresses at different sections of front axle. Determination of bearing loads at Kingpin bearings. Wheel spindle bearings. Choice of bearings. Determination of optimum dimensions and proportions for steering linkages ensuring minimum error in steering.

UNIT III
Clutch
Torque capacity of clutch. Computer aided design of clutch components, Design details of roller and sprig type of clutches.

UNIT IV
Gear Box
Computer aided design of three speed and four speed gear boxes.

UNIT V
Drive Line And Read Axle
Computer aided design of propeller shaft. Design details of final drive gearing. Design details of full floating. semi-floating and three quarter floating rear shafts and rear axle housings.

Text Books:

1. Dean Averns, " Automobile Chassis Design ", llliffe Books Ltd, 2002

References:

1. Heldt.P.M., " Automotive Chassis ", Chilton Co., New York, 2000
2. Steeds.W., " Mechanics of Road vehicles ", llliffe Books Ltd., London, 2000
3. Giles.J.G., Steering, " Suspension and tyres ", llliffe Books Ltd., London, 1999.
4. Newton, Steeds & Garret, " Motor vehicle ", llliffe Books Ltd., London, 1999.
5. Heldt.P.M., " Torque converter ", Chilton Book Co., New York, 1996
6. Giri.N.K. " Automobile Mechanics ", Khanna Publisher, New Delhi, 1996.

09ME235 MICROPROCESSOR APPLICATION IN AUTOMOBILES

Credits 4:0:0

Objective:

- *This Course mainly deals with Application of Microprocessor in Automobiles for operations.*

UNIT I
Architecture
General 8 bit microprocessor and its architecture 8085, Z-80 and MC 6800 MPU and its pin function - Architecture - Function of different sections.

UNIT II
Instruction Set
Instruction format - addressing modes - instruction set of 8085 MPU-T-STATE - Machine cycle and instruction cycles - Timing diagrams - Different machine cycles - Fetch and execute operations - estimation of execution times.

UNIT III
Assembly Language Programming
Construct of the language programming - Assembly format of 8085 - Assembly Directive - Multiple precision addition and subtraction - BCD to Binary and Binary to BCD, Multiplication, Division, Code conversion using look up tables - Stack and subroutines.

UNIT IV
Data Transfer Schemes
Interrupt structure - Programmed I/O - Interrupt driven I/O, DMA - Serial I/O.

UNIT V
Interfacing Devices & Applications
Types of interfacing devices - Input / Output ports 8212, 8255, 8251, 8279. Octal latches and tri-state buffers - A/D and D/A converters - Switches, LED's ROM and RAM interfacing. Data acquisitions - Temperature control - Stepper motor control - Automotive applications Engine control, Suspension system control, Driver information systems), Development of a high speed, high precision learning control system for the engine control.

Text Book:

1. Ramesh, Goankar.S., " Microprocessor Architecture Programming and Applications ", Wiley Eastern Ltd., New Delhi, 2002

References:

1. Aditya.P.Mathur, " Introduction to Microprocessors ", III Edition, Tata McGraw-Hill Publishing Co Ltd., New Delhi, 2003
2. Ahson.S.I. " Microprocessors with Applications in Process Control ", Tata McGraw-Hill, New Delhi, 20004
3. SAE Transactions, 2000 Sec 3.
4. Jabez Dhinagar.S., " Microprocessor Application in Automobiles ".2000
5. L.Bianco and A.Labella., " Automotive Micro Electronics ", Elsevier science publishers. 2005

09ME236 PRODUCTION PROCESSES FOR AUTOMOTIVE COMPONENTS

Credits : 4:0:0

Objective:
- *This course mainly deals with various production techniques for Automotive Components and advances in Recent Trends in manufacturing Auto Components.*

UNIT I

Power Metallurgy
Process flow chart - Production of metal powders and their raw materials - Manufacture of friction lining materials for clutches and brakes - Testing and inspection of PM parts.

UNIT II
Forming Process
Forging - process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft, transmission gear blanks, foot brake linkage, steering knuckles, Extrusions: Basic process steps, extrusion of transmission shaft, steering worm blanks, brake anchor pins, rear axle drive shaft, axle housing spindles, piston pin and valve tappets.
Hydro forming: Process, hydro forming of manifold and comparison with conventional methods- Hydro forming of tail lamp housing. Stretch forming - Process, stretch forming of auto body panels. Super plastic alloys for auto body panels.

UNIT III
Casting And Machining
Sand casting of cylinder block and liners - Centrifugal casting of flywheel, piston rings, bearing bushes, and liners, permanent mould casting of piston, pressure die casting of carburettor other small auto parts. Machining of connecting rods - crank shafts - cam shafts - pistons - piston pins - piston rings - valves - front and rear axle housings - fly wheel - Honing of cylinder bores - Copy turning and profile grinding machines.

UNIT IV
Gear Manufacturing
Gear milling, Hobbing and shaping - Gear finishing and inspection.

UNIT V
Recent Trends In Manufacturing Of Auto Components
Powder injection moulding – Shot peen hardening of gears - Production of aluminum MMC liners for engine blocks - Plasma spray coated engine blocks and valves - Recent developments in auto body panel forming -Squeeze casting of pistons - aluminum composite brake rotors

Text Book:
1. Heldt.P.M., " High Speed Combustion Engines ", Oxford Publishing Co., New York,2005.

References:
1. Haslehurst.S.E., " Manufacturing Technology ", ELBS, London, 2000
2. Rusinoff, " Forging and Forming of metals ", D.B. Taraporevala Son & Co. Pvt Ltd., Mumbai, 1999.
3. Sabroff.A.M. & Others, " Forging Materials & Processes ", Reinhold Book Corporation, New York, 1998.
4. Upton, " Pressure Die Casting ", pergamon Press, 1999.
5. High Velocity " Forming of Metals ", ASTME, prentice Hall of India (P) Ltd., New Delhi, 1999.

09ME237 POWER PLANT ENGINEERING

Credit: 4:0:0

Objective:

- *To study various power generating units and their working economics.*

UNIT I
Simple Rankine Cycle modified Rankine cycle – Re heating – Regeneration, analysis, pressure and temperature limits. Binary vapour cycle and combined cycle.

UNIT II
Steam power plant – various components, layout, Modern high pressure boilers – sub critical and super critical – Stoker type and Pulverized type combustion systems. Economizer and Air pre heater. Ash handling and dust collectors. Draught systems. Water treatment. Condensers and cooling towers.

UNIT III
Nuclear power plant – Basic nuclear physics and nuclear reactions related to nuclear reactors, nuclear reactor materials, types of reactors, radiation shielding, waste disposal. Gas turbine power plant – components and layouts. Open and closed cycle plants – combined gas turbines and steam power plants.

UNIT IV
Diesel Engine Power Plant – components and lay-outs, selection of engine type. Environmental hazards of various power plants. Hydro-electric Power Plants – runoff, storage and pumped storage type – draft tube. Lay-out and selection of water turbine.

UNIT V
Load curve – definition – fixed and operating costs – comparison of economics of different types of power plants. Unconventional power plants – Solar, Wind, Ocean thermal Tidal, Wave and Geothermal power plants. MHD concepts of energy conversion and energy audit.

Text Books

1. *Domkundwar., 'Power Plant Engineering', Dhanpat Rai & Sons, 2005*
2. *Wakil, M.M.E.l, 'Power Plant Technology', Mc Graw Hill, 2000*

Reference Books

3. *Roy Eckart and Joel Weisman., 'Modern Power Plant Engineering', PHI, 1999.*
4. *Wakil M.M.El., 'Nuclear Heat Transport, International text book company', London,1990.*

09ME238 REFRIGERATION AND AIR CONDITIONING

Credit : 3:1:0

Objective:

- *This Course mainly deals with the Refrigeration & Air conditioning applications*

UNIT I
Review of thermodynamic principles – refrigeration. Air refrigeration – Bell-Coleman cycle and Bootstrap cycle – cycle analysis and performance calculations. Aircraft refrigeration system. Vapour compression refrigeration cycle – use of P-H charts – multistage multiple evaporator systems – cascade system – COP comparison. Vapour absorption refrigeration system. Ammonia water and Lithium Bromide water systems. Steam jet refrigeration system. Performance analysis

UNIT II

Compressors – reciprocating & rotary (element treatment) – condensers – evaporators. Refrigerants – properties – selection of refrigerants – refrigeration plant controls – testing and charging of refrigeration units. Applications to refrigeration systems – ice plant – food storage plants – milk –chilling plants – refrigerated cargo ships – cryogenic in medicine and biological uses.

UNIT III
Review of fundamental properties of psychometric – use of psychometric charts – psychometric processes – Grand and Room Sensible Heat Factors – by pass factor – requirements of comfort air conditioning – comfort charts –factors governing optimum effective temperature, recommended design conditions and ventilation standards.

UNIT IV
Types of load – design of space cooling load – Heat transmission through building. Solar radiation – infiltration – internal heat sources (sensible and latent) – outside air and fresh air load – estimation of total load – design of air conditioning cycles

UNIT V
Domestic, commercial and industrial systems – central air conditioning systems – applications: car, industry, stores, and public buildings. Air conditioning equipments – air cleaning and air filters – humidifiers – dehumidifiers – air washers – condenser – cooling tower and spray ponds – elementary treatment of duct design – air distribution system. Thermal insulation of air conditioning systems – factors affecting thermal conductivity – types of materials.

Text Books

1. Arora. C.P., 'Refrigeration and Air Conditioning', TMH, New Delhi, 2002
2. N.F. Stoecker and Jones, 'Refrigeration and Air Conditioning', TMH, New Delhi,2003

Reference Books

1. *Manohar Prasad, 'Refrigeration and Air Conditioning', Wiley Eastern Ltd*
Division of Mechanical Engineering 259,2003
2. Jordon and Prister., 'Refrigeration and Air Conditioning', Prentice Hall of India PVT Ltd., New Delhi, 1999
3. Raj. J. Dossat, 'Principles of Refrigeration', SI Version, Wiley Eastern Ltd., 1999.

09ME239 BIOMASS ENERGY SYSTEMS

CREDIT 3:1:0

Objective - *This course will address environmental impacts, policy, and economics and cover the fundamental theories and applied technologies used in production and conversion of biomass into transportation fuels, heat, power and electricity. Conversion technologies covered include ethanol fermentation, combustion, pyrolysis, gasification, and anaerobic digestion*.

UNIT 1
Introduction: Relevance of biomass as an energy source, biomass resources, cultivated biomass resources, water to biomass resources,advantage associated with biomass resources, aviliability of biomass for generation. Extent of water lands in India, Nature of waste lands. Combustion, biochemical and thermochemical Processes

UNIT 2

Wood fuelled cook stoves, Effects of various stove parameters, Effects of various stove components, Current version of improved stoves, Efficiency of stoves, utilization of biomass based fuels for thermal and shaft power applications.
Bio-conversion process - Production of Biogas and ethanol - Types of Biogas plants, Design of biogas plants, Factors affecting gas generation rate, Biogas engine for water pumping and electric power generation application, High rate digesters for industrial waste water treatment, government programs

UNIT 3
Gasification - Fuels for gasification, Briquetting, Properties of biomass – size, size distribution, bulk density, volatile matter, ash and ultimate analysis - Air gasification in a down draft gasifier, Types of gasifiers, Gasifier engine system, Use of producer gas in SI & CI engines, reasons for de-rating , Problems associated with gasifier engine system and it's efficiency.

UNIT 4
Processing for liquid fuel production. Pyrolysis -Effect of particle size, temperature - products obtained - Fluidization, - Fixed and fluidized bed systems- calculation of pressure drop in fixed bed-determination of minimum fluidization velocity, Expanded bed, dilute phase, moving solids fluidization - Elutriation in fluidized bed – Semi fluidization – applications. Pulsating column – oscillating fluidized beds.

UNIT 5
Performance of Dual fuel Engine : power capacity, Diesel substitution, thermal efficiency, Smoothness of operation, Load following capability, Maintenance and durability, Exhaust emissions. Design of a Down draft gasifier Cooling – cleaning systems Performance evaluation of a down draft gasifier.

Texts Book:
1. *Mital K.M, "Biogas Systems: Principles and Applications", ISBN –81-224-0947- New Age International publishers (P) Ltd., 2005*
2. *S Rao & B B Parulkar : "Energy Technology", khanna Publishers Delhi – 1999*
3. *Venkata Ramana P and Srinivas S.N, "Biomass Energy Systems",ISBN 81-85419-25- 6, Tata Energy Research Institute, 1999.*

Reference books
1. *A.Kaupp and J.R.gross : "State of art report for small scale Gas Producer Engine systems", Friedr Vieweg & sohn Verlags, Gmbh, Braunschweig, 2000*
2. *T.B.Reed : "Biomass Gasification Principles and technology", Noyes Data Corporation, Energy Technology Review, No.67, U.S.A., 1999*
3. *O P Vimal & M S Bhatt: "Wood Energy Systems", K L Publications, New Delhi – 1989*

09ME240 PROPULSION ENGINEERING

Credits: 3: 1: 0
Objectives:
- *To learn about the basic concept and importance of propulsion*
- *To understand the phenomena of combustion and after burners.*
- *To understand the performance of gas turbine propulsion in an efficient way.*

UNIT I
Introduction
Review of thermodynamics concepts, Principles of jet propulsion, Working cycles and air flow, Operational envelope and standard atmosphere.

UNIT II

Centrifugal Compressors

Basic concepts, Principle of operation, Work done and pressure rise, Compressibility effects, Compressor characteristics.

Axial flow Compressor: Basic operation and elementary theory. Factors affecting static pressure ratio, Degree of reaction, Off – Design performance, Axial flow compressor characteristics.

UNIT III

Combustion systems

Operational requirements, Types of combustion systems, some important factors affecting combustion design

Axial and Radial flow turbines: Elementary theory, Vortex theory. Choice of blade profiles, Pitch and chord, Estimation of stage performance. Overall turbine performance

UNIT IV

Afterburners: Afterburner components, Diffuser, Fuel injection, Atomization and vaporization, Ignition, Flame stabilization, Afterburner liner, Total pressure loss, Afterburner design parameters.

Inlets and Exhaust nozzles: Introduction to inlets and nozzles. Inlets–Type –Subsonic inlets, Supersonic inlets, Exhaust nozzles.

UNIT V

Prediction and performance of simple gas turbine: Component characteristics. Of-Design operation of the single shaft gas turbine, Equilibrium running of gas generator. Of-Design operation of free turbine engine, Incorporation of variable running losses.

Performance prediction of turbo – fan engines: Matching procedures for turbo-fan engine. Some notes on the behavior of twin-spool engines, Transient behavior of gas turbine, Principles of control systems.

Text Books:

1. *V. Ganesan, Gas turbines, Tata McGraw-Hill Publishing company limited 1999.*
2. *H. Cohen , F. C. Rogers and H. I. H. Saravana Muthu, Gas turbine theory, Edition, Longman 2001.*

References:

1. *J. D. Mattingly, William H. Heiser and David T. Pratt Aircraft engine design(AIAA Education Series), AIAA, Dec 2002 ISBN – 1563475383.*
2. *The Jet Engine, Rolls Royce Plc, 1996, ISBN – 090212235, ISBN – 0902121235*
3. *E. Irwin Treager, Aircraft Gas Turbine Engine Technology, Third edition 1995 ISBN – 002018281.*

09ME241 NON-CONVENTIONAL ENERGY SYSTEMS

Credit 3:1:0

Objective:

- *This course mainly deals about Energy Sources and various types of energy systems, like solar, biomass, wind energy systems.*

UNIT I

Introduction

World production and reserves of commercial energy sources, Energy alternatives, Form of non-conventional energy sources, features of power systems.

UNIT II
Solar Energy Systems
Solar radiation geometry, Estimation and measurement of solar energy.
Thermal systems : Water heating, Drying, Cooking, Desalination, Solar refrigeration, Solar ponds.
Photovoltaic systems: Types and characteristics of photovoltaic cells, Solar cell arrays, Balance of System (BOS).

UNIT III
Biomass Energy Systems
Thermo-chemical route: Problems and special features associated with gasifier engine system, Case study of Hosahalli biomass gasifier generator system.

UNIT 4
Wind energy Systems
Orientation systems and regulating devices, design of blades : Aerodynamic configuration of rotor and determination of blade structure, Description and performance of Vertical axis wind mills. Use of wind energy for water pumping and generation of electricity, Installation operation and maintenance of small wind energy conversion systems.

UNIT V
Energy from Water
OTEC – Principle of operation, closed and open OTEC cycles, wave energy conversion machines and recent advances, Tidal energy : Single basic and double basic tidal systems
Small – mini – Micro hydro system : concepts, types of turbine, hydrological analysis.
Other energy sources , Geothermal energy conversions, Nuclear fusion energy.

Texts Books :

1. *S.P.Sukhatme "Solar energy – principles of thermal collection and storage",TMH Publishing Co.New Delhi,2004*
2. *John A Duffle& William A Beck man "Solar energy thermal process ",Wiley –inter science publications,New York.2005*
3. *G.D.Rai "Non conventional energy sources ",Khanna publisher,New Delhi.2003*
4. *Klaus Von Mitzlaff"engine for Bio Gas ",friedr Vielveg & Sohn Braunschweig,Germany,1998*

Reference Books :
1. *Desire Le gouriers :"Wind power plants : Theory and Design",Pregamon press 2000*
2. *2.H P Garg & J Prakash :"Solar energy -fundamentals and applications",TMH Publishing company limited New Delhi,2002*
3. *Srivatsava ,Shukla & Jha:"Technology and application of bio gas",Jain Brothers New Delhi,2000*

09ME242 INTRODUCTION TO AERODYMANICS
Credit :3:1:0

Objective:

- *To understand the behavior of airflow over bodies with particular emphasis on airfoil sections in the incompressible flow regime.*

UNIT I
Basics
Wing and Airfoil section geometry – Aerodynamic Forces and moments – Force and moment components and coefficient, Pressure distribution on an airfoil, Types of drag, Estimation of lift, Drag and pitching moment coefficient from the pressure distribution. Experimental methods.

UNIT II
Elementary Flows
Incompressible flow condition, Governing equation for irrotational, Incompressible flow: Laplace's equation, Boundary conditions. Elementary flows. Combination of uniform flow with a source and sink, Doublet. Flow over a circular Cylinder, Vortex flow. Circulation, Kutta – Joukowski Theorem. Lifting flow over a cylinder, The Vortex sheet. Kevin circulation theorem.

UNIT III
Drag And Thrust Evaluations
Drag of aerospace vehicle components. Total drag estimation, Methods of drag reduction, Propellers, Performance analysis. Aerospace engines reciprocating, Turbine and rockets. Design features. Performance characteristics.

UNIT IV
Aircraft Performance In Steady Flight
Level flight, Stall, Cruise, Maximum speed, Ceiling, Cruise climb, Range and endurance. Climb performance, Performance optimization.

UNIT V
Flow Measurements And Model Testing
Non – Dimensional parameters, Similarity of flows. Model testing in wind tunnels. Pressure, Viscosity measurements-Hot wire and laser-Doppler Anemometer, Turbulence measurements. Force measurements-Wind tunnel balances.

Text Books:

1 *John D. Anderson, Jr., "Fundamentals of Aerodynamics", Third edition, McGraw-Hill publications, 2001*
2 *Anderson J.D., "Introduction to Flight", McGraw Hill, 2005*

References:

1 *E L Houghton and PW Carpenter, "Aerodynamics for Engineering students", Fourth edition, Edward Arnold publications, 2005*
2 *McCormick B.W., "Aerodynamics, Aeronautics and Flight Mechanics", Wiley and Sons New York, 1999.*
3 *Kermode A.C., "Flight without Formulae", McGraw Hill, 1985.*
4 *Anderson J.D., "Foundation of Aerodynamics", McGraw Hill Book Co, New York,1999*

09ME243 FLIGHT DYNAMICS

Credits: 4:0:0

Objective:
- *To study about rocket performance along with stability control and to understand the space environment and mechanics in satellite injection and different trajectories.*

UNIT I
Performance of single and multistage rockets, staging , separation.

UNIT II
Rocket Stability and control: Definition of stability, equilibrium, definition of static and dynamic stability; Static Longitudinal Stability and Control , Lateral and directional Stability and Control. Dynamic Stability

UNIT III
The solar system - Reference frames and coordinate systems - The celestial sphere - The ecliptic - Motion of vernal equinox - Sidireal time - Solar time - Standard time - The earth's atmosphere. Space environment - Peculiarities -Effect of space environment on the selection of materials of spacecraft.

UNIT-IV
Satellite Injection And Satellite Orbit Perturbations
General Aspects of satellite Injections – Satellite Orbit Transfer –Various Cases – Orbit Deviations Due to Injection Errors – Special and General Perturbations – Cowell's Method – Encke's Method – Method of vibrations of Orbital Elements – General Perturbations Approach.

UNIT –V
Interplanetary Trajectories
Two dimensional interplanetary trajectories - Fast interplanetary trajectories - Three dimensional interplanetary Trajectories - Launch of interplanetary spacecraft , Time of flight - Re-entry phase.

Text Books
1. "Rocket Propulsion and Spaceflight Dynamics", J.W.Cornelisse, H.F.R. Schoyer, and K.F. Wakker, Pitman, 2000
2. "Spaceflight Dynamics", William E.Wiesel, McGraw-Hill, 2001

References
1. "Spacecraft Mission Design", Charles D.Brown, AIAA Education Series, Published by AIAA, 2001
2. "Orbital Mechanics", Vladimir A. Chobotov, AIAA Education Series, AIAA Education Series, Published by AIAA, 2002
3. "Fundamentals of Astrodynamics and Applications", David.A. Vellado, Microcosm and Kluwer, 2001
4. "Rocket Propulsion Elements", Sutton, G.P. John Wiley, 1993.
5. "Elements of Astromechanics", Van de Kamp, P,Pitman, 1979.
5. Parker E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc., 1982.

09ME244 AERODYNAMICS TESTING FACILITIES & MEASUREMENT

Credits:4:0:0

Objective
- *To understand the behavior of airflow over bodies with particular emphasis on airfoil sections in the incompressible flow regime.*

UNIT I
Principles Of Model Testing
Buckingham Theorem - Non dimensional numbers - Scale effect Types of similarities.

UNIT II
Wind Tunnels
Classification - special problems of testing in subsonic, transonic, supersonic and hypersonic speed regions -Layouts - sizing and design parameters..

UNIT III
Calibration Of Wind Tunnels
Test section speed - Horizontal buoyancy - Flow angularities - Turbulence measurements - Associated instrumentation - Calibration of supersonic tunnels.

UNIT IV
Wind Tunnel Measurements
Pressure, and velocity measurements - Force measurements - Three component and six component balances - Internal balances.

UNIT – V
Flow Visualization
Smoke and Tuft grid techniques - Dye injection special techniques - Optical methods of flow visualization.

Text books:

1. Pope, A., and Goin, L., " High Speed wind Tunnel Testing ", John Wiley, 1985.
2. Rae, W.H. and Pope, A.," Low Speed wind Tunnel Testing ", John Wiley Publication , 1984

Reference

1. "Rocket Propulsion Elements", Sutton, G.P. John Wiley, 1993.
2. "Elements of Astromechanics", Van de Kamp, P,Pitman, 1979.
3. Parker E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc., 1982.

09ME245 AIRCRAFT PERFORMANCE

Credit:4:0:0

Objective:

- *To study the flight performance of aircraft under various conditions like gliding, climbing descending and steady flight and also to learn some performance problems.*

UNIT –I

Streamlined and bluff bodies, Aerofoil Characteristics, Pressure distribution round circular cylinder and airfoils, Aerofoil classification. Types of drag, Effects of Reynold's number on skin friction and pressure drag, Drag reduction of airplanes. Momentum theory of finite wings, Induced drag, Chrodwise and spanwise pressure distributions.

UNIT-II

STEADY FLIGHT

Steady level flight, Thrust/power, available and required with altitude Estimation of maximum level flight speed, conditions for minimum drag and minimum power required.

UNIT-III

GLIDING AND CLIMBING FLIGHT

Maximum range, Minimum rate of sink glide, Shallow angles of climb, Rates of climb, time to climb and ceilings, Glide hodograph.

UNIT-IV

TURINING PERFORMANCE

Bank angle and load factor, Limitations on turn, Pull up and push over, the v-n diagram.

PROPELLERS

Froude momentum and blade element theories, Propeller co-efficient, use of propeller charts, Performance of fixed and variable pitch propellers.

UNIT-V

SPECIAL PERFORMANCE PROBLEMS

Range and endurance of jet and propeller type of airplanes. Estimation of take-off and landing distances. High lift devices, Use of thrust augmentation and reverse thrust.

Textbooks

1. Houghton, E.L., and Carruthers, N.B, "Aerodynamics for engineering students ", Edward Arnold Publishers, 2000

2. Kuethe, A.M., and Chow, C.Y., "Foundations of Aerodynamics ", John Wiley & sons, 2002

Reference Books:

1. *J.J.Bertin, "Aerodynamics for engineers ", Prentice-Hall, 1988.*
2. *L.J. Clancey, "Aerodynamics ", Pitman, 1986.*
3. *Schlichting, E., "Aerodynamics of the Airplane ", McGraw-Hill, 1979*

09ME246 HELICOPTER ENGINEERING

Credit: 4:0:0

Objective:

To study the Helicopter dynamics and to understand the performance and also problems

UNIT I
Elements Of Helicopter Aerodynamics
Configurations based on torque reaction - Jet rotors and compound helicopters.

UNIT II
Rotor Control
Methods of control - Collective and cyclic pitch changes - Lead-lag and flapping hinges.
Ideal Rotor Theory
Hovering performances - Momentum and simple blade element theories.

UNIT III
Rotor Performance
Figures of merit - Profile and induced power estimation - Constant chord and ideal twist rotors.

UNIT – IV
Power Estimates
Induced, Profile and Parasite power requirements in forward flight - Performances curves with effects of altitude. Preliminary ideas on helicopter stability.

UNIT V
Lift And Control Of V/Stol Aircraft
Various configuration - Propeller, Rotor ducted fan and jet lift - Tilt wing and vectored thrust - Performances of VTOL and STOL aircraft in hover, Transition and Forward motion.
Ground Effect Machines
Drag of hovercraft on land and water. Applications of hovercraft.

Text books:
1. Gessow, A., and Myers, G.C., " Aerodynamics of Helicopter " , MacMillan & Co., N.Y. 2001
2. McCormick, B.W., " Aerodynamics of V/STOL Flight ", Academic Press, 1999.

Reference Books:
1. *Johnson, W., " Helicopter Theory ", Princeton university Press, 1999.*
2. *McCormick, B.W., " Aerodynamics, Aeronautics & Flight Mechanics " John Wiley, 1999.*
3. *Gupta, L., " Helicopter Engineering " , Himalayan Books, 200*

09ME247 HIGH SPEED AERODYNAMICS

Credits: 4:0:0
Objective:

- *To introduce the basic concepts of compressible flow , dimensional numbers like Prandtl and high speed wind tunnels.*

UNIT I
One Dimensional Compressible Flow
Energy, momentum, continuity and state equations, Velocity of sound, Adiabatic steady state flow equations, Flow through converging, diverging passages, Performance under various back pressures

UNIT II
Normal Shocks In Tubes
Pradti equation and Rankine - Hugonoit relation, Normal shock equations, Pitot static tube, corrections for subsonic and supersonic flows, Oblique shocks and corresponding equations, Hodograph and pressure Turning angle, shock polars, Flow past wedges and concave corners, strong, weak and etached shocks.

UNIT III
Prandtl-Meyer Expansion
Flow past convex corners, Expansion hodograph, Reflection and interaction of shocks and expansion, waves, Families of shocks, Method of characteristics, Two dimensional supersonic nozzle contours

UNIT IV
Compressibility Effects
Aerofoils in high speed flows, Lower and upper critical Mach numbers, Lift and draft divergence, shock induced separation, Characteristics of swept wings, Effects of thickness, camber and aspect ratio of wings, Transonic area rule, Tip effects.

UNIT V
High Speed Wind Tunnels
Blow down, indraft and induction tunnel layouts and their design features, Transonic, supersonic and hypersonic tunnels and their peculiarities, Helium and gun tunnels, Shock tubes, Optical methods of flow visualization

Text Book.

1. Shapiro,. A.H., " Dynamics and Thermodynamics of Compressible Fluid Flow ", Ronald Press, 2002.
Rathakrishnan, E., " Gas Dynamics ", Prentice Hall of India, 1999.

Reference Books:

1. Zucrow, M.J., and Anderson, J.D., " Elements of gas dynamics " McGraw-Hill Book Co., New York,1999.
2. Hodge B.K. & Koenig. K, " Compressible fluid Dynamics with Computer applications ", Prentice Hall,2000

09ME248 INDUSTRIAL ROBOTICS

Credit 3:0:0
Objectives:

- *To give an overview of the components, sensing elements used programming techniques and applications of robots*

UNIT I
Introduction
Definition of Robot - Basic Concepts - Robot configurations - Types of Robot drives -Basic robot motions –Point to point control - Continuous path control.

UNIT – II

Components and Operations
Basic control system concepts - control system analysis - robot actuation and fed back, Manipulators – director and inverse kinematics, Coordinate transformation - Brief Robot dynamics. Types of Robot and effectors –Grippers - Tools as end effectors - Robot/End - effecter interface.

UNIT III
Sensing and Machine Vision
Range sensing - Proximity sensing - Touch sensing - Force and Torque sensing. Introduction to Machine vision - Sensing and digitizing - Image processing and analysis.

UNIT IV
Robot Programming
Methods - languages - Capabilities and limitation - Artificial intelligence – Knowledge representation – Search techniques - AI and Robotics.

UNIT V
Industrial Applications
Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading - CIM –Hostile and remote environments.

Text Book

1. Mikell P. Groover, Mitchell Weiss, "Industrial Robotics, Technology, Programming and Applications ", McGraw Hill International Editions, 1st Edition, 2000

References
1. *Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall India, 2002*
2. Ibrahim Zeid, “CAD/CAM Theory and Practice”, McGraw Hill, 2003
3. K.S. Fu., R.C.Gonalez, C.S.G.Lee, " Robotics Control sensing ", Vision and Intelligence, McGraw Hill International Edition, 1987.

09ME249 COMPUTER AIDED INSPECTION AND METROLOGY
Credit 3: 1: 0

Objective:
- *To provide basic understanding fundamental principles of metrology and elements of computer aided inspection. It covers the different measuring techniques for various engineering parameters and measuring equipments.*

UNIT I
General Concepts Of Measurement
Definition-Standards of measurement-Errors in measurement-Accuracy, precision, sensitivity and readability - calibration of instruments, selection and care of instruments.

UNIT II
Linear and Angular Measurements
Length standard-Line and end standard - Slip gauges, micrometers, verniers, dial gauges comparators, various types-principle and applications-limits, fits and tolerance-design of gauges-interferometry applications-angular measuring instruments-bevel protector, levels, clinometers-sine bar, angle dekkor-alignment telescope, autocollimator.

UNIT III
Measurement of Form Errors, Surface Roughness and Measuring Machines
Straightness, flatness, alignment errors-surface texture-various measuring instruments-run out and concentricity, Tool maker's microscope-metro scope, profile projector

UNIT IV
Measurement of Screw Threads And Gears
Various elements of threads-2 wire and 3 wire methods-gears elements -various errors and measurements. Dovetail Measurement – measurement of center line of hole and hole size.

UNIT V
Computer Aided And Laser Metrology
Coordinate measuring machine-LASER micrometer- Introduction to Interferometer, optical -LASER interferometer-Non contact and in-process inspection, vision system, Image analyser, Opto electronic devices-Applications in Online Processing systems.

Text Book:

1. I.C.Gupta, "A Text Book of Engineering Metrology", Dhanpat Rai and Sons, 2000

Reference Books

1. R.K.Jain and S.C.Gupta, "Engineering Metrology", Dhanpat Rai and Sons, 2000.
2. G.N.Galyer F.W and C.R.Shotbolt, "Metrology for Engineers ", ELBS Edn 1983.
3. "ASTME Handbook of Industrial Metrology", Prentice Hall of India Ltd., 1992.
4. Robert.G. Seippel, "Optoelectronics for Technology and Engineering ", Prentice Hall New Jersey, 1989.

09ME250 COMPUTER INTEGRATED MANUFACTURING

Credit: 3:0:0

Objective:
- *To give an overview of the concepts in automation, Numerical control, Robotics and manufacturing systems.*

UNIT I
Automation and control technologies
Basic elements of automated systems, Levels of automation. Industrial control systems – process industries and discrete manufacturing industries, Continuous, discrete and computer process control. Forms of computer process control.

UNIT –II
Introduction to Numerical Control
Components of NC Machine Tools– Types of NC Machine Tools , Co-ordinate system –
Types of NC system, Interpolation schemes – CNC and DNC systems. Machine structures and slide ways , Positional transducers – transmission and slide positioning systems. Control of slide position – Optical grating, Servo system.

UNIT III

NC part programming and Machines
Manual part programming - Computer assisted part programming – APT language – NC part programming using CAD/CAM – Turning centre, Milling centre – Automatic Tool Changers (ATC) – NC Tooling.

UNIT IV
Industrial Robotics
Robot anatomy and control systems, End effectors, Sensors in robotics, Industrial robot application, Introduction to robot programming.

UNIT IV :
Manufacturing systems
Components of manufacturing systems, Classification of manufacturing systems. Group Technology – Part families, Part classification and coding. FMS and FMS components, Types of FMS, Applications and benefits, Automated Guided vehicle systems.

Text Books:

1. *Mickell. P. Groover, "Automation, Production systems & computer Integrated Mfg", Pearson Education, 2004.*
2. *P.Radhakrishan, 'Computer Numerical Control', New Central Book Agency (p) Ltd., 1st Edition, 1999.*

Reference Books:

1. *Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill, 1983.*
2. *N.K Metha, "Machine tool design and NC Machines", 2nd Edition, TMH, 1996.*

09ME251 IT IN MANUFACTURING

Credit: 3:0:0

Objective:
- *To give an introduction on the role and application of information technology in manufacturing.*

UNIT I
Computer Integrated Manufacturing
Introduction to Computer Integrated Manufacturing, Applications of Computers in Manufacturing, CIM Hardware, Activities in a CIM environment and Software for CIM, Product development through CIM, Sequential Engineering and Concurrent Engineering.

UNIT II
Manufacturing Information Systems
Definition, Characteristics of Manufacturing Information Systems (MIS), Objectives, MIS support to Computer Integrated Manufacturing (CIM), Conceptual frame work of information system, components of information system, architecture. Total quality management of MIS.

UNIT III
Information system applications in manufacturing Sector

Information system for Production Management, Financial Management, Materials Management, Personnel Management, Marketing Management. Manufacturing systems modules-Manufacturing database, Master production schedule, Work in process control, inventory control.

UNIT IV
Decision Support systems (DSS) and Executive Information Systems (EIS)
Definition, Characteristics, ingredients, categories and classifications of DSS. Benefits and limitations of DSS. Definition of EIS, Characteristics, EIS needs, components, development process, obstacles.

UNIT V
Business Process Reengineering (BPR) and Enterprise Management Systems (EMS)
Definition of BPR, Business performance measure, process model of the organization, Reengineering opportunity, EMS- meaning, components. Enterprise Resource planning system (ERP), architecture, models and modules, ERP basic features, benefits of ERP.

Text Book

1. *Mickell. P. Groover, "Automation, Production systems & computer Integrated Mfg", Pearson Education, 2004.*
2. *W.S.Jawadekhar, "Management Information Systems", 2nd Ed. TMH, 2002*

References

1. *James A.O'Brien , "Management Information Systems" , 4th Ed, Irwin McGrawHill, 1999.*
2. *R.Senapathy , "Management Information Systems", Laxmi Publications, 2004.*
3. *A.K.Kochhar, "Development of Computer based production systems", Edward Arnold, 1979.*
4. *George M.Marakas, "Decision support systems in the 21st century", Pearson Education, 2003.*

09ME252 INTRODUCTION TO MICRO ELECTRO MECHANICAL SYSTEMS

Credit: 3:0:0
Objective:
- *To give an introduction to the concepts in micro electro mechanical systems and understand the various sensors.*

UNIT I
Introduction: MEMS and Microsystems – Evolution of Micro Fabrication – Micro Systems and Microelectronics. Application of MEMS in Various Fields.

UNIT II
Working Principle of MEMS Devices
Working Principle:- Micro Sensors – Acoustic wave sensor, Biomedical sensor, Chemical sensor, Optical sensor, pressure sensor, thermal sensor; Micro Actuation – Actuation using thermal force, shape-memory alloys, piezo crystal, electrostatic forces; Micro Actuators – micro grippers, micro motors, micro valves, micro pumps Micro Accelerometer; Micro Fluidics.

UNIT III

Materials for MEMS: Introduction – Substrate and Wafer, Active Substrate Material. Silicon as a substrate material, Silicon Compounds, Silicon Piezo Resistors, Gallium Arsenide, Quartz, Piezo Electric Crystals, Polymers.

UNIT IV

Scaling Laws in Miniaturization: Introduction to Scaling – Scaling in Geometry, Scaling in Rigid Body Dynamics, Scaling in Electrostatic Forces, Scaling in Electromagnetic Forces, Scaling in Electricity, Scaling in Fluid Mechanics, Scaling in Heat Transfer.

UNIT V

MEMS Fabrication Techniques: Introduction – Photolithography, Ion Implantation, and Diffusion – Oxidation, CVD, PVD, Etching. Overview of Micro Machining – Bulk Micro Machining, Surface Micro Machining, LIGA Process. MEMS Packaging:- Introduction to MEMS packaging. Case study on pressure sensor packaging.

Text Books:

1) *Tai-Ran Hsu, "MEMS & Microsystems – Design and Manufacture," Tata McGraw Hill, 2002.*

Reference Books:

1) *Naldim Maluf," An Introduction to Micro Electro Mechanical Systems", Artech House, 1999.*
2) *Sergey Edward Lyshevski," MEMS & NEMS, Devices and Structures", CRC Press, 2002.*
3) *Sami Franssila," Introduction to Micro Fabrication", Wiley, 2004.*

09ME253 MECHATRONICS

Credits:3:0:0

Objective:

- *Mechatronics subject deals with mechanical and electronic devices. -To know the basic concept of pneumatic, electro pneumatic, electro hydraulic, and hydraulic components.-To know the basic concept of sensors, transducers, electronic interface subsystems, electromechanical drives, microprocessor and programmable logic controllers.*

UNIT I

Introduction: Introduction to mechatronics – Systems - Measurement systems - Control systems - Pneumatic actuation systems - Electro-Pneumatic systems - Hydraulic actuation systems – Electro-hydraulic actuation systems.

UNIT II

Sensors and Transducers: Introduction – Performance Terminology – Displacement, position and proximity – velocity and motion – Fluid pressure – Temperature sensors – Light sensors – Selection of sensors – Signal processing.

UNIT III

Electronic Interface Subsystems: Sensor interfacing – Interfacing – Solenoids – Buffer IC's – Over current sensing, resettable fuses, thermal dissipation.
Electromechanical drives: Relays and solenoids, stepper motors – DC servomotors.

UNIT IV

Microcontrollers overview: Microprocessor structure – Analog interfacing – Digital interfacing – Digital to analog converters – Analog to digital converters – LED Blinking, voltage measurement using ADC.

UNIT V
Programmable Logic Controllers: Basic structure – Programming – Ladder diagram – Timers, internal Relays and Counters – Shift Registers – Master and jump controls – Analog input/output – PLC selection – Application.

Text Books

1. *"Mechatronics", HMT Ltd., Tata McGraw Hill Publication Co. Ltd., 2002.*

Reference Books

1. *Dan Necsulescu, "Mechatronics", Pearson Education Asia, 2002 (Indian reprint).*
2. *Devadas Shetty, Richard Akolk,"Mechatronics System Design" First reprint 2001.*
3. *Bolton W., "Electronic Control Systems in Mechanical and Electrical engineering" 2002 Edition.*
4. *Ramachandran S., Shiva Subramanian A., "Mechatronics" 2004 Edition.*

09ME254 BASIC AUTOMOBILE ENGINEERING

Credit: 3:0:0

Objective:

- *This course deals mainly with Basic concepts of Automobile Engineering and types of IC Engines.*

UNIT I
Introduction
Classification of vehicles, body and load (definition only) - Layout of an automobile chassis, function of major components of a vehicle and introduction to their different systems such as frame, transmission (clutch and gear box), braking system, steering and suspension systems (just line diagrams and utility)

UNIT II
Thermodynamics
First and second law of thermodynamics (concept only), Otto cycle, diesel cycle, fuel used, properties of fuels, air requirement for complete combustion of fuel

UNIT III
IC Engines
Concept of two stroke and four stroke petrol and diesel engines and their applications to automobiles. Various terms, specification of automobile engines

UNIT IV
Automotive Systems
Automobile fuel system: Fuel tank, filters, spark plug, ignition systems, carburetor, MPFI, CRDI, fuel injection - Automobile cooling system: Air and water cooling, radiator, fan, water pump - Auto lubrication system: Lubricants, necessity and desirable properties.

UNIT V
Auto Industry in India
History, leading manufacturers, development in automobile industry, trends, new products

Text Books

1. Automobile engineering by Ramalingam.k(2004), Scitech publications, chennai
2.Automobile Engineering by Dr. Kirpal Singh(2003), Strandard Publishers, Delhi

References

1. Automobile Engineering by RB Gupta, Satya Parkashan, New Delhi
2.Thermal Engineering by P L Ballaney, Khanna Publishers, New Delhi

09ME255 COMPUTER WORKSTATION ERGONOMICS

Credits: 3:0:0
Objectives:

- *The students completing this course are expected to: apply the ergonomic principles to the development of computer workstations in which* ***people*** *play a significant role. They will recognize the human as the most important component of our current technological systems. They will be able to become as Ergonomists who can apply the Ergonomic aspects in the design of office (computer) workstations to fit and accommodate the human. They will be able to identify problems faced by different kinds of people and to design suitably to reduce the discomfort experienced by them*

UNIT I
Introduction
Introduction – The Development of Ergonomics: Evolution of Disciplines – Directions in Europe – Directions in North America – Names for the Discipline: “Ergonomics” and “Human Factors”. The Ergonomic Knowledge Base: Professional Organizations – Sources of Ergonomic Information

UNIT II
The anatomical and Mechanical Structure of the Human Body
Anthropology and Anthropometry: Measurement Techniques – Available Anthropometric Information – Anthropometric statistics – “Fitting” Design procedures. Human Biomechanics: The Skeletal System – Muscle – Biomechanical Description of the Body – Human Strength – Assessment of Human Strength.

UNIT III
How the Mind Works
The “Traditional” and the “Ecological” Concepts – Organization of the Nervous system – Responding to Stimuli – Mental Workload: “Stress” on Individuals and Crews – Strain Experienced by an Individual – Strain Experienced by Confined groups. Enhancing Performance: General Findings – Specific Findings – Enhancing Team work

UNIT IV
The Office (Computer) Work Station

Introduction – Theories of Healthy Sitting – Ergonomic Design of the Office Workstation: Designing the Visual Interface – Designing the Motoric Interface – Designing the Sit- Down Workstation. Design Principles: Environment – Design for Change – Furniture – Designing the stand up workstation – Data Entry Devices – Display Screen – Job Content and Work Organization – Changes through Technological Developments.

UNIT V
Designing for Special Population
Special Designs for Women and Men – Designing for Pregnant Women – Designing for Children – Designing for the Aging: Anthropometry – Changes in Biomechanics – Designing for the Aging Vision – Ergonomic Design for Disabled Persons – Ergonomic means to Enable the Disabled.

Text Book

1. *Karl Kroemer, Henrike Kroemer, Katrin Kroemer-Elbert, "ERGONOMICS" How to Design for Ease & Efficiency, Prentice Hall International Editions, 2001.*

References

1. *McCormick, E.J., and Sanders, M.S: Human Factors in Engineering and Design. Published by McGraw-Hill, New York, 1993.*
2. *Wesley E. Woodson, Berry Tillman and Peggy Tillman: Human Factors Design Handbook, Published by McGraw-Hill Inc., 1992.*
3. *Garriel Salvendy, Handbook of Human Factors, A Wiley-Interscience Publications, Published by John Wiley & Sons, Inc., 1987.*

09ME256 APPLIED THERMODYNAMIC AND HEAT TRANSFER

Credit: 3:0:0

Objective :

- *To develop a fundamental understanding of the processes by which heat and energy are inter-related and converted and by which heat is transferred*

UNIT I
Basic concepts
Thermodynamic properties – Mass, specific volume, Density, Specific gravity, Humidity - Intensive & Extensive properties -Temperature and pressure measurements - Kelvin scale, Fahrenheit scale, Rankine scale absolute, pressure, gauge pressure – Physical insight to potential energy, kinetic and internal energy – Concept of Temperature and Heat - Temperature and Zeroth Law of Thermodynamics

UNIT II
Laws of Thermodynamics
Thermodynamics Systems – First law of Thermodynamics - Energy balance for closed system – Energy change of a system – Mechanism of energy transfer – Efficiencies of mechanical and electrical devices – Energy of a flowing fluid
Off shoot of II law from I – Thermal energy reservoirs - Kelvin's and clausius statement - Heat engine & Heat pump - Efficiency and coefficient of performance – Irreversible process- Factors that make a process irreversible-concept of entropy - Carnot cycle.

UNIT III
Properties Of Substances

Gas laws - concept of Ideal and real gas – Compressibility factor – Specific heats of solids and liquids – Pure substance – Phases of pure substance – Properties of steam. Organic and inorganic refrigerants – Unit of refrigeration-properties of refrigerants-selection of refrigerants - Vapour compression cycle

UNIT IV
Heat Transfer
Modes of Heat transfer – Fourier's law of conduction – Heat conduction in plane wall and cylinder – Thermal conductivity of various Materials – Critical thickness of insulation – Newton's law of cooling – Physical mechanism of forced and free convection – Overall Heat transfer coefficient - Spectrum of Electromagnetic radiation - Thermal radiation - Laws of radiation – Black body & Gray body

UNIT V
Application:
Working principle of Cochran Boiler and Babcock and Wilcox boiler, steam turbine, steam power plant Refrigerator, Air conditioner, Petrol and Diesel Engine, Heat pipe, vacuum chamber, Microwave oven, Pressure cooker

Text Book.

1. P.K. Nag "Basic and Applied Thermodynamics", Tata Mc Graw Hill, 2002
2. R.K. Rajput "Thermal Engineering", Sixth Edition, Laxmi publication (p) Ltd,2005

Reference Books

1. *S.C. Arora & S. Domkundwar "A Course in Heat & Mass Transfer", 4th Edition, 2000.*
2. *Yunus.A Cengel., 'Heat Transfer a Practical Approach', Tata McGraw Hill, 2nd Ed., 2003*

09ME257 MATERIAL SCIENCE AND ENGINEERING

Credit 3:0:0

Objective:
- *To provide an overview of material science, mechanical behavior, failure of materials, Phase diagrams and thermal treatment.*

UNIT I
Crystallography
Classifications of materials – properties of engineering materials – band energy and activation energy- structure of solid materials -BCC- FCC & HCP structures – atomic packing factor- polymorphism- Miller indices- metallographic analysis- specimen preparation metallurgical and scanning electron microscope.

UNIT II
Mechanical Behavior
Defects in crystals -point defects line defect edge and screw dislocations – propagation of dislocation - Frank Read source – surface imperfections - diffusion - mechanisms of diffusion - Fick's Laws of diffusion – plastic , deformation- slip and twinning – recovery re-crystallization and grain growth.- strengthening mechanisms strain hardeningprecipitation hardening.

UNIT III

Failure of materials.

Fracture – ductile and brittle fracture - Griffith's theory of crack propagation protection against fracture- Creep- mechanisms of creep – creep resistant materials. Fatigue failure, SN curve- prevention of fatigue failure.

UNIT IV

Phase diagram

Solid solution, Phases- phase diagrams- Gibbs phase rule- cooling curves, types of Equilibrium diagrams, lever rule – phase diagrams of Copper-Nickel, Bismuth -Cadmium, lead-Tin system. Iron Carbide equilibrium diagram

UNIT V

Heat treatment of Steel.

Annealing normalizing - spheroidsing- hardening, tempering - Hardenability - Jomnys test for hardenability- case hardening- carburizing- nitriding, induction hardening- flame hardening.

Text Books

1. *Raymond A Higgins "Engineering Materials (Applied Physical Metallurgy) English Language book society, 2000.*
2. *Khanna .O.P " A text book of Materials Science and Metallurgy" Dhanpat Rai and Sons Delhi, 2004*

Reference Books

1. *Robert, E. Reed Hill, "Physical Metallurgy Principles", Affiliated East West Press, 1973.*
2. *Williams D. Callister " Material Science and Engineering" John wiley & sons inc. 1997.*
3. *Raghavan. V, "Material Science and Engineering, Prentice Hall of India Pvt. Ltd, New Delhi, 1998.*

09ME258 HEAT AND MASS TRANSFER LAB

Credits:0:0:2

1. Determination of thermal conductivity in a composite wall.
2. Determination of heat transfer coefficient in forced convection
3. Determination of heat transfer coefficient in free convection
4. Determination of emissivity of the given test surface.
5. Determination of Stefan-boltzman constant in radiation heat transfer
6. Determination of heat transfer coefficient in a parallel floe heat exchangers.
7. Determination of heat transfer coefficient in a counter flow heat exchangers
8. Determination of heat transfer coefficient in a fin-pin (free convection) apparatus.
9. Determination of heat transfer coefficient in a fin-pin (forced convection) apparatus.
10. Determination of effectiveness in coiled type heat exchanger .
11. Find the COP of the Refrigeration system using LPG.
12. Find the heat transfer coefficient in fluidized bed heat exchanger.

09ME259 MATLAB

Credits: 0:0:2

1) Knowing MATLAB
2) Solving simple mathematical problems using MATLAB
3) Solving Matrices problems using MATLAB
4) Solving PDE using MATLAB
5) Solving Engineering problems in MATLAB
6) Knowing simulink in MATLAB
7) System Simulation using MATLAB
8) Optimization using MATLAB
9) Finite element analysis using MATLAB
10) Vibration simulation using MATLAB
11) Prediction simulation using MATLAB
12) Digital Image processing using MATLAB

09ME263 PRODUCTION MANAGEMENT AND QUALITY SYSTEMS

Credit 3:1:0

Objective :

To provide knowledge about the various industrial activities like production planning and control , materials management and inventory control , MRP ,JIT and quality control

UNIT I: Production planning and control (PPC)
Introduction of PPC-Objectives and functions of PPC-Routing, scheduling, machine loading, dispatching, production control-Types of production systems-Job order, batch, continuous production systems

UNIT II: Materials management and inventory control
Objectives and functions of materials management-classification of inventories-Inventory functions. Determinaion o inventory level- economic order quantity (EOQ) calculation-Two bin system-ABC analysis, VED,SDE,HML,MNG analysis

UNIT III: Introduction to MRP and JIT
Concept of MRP-Inputs to MRP-MRP outputs, benefits and limitations of MRP,MRP II, Concept of JIT, goals of JIT, components of JIT, Beneits and limitations of JIT,KANBAN pull system of inventory control-Introduction to agile and lean manufacturing.

UNIT IV: Quality control
Quality control charts-variable quality control charts -attribute control charts C,P,NP and U charts-Single, Double and Multiple sampling plans

UNIT V: Quality systems
TQM concepts-Elements and benefits of TQM-Need for bench marking and benefits of bench marking-ISO 9000 Quality systems, ISO 14000 Quality systems

Text book

1. M.S.Mahajan,"Industrial engineering and production management", Dhanpat Rai, 2008
2. S.Bhaskar," Statistical Quality Control &Reliability Engineering, Anuradha publishers, 2006

Reference Book

1.Dale.H.Bestefield,Total Quality Management, Prentice Hall of India 2006
2.Dieter George E., Engineering Design-A Materials and Processing Approach, McGrawHill,International Edition Mechanical Engg ., Series ,2000
3. 3. Karl t. Ulrich and Steven d Eppinger, Product Design and Developement ,McGraw Hill,Edition 2004

09ME264 FUNDAMENTALS OF ENGINEERING THERMODYNAMICS

Credit: 4:0:0

Objective:

- *To learn about the basic concepts of engineering thermodynamics. To provide knowledge about second law of thermodynamics, properties of pure substances and gas mixtures. To understand about the various air standard cycles.*

UNIT I
Basic concepts
Concept of continuum, microscopic and macroscopic approach, thermodynamic systems – closed, open, isolated, control volume. Thermodynamic properties and equilibrium state of a system, state diagram, path and process, quasi-static process, work, modes of work, zeroth law of thermodynamics – concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities C_v and C_p, enthalpy, steady flow process with reference to various thermal equipments.

UNIT II
Second law of thermodynamics
Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Carnot cycle, reversed Carnot cycle, efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy – Carnot theorem, entropy and reversibility, absolute entropy availability, irreversibility

UNIT III
Properties of pure substances
Thermodynamic properties of pure substances in solid liquid and vapour phases, phase rule P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non flow and flow processes -simple problem.

UNIT IV
Gas mixtures
Properties of ideal and real gases, equation of state, Avagadro's law, Gay Lussac's law Graham's law of diffusion, kinetic theory of gases, RMS and average velocity, ideal gas and deviation from it, Vander Wall's equation of states compressibility, compressibility chart,Expansivity Types of fuels-HCV,LCV, Determination of Calorific value -Bomb-calorimeter,Junker's calorimeter, Stochiometric Mixture.

UNIT V
Air standard cycles
Otto, Diesel, Dual, Brayton , Rankine cycles – calculation of mean effective pressure and air standard efficiency.

Text Books

1. Nag P.K., Engineering Thermodynamics, TMH, New Delhi, 2002.

Reference Books
1. Holman. J.P., Thermodynamics, 4th edition, McGraw Hill, 2002
2. Roy choudhury T., Basic Engineering Thermodynamics, TMH, 1999.
3. Yunus Ccngel 'Thermodynamics', TMH, 2008

09ME265 FUNDAMENTALS OF HEAT AND MASS TRANSFER

Credits: 4:0:0
Objective:

- *To provide knowledge about Conduction, convection, radiation, heat transfer during boiling and condensation. To learn about the design of heat exchangers. To understand the principles of mass transfer.*

UNIT I
Introduction to conduction heat transfer, Fourier's law of conduction, thermal conduction equation – derivation in Cartesian, Cylindrical and Spherical coordinates. One dimensional steady state conduction in plane wall and composite wall. Thermal contact resistance variable conductivity, thermal resistance, electrical analogy, radial systems – cylinder, sphere. Overall heat transfer coefficients, critical thickness of insulation. Heat generation in plane wall, cylinder and sphere.

UNIT II
Steady state conduction in two dimensions, conduction shape factor, numerical method of analysis. Unsteady state conduction – lumped heat capacity systems, significance of Biot and Fourier numbers, use of Heisler and Grober charts.

UNIT III
Concept of hydro dynamics and thermal boundary layers. Significance of non-dimensional numbers in connection. Dimensional analysis for free and forced convection. Forced Convection – heat transfer over a flat plate, flow through pipes, use of empirical relations. Free Convection – heat transfer from vertical, horizontal and inclined surfaces. Conduction and Convection systems – fins with different boundary conditions

UNIT IV
Types of heat exchangers, overall heat transfer coefficients, LMTD and NTU methods, fouling factor.,. Radiation – nature of thermal radiation, black body concepts, gray body, radiation shape factor, relation between shape factors, radiation heat transfer between two surfaces. Re-radiating surface, radiation shields.

UNIT V

Condensation and Boiling processes. Mass transfer – Fick's law of diffusion, equi-molal counter diffusion, Stephen's law, Mass transfer coefficient, non-dimensional number in mass transfer, evaporation process in the atmosphere

Text Books:

1. Holman J.P., 'Heat Transfer', SI Metric 8th Ed., Mc Graw Hill, ISE, 2003.
2. Sachdeva, 'Heat and Mass Transfer', Wiley Eastern, 2nd Ed, 2005.

Reference Books:

1. Frank.P.Incropera,David.P.DeWitt 'Heat & Mass Transfer',John Wiley,5Th Edition 2005.
2. P.S.Ghoshdastidar., ' Heat Transfer', Oxford, 2005.
3. Schaum Series., 'Heat Transfer', McGraw Hill, 2004.
4. Yunus.A.Cengal,' Heat Transfer',Tata McGraw Hill,2nd Edition 2003.

09ME266 INDUSTRIAL ROBOTICS

Credit 3:0:0

Objectives:

- To be familiar with the basic concepts, parts of robot and types of robots
- To give the student familiarities with the various drive systems for robot.
- To give the functions of various Sensors and their applications in robots.
- To learn the basics of Programming methods & Languages of robot.
- To discuss about the various industrial applications of robots

UNIT I
Introduction
Need of robotics - History of robotics –Laws of Robotics - Definitions of Robot - Robot Classification - Various Robot drive systems.

UNIT - II
Components and Operations
Basic Components of a Robot system - Robot effectors – Different types of Grippers - Tools as end effectors – Selection of end-effectors. Coordinate transformation – homogeneous transformations –some problems on homogeneous transformations - Direct and inverse kinematics- D-H notation - Brief introduction on Robot dynamics.

UNIT III
Sensing Elements
Need of sensing elements – classification - Range sensing - Proximity sensing - Touch sensing - Force and Torque sensing. Introduction to Machine vision - Sensing and digitizing - Image processing and analysis.

UNIT IV
Robot Programming

Different methods of robot programming - Robot languages and their Capabilities and limitations - AI and Robotics - Artificial intelligence - Knowledge representation - Search techniques.

UNIT V
Industrial Applications
Application of robots in Machining - Welding - Assembly - Material handling - Loading and unloading -CIM -Hostile and remote environments.

Text Book
1. Mikell P. Groover, Mitchell Weiss, "Industrial Robotics, Technology, Programming and Applications ", McGraw Hill International Editions, 1st Edition, 2003

References
1. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall India, 2002
2. R.K.Mittal and I.J.Nagrath , "Robotics and Control" Tata McGraw Hill, New Delhi, 2003.
3. K.S. Fu., R.C.Gonalez, C.S.G.Lee, " Robotics Control sensing ", Vision and Intelligence, McGraw HillInternational Edition, 1987.

09ME267 DESIGN OF MACHINE ELEMENTS

Credit: 3:1:0
Objectives:
To introduce the factors influencing the machine design
To train students to design against fatigue failures
To equip students with skills to design couplings, joints and engine parts

UNIT I
Introduction to the design process – factors influencing the machine design, selection of materials based on its physical and mechanical properties. Direct bending, torsional and combined stress equations, impact, and shock loading. Criteria of failure, stress concentration factor, size factor, surface finish factor – factor of safety, design stress,
theories of failures – simple problems.

UNIT II
Variable and cyclic loads – fatigue strength and fatigue limit – S-N- curve, combined cyclic stress, Soderberg and Goodman equations – Design of helical, leaf, disc and torsional springs under constant loads and varying loads.

UNIT III
Design of solid and hollow shaft based on strength, rigidity and critical speed. Design and drawing of keys, keyways, couplings, rigid and flexible couplings.

UNIT IV
Design of riveted joints - pressure vessels and structures, Screw joints, Cotter joints, knuckle joints and pipe joints.

UNIT V
Design of piston, connecting rod, crankshaft, and flywheel.

Text Books:
1. S MD Jalaludin , "Machine Design", Anuradha Publishers,2002.
2. T. J. Prabhu, Fundamentals of Machine Design, 2001.

Reference Books:
1. 1. Joseph Edward Shighley, "Mechanical Engineering Design", McGraw Hill, 1992.
2. Hall A.S., Holowenko, A.R. and Laughlin, HIG., "Theory and Problems in Machine Design" , Schaum series.
3. Sundarrajamoorthy T.V. and Shanmugam, "Machine Design", Khanna Publishers, 1989.

Hand Book
1. Design Data Book, PSG College of Technology, Coimbatore, Use of approved data books are permitted.

09ME268 FOOD PROCESSING EQUIPMENT DESIGN

Credits 4:0:0

Objective:
- *This course mainly deals with design of food processing equipments, selection of materials, design consideration factors for various equipments and design of gear and gear nomenclature.*

UNIT I
Cast iron- steel- alloy steels-other materials - their composition and applications – mechanical and thermal properties - stainless steels, grades, composition, properties of stainless steels -corrosion in metals - types and preservation - non ferrous metals - brass and aluminium their properties and application

UNIT II
Introduction ,classification of heat exchangers, Arithmetic mean temperature difference(AMTD),logarithmic mean temperature difference(LMTD)-parallel flow and counter flow, overall heat transfer coefficient, fouling in heat exchangers-fouling effect calculations. Effectiveness in heat exchangers- parallel flow and counter flow .Number of transfer unit (NTU) Design of shell and tube heat exchangers - Design considerations.

UNIT III
Design consideration in cleaning and grading. Design of cleaner grader-design requirement for drying systems and design of drier - design consideration of evaporator and design of evaporator. Pressure drop and pumping power calculations in double pipe and shell and tube heat exchangers. Design of condensers .Cooling tower-Types and design.

UNIT IV
Design of riveted joints - pressure vessels and structures, Screw joints, Cotter joints, knuckle joints and pipe joints.

UNIT V

Cams: Types of cams and followers displacement, velocity and acceleration curves for uniform velocity, uniform acceleration and retardation, -knife edge, Rollers and flat faced followers. Cylindrical and face cams, polynomial cams, cams with special contours. Theory of gearing, gear nomenclature, law of gearing, tooth forms of gears, minimum number of teeth. Length of arc of contact, interface. Gear trains: Types, velocity ratio and torque calculation in epicyclic gear trains.(simple problems only)

Text Books

1. S.D.Dawande; "Principles of Heat Transfer and Mass Transfer", Central Techno Publications, 2000.
2.Khurmi, R. S. & Gupta, J.K. A "text-book of Machine Design", Euresia Publishing House (Pvt.) Ltd. ,New Delhi, 2003

Reference Books :

1 Amitabha Ghosh and Ashok Kumar Mallik. "Theory of Mechanisms and Machines" - 2nd Edition, Affiliated East andWest Press Limited, 1988.
2 Sundarrajamoorthy T.V. and Shanmugam, "Machine Design", Khanna Publishers, 2003
3. Hall A.S. Holowenko A.R. and Laughlin H.G., 'Theory and Problems in Machine Design', Schaum's Series,2000.
4. Hall and Allen, 'Machine Design', S.Schaum's Series, .Ist edition 2001
5. Joseph Edward Shighley, 'Mechanical Engineering', McGraw Hill, 2002

09ME301 APPLIED MATHEMATICS

Credit: 3:1:0

Objectives :

- *The course introduces classical methods of calculus of variations and applied numerical methods. Attention is paid to the practical problems of interest in Mechanical Engineering, Structural optimization and composites etc. the students are given exposure to numerical methods to solve the Engineering problems.*

UNIT I
Calculus of Variations:
Variation & its properties-Euler's equation-Functionals dependant on its first, higher order derivatives& of several independent variables-some applications –Ritz method& Kantorvich methods

UNIT II
Numerical Solution of Partial Differential Equation
Solution of Laplace & Poisson equation on a rectangular region by Liebmann's Method-Differential equation by the explicit & Crank Nickolson-Impilicit methods-Solution of wave equation by explicit scheme.

UNIT III
Initial, Eigen & Boundary Value Problems

Initial values problems- Taylor & Maclaurin series, Picards, Euler, Improved Euler and Modified Euler, Runge- Kutta methods, Milne's & Adams predictor corrector methods. Eigen value problems: Power & inverse power methods, Jacobi's & given, methods.Boundary value problems: Raleigh- Ritz, Collocation, Galerkin methods.

UNIT IV
Solution of Numerical & Transcendental Equation
Linear equations-Horner's method, Bolzano's bisection, Iteration, False position, Newton-Raphson, Muller, Chebyshev, Graeffe's root, Barstow's, Birge-vieta methods Gauss-Elimination, Gauss Jordan, Triangular, Crout's, Gauss-Seidel, Gauss-Jacobi, Relaxation methods- System of non-linear equations- Newton-Raphson method

UNIT V
Numerical Integration
Newton-Cote's Quadrature formula, Trapezoidal, Simpson, Weddle's rule (Single & Double Integrals) Romberg's method, Gaussian- Quadrature Formulas-Natural cubic spline functions, Beizer curves

Text books:

1. T.Veerarajan, T.Ramachandran, Numerical Methods, Tata McGraw Hill.2003
2. P.Kandasamy et al., Numerical Methods S. Chand & Co Ltd.2005

Reference:
3. Naveen Kumar, An elementary Course on Variational problems in Calculus, Narosa publishing house.2003
4. Curtis F-Gerald, Applied Numerical Analysis (5th edition), Addison Wesley publishing company,2001
5. Ward Cheney, David Kincaid, Numerical Mathematics & Computing (3rd edition), Brooks/Cole publishing Company Ltd.,2000

09ME302 ADVANCED THERMODYNAMICS

Credits 3:1:0

Unit I
First law and Second law analysis – concept of entropy – principle of increase of entropy – entropy generation – Availability – concept of exergy – Helmholtz function – Gibb's function – On Sager reciprocity relation.

Unit : II
Thermodynamic relations, Maxwell's relations, T-ds equations – specific heat relations – energy equation – Joule Thomson effect – Clausius Claperyon Equation. Criteria for Equilibrium – Gibb's phase rule – Conditions for stability.

Unit : III

Compressibility factor, fugacity and activity, computation from the generalized charts, dependence of fugacity and activity on pressure and temperature, chemical – equilibrium. Phase rule – ideal and real solution of gases, liquids, equilibrium system.

Unit IV : Combustion Principles - Thermodynamics concepts of combustion. First law and second law of thermodynamics applied to combustion process – heat of combustion – Adiabatic flame temperature – stoichiometry and excess air – combustion calculations – minimum air required for complete combustion of fuel – chemical equilibrium and dissociation.

Unit V : Kinetic Theory of Gases
Perfect gas model, Distribution of translational velocities distribution function, molecular collisions and mean free path, equi partition of energy.

Text Books

1. Yunus A Cengel, 'Thermodynamics An Engineering Approach', The McGraw Hill Companies, 6th Edition, 2008.
2. P.K. Nag., 'Engineering Thermodynamics', 3rd Edition., McGraw Hill, 2005.

Reference Books

1. G.J. Van Wylen & R.E. Sonntag., 'Fundamentals of Classical Thermodynamics', Willy Eastern Ltd., 1989 (Unit I, II & III)
2. J.P. Holman., 'Thermodynamics', 4th Ed., McGraw Hill, 1988.
3. Juisheng Hsieg., 'Principles of Thermodynamics', McGraw Hill, 1978.
4. Smith K. Van Ness H.C., 'Introduction to Chemical Engineering Thermodynamics',McGraw Hill, NY, 1987.

09ME303 ADVANCED FLUID MECHANICS

Credits 3:1:0

Objectives:

- *To learn about Eulerian, Lagrangian equation, Bernoulli's equation, Differential momentum equation, Navier Stoke Equations and Energy Equation. To learn about irrotational motion in two dimensions, flow over cylinders and boundary layer principles.*

UNIT I
Method of describing fluid motion– Lagrangian, Eulerian Method – Local and individual time rates of change, acceleration, - Eulerian and lagrangian equation of Continuity. Bernoulli's equation from Euler's equation– solved problems related to liquid motion, related to equation of continuity.

UNIT II
Forces and stress acting on fluid particles. Differential momentum equation. Navier Stoke Equations of Motion for simple cases in rectangular, cylindrical and spherical coordinate. Energy Equation

UNIT III

Irrotational motion in two dimensions, sources and sink Complex potential due to a source, due to a doublet, Images with respect to straight line, solved problem. Vortex motion-Vortex tube, Helmohltz's vorticity theorem, velocity potential and stream function.

UNIT IV
Flow over Circular cylinders, sphere, solution of Laplace equation, Joukowshi transformation, Flow past cylinder with and without circulation, flow past Rankine body. Liquid streaming past a fixed sphere and solved problems. Analytic function Conformal Transformation of infinite and semi – infinite strip

UNITV
Boundary layer principles, flat plate, conduits, curved solid bodies, Prandtl mixing length turbulent theory, universal velocity profile, and momentum eddy concept – simple applications.Von Karman integral equation to Boundary layer –with and without pressure gradient.

Text Books

1. Streeter, 'Fluid Dynamics', 3rd Ed., McGraw Hill,2006.
2. Raisinghania.M.D, 'Fluid Dynamics', 4th Ed., S.Chand & Company Ltd, 2002.

Reference Books

1. Fox R.N. and McDonald A.T., 'Fluid Mechanics', John Wiley & Sons, 1999.
2. *Dr. J.K Goyal I K.P. Gupta., 'Fluid Dynamics', 3rd revised Ed., Pragathiprakasam, Meerut, 1999.*
3. Schlichting.H., 'Boundary layer Theory' ,8th Ed.,McGraw Hill, New york,2001.

09ME304 COMPUTER INTEGRATED MANUFACTURING SYSTEMS

Credit: 4:0: 0

Objective:
- *To use computers in the area of manufacturing to reduce manual processing and linking computers to all the manufacturing machines and increase the productivity, reduce the unnecessary costs. To study about group technology, computer aided process planning, material requirement planning (MRP)* **Enterprise resource planning (ERP),** *Computer aided quality control and Flexible manufacturing systems, Artificial intelligence and Expert systems*

UNIT I
Introduction
Objectives of a manufacturing system-identifying business opportunities and problems classification production - systems-linking manufacturing strategy and systems-analysis of manufacturing operations.

UNIT II
Group Technology And Computer Aided Process Planning

Introduction-part families-parts classification and cooling - group technology machine cells benefits of group - technology. Process planning function CAPP - Computer generated time standards.

UNIT III
Computer Aided Planning And Control
Production planning and control-cost planning and control-inventory management-Material requirements planning - (ERP)-shop floor control-Factory data collection system-Automatic identification system-barcode technology automated data collection system.

UNIT IV
Computer Monitoring
Types of production monitoring systems-structure model of manufacturing process-process control & strategies direct digital control-supervisory computer control-computer in QC - contact inspection methods non-contact inspection method - computer-aided testing - integration of CAQC with CAD/CAM.

UNIT V
Integrated Manufacturing System
Definition - application - features - types of manufacturing systems-machine tools-materials handling system computer control system - DNC systems manufacturing cell. Flexible manufacturing systems (FMS) - the FMS concept-transfer systems - head changing FMS – variable mission manufacturing system - CAD/CAM system - human labour in the manufacturing system-computer integrated manufacturing system benefits. Rapid prototyping - Artificial Intelligence and Expert system in CIM.

Text Books:

1. Groover, M.P., "Automation, Production System and CIM", Prentice-Hall of India,2005.

References:

1. David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi, I Edition 1999
2. Yorem Koren, "Computer control Manufacturing Systems", McGraw Hill, 1999.
3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International 1999

09ME305 COMPUTER APPLICATIONS IN DESIGN

Credit: 4:0:0

Objective:

- *To study how computer can be used in mechanical engineering design. To familiarize the basics of CAD and Visual realism. To learn about the assembly of parts, tolerance analysis, mass property calculation, Solid modeling techniques and rapid prototyping.*

UNIT I
Introduction to Computer Graphics Fundamentals
Output primitive-(points, Lines, curves, etc) 2-D Transformation (**2-D** Translation, scaling, rotation) Windowing and clipping transformation.

UNIT II
Introduction to CAD Software's
Writing interactive programs to solve design problems and production of drawings using any languages like Auto LISP/C/ FORTRAN etc. Creation of surfaces, solids etc., using solid modeling pack (prismatic and revolved parts)

UNIT III
Visual Realism
Hidden line- surface- Solid removal algorithms shading- coloring . Introduction to parametric and variational geometry based on software's and their principles creation of prismatic and lofted parts using these packages.

UNIT IV
Assembly of Parts
Assembly of parts, tolerance analysis and mass property calculations, mechanism simulation.

UNIT V
Solid Modeling – Rapid prototyping – data exchange- Documentation- Customizing- solid Modeling system.

Textbooks
1. IBRAHIM ZEID,CAD/CAM- Theory and Practice McGraw Hill, Indian Edition,2005

References:
1. Mikell. P. Grooves and emory, W. Zimmers Jr. "CAD/CAM Computer aided Design and Manufacturing " prentice Hall of Inc., 2002
2.Donald Hearn and M Pauline Baker "Computer Graphics Printice Hall Inc. III Edition2006.
3. Hall A.S. Holowenko A.R. and Laughlin H.G., 'Theory and Problems in Machine Design', Schaum's Series,2000.
4. Hall and Allen, 'Machine Design', S.Schaum's Series, .Ist edition 2001
5. Joseph Edward Shighley, 'Mechanical Engineering', McGraw Hill, 2002

09ME306 MECHANICAL MEASUREMENTS
Credit : 4 : 0 : 0

Objective *:*
- *To provide an overview of measurement techniques for measuring process parameters in industry and in research*

UNIT I
Measurement of Temperature
Introduction – temperature standards – liquid in glass thermometers – calibration – stem correction – total and partial immersion thermometers – bimetal thermometers – pressure thermometers – vapor pressure thermometers – resistance thermometers – instrumentation for resistant thermometers – thermistor – thermo electric thermometers – loss thermo couples – measurement of thermo em – extension wires – effective junctions – thermo piles – pyrometers – total radiation and optical pyrometers – infrared and photo electric pyrometers – calibration of temperature measuring devices.

UNIT II

Measurement of Pressure and Level

Measurement of pressure – bourdon tube – calibration of bourdon tube – eleastic diaphragm – inductive pressure sensors – strain gauge pressure cells – bulk modulus pressure gauge – McLeod Gauge – thermal conductivity gauge – ionization gauges – dynamic characteristics of pressure measurement systems – calibration of pressure measurement systems – level measurements – direct methods – float type level sensors – float switches – pressure gauge and piezomeric level meters – capacitance and resistance type level sensors – radio active method of level sensing – solid level detectors – grid response units – electrical capacitance and diaphragm methods – probe deflection unit – electrical contact and rotating paddle unit

UNIT III

Measurement of Flow

Introduction – classification of flow meters – flow characteristics – obstruction meters – ventury meters and dall tubes – variable area meters – rotameters- measurement of fluid velocity – total, static and direction sensing probes – special flow meters – turbine type flow meters – thermal flow meters – magnetic flow meters – mass flow meters – ultrasonic flow meters – pulse producing flow meters – calibration of flow meters

UNIT IV

Measurement of Strain

Theory of strain gauges – construction – bonded and unbounded strain gauges – metal foil and semi conductors gauges – gauge factor of strain gauges – selection and installation – bonding methods – gauge protection – gauge configuration – strain gauge circuits – ballast and bridge circuits – bridges with 2 and 4 arm sensitivity – compensating gauge – bridge constant – constant current strain gauge circuits – temperature compensation – calibration of strain gauges – commercial strain measuring systems – use of strain gauges on rotating shafts – different gauge orientation and interpretation of results

UNIT V

Measurement of Force ,Torque and Miscellaneous Measurements

Introduction – mass standards – pendulum scale – elastic transducers – the proving ring – strain gauge load cells – temperature sensitivity – piezo load cells – ballistic weighing – hydraulic and pneumatic systems – measurement of torque – mechanical and hydraulic dynamometers – electric dynamometers – transmission dynamometers – acoustical measurement – basic acoustical parameters – micro phones – sound level meters – measurement of humidity – hair hygrometer – measurement of pH – pH meter – measurement of air pollution – Orsat apparatus – gas chromatography – nuclear instrumentation – Giger muler counter – scintillation counter – ionization chamber

Text Books:

1. *Beckwith, "Mechanical Measurement" Narosa Publishing House2003*
2. *R.K. Jain, "Mechanical and Industrial Measurements" Khanna Publishers, 2000*

Reference:

1. *J.P. Holeman, "Experimental methods for Engineers" McGraw Hill Publishers, 1998*
2. *E.O. Doebelin, "Measurement systems : Application and Design" McGraw Hill Publishers, 1990*
3. *B.C. Nakra "Instrumentation measurement and Analysis" Tata McGraw-Hill Publising Company, 2002*

09ME307 ERGONOMIC DESIGN AND ANALYSIS

Credits: 4:0:0

Objectives

- *The students completing this course are expected to: apply the scientific principles, methods, and data drawn from a variety of disciplines to the development of engineering systems in which **people** play a significant role. They will be able to achieve the utmost goal of ergonomics i.e., the "humanization" of work. They will recognize the human as the most important component of our* *current technological systems. They will be able to become as Ergonomists who can apply the Ergonomic aspects in the design of tools, machines, work tasks, and job procedures to fit and accommodate the human. They will be able to identify problems faced by different kinds of people and to design suitable equipments to reduce the discomfort experienced by them*

UNIT I

The anatomical and Mechanical Structure of the Human Body

Anthropology and Anthropometry: Measurement Techniques – Available Anthropometric Information – Anthropometric statistics – "Fitting" Design procedures. Human Biomechanics: The Skeletal System – Muscle – Biomechanical Description of the Body – Human Strength – Assessment of Human Strength.

UNIT II

Designing to Fit Body Posture

Evaluation of "Suitable" Positions at Work - Body Postures at Work - Recording and Evaluating Postures at Work - Designing for Standing Operator, and Sitting Operator - Designing for Foot Operation and for Hand use - The use of Tables of Exerted Torques and Forces - Avoiding Posture Overuse Disorders in Shop and Office - Biomechanical Strains of the Body - Occupational Activities and Related Disorders - OD Prone Activities and Postures - Ergonomic Means to Counter ODs.

UNIT III

Handling Loads

Strains associated with Load Handling - Assessing Body Capabilities Related to Material Handling - Back Injury and Pain – Personal Training – Proper Lifting Techniques – Personnel selection by Physical Testing: Capacity Limitations – Assessment Methods – Screening Techniques – Ethical and Legal Considerations.

UNIT IV

Ergonomic Design and Analysis

Ergonomic Design - Facility Layout - Ergonomic Design of Workstation and Work Task - Permissible loads for Manual Material Handling - RULA (Rapid Upper Limb Assessment) Ergonomic Analysis - Limits for lifting and lowering - Lift / Lower Ergonomic Analysis - Ergonomic Rules for Industrial Manual Handling Tasks - NIOSH 1981, NIOSH 1991 and Snook/Ciriello guidelines - Push / Pull Ergonomic Analysis and Carry analysis

UNIT V

Designing for Special Population

Special Designs for Women and Men – Designing for Pregnant Women – Designing for Children – Designing for the Aging: Anthropometry – Changes in Biomechanics – Designing for the Aging Vision – Designing for the Older Worker – Designing for the aging Driver and Passenger – Ergonomic Design for Disabled Persons – Ergonomic means to Enable the Disabled.

Text Book

1. *Karl Kroemer, Henrike Kroemer, Katrin Kroemer-Elbert, "ERGONOMICS" How to Design for Ease & Efficiency, Prentice Hall International Editions, 2001.*

Reference Books:

1. *McCormick, E.J., and Sanders, M.S: Human Factors in Engineering and Design. Published by McGraw-Hill, New York, 1993.*
2. *Anil Mital and Waldemar Karwowski: Workspace, Equipment and Tool Design. Published by Elsevier Science Publishers, 1991.*
3. *Wesley E. Woodson, Berry Tillman and Peggy Tillman: Human Factors Design Handbook, Published by McGraw-Hill Inc., 1992.*
4. *Waldemar Karwowski and William S. Marras: The Occupational Ergonomics Handbook, Published by CRC Press LLC, 2006.*

09ME308 MICROMANUFACTURING AND NANO TECHNOLOGY

Credits: 4:0:0

Objective :

- *To give an introduction to the concepts in micromachining and nanotechnology*

UNIT I

Micro Fabrication and Micro Manufacturing

Introduction-Photo lithography-ion implantation-Diffusion-Oxidation-Chemical vapour deposition-physical vapour deposition-depolition by Epitaxy-Etching-Micro manufacturing-Introduction-Bulk micromanufacturing-Isotropic and Anisotropic Etching-wet etchants-Etch stop-Dry Etching-Surface micromanufacturing-Mechanical problems associated with Surface Micromachining-The LIGA process-general description-Materials for substrates and photoresists-The SLIGA process.

UNITII

Introduction to principles of Micro Electro Mechanical Systems & Micro Opto Electro Mechanical Systems (MOEMS)

Introduction- Micro Electro Mechanical Systems (MEMS) –microelectronics fabrication methods- Micro instrumentation-Micro instrumentation -Micro Mechatronics-Nano finishing- Optically variable devices-MECS-Micro propulsion-e beam Nano lithography-Nanotechnology-Carbon nano tubes-Molecular Logic Gates- Micro devices-Bio sensors,-Principles of MEMS-introduction-Mechanical MEMS-thermal MEMS-Magnetic MEMS-and MOEMS-

UNIT III

Laser Micromachining and Nano Finishing Techniques

Laser technology in Micro manufacturing- Introduction - Generation of laser- properties of laser-Practical Lasers-Applications –Nano Finishing Techniques-Introduction-Traditional anfd advanced finishing process-Abrasive Flow machining-Magnetic Abrasive finishing-Magnetorheologial Finishing-Magnetorheologial Abrasive Flow Finishing-Magnetic Float Polishing- Elastic Emission Machining-Ion Beam Machining- Chemucal Mechanical Polishing

UNIT IV

Introduction to Nanotechnology and investigating materials in Nanoscale

Introduction to Nanotechnology-Experimental methods-Introduction-Electron Microscopy-Scaning probe microscopy-Optical microscopy for Nanoscience and Technology

UNIT V

Carbon Nanotubes , their production ,application and societal implications of Nano Science and Nano Technology

Introduction-Carbon nanotubes-structures-properties-production of carbon Nano tubes-Chemical Vapor deposition-Arc discharging-Laser ablation-Mechanisms of growth-purification-Applications of carbon Nanotubes- Electrical transport of carbon nanotubes-applications in computers biomedical applications-X-ray equipments-Nano mechanical actuators-Societal implications of Nano science and Nanotechnology-Issues-Nanopolicies -nano technology for economic and social development

Text book

1. N.PMahalik, "Micro manufacturing and Nanotechnology," Springer Verlag, Berlin Heidelberg 2006
2. T Pradeep, "NANO The Essentials" Tata McGraw-Hill New Delhi 2007
3. Tai-Ran Hsu " MEMS &Microsystems Tata McGraw-Hill New Delhi 2005

Reference Books:

1. *V K Jain "Advanced Machining Processes" allied Publishers (P) Ltd. 2008*
2. *Introduction to Nanotechnology, Charles P.Poole, Jr. and Frank J.Owens, Wiley, 2003*
3. *Michael Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and Burkhard Raguse, "Nanotechnology – Basic Science and Emergin Technologies", Chapman &*Hall(CRC), 2004

09ME309 INSTRUMENTATION IN THERMAL ENGINEERING

Credits:3: 1: 0

Objective:

- *This course covers different measuring instruments and reliability of instruments, the use of computers in measurement, measurement of physical quantities like pressure temperature and flow, use of intelligent instruments. Course also covers Laser Doppler anemometer, heat flux measurement, Chemical, thermal, magnetic and optical gas analyzers. This study is useful for understanding the instrumentation in thermal engineering and also for the research in thermal engineering.*

UNIT I
Measurement Characterstics
Instrument classification, Characteristics of Instruments - Static and dynamic, experimental error analysis, systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments.

UNIT II
Microprocessors And Computers In Measurement
Data logging and acquisition, use of intelligent instruments for error reduction, element of micro-computer interfacing, intelligent instruments in use.

UNIT III
Measurement Of Physical Quantities
Measurement of thermo-physical properties, instruments for measuring temperature, pressure and flow, use of intelligent instruments for the physical variables.

UNITIV
Flow Visualilsation
Techniques, shadow graph, Schlieren, interferometer, Laser Doppler anemometer, heat flux measurement, Telemetry in engines.

UNIT V
Measurements Analysis
Chemical, thermal, magnetic and optical gas analyzers, measurement of smoke, dust and moisture, gas Chromatography, spectrometry, measurement of pH, Review of basic measurement techniques.

Text book

1. Holman, J.P., Experimental methods for engineers, McGraw-Hill, 2007

References:

1. Barney, Intelligent Instrumentation, Prentice Hall of India, 1988.

2. Prebrashensky, V., Measurements and Instrumentation in Heat Engineering, Vol.1 and 2, MIR Publishers,1980.
3. Raman, C.S., Sharma, G.R., Mani, V.S.V., Instumentation Dervices and systems, Tata McGraw Hill, New Delhi, 1983.
4. Doeblin, Measurements System Application and Design, McGraw Hill, 1978.
5. Morris. A.S, Principles of Measurements and Instrumentation, Prentice Hall of India, 1998.

09ME310 FLUIDISED BED SYSTEMS

Credits:3:1:0
Objective:

- *This course covers fluidized bed behavior, different modes of heat transfer, heat recovery systems, Fluidized Bed Combustion and Gasification. The system design and also industrial applications like Pollution control and Environmental Effects-Cost Analysis are also covered in this course. The topics will enable the student to understand the theory behind the fluidized bed systems.*

UNIT I
Fluidized Bed Behaviour
Fluidization Phenomena - Regimes of Fluidized Bed Behavior - Characterization of Fluidized Particles – Two Phase and Well Mixed Theory of Fluidization - Solids Mixing Particle Entrainment and Carryover.

UNIT II
Heat Transfer
Different modes of Heat Transfer in Fluidized Bed-Use of Immersed Tubes - Finned Tubes - Heat Recovery Systems.

UNIT III
Combustion And Gasification
Fluidized Bed Combustion and Gasification, Pressurised Systems, Sizing of Combustion and Gasification Systems, Start-up Methods, Fast Fluidized Beds, Different Modes of Heat Transfer in Fluidized Beds.

UNIT IV
System Design
Design of Distributors, Fluidized Bed Furnaces for fossil and Agricultural Fuels, Fluidized Bed Heat Recovery Systems, Fluid Bed Dryers.

UNIT V
Industrial Applications
Sulphur Retention - Nitrogen Emission Control - Furnaces, Dryers, Heat Treatment, etc, Pollution control and Environmental Effects-Cost Analysis.

Text Book:

1.Howard, J.R., Fluidized Bed Technology: Principles and Applications, Adam Hilger, NewYork, 2001

References:

1. Geldart, D, Gas Fluidization Technology, John Wiley & Sons, NewYork, 1999
2. Howard, J.R. (Ed), Fluidized Beds: Combustion and Applications, Applied Science Publishers, NewYork,2001
3. Yates, J.G.Fundamentals of Fluidized bed Chemical Processes, Butterworths, 2000
4. Reed, T.B., Biomass Gasification: Principles and Technology, Noyes Data Corporation, New Jersey, 2000

09ME311 OPTIMIZATION FOR DESIGN OF FOOD PROCESSING MACHINERIES

Credit 4:0:0

Objective:

- *This mainly deals with optimization design of food processing equipments, classical optimization techniques , multivariable optimization ,constrained optimization and other special optimization methods.*

UNIT I

Introduction to optimum design. Need of optimization of preliminary design by identification of design requirements and by use of appropriate design strategy, Engineering applications of optimization, statement of an optimization problem, classification of optimization problem, optimization techniques.

UNIT II

Classical optimization techniques. Introduction, single variable optimization – optimality criteria, bracketing methods, region elimination methods, point estimation method, gradient based method, root finding using optimization technique

UNIT III

Multi variable optimization – optimality criteria, unidirection search, direct search method – evolutionary optimization method, simplex search method, hooke-jeeves pattern search method, powell’s conjugate direction method, gradient based methods – cauchy’s method, newton’s method, marquardt’s method, conjugate method, variable-metric method.

UNIT IV

Constrained optimization – Kuhn-tucker conditions, transformation methods, sensitive analysis, direct searchfor constrained minimization, linearized search technique, feasible direction method, generalized reduced gradient method, gradient projection method.

UNIT V

Special methods – integer programming, geometric programming, Genetic algorithm, simulated annealing, global optimization.

Text book:

1) *Kalyanmay Deb, “Optimization for Engineering Design – Algorithm and Examples” PHI PUBLICATIONS, 2003.*

2) S. S. Rao, *"Engineering Optimization – Theory and Practice" NAI publishers, 2005.*

Reference Book

1. Clive L. Dym, 2004. "Principles of Mathematical Modeling", Second Edition, Academic Press.

2. Law.M.Averil and Kelton,W.David. 2000. Simulation Modelling and Analysis. McGraw Hill International Series, Boston.

09ME312 DIMENSIONAL ANALYSIS AND SIMILITUDE

Credit 4:0:0

Objective:

- *This mainly deals with the agricultural processing systems and modeling concepts and various dimensional numbers.*

UNIT I

Agricultural processing systems - modelling concept - nature and use of dimensions - scope of dimensional analysis. Units - fundamental and systems - physical dimensions - transformation of units. Solving problems on basic and derived units of measurement and conversion. Dimensional analysis - dimensional homogeneity - dimensional numbers. Solving problems on dimensional analysis

UNIT II

Reynolds' number, Froudes' number, Mach's number and Whebber's number - Buckingham's theorem - examples. Solving problems on computation of dimensional products. Calculation of dimensionless products - determinants - number of dimensionless products in a complete set. Solving problems on computation of dimensionless products. Singular dimensional matrix - arrangement of variables - transformation of dimensionless products - examples. Solving problems on transformation of units of measurement. Linear dependence - examples on computation of dimensionless products.

UNIT III

Algebraic theory of dimensional analysis - transforming units of measurement - dimensional homogeneity - dimensional homogeneity of a sum and exercise on dimensional homogeneity. Solving problems on dimensionless homogeneity. Solving problems on dimensional analysis - stress, strain and elastic loading system. Products that are not dimensionless - reduction to dimensionless form - examples

UNIT IV

Solving problems on dimension analysis of static loading. Exercise on dimension analysis of bending and vibration. Similarity and model testing - models - uses - applications and advantages - features of models - complete similarity - examples. Model laws - concept of similarity - time scale factor - kinematic similarity - dynamic similarity - examples. Solving problems on similarity. Empirical methods in model engineering - use of similarity in mathematical investigation – examples.

UNIT V

Applications of dimensional analysis - stress and strain - elastic loading systems, static loading, bending, vibration - examples. Applications of dimensional analysis - in fluid mechanics, heat transfer and electromagnetic theory - examples. Electromagnetic theory - differential equations and similarity - interpretation of dimensionless products in fluid mechanics, cleaning and grading, size reduction and blending, storage structures. Examples on applications of similarity and model studies in drying and storage. Examples on application of similarity and model studies in size reduction, grading, mixing and blending.

Text book:

1. Kumar.V.J.F. and Divakar Durairaj,C.2002. Dimensional Analysis and Similitude- Through Worked examples. Saraan Publishers, Coimbatore.

Reference Book

1.. Law.M.Averil and Kelton,W.David. 2000. Simulation Modelling and Analysis. McGraw Hill International Series, Boston.

2.. Langhaar,H.I. Dimensional analysis and similitude. John Wiley and Sons, USA,2001.

09ME313 COMPUTER AIDED DESIGN AND MANUFACTURING OF FOOD PROCESSING EQUIPMENTS

Credit 4:0:0

Objective:

- *This mainly deals with the concepts of design process , computer graphics , Modelling techniques and numerical control systems.*

UNIT I

Design Process

Introduction to CAD/CAM-Benefits of CAD/CAM-Reasons for Implementing CAD/CAM-Historical development-Design and Manufacturing Process-Conventional and Computer representations of Drawings and Diagrams, its strength and weaknesses-Product cycle - Sequential and concurrent engineering

UNITII

Computer Graphics, Basic Concepts and Systems.

Origin of computer Graphics, Fundamentals of Computer Hardware- interactive graphic display graphic systems. Display devices- Hard copy devices- interactive graphic input & output devices display processors.

UNIT III

Solid Modeling

Geometric Modeling - Wireframe, Surface and Solid models - CSG and B-REP Techniques -Features of Solid Modeling Packages - Parametric and features - Interfaces to drafting, Design Analysis. 2D, 3D transformations - Translation , Rotation , Scaling - Concatenation

UNIT IV

Numerical Control

Conventional Numerical control – Introduction, Basic components of an NC system, NC procedure, NC coordinate system, NC motion control system, Application of NC, Economics of NC. Computer controls in NC – Introduction, Problems with conventional NC, CNC, DNC, Adaptive control machining systems, Trends and New Developments in NC.

UNIT V

Emerging Trends in CAD/CAM

Reverse Engineering -Re-engineering -Rapid prototyping-Concurrent engineering and design methodology-Product Data Management & application, Robotics, Computer aided process planning, Computer Integrated Manufacturing systems, CAD/CAM Implementation.

Text Book:

1. *Groover and Zimmers, " CAD / CAM : Computer Aided Design and Manufacturing," Prentice Hall of India, New Delhi, 2002.*
2. *Ibrahim Zeid, " CAD - CAM Theory and Practice ", Tata McGraw Hill Publishing Co. Ltd., 2005.*

Reference Book:

1.Donald Hearn and M Pauline Baker "Computer Graphics Printice Hall Inc. III Edition2006.
2. Hall A.S. Holowenko A.R. and Laughlin H.G., 'Theory and Problems in Machine Design', Schaum's Series,2000.
3. Hall and Allen, 'Machine Design', S.Schaum's Series, .Ist edition 2001
4. Joseph Edward Shighley, 'Mechanical Engineering', McGraw Hill, 2002

MECHANICAL SCIENCES AND ENGINEERING

ADDITIONAL SUBJECTS

Code	Name of the Subject	Credits
10ME101	Workshop Practice	0:0:2
10ME201	Mechanics of Machines – II	3:1:0
10ME202	Instrumentation & Control Systems	4:0:0
10ME203	Computational Fluid Dynamics	3:1:0
10ME204	Computer Aided Design	4:0:0
10ME205	Finite Element Analysis	3:1:0
10ME206	Mechanical Vibrations	3:1:0
10ME207	Product Design and Development Strategies	4:0:0
10ME208	Tribology and surface Engineering	4:0:0
10ME209	Design Lab	0:0:1
10ME210	Fluid Power Control Lab	0:0:2
10ME211	Computer aided Manufacturing and Simulation Lab	0:0:1
10ME212	Computer aided Manufacturing and Simulation Lab	0:0:2
10ME213	MECHATRONICS	3:0:0

10ME101 WORKSHOP PRACTICE

Credit: 0:0:2

Course Objective:
To enable students to practice soldering techniques
To facilitate students to practice characterization of electronic devices.
To familiarize wiring of tube lights and lights used in stair case
To train students in the assembly of PC and trouble shooting.
To give basic training on fitting, Carpentry and plumping practices.

Course Outcome:
Students will be able to use their skills during their project work
Students will be able to understand the practical difficulties encountered in industries during any assembly work
Students will be able to do simple electronic and electrical work through out their carrier.
Students will be able to rectify simple problem connected with pipe fittings

I ELECTRICAL SCIENCES

ECE

1. Soldering Simple Electronics Circuits
2. Characterization of basic Electronics Devices.

EEE

3. Wiring of Tube Lights & Staircase Wiring
4. Types of thermocouples & application

II COMPUTER SCIENCE AND TECHNOLOGY

5. Assembly of PC
6. Installation of Operating System (OS) and Disc Partitioning

III MECHANICAL SCIENCES

Fitting Shop

7. Making of V-fitting and drilling
8. Making of T-fitting

Carpentry Shop

9. Middle Lap joint
10. Dove Tail joint

Plumbing Shop

11. Practice of pipe fitting using L-bow, Tee and Union joints

10ME201 MECHANICS OF MACHINES – II

Credits: 3:1:0

Course Objectives

- To impart students with the knowledge about motion, masses and forces in machines.
- To enable students to apply fundamental of mechanics to machines which include engines, linkages etc.,
- To facilitate students to understand the function of flywheels, the concept of balancing of rotating and reciprocating masses
- To give awareness to students on the phenomenon of vibration and its effects

Course Outcomes

- The students will be able to determine velocities & accelerations of various planar mechanisms.
- Students will have an understanding of static force relationships and inertia forces and their effect that exist in machines
- Students will demonstrate the dynamics of flywheel and their motion
- Students will be able to perform balancing, vibration and critical speeds with respect to machine dynamics

Unit I

Static force analysis, free body diagrams, conditions of two, three and four force members. Inertia forces and D' Alembert's principle and its application. Dynamic force analysis of mechanisms including slider crank mechanisms

Unit II

Flywheels – turning moment diagrams and fluctuation of energy of reciprocating engine mechanisms, coefficient of fluctuation of energy and speed.

Unit III

Static and dynamic balancing of rotating masses in single and different planes, unbalance due to reciprocating parts, primary and secondary forces and couples, partial balancing of reciprocating masses of in-line, V and W engines, balancing of radial engines.

Unit IV

Undamped free vibration of single degree system, simple pendulum, compound pendulum, springs in series, springs in parallel and combinations. Damped free vibration of single degree freedom systems, types of damping, free vibrations with viscous damping, critically damped system. Under damped system - Logarithmic decrement. Forced vibration of single degree of freedom systems. Steady state vibration, magnification factor versus frequency ratio for various damping ratios. - vibration isolation and transmissibility, critical speed – whirling of shafts.

Unit V

Torsional vibrations – Torsional vibration of single and multiple rotor systems, equivalent shafts, geared systems, Holzer's method

Text Books:

1. Ballaney, P.L., " Theory of Machines ", Khanna Publishers, New Delhi, 2002.
2. Prof.Nakara iit, delhi

Reference Books:

1. Shigley, J.E. and Uicker, J.J., "Theory of Machines and Mechanisms", TMH ND,1998.
2. Amithabha Ghosh, and Ashok Kumar Malik., "Theory of Mechanisms andMachines", 2nd Ed., Affiliated East and West Press Limited, 1998.

10ME202 INSTRUMENTATION AND CONTROL SYSTEMS

Credits: 4:0:0

Course Objectives:

To provide knowledge on the fundamentals of measurement science and measuring instruments
To provide a knowledge on the basics of control system theory

Course Outcomes:

Students will be conversant with measurement techniques and the use of measuring instruments
Will have working knowledge for dealing with problems involving control system fundamentals

Unit I Fundamentals of Measurements

Methods of measurements-the generalized measurement system-calibration-types of input quantities-analog and digital measurements-standards –dimensions and units of measurements-treatment of uncertainties-nomenclature of terms in measurement-errors and classification of errors-single test data –variable sample and replicated test data-treatment of uncertainties-propagation of uncertainty

Unit II Sensors and measurement of temperature

Sensors and transducers-primary and secondary transducers-classification of first stage devices-variable resistance transducers-variable inductance elements-the differential transformer-variable reluctance transducers-capacitive transducers-piezo electric and photo electric transducers-measurement of temperature-liquid in glass thermometers -pressure thermometers-resistance thermometers-lead wire compensation –thermoelectric thermometers-laws of thermocouples-lead wires for thermocouples –ambient temperature compensation -pyrometers-total radiation and optical pyrometers-infrared pyrometers

Unit III Measurement of pressure and flow

Measurement of pressure-bourdon tube pressure gauge-calibration of bourdon tube pressure gauge-elastic diaphragms-corrugated diaphragms-strain gauge pressure cells-bulk modulus gauge-the Mc Leod gauge –thermal conductivity gauges and ionization gauges-measurement of flow-classification of flow meters-obstruction flow meters-variable area flow meters-turbine type flow meters-thermal flow meters-magnetic flow meters-ultrasonic flow meters.

Unit IV Measurement of strain and miscellaneous measurements

Measurement of strain-electrical resistance strain gauges-bonded and unbounded strain gauges metallic resistance strain gauges-gauge factors-specifications and installation of factors for strain gauges-bridges with two and four arms sensitive to strain-calibration of strain gauges-strain gauge rosettes-measurement of humidity-hair hygrometers-measurement of PH-PH meters-measurement of air pollution-Orsat apparatus-nuclear instrumentation-Geiger Muller counter-scintillation counter.

Unit V Basics of control system theory

Control systems-open and closed loop control systems-servomechanisms and regulators-control system fundamentals-block diagrams-block diagram reduction-simple problems signal flow graphs Masons gain formula-mathematical models of control systems-stability of control systems-Routh and Hourwitz stability criteria

Text Books

1. Thomas .G. Beckwith, Lewis Buck and Roy D Maragani- Mechanical Measurements-Narosa publishing house-2000
2. Nagoor Kani ,A, Control Systems, RBA Publicatrions-2000

Reference Books

1. Benjamin C KUO ,Faridgolnaraghi ,Automatic control Systems –John Wiley and Sons 2002
2. Holman J P, Experimental methods for Engineers, TataMC Graw Hill publishers 2000
3. R.K. Jain, “Mechanical and Industrial Measurements” Khanna Publishers, 2002

10ME203 COMPUTATIONAL FLUID DYNAMICS

Credits: 3:1:0

Course Objective:

- To provide the knowledge of governing equations of fluid dynamics, able to discretise the equations and incorporate the boundary conditions.
- To provide the knowledge of the solution methodologies of discretised equations and incorporate the turbulence and combustion models.

Course Outcome:

- The students will have the knowledge of performing CFD Analysis.
- The students will be able to apply the boundary conditions and solve CFD problems.
- The students will be able to solve problems using turbulence and combustion models.

Unit I Governing Equations And Boundary Conditions

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Physical boundary conditions – Time averaged equations for Turbulent flow - Turbulence -Kinetic -Energy Equations – mathematical behavior of PDEs on CFD: Elliptic, Parabolic and Hyperbolic equations.

Unit II Diffusion (Heat Conduction)

Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problems

Unit III Convection And Diffusion
Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, upwind, hybrid and power-law schemes - Discretization equations for two dimensional convection and diffusion.

Unit IV Solution Methodologies
Solution methodologies: Direct and iterative methods, Relaxation method, Alternating Direction Implicit method.
Representation of the pressure - Gradient term and continuity equation - Staggered grid - Momentum equations - Pressure and velocity corrections - Pressure - Correction equation, SIMPLE algorithm and its variants.

Unit V: Turbulence and combustion
Turbulence models: mixing length model, two equation (k-E) models. Combustion models: pre mixed combustion, diffused combustion, Simple chemical reacting system.

Text Book:

1. Versteeg, H.K, and Malalasekera, W., “An Introduction to Computational Fluid Dynamics: The Finite Volume Method”, Longman, 1998

Reference Books:

1. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw- Hill Publishing Company Ltd., 1998.
2. Patankar, S.V., “Numerical Heat Transfer and Fluid Flow”, McGraw-Hill, 1980. Ane-Books2004 Indian Edition.
3. Muralidhar, K and Sundarajan .T., “Computational Fluid Flow and Heat Transfer”, Narosa Publishing House, New Delhi, 1995.
4. Bose, T.K., “Numerical Fluid Dynamics”, Narosa publishing House, 1997.
5. Muralidhar, K and Biswas “Advanced Engineering Fluid Mechanics”, Narosa Publishing House, New Delhi, 1996.
6. Anderson, J.D., “Computational fluid dynamics – the basics with applications”, 1995. ltural wastes.

10ME204 COMPUTER AIDED DESIGN

Credit 4:0:0

Course Objective
- To familiarize the students on the application of computer in the field of Engineering Design.
- To impart fundamental knowledge about CAD packages.
- To expose students to the function of CAD packages & hard wire required to run this CAD software.

Course Outcome
- Students will be able to apply different CAD software for creating CAD Models.
- Students will have through knowledge in the graphic standards and the techniques used for solid modeling and surface modeling.

Unit I Design Process

Introduction to CAD, Benefits of CAD, Reasons for Implementing CAD, Historical Development - Design Process-Conventional and Computer representations of Drawings and Diagrams, its strength and weaknesses. Product cycle - Sequential and concurrent engineering, Graphics standards for CAD. Emerging Trends In CAD - Reverse Engineering -Re-engineering -Rapid prototyping-Product Data Management & application

Unit II Computer Graphics, Basic Concepts and Systems.

Origin of computer Graphics, Fundamentals of Computer Hardware- interactive graphic display- Graphic systems. Display devices- Hard copy devices- interactive graphic input & output devices display processors. Introduction and study of various Operating systems like Unix ,Windows ,MS-DOS .

Unit III Algorithms & Transformation

Algorithms to draw – Line and Circle. Coding the algorithms using C program. 2D , 3D transformations - Translation , Rotation , Scaling - Concatenation

Unit IV Solid Modeling

Geometric Modeling - Wireframe, Surface and Solid models - CSG and B-REP Techniques - Features of Solid Modeling Packages - Parametric and features - Interfaces to drafting, Design Analysis.

Unit V Techniques for Geometric Modeling

Representation of curves - Bezier curves - Cubic spline curve - B-Spline curves – Rational curves – Surface Modeling techniques - surface patch - Coons patch - bi-cubic patch – Bezier and B-spline surfaces

Text Book:

1. Ibrahim Zeid, " CAD - CAM Theory and Practice ", Tata McGraw Hill Publishing Co. Ltd., 2005.
2. Sadhu Singh, " Computer Aided Design and Manufacturing ", Khanna Publishers, New Delhi, 2005.

References:

1. P.Radhakrishnan and C.P.Kothandaraman, " Computer Graphics and Design ",Dhanpat Rai and Sons, New Delhi, 2003.
2. Groover and Zimmers, " CAD / CAM : Computer Aided Design and Manufacturing Prentice Hall of India, New Delhi, 2002.
3. V.Ramamurthi, " Computer Aided Mechanical Design and Analysis ", TataMcGraw Hill Publishing Co Ltd., 2000.
4. Kunwoo Lee, "Principles of CAD/CAM/CAE Systems", Addison Wesley, 2005

10ME205 FINITE ELEMENT ANALYSIS

Credit 3:1:0

Course Objective:

1. To equip the students with the Finite Element Analysis fundamentals.
2. To enable the students to formulate the design problems into FEA.
3. To introduce basic aspects of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems.

Course Outcome:

Upon completing this course, the students will be able to:
1. Identify mathematical model for solution of common engineering problems.
2. Formulate simple problems into finite elements.
3. Solve structural, thermal, fluid flow problems.
4. Use professional-level finite element software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer.
4. Derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts.

Unit I:
Introduction: Basic concepts- General applicability of the method to structural analysis, heat transfer and fluid flow problems-Historical Background -finite element packages- Boundary Value and Initial Value Problem-Weighted Residual Methods.

Unit II
General Procedure of FEA-Element Types and its Characteristics-Concept of Element Assembly -Bandwidth and its effects- Boundary conditions-Aspect Ratio- Pascal's Triangle- Stiffness matrix for Spar element, Beam element-Shape Function for Spar element, Beam element.

Unit III
Convergence and Continuous criteria- Local, Global and Natural Co-ordinate System- Area co-ordinate system- Shape Function for Triangular, Rectangular Elements and Stiffness matrix

Unit IV:
Introduction to Higher Order Elements-Shape Function for Quadratic Element, Cubic Element-Isoparametric elements-Eight node and Nine node quadrilateral element. Structural Problems: Equations of elasticity- plane elasticity problems - Bending of elastic plates .

Unit V
Heat Transfer Problems. One Dimensional Basic equation of heat transfer derivation of finite element equation- Fluid Mechanics Problems: incompressible fluid flow.

Text Book.
Rao. S.S. ' The Finite Element Method in Engineering', IInd Ed., Pergamon Press, Oxford, 2001.

Reference Books:
1 David.V.Hutton, " Fundamentals of Finite Element Analysis", Tata McGraw Hill,2003
2 Tirupathi.R.Chandrupatla, Ashok.D.Belegundu. 'Introduction to Finite Elements in Engineering', Prentice Hall of India, 2004.

10ME206 MECHANICAL VIBRATIONS

Credit 3:1:0

Course Objectives:
1. To train students to formulate mathematical models of problems in vibrations using Newton's second law or energy principles,
2. To develop the students skills in analyzing the vibration behavior of mechanical systems under different types of loading.

3. To train student for determining a complete solution to mechanical vibration problems using mathematical or numerical techniques
4. To train students to solve vibration problems that contain multiple degrees of freedom Students will study ways to reduce unwanted vibration and the equipment used for collecting response data.

Course Outcome:

Upon completing this course, student will be able :

1. To construct the equations of motion from free-body diagrams.
2. To solve for the motion and the natural frequency for free, forced vibration of undamped motion and damped motion.
3. To solve vibration problems that contains multiple degrees of freedom.
4. To identify the modes of a system and compute its natural frequencies.
5. To study the ways to reduce unwanted vibration and the equipment used for collecting response data.

Unit I
Relevance of and need for vibrational analysis - Mathematical modelling of vibrating systems - Discretes and continuous systems - review of single-degree of freedom systems - free and forced vibrations, Various damping models.

Unit II
General solution to free vibration problem - damped free vibration - Forced vibration of undamped system -dynamic vibration absorbers - Technical applications.

Unit III
Free and forced vibrations of multi-degree of freedom systems in longitudinal torsional and lateral modes -Matrix methods of solution-normal modes - Orthogonality principle-Energy methods

Unit IV
Torsional vibrations - Longitudinal vibration of rods - transverse vibrations of beams - Governing equations of motion - Natural frequencies and normal modes - Energy methods

Unit V
Vibration instruments - Vibration exciters Measuring Devices - Analysis - Vibration Tests - Free and Forced Vibration tests.

Text Book:

1. Singiresu.S.Rao., "Mechanical Vibrations", Addison Wesley Longman ,2003.

Reference Book:

1. Rao, J. S . , & Gupta K.--"Ind. Course on Theory and Practice Mechanical Vibration", NewAge International (P) Ltd.,2005.
2. Kelly, "Fundamentals of Mechanical Vibrations", Mc Graw Hill Publications, 2000.
3. Thomson, W.T.,--"Theory of Vibration with Applications" CBS Publishers and Distributers, NewDelhi,2002
4. Rao V. Dukkipati, J. Srinivas., Vibrations : problem solving companion, Narosa Publishers, 2007.

10ME207 PRODUCT DESIGN AND DEVELOPMENT STRATEGIES

Credit 4:0:0

Course Objective:

- To familiarize the students about the important practices followed during designing and developing a product in industries.
- To impart the knowledge about the entire product life cycle right from its conceptual stage to its development stage.
- To enable the students with various concepts like modelling, simulation, material selection and GD&T.

Course Outcome:

- Students will be have the knowledge of designing and developing a product in industries
- Students will be able to know the importance of Mathematical modeling and simulation and its help in developing new products

Unit I Nature and Scope of Product Engineering

Importance of product design, Design Constraints, Safety and reliability considerations, The Design process-A simplified approach, Consideration of a Good Design, Detail description of Design process (Morphology of Design), Technological Innovation and the design process; Product and Process cycle.

Unit II Modeling and Simulation

The role of Models in Engineering Design-Mathematical modeling, Similitude and scale modeling, Simulation, Finite-Difference method, Monte Carlo method, Geometric modeling on the computer, Finite Element Analysis.

Unit III Material Selection and Materials in Design

Relation of Materials Selection to Design, Performance Characteristics of materials, The Materials Selection process – Design process and materials selection, Ashby charts, Material selection in Embodiment design, Economics of materials, Methods of material selection- Selection with Computer-Aided database, Weighted Property Index, Value analysis, Design examples- Materials systems, Material substitution.

Unit IV Functional and Production Design

Form design- Influence of basic design, Mechanical loading and material on Form design- Form design of Grey castings, Malleable iron castings, Aluminum castings, Pressure die castings, Plastic moldings, Welded fabrications, Forging and Manufacture by machining methods. Influence of Space, Size, Weight, etc., on Form design, Aesthetic and Ergonomic considerations .

Unit V: Dimensioning and Tolerancing

Dimensioning systems, Dimensioning Rules, Geometric Tolerancing, Datum features, Functional production and Inspection datum, Tolerancing types, Tolerance analysis.

Text Books

1. Dieter. G. E, “Engineering Design", McGraw Hill, 2000..
2. David A. Madsen, “Engineering Drawing and Design”, Delmar Thomson Learning Inc. 2002, 3rd Edition.

Reference Books

1. Kevin Otto & Kristin Wood, “Product Design”, Pearson Educational Inc. 2004.
2. Karl T Ulrich, Steven D Eppinger, “ Product Design & Development”, Irwin Homeward Boston Publishers, 2004.

10ME208 TRIBOLOGY AND SURFACE ENGINEERING

Credits: 4:0:0

Course Objective:
To introduce factors affecting surface characteristics and friction
To familiarize students with different types of wear of metals, ceramic and polymers.
To introduce different types of lubricants and their properties.
To introduce modern microscopy techniques used for characterization of surfaces
To introduce various techniques used in improving surface properties utilized in bearings.

Course Outcome:
The students will be able to design, improve tribological systems
The students will be able to contribute to research and development of bearings
The students will be able to perform failure analysis and improve the performance of mechanical components.

Unit I Surfaces and Friction
Typology of solid surfaces - Measurement methods – Profilometry – Electron microscopy - Optical microscopy –Statistical description - Adhesion - Ploughing- Friction Characteristics of metals - Friction of non metals. - friction of Ceramic materials and polymers - Rolling Friction – Stick slip motion – Measurement of Friction.

Unit II Wear
Types of wear – Adhesive wear – Archard wear equation -Abrasive wear - Corrosive wear - Surface Fatigue wear situations – Minor forms of wear – Fretting – Erosion - Percussion – Wear of Ceramics and Polymers -Wear of metals.

Unit III Lubricants And Lubrication Types
Types and properties of Lubricants - Testing methods - Hydrodynamic Lubrication – Elasto hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication Hydrostatic Lubrication.

Unit IV Nano Tribology
Nano tribology introduction- Measurement tools – surface force apparatus – Scanning tunneling microscope – Atomic force microscope / Friction force microscope – measurements – Fabrication techniques for MEMS / NEMS – atomic scale simulations.

Unit V Surface Engineering And Materials For Bearings
Surface treatments – Thermochemical treatments – surface coating – Hard facing – Vapour deposition process - Plating and anodizing - Materials for rolling Element bearings - Materials for fluid film bearings -Materials for marginally lubricated and dry bearings

Text Book:

1. Prasanta Sahoo. , “ Engineering Tribology”,Prentice Hall of India, 2005.
2. Sushil Kumar Srivastava, “ Tribology in Industries” , S.Chand Publishers, 2005.

References:

1. Kragelsky, “Friction Wear & Lubrication”, Mir Publications, 1981.
2. “Tribology hand book” Edited by: M.J. Neale, ISBN: 978-0-7506-1198-5

Web References:

1. http://www.csetr.org/link.htm
2. http://www.me.psu.edu/research/tribology.htm

10ME209 DESIGN LABORATORY

Credit: 0:0:1

Course Objective:
To impart students programming skills of C program to design and synthesis the machine elements used in the mechanical industry.

Course Outcome:
The student will be able to design and synthesize a mechanical component using C program under static load condition.

List of Experiments:

1) Design and Synthesis of Coil spring using C program.
2) Design and Synthesis of Flanged Coupling using C program.
3) Design and Synthesis of Spur Gear using C program.
4) Design and Synthesis of Roller Bearing using C program.
5) Design and Synthesis of Belt Drives using C program.
6) Design and Synthesis of Chain Drives using C program.

10ME210 FLUID POWER CONTROL LABORATORY

Credits: 0:0:2

Course Objective:
To know the basic concept of fluid power
To know the working principle of pneumatic components
To know the working principle of electro-pneumatic components
To know the working principle of hydraulic components
To study the working principle of programmable Logic controller.
To know the application of fluid power components in industries

Course Outcome:
The student will be able to design, application of fluid power components in Industries.

LIST OF EXPERIMENTS

1. Development and simulation of a pneumatic circuit to study the use of direct control of single acting and double acting cylinder.
2. Development and simulation of a pneumatic circuit to study the use of Logic AND function using Two pressure valve.
3. Development and simulation of a pneumatic circuit to study the use Logic OR function using shuttle valve
4. Development and simulation of a pneumatic circuit to study the use of Time delay valve.
5. Development and simulation of a pneumatic circuit to study the use of pressure sequence valve.
6. Development and simulation of a pneumatic circuit to study the use of quick exhaust valve.
7. Development and simulation of a pneumatic circuit to study the use of multiple actuators in a material handling system.
8. Development and simulation of a pneumatic circuit to study the use of Flow control valve.
9. Development and simulation of an electro-pneumatic circuit to study the use of Limit Switch.
10. Development and simulation of an electro-pneumatic circuit to study the use of Relay and solenoid valves.

11. Development and simulation of an electro-pneumatic circuit to study the use of Optical Proximity switch.
12. Development and simulation of an electro-pneumatic circuit to study the use of Logic AND function.
13. Development and simulation of an electro-pneumatic circuit to study the use of Logic OR function.
14. Development and simulation of a hydraulic circuit to study the use of double acting cylinder with 4/2 way directional control valve.
15. Development and simulation of a hydraulic circuit to study the use of hydraulic motor with 4/2 way directional control valves.
16. Development and simulation of a hydraulic circuit to study the use of flow control valve.
17. Study of programmable Logic controller.

(12 Experiments from the given above will be offered to students)

10ME211 COMPUTER AIDED MANUFACTURING AND SIMULATION LAB

Credit: 0:0:1

Course Objectives:

- To model a part in EdgeCAM environment
- To generate codes for CNC lathes and milling machines
- To select tool for a machining operation
- To simulate the code and verify machining processes

List of Exercises

1) Study of EdgeCAM environment.
2) Model a component in EdgeCAM
3) Select the machine and tools required to produce the component
4) Simulate the production process for Turning
5) Simulate the production process for 3- Axis milling
6) Generate the CNC code required to machine a component on the selected machine

10 ME212 COMPUTER AIDED MANUFACTURING AND SIMULATION LAB

Credits: 0:0:2

Course Objectives:

- To model a part in EdgeCAM environment
- To generate codes for CNC lathes and milling machines
- To select tool for a machining operation
- To simulate the code and verify machining processes
- To export the codes to a CNC machine

List of Exercises

1) Study of EdgeCAM environment.
2) Modeling using other 3D packages and Importing to EdgeCAM.
3) Model a component in EdgeCAM-I
4) Model a component in EdgeCAM-II
5) Select the machine and tools required to produce the component
6) Simulate the production process for Turning-I
7) Simulate the production process for Turning-II
8) Simulate the production process for 3- Axis milling-I
9) Simulate the production process 3- Axis milling-II
10) Generate the CNC code required to machine a component on the selected machine
11) Communicate with machine tool controllers
12) Managing a tool data base

10ME213 MECHATRONICS

Credits: 3:0:0

Objective:

- Mechatronics subject deals with mechanical and electronic devices. -To know the basic concept of pneumatic, electro pneumatic, electro hydraulic, and hydraulic components.-To know the basic concept of sensors, transducers, electronic interface subsystems, electromechanical drives, microprocessor and programmable logic controllers.

UNIT I

Introduction: Introduction to mechatronics – Systems - Measurement systems - Control systems - Pneumatic and hydraulic actuation systems – Mechanical actuation systems-Electro-Pneumatic and hydraulic systems.

UNIT II

Sensors and Transducers: Introduction – Performance Terminology – Displacement, position and proximity – velocity and motion – Fluid pressure – Temperature sensors – Light sensors – Selection of sensors – Signal processing.

UNIT III

Electronic Interface Subsystems: Sensor interfacing – Interfacing – buffer- parallel and serial ports, Solenoids – relays. Electromechanical drives: stepper motors – servomotors DC and AC.

UNIT IV

Microcontrollers overview: Microprocessor structure – Analog interfacing – Digital interfacing – Digital to analog converters – Analog to digital converters – Application-LED Blinking, voltage measurement using ADC.

UNIT V

Programmable Logic Controllers: Basic structure – Programming – Ladder diagram – Timers, internal Relays and Counters – Shift Registers – Master and jump controls – Analog input/output – PLC selection – Application.

Text Book

1. Bolton W., "Electronic Control Systems in Mechanical and Electrical engineering", 4th Edition, 2009, Pearson Education.

Reference Books

1. "Mechatronics", HMT Ltd., Tata McGraw Hill Publication Co. Ltd., 2002.
2. Dan Necsulescu, "Mechatronics", Pearson Education Asia, 2002 (Indian reprint).
3. Devadas Shetty, Richard Akolk, "Mechatronics System Design" First reprint 2001.

SCHOOL OF MECHANICAL SCIENCES

REVISED AND NEW SUBJECTS

SUB CODE	SUBJECTS	CREDIT
09ME314	Research Methodology	4:0:0
09ME315	Drives and Control Systems for Robots	4:0:0
09ME316	Propulsion Engineering	3:1:0
10ME301	Advanced Strength of Materials	4:0:0
10ME302	Finite Element Analysis	3:1:0
10ME303	Theory of Metal Cutting	4:0:0
10ME304	Industrial Robotics	4:0:0
10ME305	Metrology and Measurement systems	4:0:0
10ME306	Control of CNC Machine Tools	3:1:0
10ME307	Advanced Fluid Mechanics & Computational Fluid Dynamics	3:1:0

09ME314 RESEARCH METHODOLOGY

Credit: 4:0:0

Objectives:

- Deals about the introduction to research, literature review
- Detailed discussion about research designs and data analysis and various problem solving methods
- Presents a clear way of how to write doctoral dissertations, research papers and the presentation methodology

Unit I: Introduction to Research:
Introduction- Scientific Investigation - Research Process- Broad Problem Area, Preliminary
Problem Identification and analysis-design of research sources, and complete the Research
Methodology.

Unit II: Literature Review:
Introduction- Aim- Content- Surveying- Synthesizing-Critical Analysis-Reading materials-Reviewing- Rethinking-Selection of Sources-Critical evaluation-interpretation-Academic language- Advantages.

Unit III : Design of Experiments & Measurements
Research Design: Meaning, Need, features, concepts,
Basic principles of Experimental designs. Measurement in research, Measurement Scales, Source of error in measurement. Simple regression analysis

Unit IV : Analysis & Interpretation
Characteristics and application of multivariate analysis, Classification of multivariate analysis, Multivariate analysis techniques, Factor analysis, Path analysis. Meaning and techniques of interpretation,

Unit V: Dissertation:

Dissertation- Objective- Course Requirement - Definitions- Length- Format- abstract- Introduction-Statement of the Problem- Methods, Scope and Limitations-Literature Review -Procedures-Research Process-Theoretical Framework-Research Design-Experimental Design-Data Gathering- Data Analysis- Interpretation- Measurement Variables- numerical results –Simulations-Reliability-Validity-Results- Conclusion and summation- Acknowledgments-Bibliography-Appendices.

Reference Books:

1. Burns,R, *Introduction to Research Methods*, Addison Wesley Longman, Third Edition, 1997.
2. Kothari Research Methodology New Age Publishers 2005

09ME315 DRIVES AND CONTROL SYSTEMS FOR ROBOTS

Credit: 4:0:0

Course Objective:

a. To be familiar with various robot drive mechanisms.
b. To give the student familiarities with the hydraulic drives for robots.
c. To give the student familiarities with the pneumatic drives for robots.
d. To give the student familiarities with the electric drives for robots.
e. To give knowledge about various servo control systems for robots.

Course Outcome:

1. Students will be equipped with various robot drive mechanisms.
2. Students will be familiarized with the hydraulic drives for robots.
3. Students will have good knowledge about the pneumatic drives for robots.
4. Students will be equipped with the electric drives for robots.
5. Students will be well versed working principles about various servo control systems for robots.

Unit I : Robot Drive Mechanism

Objectives, motivation, open loop control, closed loop control with velocity and position feedback, Types of drive systems. Functions of drive system. Lead Screws, Ball Screws, Chain & linkage drives, Belt drives, Gear drives, Precision gear boxes, Harmonic drives, Cyclo speed reducers

Unit II : Hydraulic Drives

Introduction, Requirements, Hydraulic piston and transfer valve, hydraulic circuit incorporating control amplifier, hydraulic fluid considerations, hydraulic actuators Rotary and linear actuators. Hydraulic components in robots.

Unit III : Pneumatic Drives

Introduction, Advantages, pistons-Linear Pistons, Rotary pistons, Motors-Flapper motor, Geared motor, Components used in pneumatic control. Pneumatic proportional controller, pneumatically controlled prismatic joint.

Unit IV : Electric Drives

Introduction, Types, DC electric motor, AC electric motor, stepper motors, half step mode operation, micro step mode. Types of stepper motors, Direct drive actuator.

Unit V : Servo Systems For Robot Control

General aspects of robot control. Basic control techniques, mathematical modeling of robot servos, error responses and steady state errors in robot servos, feedback and feed forward compensations, hydraulic position servo, computer controlled servo system for robot applications, selection of robot drive systems.

Reference Books:

1. Richard D. Klafter, Thomas. A, Chmielewski, Michael Negin, Robotics Engineering an Integrated Approach, Prentice Hall of India Pvt. Ltd., 2008.
2. Francis N-Nagy Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987
3. P.A. Janaki Raman, Robotics and Image Processing an Introduction, Tata Mc Graw Hill Publishing company Ltd., 1995
4. Mikell P. Groorer, Mitchell welss, Roger N. Nagel, Nicholas G.Odrey, Industrial Robotics, Technology programming and Applications, Mc Graw Hill International Edition, 1986
5. Bernard Hodges, Industrial Robotics, Second Edition, Jaico Publishing house, 1993
6. Robert J. Schilling, Fundamentals of Robotics Analysis and Control, Prentice Hall of India Pvt. Ltd., 2000
7. Tsuneo Yohikwa, Foundations of Robotics Analysis and Control, Prentice Hall of India Pvt. Ltd., 2001
8. John J. Craig, Introduction to Robotics Mechanics and Control, Second Edition, Addison Wesly Longman Inc. International Student edition, 1999

09ME316 PROPULSION ENGINEERING

Credits: 3: 1: 0

Objectives:

- To learn about the basic concept and importance of propulsion
- To understand the phenomena of combustion and after burners.
- To understand the performance of gas turbine propulsion in an efficient way.

Unit I : Introduction

Review of thermodynamics concepts, Principles of jet propulsion, Working cycles and air flow, Operational envelope and standard atmosphere.

Unit II : Centrifugal Compressors

Basic concepts, Principle of operation, Work done and pressure rise, Compressibility effects, Compressor characteristics.

Axial flow Compressor: Basic operation and elementary theory. Factors affecting static pressure ratio, Degree of reaction, Off – Design performance, Axial flow compressor characteristics.

Unit III : Combustion Systems

Operational requirements, Types of combustion systems, some important factors affecting combustion design

Axial and Radial flow turbines: Elementary theory, Vortex theory. Choice of blade profiles, Pitch and chord, Estimation of stage performance. Overall turbine performance

Unit IV : Afterburners

Afterburner components, Diffuser, Fuel injection, Atomization and vaporization, Ignition, Flame stabilization, Afterburner liner, Total pressure loss, Afterburner design parameters.
Inlets and Exhaust nozzles: Introduction to inlets and nozzles. Inlets–Type –Subsonic inlets, Supersonic inlets, Exhaust nozzles.

Unit V : Prediction and performance of simple gas turbine
Component characteristics. Of-Design operation of the single shaft gas turbine, Equilibrium running of gas generator. Of-Design operation of free turbine engine, Incorporation of variable running losses.
Performance prediction of turbo – fan engines: Matching procedures for turbo-fan engine. Some notes on the behavior of twin-spool engines, Transient behavior of gas turbine, Principles of control systems.

Text Books:

1. V. Ganesan, Gas turbines, Tata McGraw-Hill Publishing company limited 1999.
2. H. Cohen , F. C. Rogers and H. I. H. Saravana Muthu, Gas turbine theory, Edition, Longman 2001.

References:

1. J. D. Mattingly, William H. Heiser and David T. Pratt Aircraft engine design(AIAA Education Series), AIAA, Dec 2002 ISBN – 1563475383.
2. The Jet Engine, Rolls Royce Plc, 1996, ISBN – 090212235, ISBN – 0902121235
3. E. Irwin Treager, Aircraft Gas Turbine Engine Technology, Third edition 1995 ISBN – 002018281.

10ME301 ADVANCED STRENGTH OF MATERIALS

Credits: 4:0:0

Course Objectives:

1. To understand the basic concepts of stress, strain, displacement and transformations
2. To understand estimate strength, predict failure and incorporate design considerations
3. To understand and use energy methods to find force, stress and displacement in simple structures.
4. To understand stresses in open and closed sections in torsion and bending
5. To understand stress functions, and understand stresses in plates and shells, thick circular cylinders and discs, contact stresses and stress concentration.

Course Outcomes:

1. Able to apply concepts stress, displacement and transformations to 1D, and 2D solids under load.
2. Able to calculate strength, predict failure and incorporate design considerations in shafts and beams.
3. Able to apply and use energy methods to find force, stress and displacement in simple structures.
4. Able to calculate stresses in open and closed sections in torsion and bending of standard sections
5. Able to apply stress functions, and calculate stresses in plates and shells, thick circular cylinders and discs and employ contact stresses and stress concentration knowledge.

Unit I : Basic Concepts of Force, Stress, Strain and Displacement, Transformations
Introduction – force diagrams- free body diagrams- force Distributions- stress- strain relations. Displacements, Strain –Displacement relations, problems. Coordinate systems - 3D Stress Transformation- Strain transformations- Generalized 3D stress –strain relations- the equilibrium equations – Compatibility.

Unit II : Strength, Failure Modes, and Design Considerations
Strength- The Design Factor-Strength -failure theories. – Basic- Tresca, Von Mises theories and comparison of theories - Plasticity and limit design concepts- Inelastic Behavior- Engineering Approximations used in Statically Indeterminate Problems - Typical design problems involving these theories with Axial loading- Beams in bending-bending of symmetric beams in Two planes.-problems

Unit –III : Energy Techniques
Work- Strain Energy, total Strain Energy in Bars with Simple Loading Conditions-Castigliano's first Theorem- Castigliano's Second Theorem- Castigliano's Second Theorem Applied to statically Determinate problems - Deflections of Thick-Walled Curved Beams - The Virtual Load Method, the Virtual Load Method applied to Statically Indeterminate Problems - Rayleigh's Method applied to Beams in Bending. Straight Beams undergoing the combined effects of Axial and Transverse loading.

Unit - IV : **Torsion and Bending of structures**
Torsion of non circular sections, rectangular and steel rolled sections- Torsional strain energy – Closed thin - walled tubes-shear - open thin – walled beams- shear flow - torsion of closed thin-walled tubes-single cell multiple cell sections – Bending of unsymmerical Beams-Transverse shear stresses-Shear Center with one axis of symmetry- Shear center for open and unsymmetrical thin-walled beams - Composite beams in bending – Curved beams

Unit V : Concepts from the theory of Elasticity
Plane Elastic problems - The Airy Stress Function- Prandtl's stress function for torsion-Torsion of a rectangular cross section - Bending of thin–flat rectangular and circular plates- shell structures – Thick walled cylinders and rotating disks- Contact stresses - stress concentrations.

Text Book:
1. Richard G. Budynas, "Advanced Strength and Applied Stress Analysis" (2nd Edition) by, McGraw-Hill International Editions, 1999.
2. L.S. Srinath, "Advanced mechanics of solids", (2nd Edition) by Tata McGraw-Hill, 2003

Reference Books:
1. S.Timoshenko and SW Krieger ., "Theory of plates and shells" , by, McGraw - Hill International Edition 1999, Engineering mechanics series
2. S.Timoshenko and D.H.Young , "Elements of strength of Materials", by. D Van Nostrand Co., 1968

10ME302 FINITE ELEMENTS ANALYSIS

Credit : 3:1:0

Course Objective:

1. To equip the students with the Finite Element Analysis fundamentals.
2. To enable the students to formulate the design problems into FEA.
3. To introduce basic aspects of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, solution of the resulting algebraic systems and Various types of elements.
4. To provide necessary skills to implement the Galerkin residual weak formulation into the Finite Element Method for the solution of Ordinary and Partial Differential Equations.

Course Outcome:

Upon completing this course, the students will be able to:

1. Identify mathematical model for solution of common engineering problems.
2. Formulate simple problems into finite elements.
3. Determine engineering design quantities for structural , heat transfer and fluid mechanics problems
4. Use professional-level finite element software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer.
5. Derive integral statements for linear partial differential equations, such as the Laplace/Poisson equation, the wave equation, and the elasticity equations.
6. Derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts.

Unit I : Introduction:

Basic concepts- General applicability of the method to structural analysis, heat transfer and fluid flow problems- general approach of finite element method with case studies in stress analysis, classical analysis techniques-finite element packages - Solution of Finite Equations: Solution of equilibrium problems- Gauss elimination techniques, Choleski method solution of Eigen value problem , Jacobi method, power method, subspace interaction method- Solution of propagation problems, numerical solutions.

Unit II: General Procedure:

Discretization of Domain- basic element shapes- interpolation polynomials- natural coordinates- formulation of element characteristic matrices and vectors- direct approach variational approach and weighted residual approach. Formulation of one dimensional, two-dimensional, continuity conditions- isoparametric elements- curve sided elements-numerical integration.

Unit III : Solid and structural mechanics:

Basic equations of solid mechanics- Static analysis- formulation of equilibrium equations Analysis of trusses and frames- analysis of plates- Solid of revolution. Dynamic analysis –dynamic equations of motion- consistent and lump mass matrices- Free vibration analysis – dynamic response calculation.

Unit IV : Field problems:

Two dimensional field equation- governing differential equations- Integral Equations for the element matrices- Element matrices- Triangular element, Rectangular element problems. Torsion of Non circular sections: General theory- Twisting of a square bar shear stress components- Evaluation of the twisting torque- Computer solutions for the square bar problems.

Unit V: Heat Transfer Problems.
Basic equations of heat transfer derivation using finite element Method for 1D & 2D problems.
Fluid mechanics problems: Basic equations- Solutions procedure- compressible flows- Galerkin approach.
Boundary Element Method (BEM): Introduction, Types, Advantages & Disadvantages of BEM-Types of Boundary Elements-Infinite Boundary Element

Text Books:

1. Rao. S.S. "The Finite element method in Engineering", IInd Ed., Pergamon Press, Oxford, 2003
2. J.Ramachandran, "Boundary and Finite Element Theory and Problems", Narosa Publishing House, 2000.

Reference Books:

1. C.S. Desai and J.P. Abel. " Introduction to Finite Element Method" Affiliated East West Press, 2002..
2. David.V.Hutton, " Fundamentals of Finite Element Analysis", Tata McGraw Hill,2003
3. Tirupathi.R.Chandrupatla, Ashok.D.Belegundu. 'Introduction to Finite Elements in Engineering', Prentice Hall of India, 2004.
4. J. N. Reddy, "An Introduction to the Finite Element Method", 3rd ed., McGraw-Hill Education (2005).

10ME303 THEORY OF METAL CUTTING

Credit 4:0:0

Course Objective:

1. To familiarize the student with tool nomenclature and cutting forces
2. To give knowledge about heat distribution and thermal aspects of machining
3. To impart knowledge on tool materials, tool life and tool wear.
4. To educate students on failure analysis of cutting tools

Course Outcome:

1. Students will be able to analyze cutting forces in turning, drilling and milling
2. Students will be able to adjust varies parameters and reduce temperature developed during machining
3. Students will be able to reduce the cost of machinery
4. Students will be able to prevent failures of cutting tool.

Unit 1: Introduction
Basic mechanism of chip formation - types of chips-Chip breaker - Orthogonal Vs Oblique cutting - force and velocity relationship and expression for shear plane angle in orthogonal cutting - Modern theories in Mechanics of cutting - Review of Merchant and Lee Shaffer Theories.

Unit II: Tool Nomenclature and Cutting Forces
Nomenclature of single point tool - Systems of tool Nomenclature - Nomenclature of multi point tools like drills, milling cutters and broaches. Forces in turning, drilling and milling - specific cutting pressure- measurement of cutting forces.

Unit III: Thermal Aspects of Machining

Thermodynamics of chip formation - Heat distributions in machining - Effects of various parameters on temperature - Method of temperature measurement in machining – Hot machining - cutting fluids.

Unit IV: Tool Materials, Tool Life and Tool Wear
Essential requirements of tool materials - Developments in tool materials-ISO specifications for inserts and tool holders -Tool life - Conventional and accelerated tool life tests - Concepts of machinability and machinability index - Economics of machining.

Unit V: Wear Mechanisms and Chatter in Machining:
Reasons for failure of cutting tools and forms of wear - mechanisms of wear - chatter in machining - Factors effecting chatter in machining - types of chatters - Mechanism of chatter based on Force Vs Speed graph.

Text Books:

1. Shaw .M.C., " Metal cutting Principles ",Oxford clarendon Press, 2nd edition, 2005.
2. Juneja. B. L and Sekhon.G.S, "Fundamentals of metal cutting and machine tools", New Age International(p) Ltd., 2003.

References:

1. Geoffrey Boothroyd and Knight. W.A "Fundamentals of Machining and Machine tools", Crc Press, New York, 2006.
2. Bhattacharya. - " Metal Cutting Theory and Practice ", New central Book Agency pvt. Ltd., Calcutta, 2000.

10ME304 INDUSTRIAL ROBOTICS

Credits: 4:0:0

Course Objective:
1. To be familiar with the automation and brief history of robot and applications.
2. To give the student familiarities with the kinematics of robots.
3. To give knowledge about robot end effectors and their design.
4. To learn about Robot Programming methods & Languages of robot.
5. To give knowledge about various Sensors and their applications in robots.

Course Outcome:
1. Students will be equipped with the automation and brief history of robot and applications.
2. Students will be familiarized with the kinematic motions of robot.
3. Students will have good knowledge about robot end effectors and their design concepts.
4. Students will be equipped with the Programming methods & various Languages of robots.
5. Students will be equipped with the principles of various Sensors and their applications in robots.

Unit I: Introduction
Automation and robotics –History of robotics, Robot anatomy ,Robot configurations, Robot Components,Types of Robot drives – pneumatic, hydraulic and electrical drive systems, Applications -Material handling – Manufacturing Processes – Welding, Machining, Assembly and Inspection, CIM and hostile environments - safety considerations.

Unit II : Transformations and Kinematics

Coordinate transformation -Vector operations – Basic transformations matrices - Properties of transformation matrices-Homogeneous transformations– Forward solution, DH algorithm - Inverse kinematic solution, Brief Robot dynamics.

Unit III : Controls and End Effectors
Control system concepts - Analysis - control of joints - Adaptive and optimal control – End effectors - classification - Mechanical - Magnetic -Vacuum - Adhesive - Drive systems and controls- Force analysis and Gripper design.

Unit IV : Robot Programming and AI
Methods - Languages -Computer control and Robot Software - VAL Language – Trajectory Planning, Basic robot motions - Point to point control & continuous path control and interpolations AI – Basics – Goals-AI Techniques – AI & Robotics.

Unit V: Sensory Devices
Non optical and optical position sensors - Velocity and Acceleration - Range - Proximity - touch - Slip - Force -Torque - Machine vision - Image components - Representation - Hardware - Picture coding - Object recognition and categorization - Software consideration.

Text Books:

1. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall India, 2002

Reference books:

1. Mikell P. Groover, Mitchell Weiss, "Industrial Robotics, Technology, Programming and Applications ", McGraw Hill International Editions, 1st Edition, 2000
2. K.S. Fu., R.C.Gonalez, C.S.G.Lee, " Robotics Control Sensing ", Vision and Intelligence, McGraw Hill International Edition, 1987.
3. Deb S.R., " Robotics Technology and Flexible Automation ", Tata McGraw-Hill, Publishing Co., Ltd., 1994.

10ME305 METROLOGY AND MEASUREMENT SYSTEMS

Credit 4:0:0

Course Objective:
1. To educate students on different measurement systems and on common types of errors
2. To introduce different types of sensors, transducers and strain gauges used for measurement.
3. To give knowledge about thermocouples, thermometers and flow meters used for measurements
4. To introduce measuring equipments used for linear and angular measurements.
5. To familiarize students with surface roughness measurements on machine components

Course Outcome:
1. Students will be able to work in Quality control and quality assurances divisions in industries
2. Students will be able to design a sensors and transducers used for stress analysis.
3. Students will be able to design a measuring equipments for the measurement of temperature and flow.

4. Students will be able to maintain quality in engineering products.

Unit: I Science of Measurement
Mechanical measurement – direct comparison and indirect comparison – the generalized measurement system – types of input quantities – measurement standards – calibration – uncertainty – systematic and random errors – common types of errors – classifications of errors – terms used in rating instrument performance – introduction to uncertainty – zero, first and second order instruments – methods of correcting for spurious inputs – inherent insensitivity – high gain feed back –signal filtering and opposing inputs.

Unit II : Sensors and Transducers for Measurement
Sensors – primary and secondary transducers – compatibility of mechano electric transducer combination - variable resistance transducers – sliding contact devices – variable inductance elements – self inductance and mutual inductance elements – differential transformer – construction and characteristics – rotary differential transformer – capacitance transducers – active and passive transducers – piezo electric transducers – photo electric sensors –Hall effect transducers – resistance wire strain gages – types – theory of metallic strain gauges – selection and installation – strain gauge circuits – ballast circuit – bridge circuit – bridge with two and four arm sensitivity - calibration of strain gauges – application of strain gauges – load cells – measurement of strain in rotating shafts – measurement of pressure – standards of pressure – measurement of high pressure – bulk modules gauge –measurement of low pressure – the Mc Leod Gauge – thermal conductivity gauges.

Unit III : Measurement of Temperature and Flow
Measurement of temperature – liquid in glass thermometer – complete partial and total immersion thermometers – resistance thermometers – constructional details – resistance thermometer circuits – lead wire compensation for resistance thermometers – thermistors – constructional details – measuring circuits for thermistors – thermo electric thermometers – laws of thermocouples – industrial thermocouples and their ranges – making of thermocouple junctions – ambient temperature compensation – pyrometers – optical total radiation and photo electric – measurement of flow – need for flow metering – rotameter – theory and constructional details – magnetic flow meters – hotwire anemometers.

Unit IV : Linear and Angular measurements
Slip gauges - stack of slip gauge – method of selecting slip gauges – adjustable slip gauge – measurement of angles – sine bar checking unknown angles – sine center – sources of error – angle gauges - optical instruments for angular measurement – auto collimator – applications – straightness and square ness – angle dekkor – precision spirit levels – clinometers.

Unit V : Miscellaneous measurements
Measurement of surface roughness – surface texture – primary texture – secondary texture and the lay specification for surface textures – methods for measuring surface finish – the Talysurf instrument – the profilograph – Tomlinson surface meter – Tracer type profilograph – measurement of screw thread profiles – errors in pitch – microscopic method – measurement of internal thread – measurement of effective diameter – two wire and three wire method – measurement of root diameter – gear tooth measurement- measurement of gear profile – tooth thickness – tooth spacing – pitch circle diameter – Parkinson's gear tester – the coordinate measuring machine constriction and operation .

Text Books:

1. Ernest O Doeblin, "Measurement systems", McGraw Hill Publishers, 2003.
2. R. K . Jain, "Engineering Metrology", Khanna Publishers, New Delhi, 2009.

References:

1. I.C Gupta, “Engineering Metrology”, Danpat Rai Publications, 2004.
2. Beckwith Thomas G, “Mechanical Measurements”, Pearson Education, 2008.

10ME306 CONTROL OF CNC MACHINE TOOLS

Credits: 3:1:0

Course Objective:

To familiarize the students with the functioning of CNC machine tool from the control point of view.

Course Objective:

The students will able to work with CNC machine tool from the control point of view.

Unit I : Introduction to CNC systems

Need for NC/CNC machines, classification of NC systems, data feeding methods, Coordinate systems of CNC machines, difference between NC and CNC, Design consideration of CNC machine tools, Advantages of NC/CNC systems, Economic analysis of CNC machine tools, features of CNC machine tools. CNC programming-Interpolation, feed, tool and spindle functions (G-codes).

Unit II : CNC drives

Hydraulic systems and servo valves, Dc motors- Types, servo motors-DC and AC, stepping motors, DC motor response analysis, Feedback devices- Tachometer, encoders, resolvers and inductosyns. ADC, DAC, Counters.

Unit III : CNC Interpolation

Hardware interpolators- DDA integrator, exponential deceleration, linear, circular, complete itnerpolators, Software interpolators, Tustin method, NURBS and polynomial interpolators, Acceleration and deceleration control techniques.

Unit IV: CNC Control

Types of CNC control, CNC control loops, PID control, servo controller, gain tuning, feed forward control, Mathematical analysis of control loops,

Unit V : CNC Architecture

Implementation of CNC system, Numerical control kernel- types, implementation of interpolator, PLC- elements, programming, languages, Human-Machine Interface-functions, structure, Introduction to Open CNC architecture.

Text Book

1. Yoram Koren and Joseph Ben Uri, “Numerical Control of Machine Tools”, Khanna Publishers, 2000
2. Suk-Hwan Suh and Ian Stroud,Gloud “Theory and Design of CNC Systems”, Springer, 2008

Reference Books

1. Yoram Koren, “Computer Control of Manufacturing Systems” McGrawHill, 1985
2. Bollinger, “Computer Control of Machines and Processes”, Addison Wesley, 1989.

10ME307 ADVANCED FLUID MECHANICS & COMPUTATIONAL FLUID DYNAMICS

Credits 3:1:0

Course Objective:

1. To educate students on Eulerian, Lagrangian equation, Bernoulli's equation, Differential momentum equation, Navier Stoke Equations and Energy Equation
2. To give basic knowledge about Computational Fluid Dynamics
3. To familiarize students with irrotational motion in two dimensions, flow over cylinders and boundary layer principles.

Course Outcome:

1. Students will be able to analyze numerical flow problems
2. Students will be able to understand the working Computational Fluid Dynamics Software

Unit I : Introduction:

Method of describing fluid motion– Lagrangian, Eulerian Method – Local and individual time rates of change, acceleration, - Eulerian and lagrangian equation of Continuity. Bernoulli's equation from Euler's equation– solved problems related to liquid motion, related to equation of continuity.

Unit II : Momentum & Energy Equation

Forces and stress acting on fluid particles. Differential momentum equation. Navier Stokes Equations of Motion for simple cases in rectangular, cylindrical and spherical coordinate. Energy Equation

Unit III : Velocity Potential & Stream Function

Irrotational motion in two dimensions, sources and sink Complex potential due to a source, due to a doublet, Images with respect to straight line, solved problem.Vortex motion-Vortex tube, Helmohltz's vorticity theorem, velocity potential and stream function.

Unit IV : Laplace Equation and Conformal Transformation

Flow over Circular cylinders, sphere, solution of Laplace equation, Joukowshi transformation, Flow past cylinder with and without circulation, flow past Rankine body. Liquid streaming past a fixed sphere and solved problems. Analytic function Conformal Transformation of infinite and semi – infinite strip

Unit V : Computational Fluid Dynamics

Mathematical behavior of PDEs on CFD: Elliptic, parabolic and Hyperbolic equations Governing equations of fluid dynamics: Continuity, Momentum and energy equations (excluding derivation) – Physical boundary conditions - Methods of deriving the discretization equations: finite difference and finite volume methods – Implicit, explicit and Cranck-Nicholson methods - Solution methodologies: Direct and iterative methods, Relaxation method, Alternating Direction Implicit method

Text Books

1. Streeter, 'Fluid Dynamics', 3rd Ed., McGraw Hill,2006.
2. Raisinghania.M.D, 'Fluid Dynamics', 4th Ed., S.Chand & Company Ltd, 2002.
3. Versteeg, H.K, and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Longman, 1998

Reference Books

1. Fox R.N. and McDonald A.T., 'Fluid Mechanics', John Wiley & Sons, 1999.
2. Dr. J.K Goyal I K.P. Gupta., 'Fluid Dynamics', 3rd revised Ed., Pragathiprakasam,Meerut, 1999.
3. Schlichting.H., 'Boundary layer Theory', 8th Ed.,McGraw Hill, New york,2001.

SCHOOL OF MECHANICAL SCIENCES

ADDITIONAL SUBJECTS

Subject Code	Subject Name	Credit
10ME401	Two Phase Flow	4:0:0
10ME402	Computational Fluid Dynamics	3:1:0

10ME401 TWO PHASE FLOW

Credits 4:0:0

Unit – I

T1: Introduction to two phase flow-Flow patterns-Vertical co-current flow-Vertical heated
channel-Horizontal co-current flow-Flow pattern maps and transitions - Basic equations of two phase flow-Conservation of mass, momentum, energy

Unit – II

T1: The homogeneous model-The two-phase friction factor-The separated flow model-the evaluation of two-phase multiplier and the void fraction-Use of models to evaluate pressure loss-The Lockhart-martinelli equations -Pressure losses in two phase flow-Sudden enlargement, contraction, orifices, bends and valves.

T2: Classification and examples of two phase flow - Euler-Lagrange approach and Euler-Euler approach: volume of fluid (VOF) model, mixture model and Eulerian model.

Unit – III

T1: Convective boiling-Thermodynamics of vapour/liquid systems-The basic processes of boiling-vapour formation-Simple bubble dynamics.
Pool boiling-various stages of pool boiling-Convective boiling-Regimes of heat transfer, boiling map.

Unit – IV

T1: Basic processes of condensation-Liquid formation-Mechanism of evaporation and condensation at a plane liquid-Vapour interface-Crude theory-influence of non-condensable
on interfacial resistance.
T3: Film condensation-Condensation on a vertical surface-Laminar film condensation.

Unit – V

T1: Condensation within a horizontal tube, Condensation outside a horizontal tube, drop-wise condensation, Pressure gradient in condensing systems-influence of interfacial shear, pressure drop in condenser tube banks. Methods of improving the heat transfer coefficient in condensation

Text Books

1. John. G. Collier, Convective boiling and condensation, Mc Graw Hill, 1972.
2. Fluent User's Guide, Fluent Inc. Lebanon, NH03766; 2006
3. D.Butterworth and G.F.Hewitt, Two-phase flow and heat transfer, Oxford University Press, 1977

10ME402 COMPUTATIONAL FLUID DYNAMICS

Credits 3: 1: 0

Unit I: Governing Equations And Boundary Conditions
Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Physical boundary conditions – Time-averaged equations for Turbulent flow - Turbulence -Kinetic -Energy Equations – mathematical behavior of PDEs on CFD: Elliptic, Parabolic and Hyperbolic equations.

Unit II: Diffusion - Heat Conduction
Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problems

Unit III : Convection And Diffusion

Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, upwind, hybrid and power-law schemes - Discretization equations for two dimensional convection and diffusion.

Unit IV: Solution Methodologies
Solution methodologies: Direct and iterative methods, Relaxation method, Alternating Direction Implicit method.

Representation of the pressure - Gradient term and continuity equation - Staggered grid - Momentum equations - Pressure and velocity corrections - Pressure - Correction equation, SIMPLE algorithm and its variants.

Unit V: Turbulance & Combustion
Turbulence models: mixing length model, Two equation (k-ε) models.
Combustion Models: Premixed combustion, diffusive combustion, Simple chemical reacting system

Text Book:

1. Versteeg, H.K, and Malalasekera, W., “An Introduction to Computational Fluid Dynamics: The Finite Volume Method”, Longman, 1998

Reference Book:

1. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw-Hill Publishing Company Ltd., 1998.
2. Patankar, S.V., “Numerical Heat Transfer and Fluid Flow”, McGraw-Hill, 1980. Ane-Books2004 Indian Edition.
3. Muralidhar, K and Sundarajan .T., “Computational Fluid Flow and Heat Transfer”, Narosa Publishing House, New Delhi, 1995.
4. Bose, T.K., “Numerical Fluid Dynamics”, Narosa publishing House, 1997.
5. Muralidhar, K and Biswas “Advanced Engineering Fluid Mechanics”, Narosa Publishing House, New Delhi, 1996.
6. Anderson, J.D., “Computational fluid dynamics – the basics with applications”, 1995.

SCHOOL OF MECHANICAL SCIENCES

ADDITIONAL SUBJECTS

S.No.	Sub. Code	Name of the Subject	Credits
1	11ME101	Basic Engineering Drawing	0:0:2
2	11ME102	Computer Aided Graphics	0:0:2
3	11ME201	Personal Management and Industrial Relations	3:0:0
4	11ME202	Lathe Shop	0:0:1
5	11ME203	Metrology & Computer Aided Inspection	3:0:0
6	11ME204	Production Processes	3:0:0
7	11ME205	Design of Heat Exchangers and Pressure Vessels for Food Processing	3:1:0
8	11ME206	Mechanical Systems for Food Processing	3:1:0
9	11ME207	Principles of Resource and Quality Management	3:1:0
10	11ME208	Software Lab	0:0:2
11	11ME209	Heat Engines and Fluid Machinery	3:1:0
12	11ME210	Engineering Drawing Lab	0:0:2
13	10ME308	MATLAB	0:0:2
14	11ME301	Mechatronics and Machine Controls	4:0:0
15	11ME302	Engineering Materials and Applications	4:0:0
16	11ME303	Modeling Lab	0:0:2
17	11ME304	Computer Aided Engineering Laboratory	0:0:2
18	11ME305	CFD Lab	0:0:2
19	11ME306	Advanced Fluid Mechanics & Computational Fluid Dynamics	3:1:0
20	11ME307	Advanced Thermodynamics and Heat Transfer	3:1:0

11ME101 BASIC ENGINEERING DRAWING

Credits: 0:0:2
Course Objectives:

- To impart and inculcate proper understanding of the theory of projection.
- To improve the visualization skills.
- To enable the students with various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient.
- To impart the knowledge on understanding and drawing of simple residential/office buildings.

Course Outcome:

- Students will be able to understand the theory of projection.
- Students will be able to know and understand the conventions and the methods of engineering drawing.
- Students will be able to improve their visualization skills so that they can apply these skills in developing new products.
- Students will be able to prepare simple layout of factory buildings.

List of Experiments

1. Lettering and Dimension practice
    a. Lettering according to standard practice with height 10, 7, 5 mm (Upper case, Lower case and Numbers)

   b. Dimensioning practice of lines, circles, arcs using Aligned and chain dimensioning systems.
2. Geometrical construction – I.
   a. Division of lines, arcs and angles
   b. Drawing arc connecting two straight lines which are perpendicular to each other and inclined.
3. Geometrical constructions -II
   a. Construction of polygons using
      1. Semicircle on the given side
      2. Semicircle and Bi-section of given side
      3. Inscribing polygon in a circle
      4. Special Method for Hexagon
4. Conversion of pictorial views into orthographic views of V- block and bearing block.
5. Projection of points in different quadrants.
6. Projection of lines in first quadrant
   a. Parallel to both planes.
   b. Inclined to one plane and parallel to other.
   c. Parallel to one plane and perpendicular to other plane.
7. Projections of – prism, cylinder and cone -Parallel to both planes.
8. Projections of – prism, pyramid, cylinder and cone -Parallel to one plane and perpendicular to other plane.
9. Development of surface of prism, pyramid, cylinder, cube and cone. (Uncut views only).
10. Isometric views of basic solids and combination of basic solids.
11. Components of a simple building, Conventional representation of building materials.
12. Plan, Elevation and Section of single storied residential / office building with flat RCC roof and brick masonry walls having not more than two rooms. (Planning/ Designing is not expected in this course).

Text Books:

1. Venugopal K. "Engineering Graphics", 9th Edition (Revised), New Age International Publishers, 2009.
2. Narayana K.L, Kannaiah. P, "Text Book on Engineering Drawing (Engineering Graphics)", 2nd Edition, 2006.

Reference Books:

1. "Manual for Engineering Drawing-I", KSMS, 2011.
2. Bhatt N.D., "Elementary Engineering Drawing", 26th Edition. Chartor Publishing House, Anand, 2009.
3. Natarajan K.V. "A Text Book of Engineering Drawing", 16th Edition, 2006.

11ME102 COMPUTER AIDED GRAPHICS

Credits: 0:0:2

Course Objectives:

- To understand hardware, graphics display technology, input and output devices and graphics standards.
- To understand usage of various line types, arcs, and methods to draw using AutoCAD 2007.
- To understand standard, modify, draw, layers and properties tool bars and use it to draw 2D drawings.

- To understand suitable hatching and block commands, dimensioning, orthographic and isometric drawings and plotting.

Course Outcome:

- To apply hardware, graphics display technology, input and output devices and graphics standards.
- To apply usage of various line types, arcs, and methods to draw using AutoCAD 2007.
- To apply, modify, draw, layers and properties tool bars and use it to draw 2D drawings.
- To apply suitable hatching and block commands, dimensioning, orthographic and isometric drawings and plotting.

List of Experiments

1. Drawing Aids: Snap, Grid and Limits
2. Drawing aid : Osnap
3. Modifying commands
4. Methods of Drawing Lines and circles
5. Methods of Drawing Arcs
6. Application of Arcs
7. Rectangular and Polar Array and application
8. Dimensioning
9. Isometric View
10. Layers
11. Wblock
12. Building Construction Drawing

Text Book

1. Shyam Tickoo, 'AUTOCAD 2007 for Engineers and Designers ' Dreamtech India (P) Ltd. ,2007

Reference Book

1. V. Natarajan, 'Engineering Drawings and Graphics', 15th Edition 2001

11ME201 PERSONNEL MANAGEMENT AND INDUSTRIAL RELATIONS

CreditS 3:0:0

Course Objectives:

- To educate the engineering students about man power planning, recruitment and sustaining the workforce
- To educate the students about industrial work environment

Course Outcome:

- Students would know about the man power planning and sustaining the workforce
- Students will be familiar with the industrial work environment.

UNIT-I: Personnel Management Functions

Definition-functions of Personnel management-Role of human relations in PM-Personnel policies-guidelines for formulating personnel policies, advantages of written policies

UNIT II: Motivation, Job Satisfaction and Morale

Definition, Approaches to motivation, characteristics of motivation, Maslov need hierarchy theory, job satisfaction-meaning, relationship between job satisfaction and productivity, morale, determinants of morale, relationship between morale and productivity

UNIT III: Selection of Personnel and Compensation

Recruitment, sources of recruitment, selection techniques, performance appraisal methods, primary compensation, nominal and real wages, factors affecting wages, incentive compensation, linking wages with productivity, executive compensation

UNIT IV: Employee discipline and Trade union

Employee discipline, types of discipline, punishment, alternatives to punishment, essentials of a good discipline system, trade unions, definition, nature and scope of trade union, needs, objectives and function of trade union

UNIT V: Worker's Participation in Management

Origin of growth of worker participation, objectives of worker participation, factors influencing participation, labour welfare, Principle and types of labor welfare services, objectives and function of International Labour Organization

Text Book:

1. Personnel management and industrial relations, P.C.Tripathi, Sultan Chad and sons, New Delhi 2004
2. Personnel Management,Arun Monappa and Mirza Saiyadain,Tata McGraw Hill,New Delhi 2002

Reference Book:

1. Personnel Management, Edwin J Flipp J McGraw Hill, International Edition 1984

11ME202 LATHE SHOP

Credit: 0:0:1
Course Objectives:

- To understand the part drawing and identity the type of operation to be performed on the work piece.
- To operate LATHE machine for performing different types of turning operations.
- To select, apply and fix different types of tools, accessories according to the to carry out operation in LATHE
- To use the LATHE machine safely and efficiently

Course Outcome:

- The student will be able to read the part drawing and identify the different operations to be done on the work.
- The student will be able to select proper tools and select the appropriate cutting conditions.
- The student will be able to measure the dimensions and produce the job according to the drawings.

LIST OF EXPERIMENTS

1. Study of Lathe-
   a. Types of Lathe

   b. Parts of a Centre Lathe
   c. Accessories of a Centre Lathe
   d. Specifications of a Centre Lathe
   e. Cutting tools used in Centre Lathe
   f. Operations performed in a centre lathe
   g. Safety precautions
2. Practice of external step turning of a cylindrical work piece using Center Lathe.
   a. Optional Exercise - Study of single point tool nomenclature.
3. Practice of taper turning of a cylindrical work piece using Center Lathe.
   a. Optional Exercise - Study of taper turning methods.
4. Practice of knurling and countersinking operation in center lathe.
   a. Optional Exercise- Study of center drill bit.
5. Practice of drilling and borings operations in center lathe.
   a. Optional Exercise- Study of various threads (BSW, ISO, ACME, UNF and BSP).
6. Practice of external thread cutting operation in center lathe.
   a. Optional Exercise- Change gear calculations.
7. Practice of tapping operation in center lathe.

Reference Books

1. S.K. Hajra Choudhury, "Elements of work shop technology", Vol. II, 2000, pp. 77-177.
2. J.Robin and M. Sekar, "Lathe shop Manual V1", KSMS, 2010.

(Any 6 Experiments from the given above will be offered to students)

11ME203 METROLOGY AND COMPUTER AIDED INSPECTION

Credits: 3:0:0

Course Objectives:
- To impart the knowledge, basic concept and importance of metrology.
- To educate the students on different types of measurement systems.
- To impart the knowledge about the various measuring instruments to measure the linear, angular, form and surface finish measurements.
- To introduce the applications of computer and laser in the field of metrology, quality control and inspection.

Course Outcome:
- Students will be getting the updated knowledge about the metrology, quality control and Inspection so that they can meet the challenges in the industries.
- Students will be able to handle various instruments and measuring systems.
- Students will be able to design any measuring instrument or systems with this knowledge.

Unit - I General Concepts of Measurement
Definition-Standards of measurement-Errors in measurement-Accuracy, precision, sensitivity and readability - calibration of instruments, selection and care of instruments.

Unit - II Linear and Angular Measurements
Length standard-Line and end standard - Slip gauges, micrometers, verniers, dial gauges-comparators,various types-principle and applications-angular measuring instruments-bevel protractor, levels, clinometers-sine bar, angle dekkor- autocollimator.

Unit - III Measurement of Form Errors, Surface Roughness and Measuring Machines

Straightness, flatness, alignment errors-surface texture-various measuring instruments-Tomlinson surface meter, Taylor-Hobson Talysurf , tracer type profilogram ,mechanical roughness indicator-runout and concentricity, Tool maker's microscope.

Unit - IV Measurement of Screw Threads and Gears
Various elements of threads-2 wire and 3 wire methods- Errors in threads-gears elements –pitch measurements, Parkinson gear tester.

Unit - V Computer Aided and Laser Metrology
Coordinate measuring machine-LASER micrometer- Introduction to Interferometer, optical - LASER interferometers-applications.

Text Book :
1. R.K.Jain and S.C.Gupta, "Engineering Metrology", Dhanpat Rai and Sons, 2000.

Reference Books :
1. I.C.Gupta, "A Text Book of Engineering Metrology", Dhanpat Rai and Sons, 2000
2. G.N.Galyer F.W and C.R.Shotbolt, " Metrology for Engineers ", ELBS Edn 1990.
3. "ASTME Handbook of Industrial Metrology", Prentice Hall of India Ltd., 1992.

11ME204 PRODUCTION PROCESSES

Credits 4:0:0

Course Objectives:
- To impart the knowledge on Lathe operations.
- To educate the students on different milling Operations.
- To impart the knowledge about the various Non traditional machining techniques.

Course Outcome:
- Students will be able to know various operations of machines like lathe, milling machining, grinding machine

Unit – I
Lathe – Classification, specification, lathe operations – attachment for various operations, type of tools, capstan and turret lathe, automatic lathes, milling: types, specification, milling tool nomenclatures and milling operations-indexing types – simple and compound

Unit – II
Drilling and Boring, tool specification, nomenclature, shaper, planer, specification and types. Grinding – types of grinding wheels- specifications- mounting- dressing -balancing of grinding wheels. Gear shaping- gear hobbing and gear finishing.

Unit – III
Non-Traditional Machining:- Classification, Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Laser beam machining, Numerical Control Machine Tool: Classification of Numerical Control systems

Unit – IV
Metal forming: Rolling principle, rolling load, rolling variables, forging classification, Extrusion – Principle, Classification, Defects in rolled, forged and extruded components. Unconventional Forming, explosive forming, Electro magnetic forming. Introduction to powder metallurgy.

Unit - V

Moulding and casting: – Pattern, pattern allowance, and types, moulding sand preparation, types of core. Special casting process – Shell moulding, permanent moulding, precision moulding, investment casting,. Die casting, centrifugal casting, and continuous casting-Casting defects. Welding: - Classification, Gas welding, Arc Welding - TIG, MIG, resistance welding, Laser beam welding- welding defects.

Text Books:

1. S.K. Hajra Choudhray, S.K. Bose, 'Elements of Workshop Technology, Vol. II, Machine Tools', Media promoters & Publishers (P) Ltd, 2004, 11th Edition.
2. P.N. Rao, 'Manufacturing Technology', 2nd Ed. Tata McGraw Hill Publishing Ltd., 1999.

Reference Books:

1. HMT, 'Production Technology', TMH (India), 1996.
2. Heine, Richard, Carl R Loper and Philip Rosenthal, 'Principles of Metal Casting', Tata McGraw Hill Publishing Ltd., 2000.

11ME205 DESIGN OF HEAT EXCHANGERS AND PRESSURE VESSELS FOR FOOD PROCESSING

Credits 3:1:0

Course Objectives:

- To expose the student about the classification of heat exchangers their advantages and limitations
- To train the students to perform heat transfer analysis using LMTD and NTU methods.
- To develop the skill of the student to quickly evaluate the size and main parameters of Shell and Tube heat exchangers to meet the process parameters.
- To introduce the basic aspects of Fouling, Pressure drop and pumping power requirements.
- To Impart the knowledge about phase changes-Special application to Condensers and Evaporators
- To enable the students to design Heat exchanger.

Course Outcome

- The student will be able to do heat transfer analysis using LMTD or NTU method depending on the nature of problem and available data.
- The student will be able to perform thermal design of heat exchanger (Including heat exchangers with phase change).

UNIT I

Introduction, classification of heat exchangers, Arithmetic mean temperature difference(AMTD), logarithmic mean temperature difference(LMTD)-parallel flow and counter flow, overall heat transfer coefficient, fouling in heat exchangers-fouling effect calculations. Effectiveness in heat exchangers- parallel flow and counter flow .Number of transfer unit (NTU).

UNIT II

Multi pass heat exchangers-correction factor for LMTD. Design of double pipe heat exchangers-Design considerations, tube side heat transfer coefficient, shell side heat transfer coefficient, overall heat transfer coefficient. Design of shell and tube heat exchangers - Design considerations, overall heat transfer coefficient Baffles in heat exchangers –types, baffle spacing. Shell types, tube bundle,pitch.

UNIT III
Pressure drop and pumping power calculations in double pipe and shell and tube heat exchangers. Design of condensers .Cooling tower-Types and design; Simple problems.

UNIT IV
Air Pre-Heaters: Types of Air heater, recuperative and regenerative – Design considerations – High temperature and low temperature applications; Simple problems Heat exchanger sizing for heating or cooling of a batch of liquid in agitated vessel, batch cooling with external heat exchanging, jacketed batch reactor heating; Simple problems

UNIT V
Evaporators –classification-horizontal and vertical. Single effect and multi effect evaporator criteria for selecting evaporator. [Only theory].

Text Books:
1. S.D.Dawande; "Principles of Heat Transfer and Mass Transfer", Central Techno Publications, 2000.
2. Arora, S.Domkundwar; "A Course in Heat and Mass Transfer", Dhanpat Rai & Co. Ltd, 2002.

Reference Books:
1. J.M.Coulson and J.F.Richardson: Chemical Engineering VoI 1. Fluid flow, Heat Transfer and Mass Transfer. Butterworth-Heinemann, an imprint of Elservier,Sixth Edition, Indian Reprint, 2006
2. Homi, P. Serval., 'Boilers & Pressure Vessels', Multitech Publishing Company, Bombay, 1989.
3. P.K. Nag., 'Power Plant Engineering (Steam and Nuclear)', Tata McGraw Hill,New Delhi, 1998.
4. P.Chattopadhyay "Heat transfer through theory and problem" Khanna Publishers Third edition 2004.

11ME206 MECHANICAL SYSTEMS FOR FOOD PROCESSING

Credits: 4:0:0

Course Objectives:
- To provide knowledge about various types of pumps and power transmission systems
- To provide knowledge about steam generators and distribution system
- To understand the principle of chillers and material handling systems

Course Outcome:
- Students will learn about the working principle of pumps, types and their applications
- Students will learn about various types of power transmission systems and their application, types of boilers and their use in power plants
- Students will learn about the types of chillers and their use, and various material handling systems and their application in industries

Only theoretical concepts and simple problems to be taught.
Unit I

Pumps: Types of pumps employed-Centrifugal pumps, Reciprocating pumps, Rotary gear pumps, vane pumps, peristaltic pumps, and diaphragm pumps. Construction, working principles and applications.

Unit II
Mechanical power transmission systems: Relation between torques, power speed, Basics of mechanical design of shafts, hollow shafts, different coupling types, belt and gear drives - velocity ratio.

Unit III
Steam generation and distribution: Water tube and smoke tube boilers. Boiler capacity, boiler specifications, Boiler mountings and accessories, Need for pressure reduction and pressure reducing valve. Thermic fluid and hot air generators and distribution. Relative merits and demerits of steam, hot air and thermic fluid heating of foods.

Unit IV
Chillers: Freezers, Chilled water and ice, their production, types of chilled water generators, types of ice generators. Storage and instant water chillers .

Unit V
Material handling in Food plants. Importance of electro-mechanical handling. Types of elevators. Bucket, Slat, pneumatic and screw elevators, inclined elevators, Handling of wet products. Stainless steel and plastic conveyors and elevators.

Text Books

1. T.C.Robberts: Food Plant Engineering Systems, CRC Press Ltd. Washington, USA, 2002.
2. P.C.Smith, "Introduction to Food Process Engineering", Springer international Edition, 2005

Reference Books

1. R.Paul Singh, Dennis R.Heldman; "Introduction to Food Engineering" (3rd edition), Academic press, Elsevier, 2001.
2. Arthur W Farral: "Food Engineering Systems Vol-1", AVI Publications, 2003.
3. R.K.Bansal; "Fluid Mechanics and Hydraulic Machines", Laxmi publications (P) Ltd, 2004

11ME207 PRINCIPLES OF RESOURCES AND QUALITY MANAGEMENT

Credits: 3:1:0

Course Objectives

- To educate the students about how effectively the resources can be used to get maximum benefit
- To educate the students about the tools for quality improvement in product as well as service industry

Course Outcome

- Students would know about the effective utilization of the resources to gain maximum benefit
- Students would know the various tools to improve the quality in product industry as well as service industry

UNIT – I: Linear Programming & Transportation Problems

Linear Programming-Formation of the problem-Graphical Method-Simplex method-Primal dual Problems-Dual Simplex method – Two Phase Method — transportation models – Formation of transportation problem -degeneracy in transportation models.

UNIT – II: Sequencing &Network Analysis

Sequencing of "N" jobs through two machines and three machines.

Network analysis: Network Rules-Network construction –Problem Evaluation and Review Technique (PERT) – Probability of achieving completion date – Critical Path Method (CPM) - Crash time –Crash Cost analysis.

UNIT – III: Simulation and Game Theory

Random Number generation-Mid Square and Congruential methods-Monte-Carlo Simulation-Monte-Carlo simulation technique to solve inventory control problems and Queuing problems

Game Theory: Two persons – Zero sum games – Pure Strategies and Mixed Strategy – Saddle point method – Graphical method – Concept of Dominance.

UNIT – IV: Introduction to Quality Management

Definition of quality – Dimensions of Quality – Basic Concept of Total Quality Management – Historical review – Principles of TQM — Deming 14 principles– Barriers to TQM implementation – Benchmarking definition – Reasons to Benchmark and its Procedure- Quality Function Deployment (QFD) - definition – Benefits – Procedure

UNIT – V: Quality Systems & IT Tools

Quality Systems: Need for ISO 9000 and other quality systems – ISO 9000: 2000 Quality Systems –ISO 9001 requirements-Implementation Procedure for a Quality Management system-Documentation, internal audits and Registration of Quality system

IT Tools-overview of Intranet, Video conferencing, virtual Teaming-E-learning and E-governance in Quality Management

Text Books

1. S.Bhaskar, Operations Research, Anuradha Agencies, 1999.
2. Dale H. Besterfied, Total Quality Management, Pearson Education Asia, 2002.

Reference Book:

1. J.M.Juran, Quality Planning and Analysis, Fifth Edition, Tata McGraw Hill Publishers, 1998.

11ME208 SOFTWARE LAB

Credits 0:0:2

Course Objectives:

- To equip the students with the Analysis software -ANSYS &FLUENT.
- To enable the students to construct models and solve structural, thermal and fluid problems.
- Enable the students to understand the issues related to the utilization of FEA/FVM in the industry.

Course Outcome:

At the end of the course the students will be able to:

- Solve engineering problems using commercial software such as ANSYS& FLUENT
- Implement mechanical engineering concepts to use the software tools correctly and efficiently
- Analyze a mechanical component under static load condition.

LIST OF EXPERIMENTS

Using ANSYS Software

1. Analysis of 2D Truss
2. Analysis of Bicycle Frame
3. Static Analysis of Corner Bracket
4. 2D Heat Conduction within a Solid
5. Thermal Analysis of 2D Chimney
6. Thermal Analysis of 3D Fin
7. Flow in a Diverging Duct
8. Velocity analysis of fluid flow in a channel USING FLOTRAN
9. Design Optimization

Using FLUENT Software

10. Mesh generation using GAMBIT for Tube bank.
11. Comparison of velocity profile - Laminar &Turbulent Pipe Flow
12. Fluid Flow and Heat Transfer in a Mixing Elbow

11ME209 HEAT ENGINES AND FLUID MACHINERY

Credits 3:1:0

Course Objectives:

- To enable the students to understand the fundamentals and basics of Heat Engines & Machinery.
- To give exposure to students about various types of engines and fluid machinery

Course Outcome:

- At the end of the course the student will understand the fluid properties, Flows, Turbines, jets, Thermodynamics, I.C.Engine, Heat transfer.

Only theoretical concepts and simple problems to be taught.

UNIT -I: Fluid Properties

Properties of fluids: density, specific weight, specific volume, specific gravity.
Viscosity: units, kinematic viscosity, Newtons law of viscosity, variation of viscosity with temperature, types of fluids.
Surface tension and capillarity: surface tension on liquid droplet, hollow bubble.
Manometers: Peizometer, u-tube manometer, single column manometer tube differential manometer.
PUMPS: reciprocating pumps, centrifugal pumps - operating principles

UNIT-II: Types of Flow and Turbines:

Types of flow- steady and unsteady, uniform and non uniform, laminar and turbulent, compressible and incompressible, rotational and irrotational, one, two and three dimensional flows.
Impact of jets- Impulse momentum equation- moment of momentum equation, jet on vertical plate, inclined, curved plate.
Turbines: classification-working principles -Pelton wheel, Francis, Kaplan turbines. Simple problems

UNIT-III

Thermodynamics:

Basic concepts - thermodynamic system - properties - processes - cycle - equilibrium -
First law of thermodynamics - application of first law to non flow and flow process -
Second law of thermodynamics - Kelvin Planck's statement -Clausius statement -
Reversibility - Carnot theorem - heat engine.

UNIT-IV I.C.Engines
Classification of I C engines–engine components-four stroke engines and two stroke engines-differences-air standard cycles - air standard efficiency - Otto, Diesel -problems

UNIT-V Heat transfer
Modes of heat transfer – one dimensional steady state heat conduction equation – plain wall - convection - empirical relations - Radiation - laws of radiation

Text Books

1. Dr.R.K.Bansal-a Text Book of Fluid Mechanics and Hydraulic Machines. Ninth edition 2009
2. Kothandaraman,C,P., etal, "A course in heat engines and thermodynamics", Dhanpat Rai & Sons, 3rd Edition, 1993.

Reference Books

1. Som,S.R, & Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill,1998.
2. Holman, "Heat Transfer", McGraw Hill International, 7th, Edition, 1992.
3. Cengel,. A., "Introduction to Thermodynamics and Heat Transfer", Tata McGraw Hill, New Delhi, 1997.

11ME 210 ENGINEERING DRAWING LABORATORY

Credits: 0:0:2

Course Objectives:

- To impart and inculcate proper understanding of the theory of projection.
- To impart the knowledge about the practical applications of conic sections and special curves.
- To improve the visualization skills.
- To enable the students with various concepts like dimensioning and conventions related to working drawings in order to become professionally efficient.

Course Outcome:

- Students will be able to understand the theory of projection.
- Students will be able to know and understand the conventions and the methods of engineering drawing.
- Students will be able to improve their visualization skills so that they will acquire enough skills in developing new products.

List of Exercises

1. Construction of conic sections (Ellipse, Parabola, Hyperbola).
2. Construction of special curves (Cycloid, epicycloid and hypocycloid, Involutes of circles and polygons).
3. Projection of straight Lines (Inclined to both the planes only) and traces of straight lines.
4. Projection of solids (Inclined to one plane and parallel to the other).
5. Projection of solids (Inclined to both the planes).
6. Conversion of Pictorial views into orthographic views of machine parts.
7. Development of surfaces Prisms, pyramids, cylinder and cone (Cut views only).
8. Isometric views of solids (combination of solids) and conversion of orthographic views into isometric views.
9. Section of solids (Cube, prisms, pyramids, cylinder and Cone).
10. Intersection of solids(Cylinder & cylinder, Cylinder & Cone)
11. Introduction to 3D modeling in AutoCAD (For practice only).
12. Obtaining orthographic views from 3D model using AutoCAD (For practice only).

Text Books:

1. Venugopal K. "Engineering Graphics", 9th Edition (Revised), New Age International Publishers, 2009.
2. Narayana K.L, Kannaiah. P, "Text Book on Engineering Drawing (Engineering Graphics)", 2nd Edition, 2006.

Reference Books:

1. Bhatt N.D., "Elementary Engineering Drawing", 26th Edition. Chartor Publishing House, Anand, 2009.
2. Natarajan K.V. "A Text Book of Engineering Drawing", 16th Edition, 2006.

10ME308 MATLAB

Credits: 0:0:2

Course Objectives:

To perform mathematical operations using arrays and matrices in MATLAB.
To handle data using MATLAB by importing/exporting them from/to different formats
To generate two dimensional plots and perform the essential plotting commands.
To write programming codes with conditional statements and loops to solve most engineering problems.

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Course Outcome:

Students will be able to perform mathematical operations using MATLAB
Students will be able to handle data and generate the plots
Students will be able to solve most engineering problems in analytical form using MATLAB.

List of Experiments

1. Introduction to MATLAB
2. Solving simple mathematical problems using MATLAB
3. Solving Matrices problems Using MATLAB
4. Curve fitting Using MATLAB
5. Solving Differential equation using MATLAB
6. Solving Boundary Value Problem using MATLAB
7. Solving Initial Value Problem using MATLAB
8. Solving Engineering problems in MATLAB
9. Knowing simulink in MATLAB
10. System Simulation using MATLAB
11. Optimization using MATLAB
12. Finite element analysis using MATLAB
13. Vibration simulation using MATLAB
14. Digital Image processing using MATLAB
15. Simulation of a machine part using MATLAB

(Any 12 Experiments will be offered from the list as given above)

11ME301 MECHATRONICS AND MACHINE CONTROLS

Credits 4:0:0

Course Objectives:

To impart knowledge on the fundamentals of the following

1. Control systems
2. Programmable logic circuits
3. Controls in NC machine
4. Fluidic Controls and
5. Process control Pneumatics

Course Outcome

- The students will become familiar with the different aspects of mechatronic engineering.
- They will have working knowledge to handle problems involving mechatronic and control elements.

Unit - I Introduction

Introduction - multidisciplinary scenario - evolution of mechatronics - scope of Mechatronics - measurement systems - control systems - servomechanisms and regulators - control system fundamentals - block diagrams and block diagram reduction .

Unit - II Control systems and programmable logic controllers

Stability of control systems - Rouths and Hourwitz stability criteria - programmable logic controllers (PLC) - input output processing - programming (fundamentals only) – mnemonics - timers - shift registers - master and jump controls - data handling - selection of PLC.

Unit - III Elements of Mechatronics

Mechartonic elements - data presentation systems - displays - analog and digital indicators - analogous chart recorders - visual display units - CRO - printers - magnetic recorders - light indicators - liquid crystal display units - alarm indicators data loggers - computers with plug in boards-data acquisition systems.

Unit - IV Controls in NC Machines and fluidic control

Controls in NC Machines-hydraulic systems - direct current motors - stepping motors - feedback devices-encoders - resolvers - inductosyn – tachogenerators - principles of fluid logic control - Coanda effect - basic fluidic devices - fluidic logic gates - bistable - flipflop - OR and NOR gates - exclusive OR gates - fludic sensors - backpressure sensor - cone jet proximity sensor -interruptible jet senor.

Unit – V Process control Pneumatics

Process control pneumatics - signals and standards - the flapper nozzle - volume booster – air relay and force balance - pneumatic controllers - proportional pneumatic control - proportional plus integral pneumatic control - proportional plus integral plus derivative pneumatic control - PI and IP convertors.

Text books

1. W Boltson , ‘Mechatronics’,PearsonEducation third edition 2007.
2. Andrew Parr, ‘Hydraulics and Pneumatics’, Jico Publishing House ,Mumbai 2006.
3. Kuo, ‘Automatic Control Systems’, Asian student Edition, Printice Hall of India,2005.

Reference Books:

1. Mahalik,Nitaigour,Premehand, ‘Mechatronics’, TataMc.Graw Hill Publishers, New Delhi 2005.
2. Anthony Esposito, ‘Fluid Power’, Pearson Education, 2005
3. Ogata Katsuhiko , ‘Modern Control Engineering’, Printice Hall of India , 2005.
4. Yoram Koren, ‘Computer control of Manufacturing Systems’, TataMc.Graw Hill Publishers, New Delhi, 2005.

11ME302 ENGINEERING MATERIALS AND APPLICATIONS

Credits 4:0:0

Course Objective:

To provide an overview of mechanical behavior, fracture behavior, Modern metallic materials.

Course Outcome:

The students will able to choose the particular material for an application.
The students will become familiar with modern metallic materials, composite materials

Unit: I Elastic and Plastic Behavior.

Elastic behaviour – atomic model of Elastic behaviour – Rubber like Elasticity anelastic behaviour- visco elastic behaviour-plastic deformation- slip- shear strength of perfect and real crystals- movement of dislocation – effect of temperature on dislocation movement. sources of dislocation – work hardening- effect of grain size solute atoms and precipitate particles on dislocation movement.

Unit II Fracture Behaviour

Ductile and Brittle fracture - Griffiths theory – fracture toughness- Ductile Brittle Transition - protection against fracture – fatigue Failure of ferrous and non ferrous materials- fatigue tests- mechanism of fatigue failure – fatigue strength - Methods to improve fatigue strength- Creep and creep resistant materials.

Unit III Modern Metallic Materials.

Patented Steel wire - Steel martensite- ausformed steels- micro alloyed steels- precipitation hardened aluminium alloys - Maraging steels – metallic glasses – shape memory alloys, smart Materials- TRIP Steels.

Unit IV Ceramics and glasses.

Introduction- Ceramic Structures- silicate ceramics- simple silicates- layered silicates- carbon – diamond- graphite- imperfections and impurities in ceramics –brittle fracture and fractural strength of ceramics - applications and processing of ceramics- glasses- glass properties glass forming- heat treatment of glass – glass ceramics- clay products- fabrication techniques- refractories – abrasive ceramics and their processing- powder pressing and tape casting-cements- advanced ceramics- heat engine applications.

Unit V: Composite Materials.

Introduction – Particle reinforced composites- fiber reinforced composites- influence of fiber length and orientation-fiber and matrix materials- polymer matrix composites- glass fiber - reinforced polymer composites, carbon fiber- reinforced polymer composites, aramid fiber reinforced composites- metal matrix composites- ceramic - matrix composites- carbon – fiber carbon composites- hybrid composites- processing of FRP- pultrusion – filament winding- structure of composites.

Text Books:

1. Raymond A. Higgin's " Engineering Metallurgy Part 1 (Applied Physical Metallurgy) English Language Book Society.2000
2. George. E. Dieter ' Mechanical metallurgy" Mc Graw hill Book Company. 1998.
3. Thomas H. Courtney ' Mechanical Behaviour of Materials" McGraw Hill International Edition.2000

Reference Books:

1. Raymond A. Higgin's " Properties of Engineering Materials, English Language Book Society.2000
2. V. Raghavan, " Materials Science and Engineering – Prentice Hall of India (P) Ltd., New Delhi.1998.
3. Williams D, Callister " Material Science and Engineering" John Wiley & sons inc.1996.

11ME303 MODELING LAB

Credits 0:0:2

Course Objectives:

The main purpose of this course is

- To provide the role of Computer Modeling on the Mechanical Engineering studies.
- To provide some useful commands for producing models in Pro-E and Solid Works
- To visualize the object in three dimensions and producing orthographic views, sectional views and auxiliary views of it.

Course Outcome:

At the end of the course the students will be able to:

- Visualize an object in 3-D and Work with the Pro-E & Solid works commands
- Develop ability to create parts, and assemble the parts to create a functional assembly as part of problem solving.
- Students will be able to use their CAD knowledge to develop their design ideas from sketches into computer solid models.

LIST OF EXPERIMENTS

Using Pro-E Wild fire

1. Part model using Basic commands like Extrude, Round, Mirror ,Revolve , Hole & pattern
2. Part model using Rib , Chamfer, Draft commands
3. Surface model of a Phone Receiver
4. Part model using Advanced modeling commands- Sweep, Draft and Blend.
5. Generating Sectional and Auxiliary views
6. Assembly and detailing of Knuckle Joint
   Using SOLID WORKS
7. Part model using Basic commands like Extrude, Round, Mirror ,Revolve , Hole & pattern
8. Part model using Rib , Chamfer, Draft commands
9. Part model using Advanced modeling commands- Sweep, Draft and Blend.
10. Generating Sectional and Auxiliary views
11. Assembly and detailing of Plummer block
12. Assembly and detailing of Screw Jack

Text Books:

1 Venugopal K. "Engineering Graphics", 9th Edition (Revised), New Age International Publishers, 2009.
2 Narayana K.L, Kannaiah. P, "Text Book on Engineering Drawing (Engineering Graphics)", 2nd Edition, 2006.

Reference Books:

1 Bhatt N.D., "Elementary Engineering Drawing", 26th Edition. Chartor Publishing House, Anand, 2009.
2 Natarajan K.V. "A Text Book of Engineering Drawing", 16th Edition, 2006.

11ME304 COMPUTER AIDED ENGINEERING LABORATORY

Credits: 0:0:2

Course Objectives:

- To impart the fundamental knowledge on using various analytical tools like ANSYS, FLUENT, etc., for Engineering Simulation.
- To know various fields of engineering where these tools can be effectively used to improve the output of a product.
- To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools.

Course Outcome:

- The student will be able to appreciate the utility of the tools like ANSYS or FLUENT in solving real time problems and day to day problems.
- The students will become versatile in using these tools for any engineering and real time applications.
- They will also acquire knowledge on utilizing these tools for a better project in their curriculum as well as they will be prepared to face industry with confidence when it matters to use these tools in their employment.

List of Experiments:

Introduction of ANSYS tools, its utilities and Fundamentals of FEM .

1. Application of ANSYS in structural problems – Simple truss problems, 1D problem.
2. Application of ANSYS in structural problems – Beam problems, 2D and 3D problems.
3. Structural Analysis of Corner Bracket using ANSYS.
4. Application of ANSYS in vibration problems – Modal analysis
5. Application of ANSYS in vibration problems – Harmonic analysis
6. Thermal Analysis of 3D Fin Using ANSYS
7. Application of ANSYS in thermal problems – Transient heat conduction problems
8. Application of ANSYS in thermal problems – Transient heat convection problems
9. Application of ANSYS in CFD problems – Flow problem – (laminar or turbulent flow problems)
10. Application of ANSYS in coupled field problems – problems combining structural & thermal.
11. Application of ANSYS in Electrical problems – Electrical field problems.
12. Design Optimization

11ME305 CFD LAB

Credits: 0:0:2

Course Objectives:

- To familiarize the students with the working of CFD codes
- To familiarize the students with actual setting up of the problem and solution procedure
- To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools.

Course Outcome:

- To set up solution domain and grid generation
- To set up boundary conditions and generate the solution

List of Experiments:

Introduction to CFD and FLUENT

1. One-dimensional steady state heat diffusion – Laplace equation
2. One-dimensional steady state heat diffusion – Poisson equation
3. One-dimensional heat transfer in circular fin
4. One-dimensional unsteady heat diffusion
5. One-dimensional convection and diffusion
6. Compare with analytical results
7. Introduction to two-dimensional problems
8. Two-dimensional laminar pipe flow
9. Two-dimensional turbulent pipe flow
10. Two-dimensional periodic flow and heat transfer
11. Two-dimensional conjugate heat transfer
12. Periodic Flow and Heat Transfer
13. External compressible flow

11ME306 ADVANCED FLUID MECHANICS & COMPUTATIONAL FLUID DYNAMICS

Credits 3:1:0

Course Objectives:

1. To educate students on Eulerian, Lagrangian equation, Bernoulli's equation, Differential momentum equation, Navier Stoke Equations and Energy Equation
2. To give basic knowledge about Computational Fluid Dynamics
3. To familiarize students with irrotational motion in two dimensions, flow over cylinders and boundary layer principles.

Course Outcome:

1. Students will be able to analyze numerical flow problems
2. Students will be able to understand the working Computational Fluid Dynamics Software

UNIT I

Introduction:

Method of describing fluid motion– Lagrangian, Eulerian Method – Local and individual time rates of change, acceleration, - Eulerian and lagrangian equation of Continuity. Bernoulli's equation from Euler's equation– solved problems related to liquid motion, related to equation of continuity.

UNIT II

Momentum & Energy Equation

Forces and stress acting on fluid particles. Differential momentum equation. Navier Stokes Equations of Motion for simple cases in rectangular, cylindrical and spherical coordinate. Energy Equation

UNIT III

Velocity Potential & Stream Function

Irrotational motion in two dimensions, sources and sink Complex potential due to a source, due to a doublet, Images with respect to straight line, solved problem.Vortex motion-Vortex tube, Helmohltz's vorticity theorem, velocity potential and stream function.

UNIT IV

Laplace Equation and Boundary Layer theory

Flow over Circular cylinders, sphere, solution of Laplace equation, Joukowshi transformation, Flow past cylinder with and without circulation, flow past Rankine body.
Boundary layer principles, flat plate, conduits, curved solid bodies, prandtl mixing length, turbulent theory, universal velocity profile, and momentum eddy concept – simple applications.

UNIT V
Computational Fluid Dynamics
Classification of PDEs on CFD: Elliptic, parabolic and Hyperbolic equations, relevant conditions, Governing equations of fluid dynamics: Continuity, Momentum and energy equations (excluding derivation) –Methods of deriving the discretization equations: finite difference and finite volume methods – Transient solutions - Implicit, explicit and Cranck-Nicholson methods - Solution methodologies: Direct and iterative methods, Relaxation method, Alternating Direction Implicit method

Text Books
1. Streeter, VL, 'Fluid Dynamics', 3rd Ed., McGraw Hill, 2006.
2. Raisinghania.M.D, 'Fluid Dynamics', 4th Ed., S.Chand & Company Ltd, 2002.
3. Versteeg, H.K, and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Longman, 1998

Reference Books
1. Fox R.N. and McDonald A.T., 'Fluid Mechanics', John Wiley & Sons, 1999.
2. Dr. J.K Goyal I K.P. Gupta., 'Fluid Dynamics', 3rd revised Ed., Pragathiprakasam,Meerut, 1999.
3. Schlichting.H., 'Boundary layer Theory' ,8th Ed.,McGraw Hill, New york,2001.
4. Anderson, J.D., " Computational fluid dynamics – basics with applications", 1995
5. Ghoshdastidar, P.S., "Computer simulation of flow and heat transfer", Tata McGraw – Hill publishing Compony Ltd., 1998.

11ME307 ADVANCED THERMODYNAMICS AND HEAT TRANSFER

Credits: 3:1:0

Unit 1
Review of first law and second law of thermodynamics. Entropy – entropy evaluation- local and global equilibrium.Third law of thermodynamics.
Availability – availability analyses for a closed system, generalized availability analysis, availability efficiency

Unit II
State Relationships For Real Gases and Liquids.Equations of State, Real Gases -Virial Equation of State- Van der Waals (VW) Equation of State. Compressibility Charts.
James Clark Maxwell Relations Generalized Relations Helmholtz Function. Gibbs free energy or Chemical Potential, fugacity and activity,Pitzer Effect

Unit III
Thermodynamic Properties of Mixtures-Phase Equilibrium,Ideal Solution and Raoult's Law Dissolved Gases in Liquids, Henry's Law, Stability criteria, Entropy generation during irreversible transformation

Combustion Principles - Thermodynamics concepts of combustion. First law and second law of thermodynamics applied to combustion process – heat of combustion – Adiabatic flame temperature –stoichiometry and excess air – combustion calculations – minimum air required for complete combustion of fuel – chemical equilibrium and dissociation.

Unit IV

Review of Heat transfer principals-Conduction, convection and Radiation
Boiling -Boiling Curve- Boiling Nucleation - Flow Patterns in Vertical and Horizontal Tubes

Condensation Nusselt's Analysis of a Vertical Flat Plate Film Condensation on Single Horizontal Finned Tubes, Condensation in Plate Heat Exchangers- Steam Condensation Heat Transfer

Unit V

Experimental Methods - Fundamentals-Measurement Error. Heat Transfer Enhancement - Enhancement Techniques -Treated Surfaces -Rough Surfaces
Heat Transfer in Electronic Equipment and Heat Pipes-An Introduction.

Text Books

1. Advance thermodynamics engineering, kalyan annamali & ishwar k.puri ,crc press
2. Heat transfer handbook,Adrian Bejan & Allan d. Kraus,john wiley & sons, inc.,2003

Reference Books

1. Yunus A Cengel, 'Thermodynamics An Engineering Approach', The McGraw Hill Companies, 6th Edition, 2008.
2. P.K. Nag., 'Engineering Thermodynamics', 3rd Edition., McGraw Hill, 2005.
3. Holman J.P., 'Heat andMass Transfer', Tata McGraw Hill, 8th Ed., 1989.
4. Frank P. Incropera and David P. Dewit T., 'Fundamentals of Heat and Mass Transfer', 4th Ed., JohnWiley & Sons, 1998.
5. C.P. Kothandaraman., 'Fundamentals of Heat and Mass Transfer', 2nd Ed., New Age International, 1997.

S.No.	Sub. Code	Name of the Subject	Credits
1	10ME214	Metrology And Dynamics Lab	0:0:2
2	11ME308	Automotive Electricals and Electronics	4:0:0
3	11ME309	Vehicle Dynamics	4:0:0
4	11ME310	Vehicle Maintenance	4:0:0
5	11ME311	Automotive Chassis Systems	4:0:0
6	11ME312	Thermal Plasma: Concepts and Applications	4:0:0

10ME214 METROLOGY AND DYNAMICS LAB

Credits: 0:0:2

Course Objective:

- To be familiar with the different precision measuring instruments
- To learn the methods of measuring the common engineering parameters
- To be familiar with the measurements dynamic characteristics of engineering system such as vibration
- To have the knowledge of dynamic balancing of rotating parts

List of Experiments

1. Measurement of angle using sine bar
2. Measurement of angle using sine center
3. Measurement of angle using bevel protractor
4. Calibration of vernier height gauge using slip gauges
5. Circularity test bench center method and V block method
6. Measurement of screw thread dimensions using profile projector
7. Dynamic balancing of rotors
8. Determination of critical speed of whirling shafts
9. Jump speed analysis of cam and follower
10. Study of undamped free vibration of equivalent spring mass system
11. Study of undamped torsional vibration of a single rotor system
12. Determination of amplitude and frequency of forced vibration using vibration exciter and vibrometer.

11ME308 AUTOMOTIVE ELECTRICALS AND ELECTRONICS

Credits: 4:0:0

Course Objective:

To provide knowledge about application of electrical in Automobile engineering
To provide knowledge about application of electronics in Automobile engineering
Students will be able to Understand various sensor systems used in automobiles, selection of springs and dampers

Course Outcome:

Upon completion of this course the student will be able to:

Understand the electronic ignition and fuel injection system, lightning system and starting system.

Unit I

Batteries and Starting System: Different types of Batteries – Principle, Construction and Electrochemical action of Lead – Acid battery, Electrolyte, Efficiency, Rating, Charging, Testing and Maintenance. Starting System, Starter Motors – Characteristics, Capacity requirements. Drive Mechanisms. Starter Switches.

Unit II

Charging System, Lighting System and Accessories: D.C. Generators and Alternators their Characteristics. Control cutout, Electrical, Electro-mechanical and electronic regulators. Regulations for charging. Wiring Requirements, Insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods. Lighting design, Dash board instruments, Horns, wiper, Trafficators, Warning system and safety devices.

Unit III

Electronic Ignition and Fuel Injection Systems

Spark plugs, Advance mechanisms. Different types of electronic ignition systems - variable ignition timing, distributor less ignition. Spark timing control. Electronic fuel injection systems. Engine mapping.

Unit IV

Sensors and Actuators: Basic sensor arrangement. Types of sensors – Oxygen sensor, fuel metering/Vehicle speed sensor, mass air flow sensor, temperature sensor, exhaust oxygen level, manifold pressure, crankshaft position, pressure sensor and detonation sensor. Various actuators and its application in automobiles.

Unit V

Fundamentals of Automotive Electronics: Current trends in automotive electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system

Text Books

1. Young A.P. & Griffiths. L. “Automotive Electrical Equipment”, ELBS & New Press, 1999.
2. William B.Riddens “Understanding Automotive Electronics”, Fifth Edition, Butter worth Heinemann Woburn, 1998

Reference Books:

1. Bechhold “Understanding Automotive Electronics”, SAE, 1998.

2. Crouse, W.H “Automobile Electrical Equipment”, Third Edition, McGraw-Hill Book Co., 1986.
3. Judge A.W “Modern Electrical Equipment of Automobiles”, Chapman & Hall, 1992.
4. Kholi.P.L “Automotive Electrical Equipment”, Tata McGraw-Hill Co., Ltd., 2000
5. Robert Bosch “Automotive Hand Book”, Fifth Edition, SAE, 2000.
6. Ganesan.V. “Internal Combustion Engines”, Tata McGraw-Hill Publishing Co., Fifth Edition 2005.

11ME309 VEHICLE DYNAMICS

Credits: 4:0:0

Course Objective:

Understand vibrating systems and its analysis, modeling and simulation and modal analysis
Understand various Suspension systems, selection of springs and dampers
Know about the Stability of Vehicles
Know about tyres, ride characteristics and effect of camber, camber thrust
Learn about vehicle handling under different steering conditions and directional stability of vehicles

Course Outcome:

Upon completion of this course the student will be able to:
Understand and analyze the various dynamic aspects of the vehicle

UNIT I

Introduction to Vibration: Classification of vibration, definitions, mechanical vibrating systems, mechanical vibration and human comfort. Modeling and simulation studies. Single degree of freedom, free, forced and damped vibrations. Magnification factor and transmissibility. Vibration absorber. Vibration measuring instruments. Two degree of freedom system. Modal analysis

UNIT II

Suspension: Requirements. Spring mass frequency. Wheel hop, wheel wobble, wheel shimmy, Choice of suspension spring rate. Calculation of effective spring rate. Vehicle suspension in fore and aft directions. Hydraulic dampers and choice of damper characteristics. Independent, compensated, rubber and air suspension systems. Roll axis and vehicle under the action of side forces.

UNIT III

stability of vehicles: Load distribution. Stability on a curved track and on a slope. Gyroscopic effects, weight transfer during acceleration and braking, overturning and sliding. Rigid vehicle – stability and equations of motion. Cross wind handling.

UNIT IV

Tyres: Tyre forces and moments, rolling resistance of tyres, relationship between tractive effort and longitudinal slip of tyres, cornering properties of tyres, ride properties of tyre.

UNIT V

Vehicle Handling : Over steer, under steer, steady state cornering. Effect of braking, driving torques on steering. Effect of camber, transient effects in cornering. Directional stability of vehicles.

Text Books:

1. Rao J.S and Gupta. K “Theory and Practice of Mechanical Vibrations”, Wiley Eastern Ltd., 2002.
2. Dr. N. K. Giri, “Automobile Mechanics”, Seventh reprint, Khanna Publishers, Delhi, 2005

Reference Books:

1. J. Y. Wong, ‘Theory of Ground Vehicles’, John Wiley and Sons Inc., New york 2001.
2. Thomas D.Gillespie, Fundamentals of vehicle dynamics,SAE,1992
3. J.G. Giles, ‘Steering, Suspension and Tyres, Illiffe Books Ltd., 1968.
4. Groover, “Mechanical Vibration”, 7th Edition, Nem Chand &Bros, Roorkee,India, 2003

11ME310 VEHICLE MAINTENANCE

Credits: 4:0:0

Course Objective:

To acquire knowledge about basic maintenance principle of vehicle
To understand failure and reliability of vehicular components
To diagnose body and engine using various techniques

Course Outcome:

Upon completion of this course the student will be able to:
Know preventive and predictive techniques for vehicular maintenance
Apply various techniques to diagnose body and engine problems

Unit I

Maintenance Tool, Shop, Schedule, Records : Standard tool set, torque wrenches, compression and vacuum gauges, engine analyzer and scanner, computerized wheel alignment and balancing, gauges for engine tune up and pollution measurement, spark plug cleaner, cylinder re boring machine, fuel injection calibration machine. Importance of maintenance. Schedule and unscheduled maintenance. Scope of maintenance. Equipment downtime. Vehicle inspection. Reports. Log books. Trip sheet. Lay out and requirements of maintenance shop.

Unit II

maintenance, repair and overhauling of the chassis: Maintenance, servicing and repair of clutch, fluid coupling, gearbox, torque converter, propeller shaft. Maintenance of front axle, rear axle, brakes, steering systems. Tyre maintenance.

UNIT III

POWER PLANT REPAIR AND OVERHAULING

Dismantling of power plant and its components. Cleaning methods. Inspection and checking. Repair and reconditioning methods for all engine components. Maintenance of ignition system, fuel injection system, cooling system,- lubrication system. Power plant trouble shooting chart.

UNIT IV
MAINTENANCE AND REPAIR OF ELECTRICAL SYSTEMS

Care, maintenance, testing and trouble shooting of battery, starter motor, dynamo, alternator and regulator. Transistorized regulator problems.

UNIT V
MAINTENANCE AND REPAIR OF VEHICLE BODY

Body panel tools for repairing. Tinkering and painting. Use of soldering, metalloid paste.

Text Books:

1. John Dolce, Fleet maintenance, Mcgraw Hill, Newyork, 1984
2. A.W.Judge, Motor Vehicle Servicing, 3rd Edition, Pitman Paperpack, London ,1969.
3. W.Crouse, Everyday Automobile repair, Intl.student edition, TMH, New Delhi,1986.
4. Ernest Venk., Edward spicer, Automotive maintenance and trouble shooting,D.B. Taraporevala Sons, Bombay, 1963

Reference Books:

1. Stator Abbey, Automotive steering, braking and suspension overhaul, pitman publishing, London, 1971.
2. Frazee, fledell, Spicer,-Automobile collision Work, American technical publications, Chicago, 1953.
3. Service Manuals from Different Vehicle Manufacturers
4. S. Abbey, Automotive Transmission servicing and overhaul, Sir Issac Pitman, London, 1971.

11ME311 AUTOMOTIVE CHASSIS SYSTEMS

Course Objective:

To introduce vehicle chassis structure
To introduce automotive suspension systems
To broaden the understanding of components of transmission systems
To introduce steering systems
To broaden the importance of conventional and advanced braking systems

Course Outcome:

Upon completion of this course the student will be able to:

Understand the importance of vehicle frame
Determine steering systems
Identify suitable braking systems
Construct automotive suspension systems
Design a suitable transmission system

Unit I

Introduction

Layout with reference to prime mover location and drive. Frames, Constructional details – Materials – Testing of frames – Integrated body construction.

Unit II

Steering System

Front Axle types. Construction details. Materials. Front wheel geometry viz. Camber, kingpin inclination, caster, toe-in and toe-out. Conditions for true rolling motion of road wheels during steering. Steering geometry. Ackermann and Davis steering. Constructional details of steering linkages. Different types of steering gear boxes. Steering linkage layout for conventional and independent suspensions. Turning radius, wheel wobble and shimmy. Power and power assisted steering.

Unit III

Braking System

Types of brakes. Principles of shoe brakes. Constructional details, materials. Braking torque developed by leading and trailing shoes. Disc brake theory, constructional details, advantages. Brake actuating system – mechanical, hydraulic, pneumatic. Factors affecting brake performance viz. operating temperature, area of brake lining, brake clearance. Exhaust brakes. Power and power assisted brakes. Testing brakes – Road tests, garage tests and tests in the laboratory

Unit IV

Drive Line Study

Effects of driving thrust and torque reaction. Hotchkiss drive. Torque tube drive, radius rods. Propeller shaft. Universal joints. Final drives – different types, double reaction final drive. Two speed rear axle. Rear axle construction – full floating, three quarter floating and semi-floating arrangements. Differential – conventional type, non-slip type. Differential locks

Unit V

Suspension System

Types of suspension. Factors influencing ride comfort, Suspension springs – leaf spring, shackle and mounting brackets, coil and torsion bar springs. Spring materials, Independent suspension – front and rear. Rubber, pneumatic hydroelasitc suspension. Shock absorbers. Types of wheels. Construction of wheel assembly. Types of tyres and constructional details. Static and rolling properties of pneumatic tyres

Text Book

1. Kirpal Singh, ‘Automobile Engineering’, Standard Publishers, Distributor, Delhi, 2003.

Reference Books:

1. William F. Milliken, Douglas L. Milliken, Maurice Olley, Chassis Design, SAE, 2002.

2. Newton, Steeds & Garrot, The Motor vehicle, SAE - Butterworths, India, 13th edition, 2001.

11ME312 THERMAL PLASMA: CONCEPTS AND APPLICATIONS

Credits: 4:0:0

Course Objectives:

- To expose students in industrially important thermal plasma techniques.
- To prepare students to use thermal plasma techniques for various applications.

Course Outcome:

- Students will be able to know the concepts of thermal plasma techniques.
- Students will be able to apply suitable techniques for applications

UNIT I

Concepts in gaseous electronics

Generation of charge carriers: direct ionization , indirect ionization, loss of charge carriers, motion of charge carriers: drift in electric fields, diffusion of charge carriers, motion of charge carriers in magnetic fields. Thermal excitation and ionization: Boltzman distribution, Saha equation, local thermodynamical equilibrium, quasi neutrality, plasma sheath.

UNIT II

Plasma state

Temperature in plasma, different types of plasma, Generation and properties of thermal plasma: high intensity arcs, thermal RF discharges, microwave discharges, properties: plasma composition, thermodynamical and transport properties of plasma. Thermal plasma technology: plasma deposition, plasma synthesis of fine powders, thermal plasma decomposition, plasma metallurgy, plasma densification, plasma welding and cutting

UNIT III

Thermal Spraying Techniques:

Flame Spraying, Atmospheric Plasma Spraying (APS), Arc Spraying (AS), Vacuum Plasma Spraying (VPS), Controlled-Atmosphere Plasma Spraying (CAPS) & Low pressure chemical vapour deposition (LPCVD): Principles, Process Parameters and Coating Properties.

UNIT IV

Physics and Chemistry of Thermal Spraying

Jets and Flames**,** Properties of Jets and Flames**,** Momentum Transfer between Jets or Flames and Sprayed Particles, Theoretical Description, Determination of Sprayed Particles Velocities**,** Methods of Particles Temperature measurements, Chemical Modification of Sprayed in-flight particles.

UNIT V

Coating Build-Up

Impact of Particles: Particle Deformation, Particle Temperature at Impact, Nucleation, Solidification and Crystal Growth, Mechanisms of Adhesion, Coating Growth: Mechanism of Coating Growth ,Temperature of Coatings at Spraying, Generation and measurement of Thermal Stresses at Spraying, Coatings Surfaces, Microstructure of the Coatings: Crystal Phase Composition Coatings Inhomogeneity, Final Microstructure of Sprayed Coatings, Thermally Sprayed Composites :Classification of Sprayed Composites, Composite Coating Manufacturing

Text Books:

1. Introduction to plasma physics, Francis F. Chen, Springer Dec, 1995.
2. Science and engineering of thermal spray coatings, Lech Pawlowski, Second Edition, John Wiley & Sons Ltd, 2008.

Reference Books:

1. Thermal plasmas fundamentals and applications vol. 1, M.I.Boulos, P.Fauchais, E.Pfender, Springer, 1994.
2. Physics of high temperature plasma, G.Schimidt, 2nd edition Newyork: Academic Press, 1979.
3. Introduction to plasma physics, M.A.Uman, Newyork: McGraw-Hill, 1964.

LIST OF SUBJECTS

Sub. Code	Name of the Subject	Credits
10ME214	Metrology And Dynamics Lab	0:0:2
11ME308	Automotive Electricals and Electronics	4:0:0
11ME309	Vehicle Dynamics	4:0:0
11ME310	Vehicle Maintenance	4:0:0
11ME311	Automotive Chassis Systems	4:0:0
11ME312	Thermal Plasma: Concepts and Applications	4:0:0
12ME101	Engineering Graphics	0:0:4
12ME102	Workshop Practice	0:0:2
12ME201	Material Science & Engineering	3:0:0
12ME202	Production Processes I	3:0:0
12ME203	Production Processes II	3:0:0
12ME204	Metrology and Quality Control	3:0:0
12ME205	Fluid Power Control Engineering	3:0:0
12ME206	Metallurgy Lab	0:0:1
12ME207	Foundry, Smithy, Welding & Sheet Metal Laboratory	0:0:2
12ME208	Metrology Lab	0:0:1
12ME209	Fluid Power Control Laboratory	0:0:1
12ME210	CAM Laboratory	0:0:1
12ME211	Lathe Shop	0:0:1
12ME212	Special Machines Laboratory	0:0:1
12ME213	Engineering Thermodynamics	3:0:0
12ME214	Thermal Engineering I	3:0:0
12ME215	Thermal Engineering II	3:0:0
12ME216	Power Plant Engineering	3:0:0
12ME217	Heat & Mass Transfer	3:1:0
12ME218	Thermal Engineering Laboratory	0:0:1
12ME219	Heat Transfer Laboratory	0:0:1
12ME220	Internal Combustion Engines Laboratory	0:0:1
12ME221	Computer Aided Design & Manufacturing	3:0:0
12ME222	Mechanics of Machines – I	3:1:0
12ME223	Mechanics of Machines – II	3:1:0
12ME224	Design of Mechanical Transmission Systems	3:0:0
12ME225	Design of Machine Elements	3:1:0
12ME226	Resources, Production and Quality Management	3:0:0
12ME227	Computer Aided Design and Engineering Laboratory	0:0:2
12ME228	Machine Drawing	0:0:2
12ME229	Dynamics Laboratory	0:0:1
12ME230	Engineering Mechanics	3:0:0
12ME231	Mechanical Systems for food Processing	3:0:0
12ME232	Drives And Control Systems For Robots	3:0:0
12ME233	Design Laboratory	0:0:1
12ME234	Finite Element Analysis	3:0:0
12ME235	Computational Fluid Dynamics	3:1:0
12ME236	Mechanical vibrations and noise engineering	3:0:0
12ME237	Tribology and Surface Engineering	3:0:0
12ME238	Design of pressure vessels and piping	3:0:0
12ME239	Concepts of Engineering Design	3:0:0

12ME240	Human factors in Engineering and Design	3:0:0
12ME241	Product Design and Development Strategies	3:0:0
12ME242	Principles of Resource and Quality Management	3:1:0
12ME243	Fluid Power Control Lab	0:0:2
12ME244	Metrology and Dynamics Lab	0:0:2
12ME245	Industrial Robotics	3:0:0
12ME246	Computer Aided Inspection & Metrology	3:0:0
12ME247	Computer Integrated Manufacturing	3:0:0
12ME248	IT in Manufacturing	3:0:0
12ME249	Introduction to Micro Electro Mechanical Systems	3:0:0
12ME250	Mechatronics	3:0:0
12ME251	Basic Automobile Engineering	3:0:0
12ME252	Computer Workstation Ergonomics	3:0:0
12ME301	CAD/CAM Laboratory	0:0:2
12ME302	Engineering Measurements	4:0:0
12ME303	Design of Thermal Power Equipments	3:0:0
12ME304	Computer Integrated Manufacturing Systems	4:0:0
12ME305	Computer Applications in Design	4:0:0
12ME306	Engineering Materials and Applications	4:0:0
12ME307	Advanced Strength of Materials	3:1:0
12ME308	Finite Element Analysis	3:1:0
12ME309	Mechatronics and Machine Controls	4:0:0
12ME310	Computer Aided Engineering Laboratory	0:0:2
12ME311	Advanced Thermodynamics and Heat Transfer	3:1:0
12ME312	Advanced Fluid Mechanics & Computational Fluid Dynamics	3:1:0
12ME313	CFD Lab	0:0:2
12ME314	Theory of Metal Cutting	4:0:0
12ME315	Metrology and Measurement systems	4:0:0
12ME316	Industrial Robotics	4:0:0
12ME317	Automation And Robotics Lab	0:0:2
12ME318	Petroleum Refinery Engineering	4:0:0
12ME319	Natural Gas Engineering	4:0:0

10ME214 METROLOGY AND DYNAMICS LAB

Credits: 0:0:2

Course Objective:

- To be familiar with the different precision measuring instruments
- To learn the methods of measuring the common engineering parameters
- To be familiar with the measurements dynamic characteristics of engineering system such as vibration
- To have the knowledge of dynamic balancing of rotating parts

List of Experiments

1. Measurement of angle using sine bar
2. Measurement of angle using sine center
3. Measurement of angle using bevel protractor
4. Calibration of vernier height gauge using slip gauges
5. Circularity test bench center method and V block method
6. Measurement of screw thread dimensions using profile projector
7. Dynamic balancing of rotors
8. Determination of critical speed of whirling shafts
9. Jump speed analysis of cam and follower
10. Study of undamped free vibration of equivalent spring mass system
11. Study of undamped torsional vibration of a single rotor system
12. Determination of amplitude and frequency of forced vibration using vibration exciter and vibrometer.

11ME308 AUTOMOTIVE ELECTRICALS AND ELECTRONICS

Credits: 4:0:0

Course Objective:

To provide knowledge about application of electrical in Automobile engineering
To provide knowledge about application of electronics in Automobile engineering
Students will be able to Understand various sensor systems used in automobiles, selection of springs and dampers

Course Outcome:

Upon completion of this course the student will be able to:
Understand the electronic ignition and fuel injection system, lightning system and starting system.

Unit I

Batteries and Starting System: Different types of Batteries – Principle, Construction and Electrochemical action of Lead – Acid battery, Electrolyte, Efficiency, Rating, Charging, Testing and Maintenance. Starting System, Starter Motors – Characteristics, Capacity requirements. Drive Mechanisms. Starter Switches.

Unit II

Charging System, Lighting System and Accessories: D.C. Generators and Alternators their Characteristics. Control cutout, Electrical, Electro-mechanical and electronic regulators. Regulations for charging. Wiring Requirements, Insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods. Lighting design, Dash board instruments, Horns, wiper, Trafficators, Warning system and safety devices.

Unit III

Electronic Ignition and Fuel Injection Systems

Spark plugs, Advance mechanisms. Different types of electronic ignition systems - variable ignition timing, distributor less ignition. Spark timing control. Electronic fuel injection systems. Engine mapping.

Unit IV

Sensors and Actuators: Basic sensor arrangement. Types of sensors – Oxygen sensor, fuel metering/Vehicle speed sensor, mass air flow sensor, temperature sensor, exhaust oxygen level, manifold pressure, crankshaft position, pressure sensor and detonation sensor. Various actuators and its application in automobiles.

Unit V

Fundamentals of Automotive Electronics: Current trends in automotive electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system

Text Books

1. Young A.P. & Griffiths. L. "Automotive Electrical Equipment", ELBS & New Press, 1999.
2. William B.Riddens "Understanding Automotive Electronics", Fifth Edition, Butter worth Heinemann Woburn, 1998

Reference Books:

1. Bechhold "Understanding Automotive Electronics", SAE, 1998.
2. Crouse, W.H "Automobile Electrical Equipment", Third Edition, McGraw-Hill Book Co., 1986.
3. Judge A.W "Modern Electrical Equipment of Automobiles", Chapman & Hall, 1992.
4. Kholi.P.L "Automotive Electrical Equipment", Tata McGraw-Hill Co., Ltd., 2000
5. Robert Bosch "Automotive Hand Book", Fifth Edition, SAE, 2000.
6. Ganesan.V. "Internal Combustion Engines", Tata McGraw-Hill Publishing Co., Fifth Edition 2005.

11ME309 VEHICLE DYNAMICS

Credits: 4:0:0

Course Objective:

Understand vibrating systems and its analysis, modeling and simulation and modal analysis
Understand various Suspension systems, selection of springs and dampers
Know about the Stability of Vehicles
Know about tyres, ride characteristics and effect of camber, camber thrust
Learn about vehicle handling under different steering conditions and directional stability of vehicles

Course Outcome:

Upon completion of this course the student will be able to:
Understand and analyze the various dynamic aspects of the vehicle

UNIT I

Introduction to Vibration: Classification of vibration, definitions, mechanical vibrating systems, mechanical vibration and human comfort. Modeling and simulation studies. Single degree of freedom, free, forced and damped vibrations. Magnification factor and transmissibility. Vibration absorber. Vibration measuring instruments. Two degree of freedom system. Modal analysis

UNIT II
Suspension: Requirements. Spring mass frequency. Wheel hop, wheel wobble, wheel shimmy, Choice of suspension spring rate. Calculation of effective spring rate. Vehicle suspension in fore and aft directions. Hydraulic dampers and choice of damper characteristics. Independent, compensated, rubber and air suspension systems. Roll axis and vehicle under the action of side forces.

UNIT III
stability of vehicles: Load distribution. Stability on a curved track and on a slope. Gyroscopic effects, weight transfer during acceleration and braking, overturning and sliding. Rigid vehicle – stability and equations of motion. Cross wind handling.

UNIT IV
Tyres: Tyre forces and moments, rolling resistance of tyres, relationship between tractive effort and longitudinal slip of tyres, cornering properties of tyres, ride properties of tyre.

UNIT V
Vehicle Handling : Over steer, under steer, steady state cornering. Effect of braking, driving torques on steering. Effect of camber, transient effects in cornering. Directional stability of vehicles.

Text Books:
1. Rao J.S and Gupta. K "Theory and Practice of Mechanical Vibrations", Wiley Eastern Ltd., 2002.
2. Dr. N. K. Giri, "Automobile Mechanics", Seventh reprint, Khanna Publishers, Delhi, 2005

Reference Books:
1. J. Y. Wong, 'Theory of Ground Vehicles', John Wiley and Sons Inc., New york 2001.
2. Thomas D.Gillespie, Fundamentals of vehicle dynamics,SAE,1992
3. J.G. Giles, 'Steering, Suspension and Tyres, Illiffe Books Ltd., 1968.
4. Groover, "Mechanical Vibration", 7th Edition, Nem Chand &Bros, Roorkee,India, 2003

11ME310 VEHICLE MAINTENANCE

Credits: 4:0:0
Course Objective:
To acquire knowledge about basic maintenance principle of vehicle
To understand failure and reliability of vehicular components
To diagnose body and engine using various techniques

Course Outcome:
Upon completion of this course the student will be able to:
Know preventive and predictive techniques for vehicular maintenance
Apply various techniques to diagnose body and engine problems

Unit I
Maintenance Tool, Shop, Schedule, Records : Standard tool set, torque wrenches, compression and vacuum gauges, engine analyzer and scanner, computerized wheel alignment and balancing, gauges for engine tune up and pollution measurement, spark plug cleaner, cylinder re boring machine, fuel injection calibration machine. Importance of maintenance. Schedule and

unscheduled maintenance. Scope of maintenance. Equipment downtime. Vehicle inspection. Reports. Log books. Trip sheet. Lay out and requirements of maintenance shop.

Unit II

maintenance, repair and overhauling of the chassis: Maintenance, servicing and repair of clutch, fluid coupling, gearbox, torque converter, propeller shaft. Maintenance of front axle, rear axle, brakes, steering systems. Tyre maintenance.

UNIT III

POWER PLANT REPAIR AND OVERHAULING

Dismantling of power plant and its components. Cleaning methods. Inspection and checking. Repair and reconditioning methods for all engine components. Maintenance of ignition system, fuel injection system, cooling system,- lubrication system. Power plant trouble shooting chart.

UNIT IV

MAINTENANCE AND REPAIR OF ELECTRICAL SYSTEMS

Care, maintenance, testing and trouble shooting of battery, starter motor, dynamo, alternator and regulator. Transistorized regulator problems.

UNIT V

MAINTENANCE AND REPAIR OF VEHICLE BODY

Body panel tools for repairing. Tinkering and painting. Use of soldering, metalloid paste.

Text Books:

1. John Dolce, Fleet maintenance, Mcgraw Hill, Newyork, 1984
2. A.W.Judge, Motor Vehicle Servicing, 3rd Edition, Pitman Paperpack, London ,1969.
3. W.Crouse, Everyday Automobile repair, Intl.student edition, TMH, New Delhi,1986.
4. Ernest Venk., Edward spicer, Automotive maintenance and trouble shooting,D.B. Taraporevala Sons, Bombay, 1963

Reference Books:

1. Stator Abbey, Automotive steering, braking and suspension overhaul, pitman publishing, London, 1971.
2. Frazee, fledell, Spicer,-Automobile collision Work, American technical publications, Chicago, 1953.
3. Service Manuals from Different Vehicle Manufacturers
4. S. Abbey, Automotive Transmission servicing and overhaul, Sir Issac Pitman, London, 1971.

11ME311 AUTOMOTIVE CHASSIS SYSTEMS

Course Objective:

To introduce vehicle chassis structure
To introduce automotive suspension systems
To broaden the understanding of components of transmission systems
To introduce steering systems
To broaden the importance of conventional and advanced braking systems

Course Outcome:

Upon completion of this course the student will be able to:

Understand the importance of vehicle frame
Determine steering systems
Identify suitable braking systems
Construct automotive suspension systems
Design a suitable transmission system

Unit I
Introduction
Layout with reference to prime mover location and drive. Frames, Constructional details – Materials – Testing of frames – Integrated body construction.

Unit II
Steering System
Front Axle types. Construction details. Materials. Front wheel geometry viz. Camber, kingpin inclination, caster, toe-in and toe-out. Conditions for true rolling motion of road wheels during steering. Steering geometry. Ackermann and Davis steering. Constructional details of steering linkages. Different types of steering gear boxes. Steering linkage layout for conventional and independent suspensions. Turning radius, wheel wobble and shimmy. Power and power assisted steering.

Unit III
Braking System
Types of brakes. Principles of shoe brakes. Constructional details, materials. Braking torque developed by leading and trailing shoes. Disc brake theory, constructional details, advantages. Brake actuating system – mechanical, hydraulic, pneumatic. Factors affecting brake performance viz. operating temperature, area of brake lining, brake clearance. Exhaust brakes. Power and power assisted brakes. Testing brakes – Road tests, garage tests and tests in the laboratory

Unit IV
Drive Line Study
Effects of driving thrust and torque reaction. Hotchkiss drive. Torque tube drive, radius rods. Propeller shaft. Universal joints. Final drives – different types, double reaction final drive. Two speed rear axle. Rear axle construction – full floating, three quarter floating and semi-floating arrangements. Differential – conventional type, non-slip type. Differential locks

Unit V
Suspension System
Types of suspension. Factors influencing ride comfort, Suspension springs – leaf spring, shackle and mounting brackets, coil and torsion bar springs. Spring materials, Independent suspension – front and rear. Rubber, pneumatic hydroelasitc suspension. Shock absorbers. Types of wheels. Construction of wheel assembly. Types of tyres and constructional details. Static and rolling properties of pneumatic tyres

Text Book

1. Kirpal Singh, ‘Automobile Engineering’, Standard Publishers, Distributor, Delhi, 2003.

Reference Books:

1. William F. Milliken, Douglas L. Milliken, Maurice Olley, Chassis Design, SAE, 2002.
2. Newton, Steeds & Garrot, The Motor vehicle, SAE - Butterworths, India, 13th edition, 2001.

11ME312 THERMAL PLASMA: CONCEPTS AND APPLICATIONS

Credits: 4:0:0

Course Objectives:

- To expose students in industrially important thermal plasma techniques.
- To prepare students to use thermal plasma techniques for various applications.

Course Outcome:

- Students will be able to know the concepts of thermal plasma techniques.
- Students will be able to apply suitable techniques for applications

UNIT I
Concepts in gaseous electronics
Generation of charge carriers: direct ionization , indirect ionization, loss of charge carriers, motion of charge carriers: drift in electric fields, diffusion of charge carriers, motion of charge carriers in magnetic fields. Thermal excitation and ionization: Boltzman distribution, Saha equation, local thermodynamical equilibrium, quasi neutrality, plasma sheath.

UNIT II
Plasma state
Temperature in plasma, different types of plasma, Generation and properties of thermal plasma: high intensity arcs, thermal RF discharges, microwave discharges, properties: plasma composition, thermodynamical and transport properties of plasma. Thermal plasma technology: plasma deposition, plasma synthesis of fine powders, thermal plasma decomposition, plasma metallurgy, plasma densification, plasma welding and cutting

UNIT III
Thermal Spraying Techniques:
Flame Spraying, Atmospheric Plasma Spraying (APS), Arc Spraying (AS), Vacuum Plasma Spraying (VPS), Controlled-Atmosphere Plasma Spraying (CAPS) & Low pressure chemical vapour deposition (LPCVD): Principles, Process Parameters and Coating Properties.

UNIT IV
Physics and Chemistry of Thermal Spraying
Jets and Flames**,** Properties of Jets and Flames**,** Momentum Transfer between Jets or Flames and Sprayed Particles, Theoretical Description, Determination of Sprayed Particles Velocities**,** Methods of Particles Temperature measurements, Chemical Modification of Sprayed in-flight particles.

UNIT V
Coating Build-Up
Impact of Particles: Particle Deformation, Particle Temperature at Impact, Nucleation, Solidification and Crystal Growth, Mechanisms of Adhesion, Coating Growth: Mechanism of Coating Growth ,Temperature of Coatings at Spraying, Generation and measurement of Thermal Stresses at Spraying, Coatings Surfaces, Microstructure of the Coatings: Crystal Phase Composition Coatings Inhomogeneity, Final Microstructure of Sprayed Coatings, Thermally Sprayed Composites :Classification of Sprayed Composites, Composite Coating Manufacturing

Text Books:

1. Introduction to plasma physics, Francis F. Chen, Springer Dec, 1995.

2. Science and engineering of thermal spray coatings, Lech Pawlowski, Second Edition, John Wiley & Sons Ltd, 2008.

Reference Books:

1. Thermal plasmas fundamentals and applications vol. 1, M.I.Boulos, P.Fauchais, E.Pfender, Springer, 1994.
2. Physics of high temperature plasma, G.Schimidt, 2nd edition Newyork: Academic Press, 1979.
3. Introduction to plasma physics, M.A.Uman, Newyork: McGraw-Hill, 1964.

12ME101 ENGINEERING GRAPHICS

Credits: 0:0:4

Course Objective:

- To impart and inculcate proper understanding of the theory of projection.
- To improve visualization skills.
- To enable students to understand various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient.
- To impart knowledge on understanding and drawing of simple residential/office buildings.
- To understand the usage of various line types, arcs, and methods to draw using AutoCAD .
- To understand standard, modify, draw, layers and properties tool bars and use it to draw 2D drawings.
- To understand suitable hatching and block commands, dimensioning, orthographic and isometric drawings and plotting.

Course Outcome:

- Students will be able to understand the theory of projection.
- Students will be able to know and understand the conventions and the methods of engineering drawing.
- Students will be able to improve their visualization skills so that they can apply these skills in developing new products.
- Students will be able to prepare simple layout of factory buildings.
- To apply usage of various line types, arcs, and circles to draw using AutoCAD .
- To apply, modify, draw, layers and properties tool bars and use it to draw 2D drawings.
- To apply suitable hatching and block commands, dimensioning , orthographic and isometric drawings and plotting.

LIST OF EXPERIMENTS

1. Lettering and Dimension practice
   a. Lettering according to standard practice with height 10, 7, 5 mm (Upper case, Lower case and Numbers)
   b. Dimensioning practice of lines, circles, arcs using aligned and chain dimensioning systems.
2. Geometrical constructions - I.
   a. Division of lines, arcs and angles
   b. Drawing arc connecting two straight lines which are perpendicular to each other and inclined.
3. Geometrical constructions - II.

   Construction of polygons using
   i) Semicircle on the given side method
   ii) Semicircle and Bi-section of given side method
   iii) Inscribing polygon in a circle method
   iv) Special Method for Hexagon
4. Conic sections -
   i) Ellipse - Eccentricity method, Concentric circles method, Oblong method
   ii) Hyperbola - Eccentricity method, using foci and transverse axis
   iii) Parabola - Eccentricity method, Rectangle method, Tangent method
5. Conversion of pictorial views into orthographic views of V- block and bearing block.

6. Projection of points in different quadrants.
7. Projection of lines in first quadrant
   i) Parallel to both planes.
   ii) Inclined to one plane and parallel to other.
   iii) Parallel to one plane and perpendicular to other plane.
8. Projection of solids- I
   Projections of prism, pyramid, cylinder and cone – axes parallel to VP and perpendicular to HP.
9. Projection of solids- II
   Projections of prism, pyramid, cylinder and cone – axes parallel to HP and perpendicular to VP, Parallel to both planes.
10. Development of surface of prism, pyramid, cylinder, cube and cone. (Uncut views only).
11. Isometric views of basic solids and combination of basic solids.
12. Components of a simple building, Conventional representation of building materials, Plan, Elevation and Section of single storied residential / office building with flat RCC roof and brick masonry walls having not more than two rooms. (Planning/ Designing is not expected in this course).
13. Simple Exercise using various Drawing commands and Plotting using CAD software.
14. Simple Exercise using various Editing commands of AUTOCAD.
15. Simple Exercise using various Formatting commands.
16. Methods of drawing lines
17. Methods of drawing circles
18. Methods of drawing arcs
19. Simple exercise on application arcs
20. Practice and simple exercises using rectangular and polar arrays using AUTOCAD.
21. Basic Dimensioning and using of Layers
22. Simple exercises on Blocks
23. Introduction to Isometric Drawings.
24. Sectional view of Single room RCC building for hatching practice using AutoCAD.

Text Books

1. Basant Agrawal, 'C.M. Agrawal, Engineering Drawing', Tata McGraw Hill Private Ltd., 2010.
2. Shyam Tickoo, 'AUTOCAD 2007 for Engineers and Designers ' Dreamtech India (P) Ltd., 2007.

Reference Books

1. "Manual for Engineering Drawing-I", KSMS, 2011.
2. "Computer Aided Graphics Lab. Manual", KSMS,2011.
3. Bhatt N.D., "Elementary Engineering Drawing", 26th Edition. Chartor Publishing House, Anand, 2009.
4. Natarajan K.V. "A Text Book of Engineering Drawing", 16th Edition, 2006.
5. Venugopal K. "Engineering Graphics", 9th Edn. (Revised), New Age International Publishers, 2009.

12ME102 WORKSHOP PRACTICE
(Exercise Bank)

Credits: 0:0:2

Course Objective:

- To enable students to practice soldering techniques

- To facilitate students to practice characterization of electronic devices.
- To familiarize wiring of tube lights and lights used in stair case
- To train students in the assembly of PC and trouble shooting.
- To give basic training on fitting, Carpentry and plumping practices.

Course Outcome:

- Students will be able to use their skills during their project work
- Students will be able to understand the practical difficulties encountered in industries during any assembly work
- Students will be able to do simple electronic and electrical work throughout their carrier.
- Students will be able to rectify simple problem connected with pipe fittings

I ELECTRICAL SCIENCES

<u>ECE</u>

1. Soldering Simple Electronics Circuits
2. Characterization of basic Electronics Devices.

<u>EEE</u>

3. Wiring of Tube Lights & Staircase Wiring
4. Types of thermocouples & application

<u>II COMPUTER SCIENCE AND TECHNOLOGY</u>

5. Assembly of PC
6. Installation of Operating System (OS) and Disc Partitioning

III MECHANICAL SCIENCES

<u>Fitting Shop</u>

7. Making of V-fitting and drilling
8. Making of T-fitting

<u>Carpentry Shop</u>

9. Middle Lap joint
10. Dove Tail joint

<u>Plumbing Shop</u>

11. Practice of pipe fitting using L-bow, Tee, MTA,FTA and Union joints

Text Book:

1. Suyambazhahan, “Engineering Practices Laboratory Manual” PHI Learning Private Limited, 2010.

12ME103 BASIC MECHANICAL ENGINEERING

Credits: 2:0:0

Course Objective:

- To provide knowledge about IC Engines, External combustion Engines, boilers, power plants, metal forming, metal joining, machining process and materials.
- To understand about CAD and modern design softwares in the mechanical engineering.

Course Outcome:

- Students will be able to get general view about Mechanical Engineering Branch

Unit I

ENGINE: External combustion engine ,Working of Steam Engine – Steam Turbine – Impulse turbine & reaction turbine.

BOILERS: fire tube and water tube boiler – Cochran boiler – Babcock & Wilcox boiler.

INTERNAL COMBUSTION ENGINE: Working of petrol and Diesel Engine – Difference between two stroke and four stroke engines.

Unit II

CONVENTIONAL POWER PLANTS : Hydro, Thermal, Nuclear power plants – Diesel and Gas Turbine power plants; Non-conventional power plants – Solar, wind and tidal power plants – Geothermal power plant – Ocean Thermal Energy conversion power plant.

Unit III

MATERIAL PROPERTIES: Load – Types of load –stress and strain – Types of stresses and strains –Stress strain curve of ductile materials.

Introduction of Mechanical Engineering Software Packages.

Unit IV

METAL CASTING AND FORMING PROCESS : Introduction – advantages of casting – patterns –molding – melting of cast iron – forging. Metal joining Process: Introduction - welding – arc welding, gas welding

Unit V

METAL MACHINING: Lathe – Drilling machine – Milling machine – Shaping machine. Basic Engineering Materials: Properties of materials – ferrous metals and alloys – Nonferrous metals and alloys.

Text Books

1. S.R.J.Shantha Kumar, “Basic Mechanical Engineering”, HiTech Publications,2001.
2. G. Shunmagam, “Basic Mechanical Engineering”, Tata McGraw Hill, 2001.

Reference Books

1. I.E. Paul Degarmo, J.T. Black, Ronald A. Kosher, “Material and Processes in Manufacturing”, 8th Edition, John Wiley and sons, inc., 1999.
2. K.Venugopal,V.Prabhuraja,” Basic Mechanical Engineering”, Anuradha Agencies,2000
3. Williams D. Callister “ Material Science and Engineering” John wiley & sons inc. 1997.

12ME201 MATERIAL SCIENCE AND ENGINEERING

Credits: 3:0:0

Course Objective:

- To develop an understanding of materials science-- the structure of alloys, crystal defects, mechanical properties, phase diagrams, and heat treatments with their effects on properties.

Course Outcome:

- The students will develop the skills to select suitable alloys, compositions, heat treatments for different mechanical engineering applications, analyze, failures,and predict service behaviour.

Unit I

CRYSTALLOGRAPHY: Classifications of materials- metals, Ceramics, Composites, polymer – properties of engineering materials – Structure of solid metals –BCC, FCC and HCP structures , atomic packing factor, polymorphism- Miller indices.
Metallographic analysis- Optical microscope, SEM,TEM.

Unit II

MECHANICAL BEHAVIOR: Defects in crystals -point defects line defect edge and screw dislocations – propagation of dislocation - Frank Read source – surface imperfections - diffusion - mechanisms of diffusion - Fick's, Laws of diffusion – plastic , deformation- slip and twinning – recovery re-crystallization and grain growth.- strengthening mechanisms strain hardening precipitation hardening.

Unit III

FAILURE OF MATERIALS: Fracture – ductile and brittle fracture - Griffith's theory of crack propagation protection against fracture-Creep- mechanisms of creep – creep resistant materials. Fatigue failure, SN curve- prevention of fatigue, failure.

Unit IV

PHASE DIAGRAMS: Solid solution, Phases- phase diagrams- Gibbs phase rule- cooling curves, types of Equilibrium diagrams, lever rule –Iron –Iron Carbide equilibrium diagram

Unit V

HEAT TREATMENT OF STEEL & NON FERROUS ALLOYS: Annealing normalizing - spheroidising- hardening, tempering – Hardenability, Case hardening of steels- carburizing- nitriding, induction hardening- flame hardening, Age hardening of Aluminium alloys

Text Books

1. Raghavan. V, "Material Science and Engineering, Prentice Hall of India Pvt. Ltd, New Delhi, 2004.
2. Williams D. Callister " Material Science and Engineering" John wiley & sons inc. 2004..

Reference Books

1. Reza Abbaschian, Lara Abbaschian, Robert E. Reed-Hill, "Physical Metallurgy Principles", Cengage Learning, 2008.
2. Raymond A Higgins "Engineering Materials (Applied Physical Metallurgy) English Language book, society, 2003.

12ME202 PRODUCTION PROCESSES I

Credits: 3:0:0

Course Objective:

- To learn the principle, procedure and applications of Casting and Welding Processes
- To understand the principle, procedure and applications of Bulk Metal Forming, Sheet Metal Forming and powder metallurgy process

Course Outcome:

- Students will have the knowledge of various manufacturing methods and apply them.

Unit I

CASTING PROCESSES: Sand mould castings- types of sand mould-moulding machines-Moulding sand composition-properties-types of moulding sand- testing of sand properties-pattern types-allowances-colour scheme-core-types-core print. Elements of gating system - gating system design - Pouring time-gating ratio-Risering design: Chvorinov rule-Caine's Method-Casting defects, Inspection of casting. Special casting processes-Shell moulding, investment casting, die casting, centrifugal casting and continuous casting.

Unit II

BULK FORMING PROCESSES: Hot working and cold working-rolling-rolling load and power -rolling mill-defects in rolled parts. Forging-open die and close die forging operations-Forging force calculations-Forging machines-Extrusion-extrusion ratio-Hot extrusion - Cold extrusion-Extrusion force calculations-Defects- Wire, rod and tube drawing-degree of drawing operations-Drawing force and power, Processing of Plastics - Injection Moulding

Unit III

SHEET FORMING PROCESES: Sheet metal operations - punching and blanking-stripping force-punching force calculations –Clearance and shear on punch and die- Drawing-calculation of blank diameter- number of draws- Bending-allowances-bending force –stretch forming, spinning, embossing, coining-Types of sheet metal dies.

Unit IV

WELDING PROCESSES: Welding joints-welding positions-terminologies- Filler and Flux materials-– Electrodes – Coating and specifications - Gas metal arc welding, TIG welding - Submerged arc welding – Principles of Resistance welding–Electro slag welding – Thermit welding – Electron beam welding – Friction welding –welding design-heat input and melting efficiency- Weld defects,

Unit V

POWDER METALLURGY: Powder metallurgy: production of metal powder-method-particle size, distribution and size-blending- compaction of metal powder –equipment- isostatic pressing and other compacting and shaping processes-sintering-Secondary and finishing processes-impregnation-infiltration.

Text Books

1. P.N. Rao, Manufacturing Technology Foundry, Forming and Welding, TMH-2003; 2nd Edition, 2003
2. Kalpakjian, S., "Manufacturing Engineering and Technology", Pearson Education India Edition, 2006.

Reference Books

1. Roy. A. Lindberg, Processes and Materials of Manufacture, PHI / Pearson Education, 2006
2. Nagpal G.R. "Metal forming processes", Khanna publishers, New Delhi, 2004

3. Heine, Richard, Carl R Loper and Philip Rosenthal, ‘Principles of Metal Casting’, Tata McGraw Hill Publishing Ltd., 2000.
4. George E Dieter., Mechanical Metallurgy, Mcgraw Hill Higher Education; Metric Ed 3 Revised edition, 1988

12ME203 PRODUCTION PROCESSES II

Credits: 3:0:0

Course Objective:

- To understand the concept and basic mechanics of metal cutting,
- To know the working of machine tools such as lathe, shaping, milling, drilling, grinding and broaching.
- To understand the methods of gear manufacturing and to know the working concepts of unconventional machining processes

Course Outcome:

- Students will have the knowledge of various conventional and non conventional machining processes

Unit I

THEORY OF METAL CUTTING: Mechanics of chip formation, Types of chip –chip curl and chip breaker-mechanics of orthogonal cutting –Merchant circle-shear plane angle according to Merchant and

Lee and Shaffer theory -cutting forces calculations-Temperature in metal cutting-Tool life and tool wear-cutting tool materials- cutting fluids.

Unit II

TURNING: Centre Lathe –Constructional features-specifications-work holding devices- Turning parameters-cutting tools- geometry- Turning operations- taper turning methods, thread cutting methods, special attachments, machining time and power estimation capstan and turret lathes. Reciprocating machine tools- shaper, planer, slotter

Unit III

MILLING: types of milling machine, milling cutters, milling operations, Dividing head-simple, compound and angular indexing- Hole making operations: drilling, reaming, boring, tapping, machining time calculations Broaching machines: broach construction – push, pull, surface and continuous broaching machines.

Unit IV

ABRASIVE PROCESSES: grinding wheel – designation and selection, types of grinding machines –Cylindrical grinding, surface grinding, centreless grinding, honing, lapping, super finishing, polishing and buffing- -Gear cutting: forming, generations, shaping, planning and hobbing

Unit V

NON-CONVENTIONAL MACHINING PROCESSES: Electrical discharge machining (EDM) –Dielectric fluid-electrode- wire EDM-Electrochemical Machining (ECM)- Electrochemical Grinding (ECG), Ultrasonic Machining (USM)- Abrasive Jet Machining (AJM)-Laser beam machining (LBM)- Plasma Arc Machining (PAM).

Text Books:

1. Rao. P.N "Manufacturing Technology", Metal Cutting and Machine Tools, Tata Mc Graw–Hill, New Delhi, 2004.
2. Kalpakjian, S., "Manufacturing Engineering and Technology", Pearson Education India Edition, 2006.

Reference Books:

1. Roy. A. Lindberg, "Process and Materials of Manufacture", PHI / Pearson Education Fourth Edition 2006.
2. HMT – Production Technology, Tata Mc Graw Hill, 1998.
3. S.K.Hajra Choudhray, S.K. Bose, 'Elements of Workshop Technology, Vol. II,Machine Tools', Media promoters & Publishers (P) Ltd, 2000.

12ME204 METROLOGY AND QUALITY CONTROL

Credits: 3:0:0

Course Objective:

- To understand the concept of Measurements,
- To understand about Quality Control

Course Outcome:

- Students will have the knowledge of various measurement systems

Unit I

GENERAL CONCEPTS OF MEASUREMENT: Definition-Standards of measurement-Errors in measurement-Accuracy, precision, sensitivity and readability - calibration of instruments, simple problems to find least count, selection and care of instruments.

Unit II

LINEAR AND ANGULAR MEASUREMENTS: Length standard-Line and end standard - Slip gauges, micrometers, verniers, dial gauges comparators: various types-principle and applications, angular measuring instruments-bevel protractor, levels, sine bar and sine center, simple problems for finding taper angle using sine bar and sine center, angle dekkor - autocollimator.

Unit III

FORM MEASUREMENT: Straightness, flatness, surface texture-various measuring instruments-run out and concentricity, Tool maker's microscope. Various elements of threads - 2 wire and 3 wire methods, simple problems in screw threads for calculating effective diameter -gear elements - various errors and measurements.

Unit IV

COMPUTER AIDED AND LASER METROLOGY: Coordinate measuring machine-Constructional features, types, applications, LASER micrometer, Introduction to Interferometer, optical and LASER interferometers-applications.

Unit V

QUALITY CONTROL: Quality control – basic concepts of quality, economics of quality control - Quality control charts: variable control charts and attribute control charts c, p, np and U charts - Single, Double and Multiple sampling plans. Simple problems.

Text Books

1. R.K.Jain and S.C.Gupta, "Engineering Metrology", Dhanpat Rai and Sons, 2000.
2. M. Mahajan, “Statistical Quality Control”, Dhanpat Rai & Co., 2002.

Reference Books

1. G.N.Galyer F.W and C.R.Shotbolt, " Metrology for Engineers ", ELBS Edn 1990.
2. "ASTME Handbook of Industries Metrology", Prentice Hall of India Ltd., 1992.
3. Robert.G. Seippel, "Optoelectronics for technology and engineering ", Prentice Hall New Jersey,1989.

12ME205 FLUID POWER CONTROL ENGINEERING

Credits: 3:0:0

Course Objective:

- To be familiar with the hydraulic actuators and other components of its circuits
- To be familiar with the pneumatic actuators and other components of its circuits.
- To be familiar with the pneumatic and hydraulic Logical circuits
- To be familiar with the various industrial applications of fluid power circuits.

Course Outcome:

- Students will have thorough knowledge about the hydraulic actuators and other components of its circuits
- Students will have thorough knowledge about the pneumatic actuators and other components of its circuits.
- Students will be able to build various pneumatic and hydraulic Logical circuits
- Students will have present industrial applications of fluid power circuits.

Unit I

INTRODUCTION TO FLUID POWER: History of fluid power, Advantages of fluid power, Applications of fluid power, Components of fluid power systems, Closed and Open loop systems, Types of fluid power control systems.

PHYSICAL PROPERTIES OF HYDRAULIC FLUIDS: Source of hydraulic power: Pumps, Gear pumps, Vane pumps, Piston pumps, Pump performance, Pump Noise, Pump Selection, Pressure intensifiers.

Unit II

HYDRAULIC ACTUATORS AND MOTORS: Hydraulic cylinders, Mechanics of cylinder loading, Limited Rotation hydraulic actuator, Hydraulic motors: Gear, vane and piston motors, Hydraulic motors theoretical torque , power and flow rate, Hydraulic motors performance, Hydrostatic Transmission.

VALVES AND OTHER CONTROL COMPONENTS IN HYDRAULIC SYSTEMS: Direction control valves, Pressure control valves, Flow control valves, Servo valves, Cartridge valves, Hydraulic fuses, Temperature and pressure switches, Shock Absorbers.

Unit III

PNEUMATICS: Air preparation and components: Compressors, Fluid conditioners, Controls with Orifices, Air control valves, Pneumatic actuators, Pneumatic Circuit Design Considerations, Basic pneumatic circuits, Accumulator systems analysis- Air flow calculations for tubes, linear and rotary actuators.

Unit IV

FLUID LOGIC CONTROL SYSTEMS: MPL control systems, MPL control of Fluid power circuits, Principles of Fluid logic control, Basic Fluid Devices , Fluidic Sensors, Basic concepts of programmable logical control.

Unit V

TYPICAL INDUSTRIAL APPLICATIONS: Hydraulic cylinder sequencing circuit, Cylinder synchronizing circuits, Fail-safe Circuits, Speed control of a hydraulic cylinder , Intensifier circuits, Control circuits for Material handling equipments, Box-sorting System, Electrical Control of Regenerative Circuit. Fault finding and maintenance.

Text books

1. Anthony Esposito, "Fluid power with Applications", Pearson Education P. Limited,Delhi,2004.
2. Peter Rohner, "Pneumatic Control for Industrial Automation", Wiley 1990.

Reference books

1. Andrew Parr, "Hydraulics and Pneumatics – A Technicians and engineer's guide" Jaico Publishing House, Mumbai, 2005.
2. L.Stewart D.B., 'Practical Guide to Fluid Power' Taraorevala Sons & Co. Pvt.Ltd. Bombay, 1976.
3. Jagadish lal, "Fluid Mechanics And Hydraulics With Computer Applications", Metropolitan Book Co.Pvt Ltd. 2007.

12ME206 METALLURGY LABORATORY

Credit: 0:0:1

Course Objective:

- To create awareness of metallographic techniques for studying the microstructures of alloys.

Course Outcome:

- The student will be able to develop an understanding of metallurgical microscopic techniques, and to identify structures of different alloys

List of Experiments

1. Study of Metallurgical microscope and Microhardness Tester
2. Determination of strength and permeability of foundry sand
3. Identification of Cast Iron specimen (a) Grey Cast Iron(b) Spheroidal Graphite Iron (c) Malleable Cast Iron
4. Identification of Low-,medium-,and High-Carbon steels
5. Identification of Heat Treated steels: (a) Annealed(b) Normalised (c) Hardened(d)Tempered steels) and Case Hardened Steel
6. Identification of brasses and bronzes and aluminum

12ME207 FOUNDRY, SMITHY, WELDING AND SHEET METAL LABORATORY

Credits: 0:0:2

Course Objective:

- To provide principles and procedure of casting, welding, forming processes.

- To provide hands on training in all manufacturing processes such as casting, welding and forming

Course Outcome:

- Students will be able to know the principles and procedure of casting, welding, forming processes.
- Students will have hands on training in all manufacturing processes such as Casting, welding and forming.

List of Experiments

Foundry:
1. Sand Moulding using self core single piece pattern
2. Sand Moulding using self core split piece pattern
3. Sand Moulding using straight pipe pattern

Welding:
4. Welding Butt, Lap Joint
5. Welding T- Joint and Spot welding
6. Soldering and Brazing

Smithy:
7. Making a square from a round rod
8. Making an L-bend
9. Making J- bend

Sheet Metal:
10. Sheet metal working of rectangular office tray joined by spot welding
11. Sheet metal working of hopper joined by rivet joint
12 Sheet metal forming by rollers

12ME208 METROLOGY LABORATORY

Credit: 0:0:1

Course Objective:

- To understand the working principles with linear and angular measuring instruments
- To measure linear and angular dimensions of a typical work piece specimen using the measuring instruments
- To learn the methods of form measurements

Course outcome:

- Students will be able to understand the working principles with linear and angular measuring instruments
- Students will be able to measure linear and angular dimensions of a typical work piece specimen using the measuring instruments

List of Experiments

1. Calibration of micrometer and vernier height gauge / vernier caliper using slip gauges and to draw the calibration graph.

2. Measurement of taper angle using sine bar, sine centre and Measurement of angle of the V blocks by using bevel protractor.
3. Measurement of circularity of the given shaft by using bench centre method and V block method and to draw the polar graph.
4. Measurement of important dimensions of screw thread/gear by using profile projector / Tool maker's microscope.
5. Checking straightness of a surface plate using auto-collimator
6. Construction of $\bar{X}, \bar{R}$ Chart

12ME209 FLUID POWER CONTROL ENGINEERING LABORATORY

Credit: 0:0:1

Course Objective:

- To know the basic concept of fluid power
- To know the working principle of electro-pneumatic components
- To know the working principle of hydraulic components
- To know the application of fluid power in industries

Course Outcome:

- The student will be able to design the logic circuits for hydraulics and pneumatics and the applications of fluid power in Industries.

LIST OF EXPERIMENTS:

1. Development of a pneumatic circuit to study the use of Logic functions using Two pressure valve and simulation by using Fluidsim / Automation Studio software.
2. Development of a pneumatic circuit to study the use of time delay valve and simulate it in Fluidsim software.
3. Development of a pneumatic circuit to study the use of pressure sequence valve and simulate it in Fluidsim software.
4. Development of a pneumatic circuit to study the use of multiple actuators in a material handling system and simulate it in Fluidsim software.
5. Development of an electro-pneumatic circuit to study the use of Relay, limit switch and solenoid valves and simulate it in Fluidsim software.
6. Development of a hydraulic circuit to study the use of double acting cylinder and the hydraulic motor and simulate this circuit in automation studio software.

12ME210 CAM LABORATORY

Credit: 0:0:1

Course Objective:

- To write a NC program for CNC turning and milling operation and execute it.
- To select tool for a machining operation.
- To simulate the code and verify machining processes

Course Outcome:

- The student will be able to read a drawing and write a CNC program using G codes and execute in a trainer type CNC machine tool.
- The student will be able to gather knowledge on tools and their selection.

List of Experiments

1. Profile turning operation using linear and circular interpolation using CNC turning machine.
2. Profile milling operation using linear and circular interpolation using CNC mill.
3. Turning operations with cycles using CNC turning machine
4. Taper turning using HMT T70 CNC lathe
5. Thread cutting operation using CNC turning center
6. Milling operations with cycles using CNC Vertical Milling center

12ME211 LATHE SHOP

Credit: 0:0:1

Course Objective:

- Students should learn how to operate Lathe.
- Students should learn to perform various operations in Lathe.

Course Outcome:

- Students will be able to operate Lathe.
- Students will be able to perform various operations in Lathe.

List of Exercises

1. Step turning
2. Taper turning using compound rest
3. Counter sinking, Knurling and grooving
4. Drilling and boring operations
5. External Thread cutting
6. Tapping

12ME212 SPECIAL MACHINES LABORATORY

Credit: 0:0:1

Course Objective:

- Students should learn how to operate shaper machine, Milling Machines, Gear Hobbing Machine
- Students should learn to perform various operations in different special Machines.

Course Outcome:

- Students will be able to operate shaper machine, Milling Machines, Gear Hobbing Machine
- Students will be able to perform various operations in different special Machines.

List of Exercises

1. Machining Rectangular Block Using Shaper

2. Machining Rectangular Block Using Milling Machine
3. Machining V Block Using Shaper
4. Spur Gear Cutting by hobbing / Milling
5. Key Way Cutting
6. Cylindrical Grinding

12ME213 ENGINEERING THERMODYNAMICS

(Use of standard thermodynamic tables, Mollier diagram, Psychrometric chart are permitted.)

Credits: 3:0:0

Course Objective:

- To learn about the basic concepts of engineering thermodynamics.
- To provide knowledge about second law of thermodynamics, properties of pure substances and gas mixtures, Psychrometry

Course Outcome:

- Students will be able to understand the basics behind the thermal systems.

Unit I

BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS: Concept of continuum, microscopic and macroscopic approach, thermodynamic systems – closed, open, isolated, control volume. Thermodynamic properties and equilibrium state of a system, state diagram, path and process, quasi-static process, work, modes of work, zeroth law of thermodynamics – concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities C_v and C_p, enthalpy, steady flow process with reference to various thermal equipments.

Unit II

SECOND LAW OF THERMODYNAMICS: Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Carnot cycle, reversed Carnot cycle, efficiency, COP, Carnot theorem. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy, absolute entropy, availability.

Unit III

PROPERTIES OF PURE SUBSTANCES: Thermodynamic properties of pure substances in solid liquid and vapour phases, phase rule P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non flow and flow processes -simple problem.

Unit IV

GAS MIXTURES: Properties of ideal and real gases, equation of state, Avagadro's law, Dalton's law of partial pressure ,Gay Lussac's law, Graham's law of diffusion, kinetic theory of gases, Vander Wall's equation of states compressibility, compressibility chart.

Unit V

PSYCHROMETRY : Psychrometry and psychrometric charts, property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling, problems.

Text Books

1 Nag P.K., Engineering Thermodynamics, TMH, New Delhi, 2002.
2 Yunus Cengel ‘Thermodynamics’, TMH, 2000

Reference Books

1 Holman. J.P., Thermodynamics, 4th edition, McGraw Hill, 2002
2 Roy Choudhury T., Basic Engineering Thermodynamics, TMH, 2000
3 Vanwylen and Sontag, Classical Thermodynamics, Wiley Eastern, 1999

12ME214 THERMAL ENGINEERING I

Credits: 3:0:0

(Use of standard thermodynamic tables, Mollier diagram, Psychrometric chart and Refrigerant, property tables are permitted.)

Course Objective:

- To learn about steam generators, nozzle, turbine,.
- To understand about the Air compressors, Refrigeration systems.

Course Outcome:

- Students will be able to understand the power generation by the steam turbines
- Students will be able to find the performance of air compressors and refrigeration systems

Unit I

STEAM GENERATORS: Classification of boilers, Boiler terms. Performance of steam generator – Evaporative capacity, Equivalent evaporation, Factor of evaporation, Boiler efficiency, Heat losses in a boiler plant and heat balance calculations.

Unit II

STEAM NOZZLE: Steam nozzles – flow through nozzles – General relation for adiabatic flow – effect of friction – Critical pressure ratio, super saturated flow.

Unit III

STEAM TURBINES: Steam turbines – Advantages of turbines – impulse and reaction turbines, compounding, velocity diagrams for simple and multistage turbines.

Unit IV

AIR COMPRESSOR: Classification and working principle, work of compression with and without clearance. Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating air compressors. Multistage air compressor and inter-cooling – work of multistage air compressor. Problems.

Unit V

REFRIGERATION: Vapour compression Refrigeration cycle – super heat, sub cooling, performance calculations. Working principle of vapour absorption system. Ammonia-water, Lithium bromide- water systems (Description only). Comparison between vapour compression and absorption systems.

Text books

1. Kothandaraman, C.P, Domkundwar S., “Thermal Engineering “, Dhanpat Rai & Sons, 2nd edition, 2003
2. Rajput.R.K ., “Thermal Engineering “, Laxmi Publications(P) Ltd.,2009

Reference Books:

1. Rudramoorthy.R., Thermal Engineering., Tata McGraw-Hill .,2010
2. Nag P.K., Engineering Thermodynamics, TMH, New Delhi, 2002.
3. Arora, C.P., Refrigeration and Air conditioning, TMH, 2nd edition, 2002.

12ME215 THERMAL ENGINEERING II

Credits: 3:0:0

(Use of standard thermodynamic tables, Mollier diagram, Psychrometric chart and Refrigerant, property tables are permitted.)

Course Objective:

- To provide knowledge about the testing and performance of IC Engines .
- To understand about the various Gas Power cycles.

Course Outcome:

- Students will be able to find the performance of Air-conditioning systems, IC engines
- Students will be able to understand the basics of Gas dynamics and Jet Propulsion

Unit I

INTERNAL COMBUSTION ENGINES: Classification of IC engine, IC engine components and functions. Valve timing diagram and port timing diagram. Comparison of two stroke and four stroke engines. Fuel supply systems, Ignition systems, testing and performance of I.C. Engine. Knocking and Detonation. Lubrication system and cooling system.

Unit II

GAS POWER CYCLES: Otto, Diesel, Actual and theoretical p-v diagram of four stroke and two stroke engines, Dual, Brayton ,– calculation of mean effective pressure and air standard efficiency.

Unit III

GAS DYNAMICS: Isentropic flow – Isentropic flow with variable area – Mach number variation, area ratio as a function of Mach number, Impulse function, mass flow rate, flow through nozzles and diffusers. Fanno flow equation and Raleigh flow equation.

Unit IV

GAS TURBINES & PROPULSION: Classification of Gas Turbines, Constant Pressure combustion Gas turbine -open, closed cycle, Constant Volume combustion Gas turbine(simple problems), Jet Propulsion-Turbo Jet, Ram Jet, Rocket Propulsion(theory only)

Unit V

AIR-CONDITIONING: Introduction, Air-conditioning systems, Air-conditioning equipment, components and controls. Air-distribution and cooling load estimation (simple problems only).

Text books

1. Kothandaraman, C.P, Domkundwar S., “Thermal Engineering” , Dhanpat Rai & Sons, 2nd edition, 2003
2. Rajput.R.K ., “Thermal Engineering”, Laxmi Publications(P) Ltd.,2009

Reference Books

1. Rudramoorthy.R., “Thermal Engineering”., Tata McGraw-Hill .,2010

2. S.M Yahya., “Fundamentals of Compressible Fluid Flow”., New Age international Publishers .,2005
3. Arora, C.P., “Refrigeration and Air conditioning”, TMH, 2nd edition, 2002.

12ME216 POWER PLANT ENGINEERING

Credits: 3:0:0

Course Objective:

- To study various power generating units and their working economics.

Course Outcome:

- Students will know about various power generating units and their working economics.

Unit I

POWER CYCLES: Simple Rankine Cycle, modified Rankine cycle – Re heating – Regeneration, analysis,pressure and temperature limits. Binary vapour cycle and combined cycle.

Unit II

STEAM POWER PLANT : various components, layout, Modern high pressure boilers – sub critical and super critical – Stoker type and Pulverized type combustion systems. Economizer and Air pre heater. Ash handling and dust collectors. Draught systems. Water treatment. Condensers and cooling towers.

Unit III

NUCLEAR POWER PLANT: Basic nuclear physics and nuclear reactions related to nuclear reactors, nuclear reactor materials, types of reactors, radiation shielding, waste disposal.
GAS TURBINE POWER PLANT : components and layouts. Open and closed cycle plants – combined gas turbines and steam power plants.

Unit IV

DIESEL ENGINE POWER PLANT : components and lay-outs, selection of engine type. Environmental hazards of various power plants.
HYDRO-ELECTRIC POWER PLANT : runoff, storage and pumped storage type – draft tube. Lay-out and selection of water turbine.

Unit V

ECONOMICS OF POWER PLANT: Load curve – definition – fixed and operating costs – comparison of economics of different types of power plants.
UNCONVENTIONAL POWER PLANTS : Solar, Wind, Ocean thermal Tidal, Wave and Geothermal power plants. MHD concepts of energy conversion and energy audit.

Text Books

1. Domkundwar., “Power Plant Engineering”, Dhanpat Rai & Sons, 2005
2. Wakil, M.M.E.l, “Power Plant Technology”, Mc Graw Hill, 2000

Reference Books

1. Roy Eckart and Joel Weisman., “Modern Power Plant Engineering”, PHI, 1999.

2. Rajput.R.K ., “Power Plant Engineering”, Laxmi Publications(P) Ltd.,2009

12ME217 HEAT AND MASS TRANSFER

(Use of standard Heat and Mass Transfer data book is permitted.)

Credits:3:1:0

Course Objective:

- To provide knowledge about conduction, convection and radiation heat transfer.
- To learn about the phenomena of boiling and condensation, design of heat exchangers.
- To understand the principles of mass transfer.

Course Outcome:

- Students will be able to understand about conduction, convection, radiation heat transfer.
- Students will be able to design heat exchangers
- Students will be able to gather the knowledge on mass transfer.

Unit I

INTRODUCTION TO CONDUCTION HEAT TRANSFER: Fourier’s law of conduction, thermal conduction equation – derivation in Cartesian, Cylindrical and Spherical coordinates. One dimensional steady state conduction in plane wall and composite wall. Thermal contact resistance variable conductivity, thermal resistance, electrical analogy, radial systems – cylinder, sphere. Overall heat transfer coefficients, critical thickness of insulation. Heat generation in plane wall, cylinder and sphere.

Unit II

STEADY AND UNSTEADY STATE CONDUCTION: Steady State conduction in two dimensions, conduction shape factor, numerical method of analysis. Unsteady state conduction – lumped heat capacity systems, significance of Biot and Fourier numbers, use of Heisler and Grober charts.

Unit III

CONVECTION: Concept of hydro dynamics and thermal boundary layers. Significance of non-dimensional numbers in connection. Dimensional analysis for free and forced convection. Forced Convection – heat transfer over a flat plate, flow through pipes, use of empirical relations. Free Convection – heat transfer from vertical, horizontal and inclined surfaces. Conduction and Convection systems – fins with different boundary conditions

Unit IV

HEAT EXCHANGERS: Types of heat exchangers, overall heat transfer coefficients, LMTD and NTU methods, fouling factor, problems in heat exchangers, effectiveness.

MASS TRANSFER: Fick’s law of diffusion, equi-molal counter diffusion, Convective mass transfer coefficient, non-dimensional number in mass transfer, evaporation process in the atmosphere

Unit V

CONDENSATION AND BOILING PROCESSES, RADIATION: nature of thermal radiation, black body concepts, gray body, radiation shape factor, relation between shape factors, radiation heat transfer between two surfaces. Electrical analogy, Re-radiating surface, radiation shields.

Text Books

1. Holman J.P., ‘Heat Transfer’, SI Metric 8th Ed., Mc Graw Hill, ISE, 2003.

2. Sachdeva, 'Heat and Mass Transfer', Wiley Eastern, 2nd Ed, 2005.

Reference Books:

1. Frank.P.Incropera,David.P.DeWitt 'Heat & Mass Transfer',John Wiley,5Th Edition 2005.
2. P.S.Ghoshdastidar., ' Heat Transfer', Oxford, 2005.
3. Schaum Series., 'Heat Transfer', McGraw Hill, 2004.
4. Yunus.A.Cengal,' Heat Transfer',Tata McGraw Hill,2nd Edition 2003.

12ME218 THERMAL ENGINEERING LABORATORY

Credit : 0:0:1

Course Objective:

- Students should learn about Air blower, Reciprocating compressors, Refrigeration & Air Conditioning Systems, Boilers

Course Outcome:

- Students will be able to understand the working and the components of Refrigeration, Air Conditioning Systems, Boilers.

List of Experiments

1. Boiler study and trial
2. Study and performance characteristics of Steam turbine
3. Dryness fraction of steam using Calorimeters
4. Performance characteristics of a constant speed air blower
5. Verification of fan laws and static efficiency of air blower.
6. Test on reciprocating compressor.
7. Coefficient of performance of a Vapors compression Refrigeration plant.
8. Performance test on Air Conditioning Plant.
9. Performance test on Heat pump.

(Any 6 Experiments can be given)

12ME219 HEAT TRANSFER LABORATORY

Credit:**0:0:1**

Course Objective:

- Students should learn how to find heat transfer coefficients, thermal Conductivity.

Course Outcome:

- Students will be able to find heat transfer coefficients, thermal Conductivity

List of Experiments

1. Determination of thermal conductivity in a Guarded Plate.
2. Determination of heat transfer coefficient in Cylindrical rod by free convection
3. Determination of heat transfer coefficient in Flat Plate by free convection
4. Determination of emissivity of the given test surface.
5. Determination of Stefan-boltzman constant in radiation heat transfer
6. Determination of heat transfer coefficient in a parallel flow heat exchangers.
7. Determination of heat transfer coefficient in a counter flow heat exchangers

8. Determination of heat transfer coefficient in a fin-pin (free convection) apparatus.
9. Determination of heat transfer coefficient in a fin-pin (forced convection) apparatus.

(Any 6 Experiments can be offered)

12ME220 INTERNAL COMBUSTION ENGINES LABORATORY

Credit:0:0:1

Course Objectives:

- Students should learn how to find the performance of IC Engines.

Course Outcome:
- Students will be able to find the performance of IC Engines.

List of Experiments
1. Performance test on Air Cooled Engine
2. Performance test on Water Cooled Engine
3. Low speed engine pump set engine
4. Morse Test Engine
5. Performance test on Horizontal Engine
6. Performance test on 4-Stroke Twin cylinder Vertical Diesel Engine.
7. Valve Timing Diagram for 4-Stroke Diesel & Petrol Engine
8. Emission Analysis of IC engines
9. Performance test on computerized Twin cylinder four stroke Diesel Engine
10. Heat balance test on 4-Stroke bi-fuel Single cylinder Diesel Engine.

(Any 6 Experiments can be offered)

12ME221 - COMPUTER AIDED DESIGN AND MANUFACTURING

Credits: 3:0:0

Course Objective
- To familiarize the students on the application of computer in the field of Engineering Design and Manufacturing.
- To expose students to Geometric modelling and Part programming methods.
- To make the students aware of Finite Element Technique in solving industrial problems.

Course Outcome
- Students will be able to know various current trends in the design and manufacturing
- Students will have through knowledge in CNC part programming and APT language.
- Students will have a basic knowledge about FEA.

Unit I

Introduction to CAD/CAM: CAD/CAM Contents and tools – History of CAD/CAM Development. Introduction to Computer Integrated Manufacturing (CIM) – Rapid Prototyping – Concurrent Engineering – CAD Standards – IGES, GKS and PDES.

Computer Graphics Display and Algorithms: Graphics Displays – Refresh Display – DVST – Raster Display. DDA Algorithm – Bresenham's Algorithm – Coordinate systems – Transformation of geometry - Translation, Rotation, Scaling, Reflection, Homogeneous transformations – 2D Transformations - Concatenation – Clipping and Hidden line removal algorithms

Unit II

Geometric Modeling: Wireframe models and entities – Curve representation – parametric representation of analytic curves – circles and conics – Synthetic curves – Cubic splines – Bezier curve and B-Spline curves. Surface Modeling – Surface models and entities – Parametric representation of analytic surfaces – Plane surfaces – Synthetic surfaces – Bicubic Surface and Bezier surface. Solid Modeling – Models and Entities – Fundamentals of solid modelling –B-Rep, CSG and ASM.

Unit III

CNC Machine Tools: NC - NC Modes – NC Elements – NC Machine tools. CNC Hardware – Structure of CNC Machine tools – Spindle design – Drives – Actuation systems – Feedback Devices – Axes – Standards – CNC tooling – cutting tool materials – turning tool geometry – milling tooling system – tool presetting – ATC – work holding – cutting process parameter selection – CNC Machine tools – CNC Machining centres – CNC turning centres – High speed machine tools – machine control unit and support systems.

Unit IV

CNC Programming: Part Programming fundamentals – manual part programming – preparatory functions – miscellaneous functions – program number – tool compensation – canned cycles – cutter radius compensation – Advanced part programming – polar coordinates – parameters – looping and jumping – subroutines – Computer aided part programming – concepts of CAP – APT language and simple programs.

Unit V

Finite Element Analysis: Basic concepts- General applicability of the method to structural analysis, heat transfer and fluid flow problems – Boundary Value Problems and Initial Value Problems - General Procedure of FEA-Element Types and its Characteristics - Boundary conditions - Convergence and Continuous criteria – Stiffness matrix for 1D truss and beam and problems.

Text Books

1. Ibrahim Zeid, " CAD - CAM Theory and Practice ", Tata McGraw Hill Publishing Co. Ltd., 2005.
2. P.N.Rao, " CAD/CAM Principles and applications", Tata McGraw Hill Publishing Co. Ltd., 2004.
3. Rao. S.S. ‘ The Finite Element Method in Engineering’, IInd Ed., Pergamon Press, Oxford, 2009.

References Books

1. Kunwoo Lee, “Principles of CAD/CAM/CAE Systems”, Addison Wesley, 2005.
2. Groover and Zimmers," CAD/CAM: Computer Aided Design and Manufacturing” PHI, New Delhi, 2003.

12ME222 MECHANICS OF MACHINES - I

Credits: 3:1:0

Course Objective:

- To understand the basic components and layout of linkages in the assembly of a system/machine.

- To understand the principles involved in the displacement, velocity and acceleration at any point in a link of a mechanism.
- To understand the motion resulting from a specified set of linkages.
- To understand and to design few linkage mechanisms and cam mechanisms for specified Output motions
- To understand the basic concepts of toothed gearing and kinematics of gear trains.
- To understand the effects of friction in motion transmission and in machine components.

Course Outcome:

- To apply the knowledge of displacement, velocity and acceleration at any point in a link of a mechanism to solve problems in engineering applications.
- To apply the knowledge of mechanisms and cams for specified output motions.
- To apply the knowledge of gears and gear trains in power transmission

Unit I

BASICS OF MECHANISMS: Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four-bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle – Description of some common mechanisms – Quick return mechanisms, Straight line generators, Dwell mechanisms, Ratchets and Escapements, Universal Joint – Basic structures of Robot Manipulators (serial & parallel) – Design of quick return crank-rocker mechanisms.

Unit II

KINEMATICS OF LINKAGE MECHANISMS: Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method –Velocity and acceleration polygons – Velocity analysis using instantaneous centres – Kinematic analysis by complex algebra methods – Vector approach – Computer applications in the kinematic analysis of simple mechanisms – Coincident points – Coriolis component of Acceleration.

Unit III

KINEMATICS OF CAM MECHANISMS: Classification of cams and followers – Terminology and definitions – Displacement diagrams – Uniform velocity, parabolic, simple harmonic, cycloidal and polynomial motions – Derivatives of follower motions – Layout of plate cam profiles – Specified contour cams – Circular arc and tangent cams – Pressure angle and undercutting – sizing of cams.

Unit IV

GEARS AND GEAR TRAINS: Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions –Gear tooth action – contact ratio – Interference and undercutting – Non-standard gear teeth – Helical, Bevel, Worm, Rack and Pinion gears – Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains – Differentials – Automobile gear box.

Unit V

FRICTION: Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads –Bearings and lubrication – Friction clutches – Belt and rope drives – Friction aspects in brakes –Friction in vehicle propulsion and braking.

Text Books

1. Ambekar A.G, “Mechanism and Machine Theory” Prentice Hall of India, New Delhi, 2007.
2. Shigley J.E. ,Pennock G.R.and Uicker.J.J., ‘Theory of Machines and Mechanisms’, Oxford University Press,2003.

Reference Books

1. Ghosh.A, and A.K.Mallick, ‘Theory of Mechanisms and Machines’, Affiliated East-West Pvt. Ltd., New Delhi, 1988.
2. Rao.J.S. and Dukkipati.R.V. ‘Mechanisms and Machine Theory’, Wiley-Eastern Ltd., New Delhi, 1992.
3. V.Ramamurthi, Mechanics of Machines, Narosa Publishing House, 2002.
4. Robert L.Norton, Design of Machinery, McGraw-Hill, 2004.
5. Khurmi R.S. “Theory of Machines” Khanna Publishers, Delhi, 2006

12ME223 MECHANICS OF MACHINES - II

Credits: 3:1:0

Course Objective:

- To understand the force-motion relationship in components subjected to external forces.
- To understand the force-motion analysis of standard mechanisms.
- To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- To understand the effect of Dynamics of undesirable vibrations.
- To understand the principles in mechanisms used for governing of machines.

Course Outcome:

- To apply the force-motion relationship in components subjected to external forces
- To correct the undesirable effects of unbalances resulting from prescribed motions in mechanism,
- To reduce the magnitude of vibration and isolate vibration of dynamic systems.

Unit I

FORCE ANALYSIS: Applied and constraint forces – Free body diagrams – Static equilibrium conditions – Two, three & four members – Static force analysis of simple mechanisms – Dynamic force analysis – Inertia force and Inertia torque – D Alembert’s principle – The principle of superposition – Dynamic Analysis in reciprocating engines – Gas forces – Equivalent masses – Bearing loads – Crank shaft torque – Turning moment diagrams – Fluctuation of energy – Fly Wheels – Engine shaking forces – Cam dynamics – Unbalance, Spring Surge and Windup.

Unit II

BALANCING: Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing Multi-cylinder engines – Partial balancing in locomotive engines – Balancing of linkages – Balancing machines.

Unit III

FREE VIBRATION: Basic features of vibratory systems – Idealized models of basic elements and lumping of parameters – Degrees of freedom – single degree of freedom – Free vibration – Equations of motion – Natural frequency – Types of Damping – Damped vibration – Extending to multi degree freedom systems – Critical speeds of shafts – Torsional vibration – Torsionally equivalent shaft – Two and three rotor systems.

Unit IV

FORCED VIBRATION: Response to periodic forcing – Harmonic disturbances – Disturbance caused by unbalance Support motion – force transmissibility and amplitude transmissibility – Vibration isolation

Unit V

MECHANISM FOR CONTROL: Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force – Other Governor mechanisms. Gyroscopes – Gyroscopic forces and torques – Gyroscopic stabilization –Gyroscopic effects in Automobiles, ships and airplanes.

Text Books

1. Ambekar A.G., "Mechanism and Machine Theory", Prentice Hall of India, New Delhi, 2007.
2. Shigley J.E., Pennock,G.R., Uicker J.J., "Theory of Machines and Mechanisms", Oxford University Press,2003.

Reference Books

1. Ghosh A. and Mallick A.K., "Theory of Mechanisms and Machines", affiliated East-West Press Pvt. Ltd., New Delhi, 1988.
2. Rao J.S. and Dukkipati R.V., "Mechanism and Machine Theory", Wiley- Eastern Limited, New Delhi, 1992.
3. Robert L.Norton, Design of Machinery, McGraw-Hill, 2004.
4. Khurmi R.S. "Theory of Machines" Khanna Publishers, Delhi, 2006

12ME224 DESIGN OF MECHANICAL TRANSMISSION SYSTEMS

(Use of approved data books are permitted)

Credits: 3:0:0

Course Objective:

- To learn the design principles of various mechanical power transmission systems and elements

Course Outcome:

Upon completing this course, students will be able to:

- Gain knowledge on the principles and procedure for the design of power Transmission elements
- Understand the standard procedure available for Design of Transmission systems
- Learn, apply and use standard data books and catalogues.

Unit I

Bearings and Belts: Selection of bearings based on loads - Design of Journal bearings – sliding contact and rolling contact types – Design of flat belt, V-belt

Unit II
Chains,Ropes and Gears: Design and selection of Chains, ropes. Design of gears – spur gear, helical gear and herring bone gears- skew gears.

Unit III
Gears: Design of bevel gears – straight and spiral bevel types. Design of worm gears- Design of a Ratchet & pawl mechanism, Geneva mechanism

Unit IV
GearBox; Design of gearbox – speed reducers – speed diagrams, Stepped pulley.

Unit V
Cams, Clutch and Shoe Brakes: Design of cams-Contact stress and Torque calculation-Design of plate clutches – axial clutches-cone clutches- internal and external shoe brakes.

Text Books

1. Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, Sixth Edition, Tata McGraw-Hill , 2003.
2. S.Md .Jalaludeen , “ Machine Design”, Anuradha Publications, Chennai 2009
3. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000.

Reference Books

1. Sundarajamoorthy T.V and Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
2. Robert.L.Norton, ‘ Machine Design-An integrated approach’, Pearson Education,2001.
3. Hall A.S. Holowenko A.R. and Laughlin H.G., ‘Theory and Problems in Machine Design’, Schaum’s Series, 2000.

Hand Book
1. PSG College of Technology, ‘Design Data Book’, Coimbatore.2011

12ME225 DESIGN OF MACHINE ELEMENTS

(Approved Design Data Book are permitted)

Credits: 3:1:0

Course Objective:

- To make the students to Learn, analyse and design, basic machine elements in mechanical systems
- Applying the concepts studied in Engineering Mechanics and Strength of materials, to Machine Element design

Course Outcome:
- Ability to design machine elements for various applications
- Ability to solve and optimize problems based on machine design

Unit I
INTRODUCTION TO THE DESIGN PROCESS: Factors influencing the machine design, selection of materials based on its physical and mechanical properties. Direct, bending torsional and combined stress equations, impact, and shock loading. Criteria of failure, stress concentration factor, size factor, surface finish factor – factor of safety, design stress, theories of failures – simple problems.

Unit II
VARIABLE AND CYCLIC LOADS AND SPRINGS: Variable and cyclic loads – fatigue strength and fatigue limit – S-N- curve, combined cyclic stress, Soderberg and Goodman equations – Design of helical, leaf, disc and torsional springs under constant loads and varying loads.

Unit III
SHAFTS AND COUPLINGS: Design of solid and hollow shaft based on strength, rigidity and critical speed. Design of keys, keyways, Bolts and nut joints, couplings, rigid and flexible couplings.

Unit IV
JOINTS: Design of riveted joints - pressure vessels and structures, Screw joints, Cotter joints knuckle joints and pipe joints.

Unit V
DESIGN OF ENGINE COMPONENTS: Design of piston, connecting rod, crankshaft, and flywheel.

Text Books:
1. Goseph Edward Shighley, 'Mechanical Engineering Design', McGraw Hill, 2001.
2. S.Md .Jalaludeen , " Machine Design",Anuradha Publications, Chennai 2009.

Reference Books:
1. Dobrovolsky, V., 'Machine Elements', MIR Publications, 2000.
2. Hall, A.S., Holowenko, A.R. and Laughlin, HIG., Theory and Problems in Machine Design,Schaums series.
3. Sundarrajamoorthy, T.V. and Shanmugam, 'Machine Design', Khanna Publishers, 2003.

12ME226 RESOURCES, PRODUCTION AND QUALITY MANAGEMENT

Credits: 3:0:0

Course Objective:
- To introduce students on optimization techniques used in industrial practice. The subject also aims at imparting knowledge on Industrial Management Systems.

Course Outcome:

- The students will be able to model a physical problem in to a mathematical model and find optimal solutions for real situations.
- The student will also be able to contribute to the industry's quality policy in which they are placed.

Unit I
Linear Models-1: Introduction to operations research – Linear Programming – Graphical Method – Simplex method-I – Duality in simplex – Assignment Problems.

Unit II
Linear Models-2: Transportation Problems – Applications to problems with discrete variables.
Network Models: Network analysis: Project Networks – Critical Path Method – Project Evaluation and Review technique – Problems on sequencing jobs through two machines and three machines.

Unit III
Queuing Models: Queuing systems – Single server problems with Poisson arrival and exponential service (real time problems to be taught – no derivations)
Decision Models: Game Theory – Two persons zero sum games – Graphical solution – Algebraic solution – Linear Programming solution.

Unit IV
Production Management: Production systems – Production management – Scope of production management – Need for PPC – Objectives of PPC – Phases of PPC – Functions of PPC – Operations planning and scheduling – Aggregate planning – Master production schedule – capacity planning – Routing – Scheduling and Scheduling methodology.

Unit V
Quality Management: Definition of Quality – Dimensions of Quality – Quality Planning – Quality Costs – Analysis of Quality costs . Quality Circle– Introduction to Total Quality Management (TQM) – Principles and Barriers of TQM – Deming's Philosophy – Quality Function Deployment – Introduction to Seven tools of quality – Introduction to Six Sigma Concepts. ISO 9000 QS 9000, ISO 14000 – Concept –Requirements and benefits.

Text Books

1. S. Anil Kumar and N. Suresh, Production and Operations Management, New Age International Publishers, 2006.
2. H. Besterfied, Total Quality Management, Pearson Education Asia, 2002.
3. S.Bhaskar, Operations Research, Anuradha Agencies, 2009.

Reference Books

1. H.A. Taha, "Operations Research", Prentice Hall of India, 2005
2. J.M.Juran, "Quality Planning and Analysis", Fifth Edition, Tata McGraw Hill Publishers, 1998.
3. Prem Kumar Gupta, D. S. Hira, "Operations Research", Third Edition, S. Chand & Company Ltd, New Delhi, 2003.

12ME227 COMPUTER AIDED DESIGN AND ENGINEERING LAB

Credits:0:0:2

Course Objective:

- To impart creative skills to model machine elements used in the mechanical industry using modeling software.
- To equip the students with the Analysis software -ANSYS.
- To enable the students to construct models and solve structural, thermal and fluid problems.
- Enable the students to understand the issues related to the utilization of FEA in the industry.

Course Outcome:
The students will be able to:

- Understand and handle design problems in a systematic manner.
- Gain practical experience in handling 3D modeling software systems.
- Solve engineering problems using commercial software such as ANSYS
- Implement mechanical engineering concepts to use the software tools correctly and efficiently
- Analyze a mechanical component under static load condition.

Software to be used: Pro-Engineer, ANSYS Software

List of Experiments:
Using Pro-Engineer
1. 3D modeling with Extrude, Round, Mirror commands
2. 3D modeling with Revolve, Hole, pattern commands
3. 3D modeling with Rib, Chamfer, Draft commands
4. Assembly of Knuckle Joint
5. Assembly of Plummer block
6. Advanced modeling commands Sweep and Blend.

Using ANSYS Software
7.Analysis of 2D Truss
8. Analysis of Bicycle Frame
9. Static Analysis of Corner Bracket
10.2D Heat Conduction within a Solid
11.Thermal Analysis of 2D Chimney
12.Thermal Analysis of 3D Fin

12ME228 MACHINE DRAWING

Credits: 0:0:2

Course Objective:

- To Understand drawing and develop capacity to represent any matter/object with the help of picture.
- To Develop primary knowledge of working drawing.
- To Produce orthographic drawing of different machine parts.
- To Develop skill to produce assembly drawings.

Course Outcome:

- Student will be able to draw and develop any matter/object with the help of picture.
- Student will be able to develop primary knowledge of working drawing.
- Student will be able to produce orthographic drawing of different machine parts.
- Student will be able to develop skill to produce assembly drawings.

List of Experiments

1. Projection of solids (Inclined to one plane & parallel to other and inclined to both planes).
2. Cut development of surfaces – prisms, pyramids, cylinder and cone.
3. Section of solids (Cube, prisms, pyramids, cylinder and cone)
4. a) Conventional representation of common features in mechanical drawing - screw threads(internal & external), serrated and splined shaft, bearings, straight and diamond knurling, Holes on a linear and circular pitch, Helical springs (compression, tension and torsion), conical helical spring (circular and rectangular section), leaf springs (with and without eyes), spiral and disc springs gear drives (spur, screw, bevel, worm and rack & pinion).
   b) Conventional representation of materials (Wrought iron, cast iron, Spheroidal graphite iron, Low carbon steel, High carbon steel, mild steel, Cast steel, Stainless steel, brass and gun metal).
   c) Conventional representation of full and half sectional views.
5. Limits, fits and tolerances.
6. Hexagonal bolt & nut, Flanged nut, wing nut, Locking of nuts (split pin locking of castle nut, lock nut), stud and threaded hole, set screws (fillister head, countersunk head, socket head, pan head), grub screw.
7. Rivet heads (flat countersunk, mushroom head, conical head, flat head), Types of keys (sunk taper key, hollow saddle key, flat saddle key, Gib-head key, feather key, peg key, double head key, double head key, woodruff key).
8. Assembly drawing of Cotter joint.
9. Assembly drawing of Knuckle joint.
10. Assembly drawing of flanged coupling (protected type)
11. Assembly drawing of screw jack
12. Assembly drawing of Plummer block.

Text Book

1. Gopalakrishnan, “Machine Drawing” , Subash Publishers,2000 .Division of Production Engineering,

Reference Books

1. Bhatt, N.D. “Machine Drawing”, Charotar Publishing House, Anand,2003.
2. Siddheswar, N. P.Kanniah, and V.V.S. Satry, “Machine Drawing”, Tata McGraw Hill,2005
3. Revised IS codes; 10711, 10713, 10714,9609, 1165, 10712, 10715, 10716, 10717, 11663, 11668, 10968, 11669, 8043, 8000.

12ME229 DYNAMICS LAB

Credit: 0:0:1

Course Objective:

- To make the students to understand the basic mechanisms, working principle and the effect of forces on various machines based on theoretical and experimental methods.

Course Outcome:

- Students will be able to understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- Students will be able to study the effect of dynamics on vibrations.
- Students will be able to understand the principle and mechanism used in governor and gyroscope.
- Students will be able to calculate cutting forces in Lathe and Drilling machines

1 .a) Study of undamped free vibration of equivalent spring mass system
b) Study of undamped torsional vibration of single rotor system.
2 a) Study of longitudinal vibration of a single dof system.
b) Study of whirling of shaft.
3 a) Jump speed analysis of cam & follower.
b) Dynamic balancing of single rotor system.
4 a) Study of gyroscopic couple .
b) Study of governor.
5 a) Strain gauge indicator.
b) Turn table apparatus.
6 a) Drill tool dynamometer.
b) Lathe tool dynamometer .

12ME230 ENGINEERING MECHANICS

Credits:3:0:0

Course objective:

- To provide the student with a clear and thorough understanding of the forces and practical applications of engineering mechanics, covering both statics and dynamics
- To equip the student with varieties of structures and beams and to have a thorough understanding of the concept, drawing, and the use of free-body diagrams
- To enable the student to understand the centroids and moment of inertia of different sections and physical applications of these properties
- To provide understanding to the student about dynamics and frictional forces

Course Outcome:

- Students would know about the practical and theoretical applications of engineering mechanics
- Students will be familiar with statics and dynamics
- The student will be able to draw the free body diagrams and measure the dimensional values of supports and reactions.
- The student will be aware of the frictional forces applications

UNIT I

Introduction : Definitions – Basic concepts – Force – Types of forces – Resultant forces – Parallelogram law – Proof – Resolution and components of forces – Resultant of several concurrent forces, Equilibrium of a particle – Equilibrant – Equations of equilibrium – Equilibrium of a two force body – Equilibrium of a three force body – Lami's theorem.

Unit II
Statics of particle : Concurrent forces in space:- Components of force in space,Equilibrium of a particle in space – Application of statics of particle.
Equilibrium of rigid bodies:- Free body – Free body diagram – Roller problems. Moment of a force about a point – Varignon's theorem – Moment of a couple – Resolution of a given force in to force and couple system.

Unit III
Applications of statics of rigid bodies: Types of support in two dimensions – Beams – Types of loads, Analysis of roof trusses by method of joints and method of sections.Properties of surfaces and solids:- Centre of gravity and Centroid – Centroid of composite plane figure and problems – Moment of inertia – Parallel axis theorem – Perpendicular axis theorem – Moment of inertia of composite planes.

Unit IV
Friction: Frictional force – Limiting friction – Coefficient of friction and angle of friction – Impending friction – Basic concepts – Angle of repose – Cone of friction – Body on a rough inclined plane, Ladder friction, Wedge friction, Rolling resistance.
Dynamics of particle:
Kinematics : rectilinear motion – types - problems – motion of particle under gravity – rectilinear motion – variable acceleration, Curvilinear motion - velocity and acceleration of a particle

UNIT V
Kinetics : Newton's second law of motion – D-Alembert's principle – Motion of a lift – Motion on an inclined surface – Motion on connected bodies, Work – Energy method – Work energy equation – Motion of connected bodies – Impulse and momentum - Equation – Motion of connected bodies.
Impact of elastic bodies: Types of impact – Method of analysis – Problems.

Text Books
1. Beer, F.P and Johnson Jr. E.R. "Vectors Mechanics of Engineers", Vol. 1 Statics and Vol. 2 Dynamics, McGraw-Hill International Edition, 2005.
2. Rajasekaran, S, Sankarasubramanian, G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd.,2007
3. N.Kottiswaran – "Engineering Mechanics",Sri Balaji Pubilcations Edition – 2005

Reference Books
1. Palanichamy, M.S.,Nagan, S., "Engineering Mechanics – statics and dynamics", Tata McGraw-Hill,2002
2. Hibbeler, R.C., "Engineering Mechanics", Vol. 1 Statics, vol .2 Dynamics,Pearson Education Asia Pvt. Ltd.,2000
3. Irving H. shames, "Engineering Mechanics – Statics and Dynamics",IV Edition – Pearson Education Asia Pvt. Ltd., 2003.

12ME231 MECHANICAL SYSTEMS FOR FOOD PROCESSING

Credits: 3:0:0

Course Objectives:

- To provide knowledge about types of pumps and their applications.
- To learn about types of power transmission elements, steam generators and chillers.
- To understand the principles of material handling systems.

Course outcome:

The students will be able to

- Understand the working principle of pumps and their applications
- Understand about the various power transmission elements and working principle of boilers and chillers
- Understand about the construction and working principle of various material handling systems.

Unit I

Food Plant Pumps- Pumping theory- head developed-Types of pumps-Centrifugal pumps-Reciprocating pumps- Rotary gear pumps- vane pumps- and diaphragm pumps-construction-working principles and applications (Simple problems).

Unit II

Mechanical power transmission systems: design of shafts-solid and hollow shafts- types of coupling- belt drives-gear drives-chain drives and rope drives (Simple problems).

Unit III

Steam generation and distribution: Types of Water tube and smoke tube boilers- Boiler capacity- boiler specification- automatic boilers- Boiler mountings.

Thermic fluid and hot air generators and distribution- Relative merits and demerits of steam- hot air and thermic fluid heating of foods. [Only theory].

Unit IV

Chilled water and ice production: types of chilled water generators- types of ice generators. Storage and instant water chillers (Simple problems).

Unit V

Material handling in Food plants: Importance of electro-mechanical handling-Types of elevators- Bucket- Slat- pneumatic and screw elevators- inclined elevators – Design configuration-power requirement and applications handling of wet products- SS and plastic conveyors and elevators [Only theory].

Text Books

1. T.C.Robberts: Food Plant Engineering Systems, CRC Press Ltd. Washington, USA, 1989.
2. P.C.Smith, "Introduction to Food Process Engineering", Springer international Edition, 2005

Reference Books

1. R.Paul Singh,Dennis R.Heldman; "Introductin to Food Engineering" (3rd edition), Academic press, Elsevier, 2001.
2. Arthur W Farral: "Food Engineering Systems Vol-1", AVI Publications, 1990.
3. R.K.Bansal; "Fluid Mechanics and Hydraulic Machines", Laxmi publications (P) Ltd, 2004
4. Spottd M. F., "Design of Machine Elements", Prentice Hall of India Ltd, New Delhi, 2002.

12ME232 DRIVES AND CONTROL SYSTEMS FOR ROBOTS

Credits: 3:0:0

Course Objective:

- To be familiar with various robot drive mechanisms.
- To give the student familiarities with the hydraulic drives for robots.
- To give the student familiarities with the pneumatic drives for robots.
- To give the student familiarities with the electric drives for robots.
- To give knowledge about various control systems for robots.

Course Outcome:

- Students will be equipped with various robot drive mechanisms.
- Students will be familiarized with the hydraulic drives for robots.
- Students will have good knowledge about the pneumatic drives for robots.
- Students will be equipped with the electric drives for robots.
- Students will be well versed working principles about various servo control systems for robots.

Unit I

Robot Drive Mechanism: Motion conversion – rotary to rotary conversion – Ideal gears-rotary to linear conversion- lead screws- Rack and pinion – belt and pulley driving a linear load – rohlix – slider crank – cam- linkages- coupler – efficiency – eccentricity - back lash- Harmonic drives and pulley systems.

Modelling of Mechanical systems – elements, rules and nomenclature – translational example – rotational example – torsional resonance – electrical analogy

Unit II

Hydraulic Drives: Introduction- Requirements - Hydraulic actuators Rotary and linear actuators. Elements used in hydraulic circuits – DCVs –FCVs – PCVs- relief valves – Servo control valves – deflector jet servo valve – Hydraulic position servo.

Unit III

Pneumatic Drives: Introduction – Properties of air – Compressors – pneumatic conditioners – pneumatic valves – pneumatic actuators – linear and rotary actuators – pneumatic proportional controller – pneumatic controlled prismatic joint.

Unit IV

Electric Drives: Introduction - DC electric motors – shunt –series – compound – PM motor – brushless dc motor - stepper motors - half step mode operation- micro step mode – permanent magnet stepper motor – linear stepper motor - stepper motor drives - Direct drive actuator.

Unit V

Controls in a Robot: Basic control system concepts and models – mathematical models – transfer function-block diagrams-characteristic equation – control loops – open loop and closed loop systems – Controllers – on-off control – proportional control and integral control – positional feedback system- servo control modes – Proportional control system - PI controls –PD controls - PID control with Tachometric feedback system – microprocessor controlled digital servo system.

Text Books

1. Richard D. Klafter, Thomas. A, Chmielewski, Michael Negin, Robotics Engineering an Integrated Approach, Prentice Hall of India Pvt. Ltd., 2008.
2. Deb S.R., " Robotics Technology and Flexible Automation ", Tata McGraw-Hill, 2004

Reference Books

1. Mikell P. Groorer, Mitchell welss, Roger N. Nagel, Nicholas G.Odrey, Industrial Robotics, Technology programming and Applications, Mc Graw Hill International Edition, 2004
2. Robert J. Schilling, Fundamentals of Robotics Analysis and Control, PHI Pvt. Ltd., 2006
3. John J. Craig, Introduction to Robotics Mechanics and Control, Second Edition, Addison Wesly Longman Inc. International Student edition, 2008
4. Andrew Parr, 'Hydraulics and Pneumatics', Jico Publishing House ,Mumbai 2006.

12ME233 DESIGN LABORATORY

Credits: 0:0:1

Course Objective:

- To impart students programming skills of C program to design and synthesis the machine elements used in the mechanical industry.

Course Outcome:

- The student will be able to design and synthesize a mechanical component using C program under static load condition.

List of Experiments:

1) Design and Synthesis of Coil spring using C/MATLAB program.
2) Design and Synthesis of Flanged Coupling using C/MATLAB program.
3) Design and Synthesis of Spur Gear using C/MATLAB program.
4) Design and Synthesis of Roller Bearing using C/MATLAB program.
5) Design and Synthesis of Belt Drives using C/MATLAB program.
6) Design and Synthesis of Chain Drives using C/MATLAB program.
7) Design and Synthesis of Knuckle Joint using C/MATLAB program.
8) Design and Synthesis of connecting rod using C/MATLAB program.

(Any 6 experiments can be given)

12ME234 FINITE ELEMENT ANALYSIS

Credits: 3:1:0

Course Objective:

- To equip the students with the Finite Element Analysis fundamentals.
- To enable the students to formulate the design problems into FEA.
- To introduce basic aspects of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and the resulting algebraic systems.

Course Outcome:

Upon completing this course, the students will be able to:

- Identify mathematical model for solution of common engineering problems.
- Formulate simple problems into finite elements.
- Solve structural, thermal, fluid flow problems.
- Use professional-level finite element software to solve engineering problems in Solid
- mechanics, fluid mechanics and heat transfer.

Unit I

Introduction: Basic concepts- General applicability of the method to structural analysis, heat transfer and fluid flow problems-Historical Background -finite element packages- Boundary Value and Initial Value Problem-Weighted Residual Methods.

Unit II

General Procedure of FEA: Element Types and its Characteristics-Concept of Element Assembly - Bandwidth and its effects- Boundary conditions-Aspect Ratio- Pascal's Triangle- Stiffness matrix for Spar element, Beam element-Shape Function for Spar element, Beam element.

Unit III

Convergence and Continuous criteria: Local, Global and Natural Co-ordinate System- Area coordinate system- Shape Function for Triangular, Rectangular Elements and Stiffness matrix

Unit IV

Introduction to Higher Order Elements: Shape Function for Quadratic Element, Cubic Element-Isoparametric elements-Eight node and Nine node quadrilateral element. Structural Problems:Equations of elasticity- Plane stress, plane strain problems – Body forces and temperature effects – Stress calculations

Unit V

Heat Transfer Problems: Elemental equation for 1D heat transfer problem (derivation & problem)

Fluid Mechanics Problems: Inviscid & Incompressible fluid flow.

Text Books

1. Rao. S.S. ' The Finite Element Method in Engineering', IInd Ed., Pergamon Press, Oxford, 2001.
2. Larry .J.Segerland, "Applied Finite Element Analysis",Wiley India Pvt.Ltd.,2011.

Reference Books

1. David.V.Hutton, " Fundamentals of Finite Element Analysis", Tata McGraw Hill,2003
2. Tirupathi.R.Chandrupatla, Ashok.D.Belegundu. 'Introduction to Finite Elements in Engineering', Prentice Hall of India, 2004.
3. Logan. D.L. "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002.

12ME235 COMPUTATIONAL FLUID DYNAMICS

Credits 3:1:0

Course Objective:

- To provide the knowledge of governing equations of fluid dynamics, able to discretise the equations and incorporate the boundary conditions.
- To provide the knowledge of the solution methodologies of discretised equations and incorporate the turbulence and combustion models.

Course Outcome:

- The students will have the knowledge of performing CFD Analysis.
- The students will be able to apply the boundary conditions and solve CFD problems.
- The students will be able to solve problems using turbulence and combustion models.

Unit I:

Governing Equations And Boundary Conditions: Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Physical boundary conditions – Time averaged equations for Turbulent flow - Turbulence -Kinetic -Energy Equations.

Unit II:

Diffusion (Heat Conduction): Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problems

Unit III :

Convection And Diffusion: Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, upwind, hybrid and power-law schemes - Discretization equations for two dimensional convection and diffusion.

Unit IV:

Solution Methodologies: Solution methodologies: Representation of the pressure - Gradient term and continuity equation - Staggered grid - Momentum equations - Pressure and velocity corrections - Pressure - Correction equation, SIMPLE algorithm and its variants.

Unit V:

Turbulence and combustion: Turbulence models: mixing length model, two equation (k-E) models. Combustion models: pre mixed combustion, diffused combustion.

Text Books

1. Anderson, J.D., “Computational fluid dynamics – the basics with applications”, 1995.
2. Versteeg, H.K, and Malalasekera, W., “An Introduction to Computational Fluid Dynamics: The Finite Volume Method”, Longman, 1998

Reference Book

1. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw- Hill Publishing Company Ltd., 1998.
2. Patankar, S.V., “Numerical Heat Transfer and Fluid Flow”, McGraw-Hill, 1980. Ane-Books2004 Indian Edition.
3. Muralidhar, K and Sundarajan .T., “Computational Fluid Flow and Heat Transfer”, Narosa Publishing House, New Delhi, 1995.
4. Bose, T.K., “Numerical Fluid Dynamics”, Narosa publishing House, 1997.

12ME236 MECHANICAL VIBRATIONS AND NOISE ENGINEERING

Credits: 3:1:0

Course Objective:

- To train students to formulate mathematical models of problems in vibrations using Newton's second law or energy principles,
- To develop the students skills in analyzing the vibration behavior of mechanical systems under different types of loading.
- To impart the knowledge of effects of vibrations and noise and the methods to control them in engineering applications.

Course Outcome:

Upon completing this course, student will be able :

- To construct the equations of motion from free-body diagrams.
- To solve for the motion and the natural frequency for free, forced vibration of undamped motion and damped motion.
- To study the ways to reduce unwanted vibration and the equipment used for collecting response data.
- To understand the various Vibration and Noise control strategies

Unit I

INTRODUCTION: Relevance of and need for vibrational analysis –Basic concepts of vibration-classification of vibration-vibration analysis procedure- Mathematical modelling of vibrating systems -Various damping models.

Unit II

SINGLE AND TWO DOF SYSTEMS: General solution to free vibration of single degree of freedom system-- damped free vibration - Forced vibration of undamped system (single dof) - Vibration isolation -Equation of motion for free vibration analysis of undamped systems(2 dof)-dynamic vibration absorbers –semi definite system.

Unit III

Continuous systems: Torsional vibrations of rods- Longitudinal vibration of rods - transverse vibrations of beams – Governing equations of motion - Natural frequencies and orthogonality of normal functions.

Unit IV

VIBRATION ANALYSIS: Need for the experimental methods in Vibration analysis. Vibration Measuring Devices: seismometer and accelerometer -Vibration exciters: mechanical and electrodynamic –Frequency measuring instruments: single reed,multi reed and stroboscope. Signal Analysis: Spectrum Analyzers and Band pass filter. Signal conditioning devices: Filters, Amplifiers, Modulators/Demodulators, ADC/DAC. Dynamic Testing of machines and structures Experimental modal analysis, introduction to ISO/BIS Standards for vibrations and Acoustics

Unit V

ACOUSTICS: Introduction-Sound Power, Sound Intensity and Sound pressure level. The decibel scale-Decibel addition, subtraction and averaging- Loudness, Weighting networks, Equivalent sound level. Noise: Effects and Ratings. Noise: Sources, Isolation and control-Industrial noise sources-Industrial noise control strategies-Noise control at the source, along the path and at the receiver.

Text Books

1. Singiresu.S.Rao., "Mechanical Vibrations", Addison Wesley Longman ,2003.
2. Ambekar.A.G. “Mechanical Vibrations and Noise Engineering”, Prentice Hall of India, New Delhi,2006

Reference Books

1. Rao, J. S . , & Gupta K.--"Ind. Course on Theory and Practice Mechanical Vibration”,NewAge International (P) Ltd.,2005.
2. Kelly, "Fundamentals of Mechanical Vibrations”, Mc Graw Hill Publications, 2000.
3. Kewal Pujara, “Vibrations & Noise for Engineers”, Dhanpat Rai & Co (P) Ltd,2007
4. Rao V. Dukkipati, J. Srinivas., Vibrations : problem solving companion, Narosa Publishers,2007.

12ME237 TRIBOLOGY AND SURFACE ENGINEERING

Credits: 3:0:0

Course Objective:
- To introduce factors affecting surface characteristics and friction
- To familiarize students with different types of wear of metals, ceramic and polymers.
- To introduce different types of lubricants and their properties.
- To introduce modern microscopy techniques used for characterization of surfaces
- To introduce various techniques used in improving surface properties utilized in bearings.

Course Outcome:
- Students will be able to design, improve tribological systems
- The students will be able to contribute to research and development of bearings
- Students will be able to perform failure analysis and improve the performance of mechanical components.

Unit I
Surfaces and Friction: Typology of solid surfaces - Measurement methods – Profilometry – Electron microscopy -Optical microscopy –Statistical description - Adhesion - Ploughing- Friction Characteristics of metals - Friction of non metals. - Friction of Ceramic materials and polymers - Rolling Friction – Stick slip motion – Measurement of Friction.

Unit II
Wear: Types of wear – Adhesive wear – Archard wear equation -Abrasive wear - Corrosive wear -Surface Fatigue wear situations – Minor forms of wear – Fretting – Erosion - Percussion – Wear of Ceramics and Polymers -Wear of metals.

Unit III
Lubricants And Lubrication Types: Types and properties of Lubricants - Testing methods - Hydrodynamic Lubrication – Elasto hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication Hydrostatic Lubrication.

Unit IV
Nano Tribology: Nano tribology introduction- Measurement tools – surface force apparatus – Scanning tunneling microscope – Atomic force microscope / Friction force microscope – measurements – fabrication techniques for MEMS / NEMS – atomic scale simulations.

Unit V
Surface Engineering and Materials For Bearings: Surface treatments – Thermochemical treatments – surface coating-Thermal Spray Coating-Powder coating – Hard facing – Vapour deposition process - Plating and anodizing - Materials for rolling Element bearings - Materials for fluid film bearings -Materials for marginally lubricated and dry bearings

Text Books
1. Prasanta Sahoo. , “ Engineering Tribology”,Prentice Hall of India, 2005.
2. Bharat Bhushan, ‘Introduction to Tribology’, JohnWiley and sons,2002

References Books
1. Sushil Kumar Srivastava, “ Tribology in Industries” , S.Chand Publishers, 2005.
2. Gwidon W. Stachowiak, Andrew.W.Batchelor, ‘ Engineering Tribology’, Elsevier,2005

Web References:

1. http://www.csetr.org/link.htm
2. http://www.me.psu.edu/research/tribology.htm

12ME238 DESIGN OF PRESSURE VESSELS AND PIPING

Credits 3:1:0

Course objective:

- To give exposure to various types of process equipments and their design.

Course Outcome:

Upon completing the course, students will be able

- To understand the different types of stresses and their effects in pressure vessel.
- To understand the piping layout and the stresses acting on it.

Unit I

CYLINDRICAL SHELL AND VARIOUS CLOSURES : Membrane theory for thin shells, stresses in cylindrical, spherical and conical shells, dilation of above shells, general theory of membrane stresses in vessel under internal pressure and its application to ellipsoidal and torispherical end closures. Bending of circular plates and determination of stresses in simply supported and clamped circular plate. Introduction to ASME code and formulae

Unit II

JUNCTION STRESSES, OPENING AND REINFORCEMENTS: Discontinuity stresses. Stress concentration in plate having circular hole due to bi-axial loading. Theory of reinforced opening and reinforcement limits.

Unit III

SUPPORT DESIGN : Supports for vertical & horizontal vessels. Design of base plate and support lugs. Types of anchor bolt, its material and allowable stresses. Design of saddle supports.

Unit IV

BUCKLING IN VESSELS: Buckling of vessels under external pressure. Elastic buckling of long cylinders, buckling modes, Collapse under external pressure. Design for stiffening rings. Buckling under, combined external pressure and axial loading.

Unit V

PIPING STRESS ANALYSIS: Flow diagram, Piping layout and piping stress analysis. Flexibility factor and stress intensification factor. Design of piping system as per B31.1 piping code. Piping components – bends, tees, bellows and valves. Types of piping supports and their behaviour.

Text Books

1. Harvey J F, ‘Pressure vessel design’ CBS publication,2001
2. Somnath Chattopadhyay, ‘Pressure vessels: design and practice’, CRC Press,2005.

Reference Books

1. ASME Pressure Vessel and Boiler code, Section VIII Div 1 & 2, 2003

2. J.Spence & A.S.Tooth, ‘ Pressure Vessel design concepts and Principles’, Chapman & Hall,1994
3. Dennis.R.Moss, ‘Pressure vessel design Manual’, Elsevier 2004.
4. Donatello Annaratone, ‘Pressure Vessel Design’ , Springer,2007.

12ME239 CONCEPTS OF ENGINEERING DESIGN

Credits: 3:0:0

Course Objective:

- Instill the philosophy that real engineering design is often an open-ended, illstructured process
- To Provide students with in-depth practice in design and the use of a structured approach to design
- To Develop and practice teamwork, critical thinking, creativity, and independent Learning
- To Provide an introductory knowledge of business practices, economic viability, environmental
- sustainability and the social consequences of technology

Course Outcome:

Upon completing the course,

- Students will have the knowledge of design process and methods
- Students will be able to know the importance of Material selection, Quality, Statistics in design and its help in designing a new product.
- To learn the process of design based on the scientific method, to combine creative thinking with engineering principles to turn ideas into robust reality

Unit I

The Design Process: The design process - Morphology of Design - Design drawings - Computer Aided Engineering - Designing of standards - Concurrent Engineering - Product life cycle - Technological Forecasting - Market Identification -Competition Bench marking - Systems Engineering - Life Cycle Engineering - Human Factors in Design -Industrial Design.

Unit II

Design Methods: Creativity and Problem Solving - Product Design Specifications - Conceptual design - Decision theory - Embodiment Design - Detail Design - Mathematical Modeling - Simulation - Geometric Modelling - Finite Element Modelling

Unit III

Material Selection Processing And Design: Material selection Process-use of standard components - Economics - Cost Vs Performance - Weighted property Index – Value Analysis - Role of Processing and Design - Classification of Manufacturing Process - Design for Manufacture - Design for Assembly - Residual stresses - Fatigue, Fracture and Failure

Unit IV

Engineering Statistics And Reliability: Probability - Distributions - Test of Hypothesis - Design of Experiments - Reliability Theory.

Unit V

Quality Engineering: Total Quality Concept - Quality Assurance - Statistics Process Control - Taguchi Methods – Robust Design-Failure Model Effect Analysis.

Text books

1. Dieter George E., " Engineering Design -A Materials and Processing Approach", McGrawHill,International Edition Mechanical Engg ., Series ,2000.
2. M.Mahajan, ”A Text Book of Metrology”, Dhanpat Rai &Co. 2010

Reference Books

1. Karl T. Ulrich and Steven d Eppinger "Product Design and Developement " ,McGraw Hill,Edition,2004.
2. Palh .G. and Beitz .W., " Engineering Design ", Springer - Verlag , NY. 2007.
3. Amitava Mitra, ‘Fundamentals of Quality Control and Improvement’, Pearson Education Asia,2002.
4. Kevin Otto & Kristin Wood, “Product Design”, Pearson Educational Inc. 2004.
5. Ray .M.S., " Elements of Engg. Design ", Prentice Hall Inc .1985.

12ME240 HUMAN FACTORS IN ENGINEERING AND DESIGN

Credits: 3:0:0

Course Objective:

- To introduce the Fundamental terms and concepts of human factors
- To discuss anthropometric, biomechanical and physiological principles and how they are used to optimize human well-being and overall performance.
- To Identify, Analyze, Setup and implement solutions to a human factors problem
- To learn the impact of human factors in workplace design-environment and Productivity and
- To work with the latest OSHA guidelines and regulations.

Course Outcome:

Upon Completing the course, students will be able to

- Become as Ergonomists who can apply the Ergonomic aspects in the design of office (computer) workstations to fit and accommodate the human.
- Problems faced by different kinds of people and to design suitably to reduce the discomfort experienced by them

Unit I

Introduction: Definition, human technological system, multidisciplinary engineering approach, human– machine system, manual, mechanical, automated system, human system reliability, conceptual design, advanced development, detailed design and development, human system modeling.

Unit II

Human Output And Control: Physical work, manual material handling, motor skill, human control of systems, controls and data entry devices, hand tools and devices.

Unit III

Workplace Design: Applied anthropometry, workspace design and seating, arrangement of components within a physical space, interpersonal aspects of work place design, design of repetitive task, design of manual handling task, work capacity, stress, fatigue.

Environmental Conditions Illumination, climate, noise, motion, sound, vibration.

Unit IV

Biomechanics: Biostatic mechanics, statics of rigid bodies, upper extremity of hand, lower extremity and foot, bending, lifting and carrying, biodynamic mechanics, human body kinematics, kinetics, impact and collision.

Unit V

Biothermodynamics And Bioenergitics: Biothermal fundamentals, human operator heat transfer, human system bioenergetics,thermoregulatory physiology, human operator thermo regularity, passive operator, active operator, heat stress.

Human Factors Applications Human error, accidents, human factors and the automobile, organizational and social aspects, steps according to ISO/DIS6385, OSHA's approach, virtual environments.

Text Books

1. Karl Kroemer, Henrike Kroemer, Katrin Kroemer-Elbert, "ERGONOMICS" How to Design for Ease & Efficiency, Prentice Hall International Editions, 2001.
2. Alexander.D, 'Applied Ergonomics', Taylor and Francis Group, 2004.

Reference Books

1. Bridger R S, "Introduction to Ergonomics", CRC Press, 2008.
2. Karl H.E.Kroemer, ' Fitting the Human- Introduction to Ergonomics', CRC Press,2008.
3. Jan Dul, Bernard.A. Weerdmeester, 'Ergonomics for Beginners', CRC Press,2008

12ME241 PRODUCT DESIGN AND DEVELOPMENT STRATEGIES

Credits: 3:0:0

Course Objective:

- To familiarize the students about the important practices followed during designing and developing a product in industries.
- To impart the knowledge about the entire product life cycle right from its conceptual stage to its development stage.
- To enable the students with various concepts like modelling, simulation, material selection and GD&T.

Course Outcome:

- Students will have the knowledge of designing and developing a product in industries
- Students will be able to know the importance of Mathematical modeling and simulation and its help in developing new products

Unit I

Nature and Scope of Product Engineering: Importance of product design, Design Constraints, Safety and reliability considerations, The Design process-A simplified approach, Consideration of a Good Design, Detail description of Design process (Morphology of Design), Technological Innovation and the design process;Product and Process cycle.

Unit II

Modeling and Simulation: The role of Models in Engineering Design-Mathematical modeling, Similitude and scale modeling, Simulation, Finite-Difference method, Monte Carlo method, Geometric modeling on the computer, Finite Element Analysis.

Unit III

Material Selection and Materials in Design: Relation of Materials Selection to Design, Performance Characteristics of materials, The Materials Selection process – Design process and materials selection, Ashby charts, Material selection in Embodiment design, Economics of materials, Methods of material selection- Selection with Computer-Aided database, Weighted Property Index, Value analysis, Design examples- Materials systems, Material substitution.

Unit IV

Functional and Production Design: Form design- Influence of basic design, Mechanical loading and material on Form design- Form design of Grey castings, Malleable iron castings, Aluminum castings, Pressure die castings, Plastic moldings, Welded fabrications, Forging and Manufacture by machining methods. Influence of Space, Size, Weight, etc., on Form design, Aesthetic and Ergonomic considerations

Unit V

Dimensioning and Tolerancing: Dimensioning systems, Dimensioning Rules, Geometric Tolerancing, Datum features, Functional production and Inspection datum, Tolerancing types, Tolerance analysis.

Text Books

1. Dieter. G. E, “Engineering Design", McGraw Hill, 2000..
2. David A. Madsen, “Engineering Drawing and Design”, Delmar Thomson Learning Inc. 2002.

Reference Books

1. Kevin Otto and Kristin Wood, “Product Design”, Pearson Educational Inc. 2004.
2. Karl T Ulrich, Steven D Eppinger, “ Product Design & Development”, Irwin Homeward Boston Publishers, 2004.

12ME242 PRINCIPLES OF RESOURCE AND QUALITY MANAGEMENT

Credits: 3:1:0

Course Objective:

To introduce students various optimization techniques used in industrial practice. The subject also aims at imparting knowledge on Quality and Quality Management Systems.

Course Outcome:

The students will be able to model a physical problem in to a mathematical model and find optimal solutions for real situations. The will also be able to contribute to the industry’s quality policy in which they are placed.

Unit I

Linear Models-1: Introduction to operations research – Linear Programming – Graphical Method – Simplex method **-** I– Duality in simplex – Assignment Problems.

Unit II
Linear Models-2: Transportation Problems – Applications to problems with discrete variables.
Network Models: Network analysis: Project Networks – Critical Path Method – Project Evaluation and Review technique – Problems on sequencing jobs through two machines and three machines.

Unit III
Queuing Models: Queuing systems – Single server problems with Poisson arrival and exponential service (real time problems to be taught – no derivations)
Decision Models: Game Theory – Two persons zero sum games – Graphical solution – Algebraic solution – Linear Programming solution.

Unit IV
Total Quality Management: Definition of Quality – Dimensions of Quality – Quality Planning – Quality Costs – Analysis of Quality costs – Introduction to Total Quality Management (TQM) – Principles and Barriers of TQM – Deming's Philosophy – Quality Function Deployment – Procedures and Benefits - Benchmarking – Procedures and Benefits
Statistical Methods: Introduction to Seven tools of quality – Introduction to Six Sigma Concepts.

Unit V
Quality Management Systems: ISO 9000 - Need for QMS – ISO 9000:2000 Quality Systems – Elements, Implementation of Quality systems, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept –Requirements and benefits.

Text Books

1. S.Bhaskar," Operations Research", Anuradha Agencies, 2009.
2. Dale H. Besterfied, "Total Quality Management", Pearson Education Asia, 2011.

Reference Books

1 H.A. Taha, "Operations Research", Prentice Hall of India, 2005
2 Ravindran, Operational Research, John Wiley, 2010.
3 J.M.Juran, Quality Planning and Analysis, Fifth Edition, Tata McGraw Hill Publishers, 1998.

12ME243 FLUID POWER CONTROL LABORATORY

Credits: 0:0:2

Course Objective:
- To know the basic concept of fluid power
- To know the working principle of pneumatic components
- To know the working principle of electro-pneumatic components
- To know the working principle of hydraulic components
- To study the working principle of programmable Logic controller.
- To know the application of fluid power components in industries

Course Outcome:
- The student will be able to design, application of fluid power components in Industries.

LIST OF EXPERIMENTS

1. Development and simulation of a pneumatic circuit to study the use of direct control of single acting and double acting cylinder.
2. Development and simulation of a pneumatic circuit to study the use of Logic AND function using Two pressure valve.
3. Development and simulation of a pneumatic circuit to study the use Logic OR function using shuttle valve
4. Development and simulation of a pneumatic circuit to study the use of Time delay valve.
5. Development and simulation of a pneumatic circuit to study the use of pressure sequence valve.
6. Development and simulation of a pneumatic circuit to study the use of quick exhaust valve.
7. Development and simulation of a pneumatic circuit to study the use of multiple actuators in a material handling system.
8. Development and simulation of a pneumatic circuit to study the use of Flow control valve.
9. Development and simulation of an electro-pneumatic circuit to study the use of Limit Switch.
10. Development and simulation of an electro-pneumatic circuit to study the use of Relay and solenoid valves.
11. Development and simulation of an electro-pneumatic circuit to study the use of Optical Proximity switch.
12. Development and simulation of an electro-pneumatic circuit to study the use of Logic AND function.
13. Development and simulation of an electro-pneumatic circuit to study the use of Logic OR function.
14. Development and simulation of a hydraulic circuit to study the use of double acting cylinder with 4/2 way directional control valve.
15. Development and simulation of a hydraulic circuit to study the use of hydraulic motor with 4/2 way directional control valves.
16. Development and simulation of a hydraulic circuit to study the use of flow control valve.
17. Study of programmable Logic controller.

(12 Experiments from the given above will be offered to students)

12ME244 METROLOGY AND DYNAMICS LAB

Credits: 0:0:2

Course Objective:

- To be familiar with the different precision measuring instruments
- To learn the methods of measuring the common engineering parameters
- To be familiar with the measurements dynamic characteristics of engineering system such as vibration
- To have the knowledge of dynamic balancing of rotating parts

Course Outcome:

- Student will know about the different precision measuring instruments
- Student will be able to learn the methods of measuring the common engineering parameters

LIST OF EXPERIMENTS

13. Measurement of angle using sine bar
14. Measurement of angle using sine center
15. Measurement of angle using bevel protractor
16. Calibration of vernier height gauge using slip gauges
17. Circularity test bench center method and V block method

18. Measurement of screw thread dimensions using profile projector
19. Dynamic balancing of rotors
20. Determination of critical speed of whirling shafts
21. Jump speed analysis of cam and follower
22. Study of undamped free vibration of equivalent spring mass system
23. Study of undamped torsional vibration of a single rotor system
24. Determination of amplitude and frequency of forced vibration using vibration exciter and vibrometer.

12ME245 INDUSTRIAL ROBOTICS

Credits: 3:0:0

Course Objective:

- To give an overview of the components, sensing elements used programming techniques and applications of robots

Course Outcome:

- Students will be able to get an overview of the components, sensing elements used programming techniques and applications of robots

Unit I

Introduction: Definition of Robot - Basic Concepts - Robot configurations - Types of Robot drives -Basic robot motions –Point to point control - Continuous path control.

Unit II

Components and Operations: Basic control system concepts - control system analysis - robot actuation and fed back, Manipulators – director and inverse kinematics, Coordinate transformation - Brief Robot dynamics. Types of Robot and effectors –Grippers - Tools as end effectors - Robot/End - effecter interface.

Unit III

Sensing and Machine Vision: Range sensing - Proximity sensing - Touch sensing - Force and Torque sensing. Introduction to Machine vision - Sensing and digitizing - Image processing and analysis.

Unit IV

Robot Programming: Methods - languages - Capabilities and limitation - Artificial intelligence – Knowledge representation – Search techniques - AI and Robotics.

Unit V

Industrial Applications: Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading - CIM –Hostile and remote environments.

Text Book

1. Mikell P. Groover, Mitchell Weiss, "Industrial Robotics, Technology, Programming and Applications ", McGraw Hill International Editions, 1st Edition, 2000

Reference Books

1. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall India, 2002
2. Ibrahim Zeid, “CAD/CAM Theory and Practice”, McGraw Hill, 2003
3. K.S. Fu., R.C.Gonalez, C.S.G.Lee, " Robotics Control sensing ", Vision and Intelligence, McGraw Hill International Edition, 1987.

12ME246 COMPUTER AIDED INSPECTION AND METROLOGY

Credits: 3:1:0

Course Objective:

- To provide basic understanding fundamental principles of metrology and elements of computer aided inspection. It covers the different measuring techniques for various engineering parameters and measuring equipments.

Course Outcome:

- Students will be able to understand the fundamental principles of metrology and elements of computer aided inspection. It covers the different measuring techniques for various engineering parameters and measuring equipments.

Unit I

General Concepts of Measurement: Definition-Standards of measurement-Errors in measurement-Accuracy, precision, sensitivity and readability - calibration of instruments, selection and care of instruments.

Unit II

Linear and Angular Measurements: Length standard-Line and end standard - Slip gauges, micrometers, verniers, dial gauges comparators, various types-principle and applications-limits, fits and tolerance-design of gauges-interferometry applications-angular measuring instruments-bevel protector, levels, clinometers-sine bar, angle dekkor-alignment telescope, autocollimator.

Unit III

Measurement of Form Errors, Surface Roughness and Measuring Machines: Straightness, flatness, alignment errors-surface texture-various measuring instruments-run out and concentricity, Tool maker’s microscope-metro scope, profile projector

Unit IV

Measurement of Screw Threads and Gears: Various elements of threads-2 wire and 3 wire methods-gears elements -various errors and measurements. Dovetail Measurement – measurement of center line of hole and hole size.

UNIT V

Computer Aided and Laser Metrology: Coordinate measuring machine-LASER micrometer-Introduction to Interferometer, optical -LASER interferometer-Non contact and in-process inspection, vision system, Image analyser, Opto electronic devices-Applications in Online Processing systems.

Text Book

1. I.C.Gupta, "A Text Book of Engineering Metrology", Dhanpat Rai and Sons, 2000

Reference Books

1. R.K.Jain and S.C.Gupta, "Engineering Metrology", Dhanpat Rai and Sons, 2000.
2. G.N.Galyer F.W and C.R.Shotbolt, “Metrology for Engineers ", ELBS Edn 1983.
3. "ASTME Handbook of Industrial Metrology", Prentice Hall of India Ltd., 1992.
4. Robert.G. Seippel, "Optoelectronics for Technology and Engineering ", Prentice Hall New Jersey, 1989

12ME247 COMPUTER INTEGRATED MANUFACTURING

Credits: 3:0:0

Course Objective:

- To give an overview of the concepts in automation, Numerical control, Robotics and manufacturing systems

Course Outcome:

- Students will be able to understand the concepts in automation, Numerical control, Robotics and manufacturing systems.

Unit I

Automation and control technologies: Basic elements of automated systems, Levels of automation. Industrial control systems – process industries and discrete manufacturing industries, Continuous, discrete and computer process control. Forms of computer process control.

Unit II

Introduction to Numerical Control: Components of NC Machine Tools– Types of NC Machine Tools , Co-ordinate system – Types of NC system, Interpolation schemes – CNC and DNC systems. Machine structures and slide ways , Positional transducers – transmission and slide positioning systems. Control of slide position – Optical grating, Servo system.

Unit III

NC part programming and Machines: Manual part programming - Computer assisted part programming – APT language – NC part programming using CAD/CAM – Turning centre, Milling centre – Automatic Tool Changers (ATC) – NC Tooling.

Unit IV

Industrial Robotics: Robot anatomy and control systems, End effectors, Sensors in robotics, Industrial robot application, Introduction to robot programming.

Unit V

Manufacturing systems: Components of manufacturing systems, Classification of manufacturing systems. Group Technology – Part families, Part classification and coding. FMS and FMS components, Types of FMS, Applications and benefits, Automated Guided vehicle systems.

Text Books

1. Mickell. P. Groover, “Automation, Production systems & computer Integrated Mfg”, Pearson Education, 2004.
2. P.Radhakrishan, ‘Computer Numerical Control’, New Central Book Agency (p) Ltd., 1st Edition, 1999.

Reference Books:

1. Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill, 1983.
2. N.K Metha, "Machine tool design and NC Machines", 2nd Edition, TMH, 1996.

12ME248 IT IN MANUFACTURING

Credits: 3:0:0

Course Objective:

- To give an introduction on the role and application of information technology in manufacturing.

Course Outcome:

- Students will be able to know application of information technology in manufacturing.

Unit I

Computer Integrated Manufacturing: Introduction to Computer Integrated Manufacturing, Applications of Computers in Manufacturing, CIM Hardware, Activities in a CIM environment and Software for CIM, Product development through CIM, Sequential Engineering and Concurrent Engineering.

Unit II

Manufacturing Information Systems: Definition, Characteristics of Manufacturing Information Systems (MIS), Objectives, MIS support to Computer Integrated Manufacturing (CIM), Conceptual frame work of information system, components of information system, architecture. Total quality management of MIS.

Unit III

Information system applications in manufacturing Sector: Information system for Production Management, Financial Management, Materials Management, Personnel Management, Marketing Management. Manufacturing systems modules-Manufacturing database, Master production schedule, Work in process control, inventory control.

Unit IV

Decision Support systems (DSS) and Executive Information Systems (EIS): Definition, Characteristics, ingredients, categories and classifications of DSS. Benefits and limitations of DSS. Definition of EIS, Characteristics, EIS needs, components, development process, obstacles.

Unit V

Business Process Reengineering (BPR) and Enterprise Management Systems (EMS): Definition of BPR, Business performance measure, process model of the organization, Reengineering opportunity, EMS- meaning, components. Enterprise Resource planning system (ERP), architecture, models and modules, ERP basic features, benefits of ERP.

Text Books

1. Mickell. P. Groover, “Automation, Production systems & computer Integrated Mfg”, Pearson Education, 2004.
2. W.S.Jawadekhar, “Management Information Systems”, 2nd Ed. TMH, 2002

Reference Books

1. James A.O’Brien , “Management Information Systems” , 4th Ed, Irwin McGrawHill, 1999.
2. R.Senapathy , “Management Information Systems”, Laxmi Publications, 2004.
3. A.K.Kochhar, “Development of Computer based production systems”, Edward Arnold, 1979.
4. George M.Marakas, “Decision support systems in the 21st century”, Pearson Education, 2003.

12ME249 INTRODUCTION TO MICRO ELECTRO MECHANICAL SYSTEMS

Credits: 3:0:0

Course Objective:

- To give an introduction to the concepts in micro electro mechanical systems and understand the various sensors.

Course Outcome:

- Students will be able to know the concepts in micro electro mechanical systems and understand the various sensors.

Unit I

Introduction: MEMS and Microsystems – Evolution of Micro Fabrication – Micro Systems and Microelectronics. Application of MEMS in Various Fields.

Unit II

Working Principle of MEMS Devices: Working Principle:- Micro Sensors – Acoustic wave sensor, Biomedical sensor, Chemical sensor, Optical sensor, pressure sensor, thermal sensor; Micro Actuation – Actuation using thermal force, shape-memory alloys, piezo crystal, electrostatic forces; Micro Actuators – micro grippers, micro motors, micro valves, micro pumps Micro Accelerometer; Micro Fluidics.

Unit III

Materials for MEMS: Introduction – Substrate and Wafer, Active Substrate Material. Silicon as a substrate material, Silicon Compounds, Silicon Piezo Resistors, Gallium Arsenide, Quartz, Piezo Electric Crystals, Polymers.

Unit IV

Scaling Laws in Miniaturization: Introduction to Scaling – Scaling in Geometry, Scaling in Rigid Body Dynamics, Scaling in Electrostatic Forces, Scaling in Electromagnetic Forces, Scaling in Electricity, Scaling in Fluid Mechanics, Scaling in Heat Transfer.

Unit V

MEMS Fabrication Techniques: Introduction – Photolithography, Ion Implantation, and Diffusion – Oxidation, CVD, PVD, Etching. Overview of Micro Machining – Bulk Micro Machining, Surface Micro Machining, LIGA Process. MEMS Packaging:**-** Introduction to MEMS packaging. Case study on pressure sensor packaging.

Text Book

1. Tai-Ran Hsu, "MEMS & Microsystems – Design and Manufacture," Tata McGraw Hill, 2002.

Reference Books

1. Naldim Maluf," An Introduction to Micro Electro Mechanical Systems", Artech House, 1999.
2. Sergey Edward Lyshevski," MEMS & NEMS, Devices and Structures", CRC Press, 2002.
3. Sami Franssila," Introduction to Micro Fabrication", Wiley, 2004.

12ME250 MECHATRONICS

Credits: 3:0:0

Course Objective:

- Mechatronics subject deals with mechanical and electronic devices. -To know the basic concept of pneumatic, electro pneumatic, electro hydraulic, and hydraulic components.-To know the basic concept of sensors, transducers, electronic interface subsystems, electromechanical drives, microprocessor and programmable logic controllers.

Course Outcome:

- Students will be able to know the basic concept of sensors, transducers, electronic interface subsystems, electromechanical drives, microprocessor and programmable logic controllers.

Unit I

Introduction: Introduction to mechatronics – Systems - Measurement systems - Control systems - Pneumatic actuation systems - Electro-Pneumatic systems - Hydraulic actuation systems – Electro-hydraulic actuation systems.

Unit II

Sensors and Transducers: Introduction – Performance Terminology – Displacement, position and proximity – velocity and motion – Fluid pressure – Temperature sensors – Light sensors – Selection of sensors – Signal processing.

Unit III

Electronic Interface Subsystems: Sensor interfacing – Interfacing – Solenoids – Buffer IC's – Over current sensing, resettable fuses, thermal dissipation.
Electromechanical drives: Relays and solenoids, stepper motors – DC servomotors.

Unit IV

Microcontrollers overview: Microprocessor structure – Analog interfacing – Digital interfacing – Digital to analog converters – Analog to digital converters – LED Blinking, voltage measurement using ADC.

Unit V

Programmable Logic Controllers: Basic structure – Programming – Ladder diagram – Timers, internal Relays and Counters – Shift Registers – Master and jump controls – Analog input/output – PLC selection – Application.

Text Books

1. “Mechatronics”, HMT Ltd., Tata McGraw Hill Publication Co. Ltd., 2002.
2. Bolton W., “Electronic Control Systems in Mechanical and Electrical engineering” 2002 Edition.

Reference Books

1. Dan Necsulescu, “Mechatronics”, Pearson Education Asia, 2002 (Indian reprint).
2. Devadas Shetty, Richard Akolk,”Mechatronics System Design” First reprint 2001.
3. Ramachandran S., Shiva Subramanian A., “Mechatronics” 2004 Edition.

12ME251 BASIC AUTOMOBILE ENGINEERING

Credits: 3:0:0

Course Objective:

- This course deals mainly with Basic concepts of Automobile Engineering and types of IC Engines.

Course Outcome:

- Students will be able to know the basic concepts of Automobile Engineering and types of IC Engines

Unit I

Introduction : Classification of vehicles, body and load (definition only) - Layout of an automobile chassis, function of major components of a vehicle and introduction to their different systems such as frame, transmission (clutch and gear box), braking system, steering and suspension systems (just line diagrams and utility)

Unit II

Thermodynamics: First and second law of thermodynamics (concept only), Otto cycle, diesel cycle, fuel used, properties of fuels, air requirement for complete combustion of fuel

Unit III

IC Engines: Concept of two stroke and four stroke petrol and diesel engines and their applications to automobiles. Various terms, specification of automobile engines

Unit IV

Automotive Systems: Automobile fuel system: Fuel tank, filters, spark plug, ignition systems, carburetor, MPFI, CRDI, fuel injection - Automobile cooling system: Air and water cooling, radiator, fan, water pump - Auto lubrication system: Lubricants, necessity and desirable properties.

Unit V

Auto Industry in India: History, leading manufacturers, development in automobile industry, trends, new products

Text Books

1. Automobile engineering by Ramalingam.k(2004), Scitech publications, chennai
2. Automobile Engineering by Dr. Kirpal Singh(2003), Strandard Publishers, Delhi

Reference Books

1. Automobile Engineering by RB Gupta, Satya Parkashan, New Delhi
2. Thermal Engineering by P L Ballaney, Khanna Publishers, New Delhi

12ME252 COMPUTER WORKSTATION ERGONOMICS

Credits: 3:0:0

Course Objective:

- The students completing this course are expected to: apply the ergonomic principles to the development of computer workstations in which **people** play a significant role. They will recognize the human as the most important component of our current technological systems. They will be able to become as Ergonomists who can apply the Ergonomic aspects in the design of office (computer) workstations to fit and accommodate the human. They will be able to identify problems faced by different kinds of people and to design suitably to reduce the discomfort experienced by them

Unit I

Introduction: Introduction – The Development of Ergonomics: Evolution of Disciplines – Directions in Europe – Directions in North America – Names for the Discipline: "Ergonomics" and "Human Factors". The Ergonomic Knowledge Base: Professional Organizations – Sources of Ergonomic Information

Unit II

The anatomical and Mechanical Structure of the Human Body: Anthropology and Anthropometry: Measurement Techniques – Available Anthropometric Information – Anthropometric statistics – "Fitting" Design procedures. Human Biomechanics: The Skeletal System – Muscle – Biomechanical Description of the Body – Human Strength – Assessment of Human Strength.

Unit III

How the Mind Works: The "Traditional" and the "Ecological" Concepts – Organization of the Nervous system – Responding to Stimuli – Mental Workload: "Stress" on Individuals and Crews – Strain Experienced by an Individual – Strain Experienced by Confined groups. Enhancing Performance: General Findings – Specific Findings – Enhancing Team work

Unit IV

The Office (Computer) Work Station: Introduction – Theories of Healthy Sitting – Ergonomic Design of the Office Workstation: Designing the Visual Interface – Designing the Motoric Interface – Designing the Sit- Down Workstation. Design Principles: Environment – Design for Change – Furniture – Designing the stand up workstation – Data Entry Devices – Display Screen – Job Content and Work Organization – Changes through Technological Developments.

Unit V

Designing for Special Population: Special Designs for Women and Men – Designing for Pregnant Women – Designing for Children – Designing for the Aging: Anthropometry – Changes in Biomechanics – Designing for the Aging Vision – Ergonomic Design for Disabled Persons – Ergonomic means to Enable the Disabled.

Text Book

1. Karl Kroemer, Henrike Kroemer, Katrin Kroemer-Elbert, "ERGONOMICS" How to Design for Ease & Efficiency, Prentice Hall International Editions, 2001.

Reference Books

1. McCormick, E.J., and Sanders, M.S: Human Factors in Engineering and Design. Published by McGraw-Hill, New York, 1993.
2. Wesley E. Woodson, Berry Tillman and Peggy Tillman: Human Factors Design Handbook, Published by McGraw-Hill Inc., 1992.
3. Garriel Salvendy, Handbook of Human Factors, A Wiley-Interscience Publications, Published by John Wiley & Sons, Inc., 1987.

12ME301 CAD/CAM LABORATORY

Credits 0:0:2

Course Objective:

The main purpose of this course is

- To provide the role of Computer Modeling on the Mechanical Engineering studies.
- To provide some useful CNC Programming knowledge
- To visualize the object in three dimensions and producing orthographic views, sectional views and auxiliary views of it.

Course Outcome:

At the end of the course the students will be able to:

- Visualize an object in 3-D and Work with the Solid works commands
- write CNC Programming for different components for Manufacturing
- Develop ability to create parts, and assemble the parts to create a functional assembly as part of problem solving.

LIST OF EXPERIMENTS

Using SOLID WORKS

1. Part model using Basic commands like Extrude, Round, Mirror ,Revolve , Hole & pattern
2. Part model using Rib , Chamfer, Draft commands
3. Part model using Advanced modeling commands- Sweep, Draft and Blend.
4. Generating Sectional and Auxiliary views
5. Assembly and detailing of Plummer block
6. Assembly and detailing of Screw Jack
7. Study and programming of CNC XL Mill Trainer.
8. Profile cut: Linear interpolation.
9. Profile cut: Circular interpolation.
10. Profile cut: Linear and circular interpolation.
11. Square pocketing and drilling using canned cycles.
12. Mirror programming.
13. Step turning in CNC Trainer lathe.

(Any 12 Experiments can be offered)

12ME302 ENGINEERING MEASUREMENTS

Credits: 4:0:0

Course Objective:

- To provide an overview of measurement techniques for measuring process parameters in industry and in research

Course Outcome:
At the end of the course the students will be able to:

- Choose measuring instruments suitable for specific application.
- Fabricate a system for measuring simple parameters.

Unit I
MEASUREMENT OF TEMPERATURE: Introduction – temperature standards – liquid in glass thermometers – calibration – stem correction – total and partial immersion thermometers – bimetal thermometers – pressure thermometers – vapor pressure thermometers – resistance thermometers – instrumentation for resistant thermometers – thermistor – thermo electric thermometers – loss thermo couples – measurement of thermo emf – extension wires – effective junctions – thermo piles – pyrometers – total radiation and optical pyrometers – infrared and photo electric pyrometers – calibration of temperature measuring devices.

Unit II
MEASUREMENT OF PRESSURE AND LEVEL: Measurement of pressure – bourdon tube – calibration of bourdon tube – elastic diaphragm – inductive pressure sensors – strain gauge pressure cells – bulk modulus pressure gauge – McLeod Gauge – thermal conductivity gauge – ionization gauges – dynamic characteristics of pressure measurement systems – calibration of pressure measurement systems – level measurements – direct methods – float type level sensors – float switches – pressure gauge and piezometric level meters – capacitance and resistance type level sensors – radio active method of level sensing – solid level detectors – grid response units – electrical capacitance and diaphragm methods – probe deflection unit – electrical contact and rotating paddle unit

Unit III
MEASUREMENT OF FLOW: Introduction – classification of flow meters – flow characteristics – obstruction meters – venturi meters and dall tubes – variable area meters – rotameters-measurement of fluid velocity – total, static and direction sensing probes – special flow meters – turbine type flow meters – thermal flow meters – magnetic flow meters – mass flow meters – ultrasonic flow meters – pulse producing flow meters – calibration of flow meters

Unit IV
MEASUREMENT OF STRAIN: Theory of strain gauges – construction – bonded and unbounded strain gauges – metal foil and semi conductors gauges – gauge factor of strain gauges – selection and installation – bonding methods – gauge protection – gauge configuration – strain gauge circuits – ballast and bridge circuits – bridges with 2 and 4 arm sensitivity – compensating gauge – bridge constant – constant current strain gauge circuits – temperature compensation – calibration of strain gauges – commercial strain measuring systems – use of strain gauges on rotating shafts – different gauge orientation and interpretation of results

Unit V
MEASUREMENT OF FORCE ,TORQUE AND MISCELLANEOUS MEASUREMENTS: Introduction – mass standards – pendulum scale – elastic transducers – the proving ring – strain gauge load cells – temperature sensitivity – piezo load cells – ballistic weighing – hydraulic and pneumatic systems – measurement of torque – mechanical and hydraulic dynamometers – electric dynamometers – transmission dynamometers – acoustical measurement – basic acoustical parameters – micro phones – sound level meters – measurement of humidity – hair hygrometer – measurement of pH – pH meter – measurement of air pollution – Orsat apparatus – gas

chromatography – nuclear instrumentation – Giger muler counter – scintillation counter – ionization chamber

Text Books

1. Beckwith, "Mechanical Measurement" Narosa Publishing House2003
2. R.K. Jain, "Mechanical and Industrial Measurements" Khanna Publishers, 2000

Reference Books

1. J.P. Holman, "Experimental methods for Engineers" McGraw Hill Publishers, 1998
2. E.O. Doebelin, "Measurement systems : Application and Design" McGraw Hill Publishers, 1990
3. B.C. Nakra "Instrumentation measurement and Analysis" Tata McGraw-Hill Publising Company, 2002

12ME303 DESIGN OF THERMAL POWER EQUIPMENTS

Credits: 3:1:0

Course Objectives:
The main purpose of this course is

- To educate students on Thermal systems used in power generation.
- Familiarize students in design considerations for boilers heaters and condensers.

Course Outcome:
At the end of the course the students will have:

- Knowledge on thermal powers systems.
- Designing skills on various thermal equipments.

Unit I
Design considerations : Services – requirements - parameters to be considered in Boiler Design - IBR Code Furnace Design: Heat Transfer in Furnace – heat balance – types of refractory walls – Furnace – Water wall arrangements. Heat release rates – furnace bottoms – Slag removal – Cold primary air system – wind box assembly Different types of furnaces for solids and liquids.

Unit II
Water Side Design: Circulation-natural, forced-circulation ratio. Design of condensers – Economic selection of condensers. Types-Direct contact, surface condensers. Vacuum efficiency – Air leakage into the condenser-air removal-dry, wet pumps. Cooling tower-Types and design for power plant application.

Unit III
Performance of boiler: Equivalent evaporation-Boiler efficiency-boiler trail-heat losses in boiler. Economiser-types, design. Super Heater –Design, Economy of super heat limit of super heat, super heater performance, steam mass flow gas mass flow and pressure drop in super heater. Super heat temperature control. Desuperheater-design. Design of Reheater.

Unit IV

Water & Steam purification : Chemical treatment mechanical carry over – Silica carry over gravity separation – drum internals – steam washing typical arrangements of boiler drum internal in H.P. boilers

Unit V

Air Pre-Heaters: Types of Air heater, recuperative and regenerative – Design considerations – Higher temperature and low temperature applications.

Draft system design: Power requirement for draft fans, Pressure losses – Diameter and height of the chimney Design – Forced, induced, balanced drafts – Ash separators by ESP Electrostatic precipitators.

Text Books

1. P.K. Nag., 'Power Plant Engineering (Steam and Nuclear)', Tata McGraw Hill, New Delhi, 1998.
2. C.D. Shields., 'Boilers', McGraw Hill, 1982.

Reference Books

1. Homi, P. Serval., 'Boilers Pressure Vessels', Multitech Publishing Company, Bombay, 1989.
2. Skrotzki & W.A. Vepot., Power Station Engg. Economy, Tata McGraw Hill, NewDelhi, 1987.
3. Morse, T.F., ' Power Plant Engineering', Van Nostrand East West Press, revisedEdn.,1983.
4. David Sunn, Robert Houston., 'Industrial Boilers', Longman Science & Technology,1986.
5. 'Modern Power Station Practice', Vol. 8, Central Electricity Generating Board,UK,Pergamon Press, 1971.

12ME304 COMPUTER INTEGRATED MANUFACTURING SYSTEMS

Credits: 4:0: 0

Course objective:

- To use computers in the area of manufacturing to reduce manual processing and linking computers to all the manufacturing machines and increase the productivity, reduce the unnecessary costs.
- To study about group technology, computer aided process planning, material requirement planning (MRP) Enterprise resource planning **(**ERP**),** Computer aided quality control and Flexible manufacturing systems, Artificial intelligence and Expert systems

Course outcome:

- Students will be able to use computers in the area of manufacturing to reduce manual processing and linking computers to all the manufacturing machines and increase the productivity, reduce the unnecessary costs.
- Student will be able to study about group technology, computer aided process planning, material requirement planning (MRP) Enterprise resource planning **(**ERP**),** Computer aided quality control and Flexible manufacturing systems, Artificial intelligence and Expert systems

Unit I

Introduction: Objectives of a manufacturing system-identifying business opportunities and problems classification production **-** systems-linking manufacturing strategy and systems-analysis of manufacturing operations.

Unit II

Group Technology And Computer Aided Process Planning: Introduction-part families-parts classification and cooling - group technology machine cells benefits of group - technology. Process planning function CAPP - Computer generated time standards.

Unit III

Computer Aided Planning and Control: Production planning and control-cost planning and control-inventory management-Material requirements planning - (ERP)-shop floor control-Factory data collection system-Automatic identification system-barcode technology automated data collection system.

Unit IV

Computer Monitoring: Types of production monitoring systems-structure model of manufacturing process-process control & strategies direct digital control-supervisory computer control-computer in QC - contact inspection methods non-contact inspection method - computer-aided testing - integration of CAQC with CAD/CAM.

Unit V

Integrated Manufacturing System: Definition - application - features - types of manufacturing systems-machine tools-materials handling system computer control system - DNC systems manufacturing cell. Flexible manufacturing systems (FMS) - the FMS concept-transfer systems - head changing FMS – variable mission manufacturing system - CAD/CAM system - human labour in the manufacturing system-computer integrated manufacturing system benefits. Rapid prototyping - Artificial Intelligence and Expert system in CIM.

Text Books

1. Groover, M.P., "Automation, Produ tion System and CIM", Prentice-Hall of India,2005.

Reference Books

1. David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi, I Edition 1999
2. Yorem Koren, "Computer control Manufacturing Systems", McGraw Hill, 1999.
3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International 1999

12ME305 COMPUTER APPLICATIONS IN DESIGN

Credits: 4:0:0

Course Objective:

- To study how computer can be used in mechanical engineering design.
- To familiarize the basics of CAD and Visual realism.
- To learn about the assembly of parts, tolerance analysis, mass property calculation, Solid modeling techniques and rapid prototyping.

Course Outcome:

- Student will be able to study how computer can be used in mechanical engineering design.
- Student will be able to familiarize the basics of CAD and Visual realism.
- Student will be able to learn about the assembly of parts, tolerance analysis, mass property calculation, Solid modeling techniques and rapid prototyping.

Unit I

Introduction to Computer Graphics Fundamentals: Output primitive-(points, Lines, curves, etc) 2-D Transformation (**2-D** Translation, scaling, rotation) Windowing and clipping transformation.

Unit II
Introduction to CAD Software's: Writing interactive programs to solve design problems and production of drawings using any languages like Auto LISP/C/ FORTRAN etc. Creation of surfaces, solids etc., using solid modeling pack (prismatic and revolved parts)

Unit III
Visual Realism: Hidden line- surface- Solid removal algorithms shading- coloring . Introduction to parametric and variational geometry based on software's and their principles creation of prismatic and lofted parts using these packages.

Unit IV
Assembly of Parts: Assembly of parts, tolerance analysis and mass property calculations, mechanism simulation.

Unit V
Solid Modeling: Rapid prototyping – data exchange- Documentation- Customizing- solid Modeling system.

Textbook

1. IBRAHIM ZEID,CAD/CAM- Theory and Practice McGraw Hill, Indian Edition,2005

Reference Books

1. Mikell. P. Grooves and emory, W. Zimmers Jr. "CAD/CAM Computer aided Design and Manufacturing " prentice Hall of Inc., 2002
2. Donald Hearn and M Pauline Baker "Computer Graphics Printice Hall Inc. III Edition2006.
3. Hall A.S. Holowenko A.R. and Laughlin H.G., 'Theory and Problems in Machine Design', Schaum's Series,2000.
4. Hall and Allen, 'Machine Design', S.Schaum's Series, .Ist edition 2001
5. Joseph Edward Shighley, 'Mechanical Engineering', McGraw Hill, 2002

12ME306 ENGINEERING MATERIALS AND APPLICATIONS

Credits 4:0:0

Course Objective:
- To provide an overview of mechanical behavior, fracture behavior, Modern metallic materials.

Course Outcome:
- The students will able to choose the particular material for an application.
- The students will become familiar with modern metallic materials, composite materials

Unit I
Elastic and Plastic Behavior: Elastic behaviour – atomic model of Elastic behaviour – Rubber like Elasticity anelastic behaviour- visco elastic behaviour-plastic deformation- slip- shear strength of perfect and real crystals- movement of dislocation – effect of temperature on dislocation movement. sources of dislocation – work hardening- effect of grain size solute atoms and precipitate particles on dislocation movement.

Unit II

Fracture Behavior: Ductile and Brittle fracture - Griffiths theory – fracture toughness- Ductile Brittle Transition - protection against fracture – fatigue Failure of ferrous and non ferrous materials- fatigue tests- mechanism of fatigue failure – fatigue strength - Methods to improve fatigue strength- Creep and creep resistant materials.

Unit III

Modern Metallic Materials: Patented Steel wire - Steel martensite- ausformed steels- micro alloyed steels- precipitation hardened aluminium alloys- Maraging steels – metallic glasses – shape memory alloyssmart Materials- TRIP Steels.

Unit IV

Ceramics and glasses: Introduction- Ceramic Structures- silicate ceramics- simple silicates- layered silicates- carbon –diamond- graphite- imperfections and impurities in ceramics –brittle fracture and fractural strength of ceramics - applications and processing of ceramics- glasses- glass properties glass forming- heat treatment of glass – glass ceramics- clay products- fabrication techniques- refractories – abrasive ceramics and their processing- powder pressing and tape casting-cements- advanced ceramics- heat engine applications.

Unit V

Composite Materials: Introduction – Particle reinforced composites- fiber reinforced composites- influence of fiber length and orientation-fiber and matrix materials- polymer matrix composites- glass fiber - reinforced polymer composites, carbon fiber- reinforced polymer composites, aramid fiber reinforced composites- metal matrix composites- ceramic - matrix composites- carbon – fiber carbon composites- hybrid composites- processing of FRP- pultrusion – filament winding- structure of composites.

Text Books

1. Raymond A. Higgin's " Engineering Metallurgy Part 1 (Applied Physical Metallurgy) English Language Book Society.2000
2. George. E. Dieter ' Mechanical metallurgy" Mc Graw hill Book Company. 1998.
3. Thomas H. Courtney ' Mechanical Behaviour of Materials" McGraw Hill International Edition.2000

Reference books

1. Raymond A. Higgin's " Properties of Engineering Materials, English Language Book Society.2000
2. V. Raghavan, " Materials Science and Engineering – Prentice Hall of India (P) Ltd., New Delhi.1998.
3. Williams D, Callister " Material Science and Engineering" John Wiley & sons inc.1996.

12ME307 ADVANCED STRENGTH OF MATERIALS

Credits: 4:0:0

Course Objective:

- To understand the basic concepts of stress, strain, displacement and transformations
- To understand estimate strength, predict failure and incorporate design considerations
- To understand and use energy methods to find force, stress and displacement in simple structures.
- To understand stresses in open and closed sections in torsion and bending

- To understand stress functions, and understand stresses in plates and shells, thick circular cylinders and discs, contact stresses and stress concentration.

Course Outcome:

1. Student will be able to apply concepts stress, displacement and transformations to 1D, and 2D solids under load.
2. Student will be able to calculate strength, predict failure and incorporate design considerations in shafts and beams.
3. Student will be able to apply and use energy methods to find force, stress and displacement in simple structures.
4. Student will be able to calculate stresses in open and closed sections in torsion and bending of standard sections
5. Student will be able to apply stress functions, and calculate stresses in plates and shells, thick circular cylinders and discs and employ contact stresses and stress concentration knowledge.

Unit I

Basic Concepts of Force, Stress, Strain and Displacement, Transformations: Introduction – force diagrams- free body diagrams- force Distributions- stress- strain relations. Displacements, Strain –Displacement relations, problems. Coordinate systems - 3D Stress Transformation- Strain transformations- Generalized 3D stress –strain relations- the equilibrium equations – Compatibility.

Unit II

Strength, Failure Modes, and Design Considerations: Strength- The Design Factor-Strength - failure theories. – Basic- Tresca, Von Mises theories and comparison of theories - Plasticity and limit design concepts- Inelastic Behavior- Engineering Approximations used in Statically Indeterminate Problems - Typical design problems involving these theories with Axial loading-Beams in bending-bending of symmetric beams in Two planes.-problems

Unit III

Energy Techniques: Work- Strain Energy, total Strain Energy in Bars with Simple Loading Conditions- Castigliano's first Theorem- Castigliano's Second Theorem- Castigliano's Second Theorem Applied to statically Determinate problems - Deflections of Thick-Walled Curved Beams - The Virtual Load Method, the Virtual Load Method applied to Statically Indeterminate Problems - Rayleigh's Method applied to Beams in Bending. Straight Beams undergoing the combined effects of Axial and Transverse loading.

Unit IV

Torsion and Bending of structures: Torsion of non circular sections, rectangular and steel rolled sections- Torsional strain energy – Closed thin - walled tubes-shear - open thin – walled beams-shear flow - torsion of closed thin-walled tubes-single cell multiple cell sections – Bending of unsymmerical Beams-Transverse shear stresses-Shear Center with one axis of symmetry- Shear center for open and unsymmetrical thin-walled beams - Composite beams in bending – Curved beams

Unit V

Concepts from the theory of Elasticity: Plane Elastic problems - The Airy Stress Function-Prandtl's stress function for torsion-Torsion of a rectangular cross section - Bending of thin–flat rectangular and circular plates- shell structures – Thick walled cylinders and rotating disks-Contact stresses - stress concentrations.

Text Books

1. Richard G. Budynas, “Advanced Strength and Applied Stress Analysis” (2nd Edition) by, McGraw-Hill International Editions, 1999.
2. L.S. Srinath, “Advanced mechanics of solids”, (2nd Edition) by Tata McGraw-Hill, 2003

Reference Books

1. S.Timoshenko and SW Krieger ., “Theory of plates and shells” , by, McGraw – Hill International Edition 1999, Engineering mechanics series
2. S.Timoshenko and D.H.Young , “Elements of strength of Materials”, by. D Van Nostrand Co., 1968

12ME308 FINITE ELEMENTS ANALYSIS

Credits: 3:1:0

Course Objective:

- To equip the students with the Finite Element Analysis fundamentals.
- To enable the students to formulate the design problems into FEA.
- To introduce basic aspects of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, solution of the resulting algebraic systems and Various types of elements.
- To provide necessary skills to implement the Galerkin residual weak formulation into the Finite Element Method for the solution of Ordinary and Partial Differential Equations.

Course Outcome:

The students will be able to:

- Identify mathematical model for solution of common engineering problems.
- Formulate simple problems into finite elements.
- Determine engineering design quantities for structural , heat transfer and fluid mechanics problems
- Use professional-level finite element software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer.
- Derive integral statements for linear partial differential equations, such as the Laplace/Poisson equation, the wave equation, and the elasticity equations.
- Derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts.

Unit I

Introduction: Basic concepts- General applicability of the method to structural analysis, heat transfer and fluid flow problems- general approach of finite element method with case studies in stress analysis, classical analysis techniques-finite element packages - Solution of Finite Equations: Solution of equilibrium problems- Gauss elimination techniques, Choleski method solution of Eigen value problem , Jacobi method, power method, subspace interaction method- Solution of propagation problems, numerical solutions.

Unit II

General Procedure: Discretization of Domain- basic element shapes- interpolation polynomials- natural coordinates- formulation of element characteristic matrices and vectors- direct approach variational approach and weighted residual approach. Formulation of one dimensional, two-dimensional, continuity conditions- isoparametric elements- curve sided elements- numerical integration.

Unit III

Solid and structural mechanics: Basic equations of solid mechanics- Static analysis- formulation of equilibrium equations Analysis of trusses and frames- analysis of plates- Solid of revolution. Dynamic analysis –dynamic equations of motion- consistent and lump mass matrices- Free vibration analysis – dynamic response calculation.

Unit IV

Field problems: Two dimensional field equation- governing differential equations- Integral Equations for the element matrices- Element matrices- Triangular element, Rectangular element problems. Torsion of Non circular sections: General theory- Twisting of a square bar shear stress components- Evaluation of the twisting torque- Computer solutions for the square bar problems.

Unit V

Heat Transfer Problems: Basic equations of heat transfer derivation using finite element Method for 1D & 2D problems.

Fluid mechanics problems: Basic equations- Solutions procedure- compressible flows- Galerkin approach.

Boundary Element Method (BEM): Introduction, Types, Advantages & Disadvantages of BEM-Types of Boundary Elements-Infinite Boundary Element

Text Books

1. Rao. S.S. "The Finite element method in Engineering", IInd Ed., Pergamon Press, Oxford, 2003
2. J.Ramachandran, "Boundary and Finite Element Theory and Problems", Narosa Publishing House, 2000.

Reference Books

1. C.S. Desai and J.P. Abel. " Introduction to Finite Element Method" Affiliated East West Press, 2002..
2. David.V.Hutton, " Fundamentals of Finite Element Analysis", Tata McGraw Hill,2003
3. Tirupathi.R.Chandrupatla, Ashok.D.Belegundu. 'Introduction to Finite Elements in Engineering', Prentice Hall of India, 2004.
4. J. N. Reddy, "An Introduction to the Finite Element Method", 3rd ed., McGraw-Hill Education (2005).

12ME309 MECHATRONICS AND MACHINE CONTROLS

Credits: 4:0:0

Course Objective:

To impart knowledge on the fundamentals of the following

- Control systems
- Programmable logic circuits
- Controls in NC machine
- Fluidic Controls and
- Process control Pneumatics

Course Outcome:

- The students will become familiar with the different aspects of mechatronic engineering and will have working knowledge to handle problems involving mechatronic and control elements.

Unit I

Introduction: Introduction - multidisciplinary scenario - evolution of mechatronics - scope of Mechatronics - measurement systems - control systems - servomechanisms and regulators - control system fundamentals - block diagrams and block diagram reduction .

Unit II

Control systems and programmable logic controllers: Stability of control systems - Rouths and Hourwitz stability criteria - programmable logic controllers (PLC) - input output processing - programming (fundamentals only) – mnemonics -timers - shift registers - master and jump controls - data handling - selection of PLC.

Unit III

Elements of Mechatronics: Mechartonic elements - data presentation systems - displays - analog and digital indicators - analogous chart recorders - visual display units - CRO - printers - magnetic recorders – light indicators - liquid crystal display units - alarm indicators data loggers - computers with plug in boards-data acquisition systems.

Unit IV

Controls in NC Machines and fluidic control: Controls in NC Machines-hydraulic systems - direct current motors - stepping motors - feedback devices-encoders - resolvers - inductosyn – tachogenerators - principles of fluid logic control -Coanda effect - basic fluidic devices - fluidic logic gates - bistable - flipflop - OR and NOR gates - exclusive OR gates - fludic sensors - backpressure sensor - cone jet proximity sensor -interruptible jet senor.

Unit V

Process control Pneumatics: Process control pneumatics - signals and standards - the flapper nozzle - volume booster – air relay and force balance - pneumatic controllers - proportional pneumatic control - proportional plus integral pneumatic control - proportional plus integral plus derivative pneumatic control - PI and IP convertors.

Text books:

1. W Boltson , 'Mechatronics',PearsonEducation third edition 2007.
2. Andrew Parr, 'Hydraulics and Pneumatics', Jico Publishing House ,Mumbai 2006.
3. Kuo, 'Automatic Control Systems', Asian student Edition, Printice Hall of India,2005.

Reference Books:

1. Mahalik,Nitaigour,Premehand, 'Mechatronics', TataMc.Graw Hill Publishers, New Delhi 2005.
2. Anthony Esposito, 'Fluid Power', Pearson Education, 2005
3. Ogata Katsuhiko , 'Modern Control Engineering', Printice Hall of India , 2005.
4. Yoram Koren, 'Computer control of Manufacturing Systems', TataMc.Graw Hill Publishers, New Delhi, 2005.

12ME310 COMPUTER AIDED ENGINEERING LABORATORY

Credits: 0:0:2

Course Objective:

- To impart the fundamental knowledge on using various analytical tools like ANSYS, FLUENT, etc., for Engineering Simulation.
- To know various fields of engineering where these tools can be effectively used to improve the output of a product.
- To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools.

Course Outcome:

- The student will be able to appreciate the utility of the tools like ANSYS or FLUENT in solving real time problems and day to day problems.
- The students will become versatile in using these tools for any engineering and real time applications.
- They will also acquire knowledge on utilizing these tools for a better project in their curriculum as well as they will be prepared to face industry with confidence when it matters to use these tools in their employment.

List of Experiments:

Introduction of ANSYS tools, its utilities and Fundamentals of FEM .

1. Application of ANSYS in structural problems – Simple truss problems, 1D problem.
2. Application of ANSYS in structural problems – Beam problems, 2D and 3D problems.
3. Structural Analysis of Corner Bracket using ANSYS.
4. Application of ANSYS in vibration problems – Modal analysis
5. Application of ANSYS in vibration problems – Harmonic analysis
6. Thermal Analysis of 3D Fin Using ANSYS
7. Application of ANSYS in thermal problems – Transient heat conduction problems
8. Application of ANSYS in thermal problems – Transient heat convection problems
9. Application of ANSYS in CFD problems – Flow problem – (laminar or turbulent flow problems)
10. Application of ANSYS in coupled field problems – problems combining structural & thermal.
11. Application of ANSYS in Electrical problems – Electrical field problems.
12. Design Optimization

12ME311 ADVANCED THERMODYNAMICS AND HEAT TRANSFER

Credits: 3:1:0

Unit 1

Review of first law and second law of thermodynamics. Entropy – entropy evaluation- local and global equilibrium.Third law of thermodynamics.
Availability – availability analyses for a closed system, generalized availability analysis, availability efficiency

Unit II

State Relationships For Real Gases and Liquids.Equations of State, Real Gases -Virial Equation of State- Van der Waals (VW) Equation of State. Compressibility Charts.
James Clark Maxwell Relations Generalized Relations Helmholtz Function. Gibbs free energy or Chemical Potential, fugacity and activity,Pitzer Effect

Unit III

Thermodynamic Properties of Mixtures-Phase Equilibrium,Ideal Solution and Raoult's Law Dissolved Gases in Liquids, Henry's Law, Stability criteria, Entropy generation during irreversible transformation

Combustion Principles - Thermodynamics concepts of combustion. First law and second law of thermodynamics applied to combustion process – heat of combustion – Adiabatic flame temperature –stoichiometry and excess air – combustion calculations – minimum air required for complete combustion of fuel – chemical equilibrium and dissociation.

Unit IV

Review of Heat transfer principals-Conduction, convection and Radiation
Boiling -Boiling Curve- Boiling Nucleation - Flow Patterns in Vertical and Horizontal Tubes Condensation Nusselt's Analysis of a Vertical Flat Plate Film Condensation on Single Horizontal Finned Tubes, Condensation in Plate Heat Exchangers- Steam Condensation Heat Transfer

Unit V

Experimental Methods - Fundamentals-Measurement Error. Heat Transfer Enhancement - Enhancement Techniques -Treated Surfaces -Rough Surfaces Heat Transfer in Electronic Equipment and Heat Pipes-An Introduction.

Text Books

1. Advance thermodynamics engineering, kalyan annamali & ishwar k.puri ,crc press
2. Heat transfer handbook,Adrian Bejan & Allan d. Kraus,john wiley & sons, inc.,2003

Reference Books

1. Yunus A Cengel, 'Thermodynamics An Engineering Approach', The McGraw Hill Companies, 6th Edition, 2008.
2. P.K. Nag., 'Engineering Thermodynamics', 3rd Edition., McGraw Hill, 2005.
3. Holman J.P., 'Heat andMass Transfer', Tata McGraw Hill, 8th Ed., 1989.
4. Frank P. Incropera and David P. Dewit T., 'Fundamentals of Heat and Mass Transfer', 4th Ed., JohnWiley & Sons, 1998.
5. C.P. Kothandaraman., 'Fundamentals of Heat and Mass Transfer', 2nd Ed., New Age International, 1997.

12ME312 ADVANCED FLUID MECHANICS & COMPUTATIONAL FLUID DYNAMICS

Credits: 3:1:0

Course Objective:

- To educate students on Eulerian, Lagrangian equation, Bernoulli's equation, Differential momentum equation, Navier Stoke Equations and Energy Equation
- To give basic knowledge about Computational Fluid Dynamics
- To familiarize students with irrotational motion in two dimensions, flow over cylinders and boundary layer principles.

Course Outcome:

- Students will be able to analyze numerical flow problems
- Students will be able to understand the working Computational Fluid Dynamics Software

Unit I

Introduction: Method of describing fluid motion– Lagrangian, Eulerian Method – Local and individual time rates of change, acceleration, - Eulerian and lagrangian equation of Continuity. Bernoulli's equation from Euler's equation– solved problems related to liquid motion, related to equation of continuity.

Unit II

Momentum & Energy Equation: Forces and stress acting on fluid particles. Differential momentum equation. Navier Stokes Equations of Motion for simple cases in rectangular, cylindrical and spherical coordinate. Energy Equation

Unit III

Velocity Potential & Stream Function: Irrotational motion in two dimensions, sources and sink Complex potential due to a source, due to a doublet, Images with respect to straight line, solved problem.Vortex motion-Vortex tube, Helmohltz's vorticity theorem, velocity potential and stream function.

Unit IV

Laplace Equation and Boundary Layer theory: Flow over Circular cylinders, sphere, solution of Laplace equation, Joukowshi transformation, Flow past cylinder with and without circulation, flow past Rankine body.Boundary layer principles, flat plate, conduits, curved solid bodies, prandtl mixing length, turbulent theory, universal velocity profile, and momentum eddy concept – simple applications.

Unit V

Computational Fluid Dynamics: Classification of PDEs on CFD: Elliptic, parabolic and Hyperbolic equations, relevant conditions, Governing equations of fluid dynamics: Continuity, Momentum and energy equations (excluding derivation) –Methods of deriving the discretization equations: finite difference and finite volume methods – Transient solutions - Implicit, explicit and Cranck-Nicholson methods - Solution methodologies: Direct and iterative methods, Relaxation method, Alternating Direction Implicit method

Text Books

- Streeter, 'Fluid Dynamics', 3rd Ed., McGraw Hill,2006.
- Raisinghania.M.D, 'Fluid Dynamics', 4th Ed., S.Chand & Company Ltd, 2002.
- Versteeg, H.K, and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Longman, 1998

Reference Books

- Fox R.N. and McDonald A.T., 'Fluid Mechanics', John Wiley & Sons, 1999.
- Dr. J.K Goyal I K.P. Gupta., 'Fluid Dynamics', 3rd revised Ed., Pragathiprakasam,Meerut, 1999.
- Schlichting.H., 'Boundary layer Theory' ,8th Ed.,McGraw Hill, New york,2001.
- Anderson, J.D., " Computational fluid dynamics – basics with applications", 1995
- Ghoshdastidar, P.S., "Computer simulation of flow and heat transfer", Tata McGraw – Hill publishing Compony Ltd., 1998.

12ME313 CFD LABORATORY

Credits: 0:0:2

Course Objective:

- To familiarize the students with the working of CFD codes
- To familiarize the students with actual setting up of the problem and solution procedure
- To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools.

Course Outcome:

- To set up solution domain and grid generation
- To set up boundary conditions and generate the solution

List of Experiments:

Introduction to CFD and FLUENT

1. *One-dimensional steady state heat diffusion – Laplace equation
2. *One-dimensional steady state heat diffusion – Poisson equation
3. *One-dimensional heat transfer in circular fin
4. *One-dimensional unsteady heat diffusion
5. *One-dimensional convection and diffusion

   * Compare with analytical results
6. Introduction to two-dimensional problems
7. Two-dimensional laminar pipe flow
8. Two-dimensional turbulent pipe flow
9. Two-dimensional periodic flow and heat transfer
10. Two-dimensional conjugate heat transfer
11. Periodic Flow and Heat Transfer
12. External compressible flow

12ME314 THEORY OF METAL CUTTING

Credits: 4:0:0

Course Objective:

- To familiarize the student with tool nomenclature and cutting forces
- To give knowledge about heat distribution and thermal aspects of machining
- To impart knowledge on tool materials, tool life and tool wear.
- To educate students on failure analysis of cutting tools

Course Outcome:

- Students will be able to analyze cutting forces in turning, drilling and milling
- Students will be able to adjust varies parameters and reduce temperature developed during machining
- Students will be able to reduce the cost of machinery
- Students will be able to prevent failures of cutting tool.

Unit I

Introduction: Basic mechanism of chip formation - types of chips-Chip breaker - Orthogonal Vs Oblique cutting - force and velocity relationship and expression for shear plane angle in orthogonal cutting - Modern theories in Mechanics of cutting - Review of Merchant and Lee Shaffer Theories.

Unit II

Tool Nomenclature and Cutting Forces: Nomenclature of single point tool - Systems of tool Nomenclature - Nomenclature of multi point tools like drills, milling cutters and broaches. Forces in turning, drilling and milling - specific cutting pressure- measurement of cutting forces.

Unit III

Thermal Aspects of Machining: Thermodynamics of chip formation - Heat distributions in machining - Effects of various parameters on temperature - Method of temperature measurement in machining – Hot machining - cutting fluids.

Unit IV

Tool Materials, Tool Life and Tool Wear: Essential requirements of tool materials - Developments in tool materials-ISO specifications for inserts and tool holders -Tool life - Conventional and accelerated tool life tests - Concepts of machinability and machinability index - Economics of machining.

Unit V

Wear Mechanisms and Chatter in Machining: Reasons for failure of cutting tools and forms of wear - mechanisms of wear - chatter in machining - Factors effecting chatter in machining - types of chatters - Mechanism of chatter based on Force Vs Speed graph.

Text Books

1. Shaw .M.C., " Metal cutting Principles ",Oxford clarendon Press, 2nd edition, 2005.
2. Juneja. B. L and Sekhon.G.S, "Fundamentals of metal cutting and machine tools", New Age International(p) Ltd., 2003.

Reference Books

1. Geoffrey Boothroyd and Knight. W.A "Fundamentals of Machining and Machine tools", Crc Press, New York, 2006.
2. Bhattacharya. - "Metal Cutting Theory and Practice ", New central Book Agency pvt. Ltd., Calcutta, 2000.

12ME315 ADVANCED METROLOGY

Credits: 4:0:0

Course Objective:

- To introduce the science of measurement and measuring machines commonly used.
- To impart knowledge about limits, fits and tolerances, geometric dimensioning aspects
- To introduce the methods of acceptance test for conventional machine tools.
- To familiarize students with the concepts of Laser metrology and surface roughness.

Course Outcome:

- Students will be able to work in metrology divisions in industries
- Students will be able to understand GD and T symbols and apply them.
- Students will be able to understand the advanced metrology systems.

Unit I

SCIENCE OF MEASUREMENT: Mechanical measurement – direct comparison and indirect comparison – the generalized measurement system – types of input quantities – measurement standards – calibration – -procedures, records, intervals, standards, Uncertainty, Errors – classifications of errors – terms used in rating instrument performance – zero, first and second order instruments – methods of correcting for spurious inputs – inherent insensitivity – high gain feed back –signal filtering and opposing inputs.

Unit II

MEASURING MACHINES: Study of Measuring Machines : Length bar Measuring Machine, Co-ordinate Measuring Machine [CMM] –types, construction, programming, Electronic Inspection and Measuring Machines, Multi Dimension Auto Gauging and Sorting Machine, gear tooth measurement- measurement of gear profile – tooth thickness – tooth spacing – pitch circle diameter – Parkinson's gear tester; Photo Electric Micrometer, Telemetric System, Fluidic Numerical Control System, Isometric Viewing of Surface Defects, Image Shearing Microscope for Vertical Dimensions.

Unit III

LASER METROLOGY AND MICROSCOPY: Laser Metrology - Monochromatic Light, Principle of Interference, Light Sources of Interferometry, Optical Flat, Michelson Interferometer, distance measurement using laser, Gauge block interferometer. Principles of Microscopy - Reticles and Eye piece, application and limitations, confocal microscopy and its applications. Interference microscopy, optical profiler and applications. Vision systems- Principles and applications, Principles of Scanning and Transmission Electron Microscopy and its applications.

Unit IV

ACCEPTANCE TESTS FOR MACHINE TOOLS AND SURFACE FINISH MEASUREMENTS: Alignment of Geometric Tests ;Equipment Required for Geometrical Tests ; Alignment Tests for :Lathe ,Milling Machine ,Shaping Machine, Radial Drilling Machine, Use of Laser for alignment and calibration of machine tools, introduction to ball bar measurement.
Measurement of surface roughness – surface texture – primary texture – secondary texture and the lay specification for surface textures – methods for measuring surface finish – the profilograph – Tomlinson surface meter – Tracer type profilograph.

Unit – V

Introduction to Tolerancing and Dimensioning: Introduction : Limits, Tolerance, Unilateral, Bi-lateral systems, relation between tolerance and cost ;Terminology for Limits and Fits ;Allowance, System of Obtaining Different Types of Fits;Hole Basis and Shaft Basis Systems ;Standard Limit System ; Indian Standard System of Limits and Fits (IS :919-2709) ; Designation of Holes ,Shafts and Fits.
Meaning of GD and T, Various Geometric symbols used in GD and T , Datum feature, Material Conditions- MMC,LMC,RFS (Introduction only),Definition and representation of Form and Orientation tolerance features– Flatness, straightness, circularity. cylindricity, parallelism, perpendicularity. Fundamentals of true position theory.

Text Books

1. Ernest O Doeblin, "Measurement systems", McGraw Hill Publishers, 2003.
2. R. K . Jain, "Engineering Metrology", Khanna Publishers, New Delhi, 2009.
3. Geometric Dimensioning` and Tolerancing for Mechanical Design," Gene R. Cogorno, McGraw Hill, 2006.
4. Fundamentals of Dimensional Metrology, Connie L Dotson, Thomas Delmar Publishers, 2006.

Reference Books

1. I.C Gupta, "Engineering Metrology", Danpat Rai Publications, 2004.
2. Beckwith Thomas G, "Mechanical Measurements", Pearson Education, 2008.
3. M.Mahajan, "A Text Book of Metrology", Dhanpat Rai &Co. 2010
4. Jay L. Bucher,"The Metrology Handbook",American Society for Quality April 2004.

12ME316 INDUSTRIAL ROBOTICS

Credits: 4:0:0

Course Objective:

- To be familiar with the automation and brief history of robot and applications.

- To give the student familiarities with the kinematics of robots.
- To give knowledge about robot end effectors and their design.
- To learn about Robot Programming methods & Languages of robot.
- To give knowledge about various Sensors and their applications in robots.

Course Outcome:
- Students will be equipped with the automation and brief history of robot and applications.
- Students will be familiarized with the kinematic motions of robot.
- Students will have good knowledge about robot end effectors and their design concepts.
- Students will be equipped with the Programming methods & various Languages of robots.
- Students will be equipped with the principles of various Sensors and their applications in robots.

Unit I

INTRODUCTION: Automation and robotics –History of robotics, Robot anatomy ,Robot configurations, Robot Components,Types of Robot drives – pneumatic, hydraulic and electrical drive systems, Applications -Material handling – Manufacturing Processes – Welding, Machining, Assembly and Inspection, CIM and hostile environments - safety considerations.

Unit II

TRANSFORMATIONS AND KINEMATICS : Coordinate transformation -Vector operations – Basic transformations matrices - Properties of transformation matrices-Homogeneous transformations– Forward solution, DH algorithm - Inverse kinematic solution, Brief Robot dynamics.

Unit III

CONTROLS AND END EFFECTORS: Control system concepts - Analysis - control of joints - Adaptive and optimal control – End effectors - classification - Mechanical - Magnetic -Vacuum - Adhesive - Drive systems and controls- Force analysis and Gripper design.

Unit IV

ROBOT PROGRAMMING AND AI: Methods - Languages -Computer control and Robot Software - VAL Language – Trajectory Planning, Basic robot motions - Point to point control & continuous path control and interpolations AI – Basics – Goals-AI Techniques – AI & Robotics.

Unit V

SENSORY DEVICES: Non optical and optical position sensors - Velocity and Acceleration - Range - Proximity -touch - Slip - Force -Torque - Machine vision - Image components - Representation -Hardware - Picture coding - Object recognition and categorization - Software consideration.

Text Book

1. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering – an Integrated Approach", Prentice Hall India, 2002

Reference books

1. Mikell P. Groover, Mitchell Weiss, "Industrial Robotics, Technology, Programming and Applications ", McGraw Hill International Editions, 1st Edition, 2000
2. K.S. Fu., R.C.Gonalez, C.S.G.Lee, " Robotics Control Sensing ", Vision and Intelligence, McGraw Hill International Edition, 1987.

3. Deb S.R., " Robotics Technology and Flexible Automation ", Tata McGraw-Hill, Publishing Co., Ltd., 1994.

12ME317 AUTOMATION AND ROBOTICS LAB

Credits: 0:0:2

Course Objective:

- To design pneumatic and electropneumatic components for automation
- To know components, ladder logic design, programming for PLC/Microcontroller and robot
- To understand the configuration of robot and reconfigure them for a custom application

Course Outcome:

- To carry out automation design for an application
- To select components for automation
- To program and install the automation system

LIST OF EXPERIMENTS

1. Design and simulation of pneumatic logic gates like AND, OR, NOR, NAND AND XOR.
2. Design and simulation of electro pneumatic circuit for Dual-cylinder sequential circuit.
3. Design and simulation of electro pneumatic circuit for reciprocating cylinder Design
4. Design and simulation of electro pneumatic circuit for box sorting System.
5. Logic circuit design for Gates using PLC or Micro Controller.
6. Logic circuit design to control traffic light signals using PLC or Microcontroller
7. Logic circuit design to control motor using PLC or Micro Controller.
8. Pick and Place programming using FANUC Robot using teach pendant.
9. Pick and Place programming using Inttelitech Robot in program mode.
10. Programming for a custom operation using Inttelitech Robot in program mode.
11. Assembly of Mobile Robot structure using Vex Robots
12. Programming of Mobile Robot using Vex Robots.

12ME318 PETROLEUM REFINERY ENGINEERING

Credits: 4:0:0

Course Objective:

- To educate students on process involved in petroleum extraction.
- To introduce different types of petroleum products.

Course Outcome:

- Students will be able to work in Petroleum industries.
- Students will be able to understand chemical processes involved in Refinery process.

Unit I

Origin, Exploration and production of petroleum, Types of crudes, Composition, characteristics, products pattern and characteristics, indigenous and imported crudes, Availability Vs Demands, Future outlook.

Unit II
Engineering aspects of refining, Reaction stoichiometry; Chemical kinetics; Thermochemistry and chemical equilibrium; Mixuing in flow systems; Reactor design. Crude heating, Primary distillation, principles, Separation of cuts, Gaps/ overlaps, Stripping, Desalting, heat balance in distillation, Energy input and recovery, Vacuum distillation, Types of trays, Draw offs, intermediate product quality control.

Unit III
Lube oil and wax processing, Solvent extraction, Dewaxing, Deciling, Deasphalting, Clay contacting, principles, technologies, operating parameters, Feed and product qualities and yields. Asphalt Manufacture, product qualities, Air blowing technology, Tankage operations, Storage and handling of crude products.

Unit IV
Fluid catalytic cracking, principles, recent developments, Feedstocks and product yields and qualities, Catalysts and operating parameters.
Hydrocracking, principles, process requirements, product yields and qualities, Residcracking – implications and technology.

Unit V
Catalytic reforming and Isomerisation, Reforming, Principles, developments in technology, Catalyst types and their performance, Effects of operating parameters, Feed quality, Product improvement; Sulphur removal, Aromatics removal, Hydrofinishing, Catalyst regeneration, Catalytic dewaxing. Environmental aspects of refining.

Text Books

1. Nelson, W.L "Petroleum Refinery Engineering" McGraw Hill Publishing Company Limited, 1985.
2. Hobson, G.D. – Modern petroleum Refining Technology, 4th Edition, Institute of Petroleum U.K. 1973.

Reference Books

1. Smalheer, C.V and R.Kennedy Smith Lubricant Additives. The Lezius – Hill Company, Cleveland, Ohio. USA, 1987
2. Donald L.Katz and Robert L.Lee, Natural Gas Engineering, Mc Graw – Hill Publishing Company, NY, 1990.
3. Watkins, R.N "Petroleum Refinery Distillation", 2nd Edition, Gulf Publishing Company, Texas, 1981.

12ME319 NATURAL GAS ENGINEERING

Credits: 4:0:0

Course Objective:
- To educate students on applications of natural gas.
- To introduce literature on fuel science and technology.

Course Outcome:

- Students will be able to understand the importance of non-conventional fuels.

Unit I
Availability of natural gas, Properties and composition, Exploration and control of gas, output, Estimation of availability quantity.

Unit II
Natural gas application in Chemical Process and transportation industry LNG technology, Natural gas storage and transport, Economics of natural gas utilization.

Unit III
General Hydrodynamic equations for flow of fluids through porous media, two dimensional flow problems and potential theory methods, gravity flow systems, systems of non uniform permeability, multiple well systems using computerized streamline tracking methods.

Unit IV
Use of multiphase flow correlations to determine flow ratio and pressure traverse in flowing oil wells, gas condensate wells, gathering systems and pipe lines, application of correlations to the design of gas system

Unit V
Reservoir fluid properties – PVT properties for oil gas systems, phase Behavior of complex hydrocarbon mixtures at high temperature and pressure - thermodynamic property evaluation, packages used in petroleum industry.

Text Books

1. Donald L.Katz and Robert L.Lee, Natural Gas Engineering, Mc Graw – Hill Publishing Company, NY, 1990.
2. Speight, J.G Fuel Science and Technology Handbook, Marcel Decker Inc. 1990.
3. Guide to Natural Gas Utilization Technologies, Fairmount Press Inc. 1987.

Reference Books

1. Lom. W.L and A.F. Williams, Substitute Natural Gas, Kalstod Willey, New York, 1976.
2. Dermott, M.C. Liquified Natural Gas Technology, Neysos Park Ridge, N.J. 1973.
3. M.J. Econonides A.Daniel “Petroleum Production Systems”, Prentice Hall Petroleum Engineering series 1999.
4. Michael J.Economides, A.Daniel Hill and Christine Ehlig – Economides, Petroleum Production Systems, PTR Prontice Hall, NJ, 1993.
5. Dring, M.M – The Natural Gas Industry – A review of World Resources and Industrial Applications, Butterworth, London, 1974.

LIST OF SUBJECTS

Sub. Code	Name of the Subject	Credits
12ME320	Aircraft Structures	3:1:0
12ME321	Heat conduction – Direct and Inverse problems	3:1:0
12ME322	Micro Electro Mechanical Systems	4:0:0
12ME323	Nuclear Power Engineering	4:0:0
12ME324	Advanced Surface Engineering	4:0:0
12ME325	Drives and Control Systems for Robots	4:0:0
12ME326	Advanced Turbo Machinery	4:0:0
12ME327	Introduction to Fuel Cells	4:0:0
12ME328	Thermo Chemical Conversion of Biomass	4:0:0
12ME329	Industrial Tribology	4:0:0
12ME330	Control of CNC Machine Tools	3:1:0
12ME331	Combustion in Engines	3:1:0
12ME332	Advanced Refrigeration and Air Conditioning Systems	3:1:0
12ME333	Solar Energy Utilization	3:1:0
12ME334	Design and Analysis of Heat Exchangers	3:1:0
12ME335	Vehicle Maintenance	4:0:0
12ME336	Vehicle Dynamics	4:0:0
12ME337	Automotive Electricals and Electronics	4:0:0
12ME338	Alternative Fuels for IC Engines	4:0:0
12ME339	Engineering Product Design and Development Strategies	4:0:0
12ME340	Metal Cutting Theory and Practice	4:0:0
12ME341	Principles of Mechanical Vibrations	3:1:0
12ME342	Industrial Vibration and Noise Engineering	4:0:0
12ME343	Design of Thermal Power Equipments	3:1:0
12ME344	Industrial Robotics	4:0:0
12ME345	Design for Manufacturing and Assembly	4:0:0
12ME346	Manufacturing System and Simulation	3:1:0
12ME347	Manufacturing Information Systems	4:0:0
12ME348	Materials Characterization	4:0:0
12ME349	Design of Mechanical System Elements	3:1:0
12ME350	Vacuum Technology	3:1:0
12ME351	Micromanufacturing and Nano Technology	4:0:0
12ME352	Advanced Instrumentation in Thermal Engineering	3:1:0
12ME353	Energy Conservation and Management	3:1:0
12ME354	Vibration Laboratory	0:0:1
12ME355	Fluidised Bed Systems	3:1:0
12ME356	Human Factors Engineering	4:0:0
13ME101	Engineering Drawing	0:0:2
13ME102	Workshop Practice	0:0:2
13ME103	Basic Mechanical Engineering	3:0:0

12ME320 AIRCRAFT STRUCTURES

Credits: 3:1:0

Objective:

- To introduce the various structural components of aircrafts and aerospace vehicles
- To study their behavior under different types of loads
- To understand structural design methods for aerospace vehicles

Outcome:

By the end of the course students will be able to

- Understand various methods of analysis of aerospace structural members.
- Understand the buckling of plates and the concepts of shear flow
- Understand the basics of Aircraft materials

Unit I

STATICALLY DETERMINATE AND INDETERMINATE STRUCTURES: Analysis of planar and space trusses -Method of joints and tension coefficient Method, Clapeyron's Three Moment Equation, Castigliano's theorem, Maxwell's Reciprocal theorem, Unit load method – applications, Moment Distribution Method.

Unit II

THIN WALLED SECTIONS: Shear flow in open thin walled sections – Symmetrical and unsymmetrical thin walled section- Multiple shear flow junctions, Shear center in open section, Shear center in closed thin walled section, Statically determinate shear flow, Closed multi-cell section.

Unit III

AIRCRAFT STRUCTURAL ANALYSIS: Basic structural elements in Aircraft structures – Axial member – shear panel – Bending members – Torsion members, Load transfer – wing and fuselage, Wing structures, Fuselage Structures, Aircraft materials, Shear and bending moment distribution for semi cantilever and other types of wings and fuselage, thin webbed beam.

Unit IV

BUCKLING OF PLATES: Rectangular sheets under compression, Local buckling stress of thin walled sections, Crippling stresses by Needham's and Gerard's methods. Thin walled column strength. Sheet stiffener panels. Effective width, inter rivet and sheet wrinkling failures.

Unit V

AIRCRAFT MATERIALS: Properties of flight vehicle materials importance of strength to weight ratio, temperature variations, factors affecting choice of materials for different part of airplane. Light metal alloys: heat treatment, high temperature and corrosion resistant alloys,

Composite materials: classification and characteristics of composite materials, strength to weight comparison with metals, fiber reinforced and particulate composites.

Text Books

1. Megson, T.M.G., "Aircraft Structures for Engineering Students", 2007.
2. G Lakshmi Narasaiah "Aircraft Structures", BS Publications.,2010
3. G F Titterton, Aircraft Materials and Processes, Himalayan Books, New Delhi, 1956

Reference Books

1. Sun C T, " Mechanics of Aircraft Structures", Wiley India,2010 (Unit V)
2. Peery, D.J., "Aircraft Structures", McGraw–Hill, N.Y., 2011.
3. Donaldson B K, "Analysis of Aircraft Structures" Cambridge Aerospace, 2008

12ME321 HEAT CONDUCTION – DIRECT AND INVERSE PROBLEMS

Credits: 3:1:0

Objective:
To familiarize the student with

- the phenomena of conduction heat transfer
- possible analytical/closed form solutions of heat conduction equations in Cartesian and Cylindrical coordinate system
- methods of numerical simulation of conduction problem
- methods for assessment of boundary conditions from known temperature history

Outcome:
The student will be able to

- Find the temperature history in a give body for variety of boundary and initial conditions.
- Find the thermal properties of the material from known temperature history
- Find the boundary conditions from known temperature history

Unit I
GENERAL THEORY: Introductory – Conductivity – Heat flux of Heat across any Surface – Isothermal process – Conduction of Heat in an Isotropic solid – The Differential Equation of Conduction of Heat in an Isotropic Solid –Initial and Boundary conditions – Dimensionless parameters – Experimental methods for the determination of Thermal Conductivity – the Mathematical Interpretation of the Initial and Boundary Conditions – Related Differential Equations –Conduction of Heat in an Anisotropic solid – the Differential Equation of Conduction of Heat in an Anisotropic Solid – Conduction in a thin crystal plate – The variation of Thermal Conductivity and the Flux vector in Anisotropic solids.

Unit II
LINEAR FLOW OF HEAT IN SOLIDS FOR SEMI-INFINITE BODIES – STEADY AND UNSTEADY: Simple solutions of the Equation of Linear Flow of Heat – The Infinite solid, Laplace's solution – the use of Fourier integrals and Fourier transforms.
The semi infinite solid – Initial temperature f(x) surface temperature zero – Initial temperature zero surface temperature φ(t) – Surface temperature a Harmonic function of time – Radiation at the surface in to a medium at zero temperature initial temperature constant – Radiation at the surface in to a medium at temperature f(t) initial temperature zero – The flux of heat at x=0 a prescribed function of the time zero initial temperature

Unit III
LINEAR FLOW OF HEAT IN SOLIDS BOUNDED BY TWO PARALLEL PLANES – STEADY AND UNSTEADY: Steady Temperature – The region $0 < x < l$ ends kept at zero temperature initial temperature f(x) – The region $0 < x < l$ initial temperature f(x) the ends at constant temperature or insulated – The region $0 < x < l$ ends at temperature $\varphi_1(t)$ and $\varphi_2(t)$ initial temperature f(x) – The slab with periodic surface temperature – Steady periodic temperature in composite slabs – The slab with prescribed flux at its surface – The region $0 < x < l$ Radiation at the ends in to a medium at zero temperature initial temperature f(x) – The region $-l < x < l$ Radiation at then ends $x= \pm l$ into a medium at zero temperature initial temperature f(x) – Special problems and numerical results for the slab with a radiation boundary condition – The region $-l < x < l$ with zero initial temperature and radiation at the ends into medium at φ(t) – The slab with one face in contact with a layer of perfect conductor or well-Stirred fluid – The slab with heat produced within it.

Unit IV

LINEAR FLOW OF HEAT IN SOLIDS BOUNDED BY CYLINDRICAL COORDINATE SURFACES – STEADY AND UNSTEADY: Introductory – The steady temperature in a infinite or semi-infinite medium due to heat supply over a circular area – Steady temperature in finite and semi-infinite cylinder – Variable state product solutions – Determination of conductivity from cylinders – The finite cylinder $-l < x < l$, $0 \le r < a$, initial temperature $f(r, \theta, z)$ – The semi-infinite cylinder.

NUMERICAL METHODS IN HEAT TRANSFER: Finite differences – Linear flow of heat in an infinite region – Boundary conditions – Heat production, Variable diffusivity and Latent heat – Relaxation methods.

Unit V

INVERSE HEAT CONDUCTION PROBLEMS: Inverse Heat Transfer Problem Concept - Application Areas of Inverse Heat Transfer - Classification of Inverse Heat Transfer Problems - Difficulties in the Solution of Inverse Heat Transfer Problems - An Overview of Solution Techniques for Inverse Heat Transfer Problems - The Levenberg-Marquardt Method for Parameter - The Conjugate Gradient Method for parameter Estimation - The Conjugate Gradient Method with Adjoint Problem for Parameter Estimation - The Conjugate Gradient Method with Adjoint Problem for Function Estimation - Solution of a Test-Problem.

Introduction - Coordinate Transformation Relations - Simple Transformations - Basic Ideas in Numerical Grid Generation and Mapping - Boundary Value Problem of Numerical Grid Generation - A Generalized Coordinates Approach for Inverse Heat Conduction Problems.

Text Books:

1. Carslaw, H S and Jaeger, J C – Conduction of heat in Solids, Clarendon Press,1986.
2. Beck, J V, Blackwell, B and Charles R St. Clair, Jr – Inverse Heat Conduction – Ill-posed Problems, New York etc., J. Wiley & Sons 1985.

Reference Books:

1. Ozisik, M. Necati - Finite Difference Methods in Heat Transfer, CRC Press, 1994.
2. Frank P. Incropera, David P. DeWitt, Theodore L. Bergman, Adrienne S. Lavine- Fundamentals of Heat and Mass Transfer, 6th edition John Wiley & Sons, 2006.

12ME322 MICRO ELECTRO MECHANICAL SYSTEMS

Credits: 4:0:0

Objective:

- To introduce to the students about the basic concepts of MEMS
- To make them understand the Physics behind the efficiency of MEMS
- To impart the knowledge about the materials used in MEMS
- To know about the various MEMS manufacturing techniques

Outcome:

The student will be able to

- Apply various concepts, physics, materials and manufacturing techniques about MEMS
- design some basic MEMS structures
- fine tune their designs in to working MEMS devices

Unit I

OVERVIEW OF MEMS AND MICROSYSTEMS: MEMS and Microsystems – Evolution of Micro Fabrication – Micro Systems and Microelectronics. Application of MEMS in Various Fields. Micro System – Working Principle – Micro Sensors, Micro Actuators, Micro Accelerometer, Micro Fluidics.

SCALING LAWS IN MINIATURIZATION: Introduction to Scaling – Scaling in Geometry, Rigid Body Dynamics, Electrostatic Forces, Electromagnetic Forces, Electricity, Fluid Mechanics, and Heat Transfer.

Unit II

MICRO SYSTEMS DESIGN: Engineering science for Microsystems, design – atomic structure of matter, ions and ionization, molecular theory, doping of semiconductors, diffusion process, and quantum physics, plasma physics, electrochemistry. Engineering mechanics for micro system design – static thin plates, mechanical vibration, thermodynamics, fracture mechanics, thin film mechanics, overview of finite element stress analysis.

Unit III

MATERIALS FOR MEMS AND MICROSYSTEMS: Introduction – Substrate and Wafer, Active Substrate Material. Silicon as a substrate material, Silicon Compounds, Silicon Piezo Resistors, Gallium Arsenide, Quartz, Piezo Electric Crystals, Polymers, Packaging Materials.

Unit IV

MICRO SYSTEMS FABRICATION: Introduction – Photolithography, Ion Implantation, and Diffusion – Oxidation, CVD, PVD, Deposition by Epitaxy, Etching.

OVERVIEW OF MICRO MACHINING: Bulk Micro Machining, Surface Micro Machining, LIGA Process.

Unit V

MICRO SYSTEMS PACKAGING: Overview of mechanical packaging of microelectronics, microsystems packaging. Essential packaging techniques, 3D packaging, assembly of micro systems – signal mapping and transduction.

CASE STUDY: Design a Model of a Pressure Sensor with Packaging.

Text Book:

1. Tai-Ran Hsu," MEMS and Micro Systems – Design and Manufacture", Tata McGraw Hill, 2002.

Reference Books:

1. Naldim Maluf," An Introduction to Micro Electro Mechanical Systems", Artech House, 1999.
2. Sergey Edward Lyshevski," MEMS and NEMS, Devices and Structures", CRC Press, 2002.

12ME323 NUCLEAR POWER ENGINEERING

Credits: 4:0:0

Objective:

- To Introduce the safety principles and methods utilized in designing, constructing and operating a safe nuclear power plant.
- To introduce the fundamental terms and concepts of nuclear power engineering.
- To discuss neutron life cycle, heat flow, radiation, fluidized bed reactor.
- To Identify, Analyze, Setup and implement solutions to different practical equipments.

Outcome:

- Perform safety calculations in support of the preparation of an abbreviated Safety Analysis Report for an advanced reactor.
- Students will be able to determine thermal reaction equation, temperature, pressure coefficient.
- Students will have an understanding of coolant channel orificing, hot spot factors
- Students will acquire knowledge on reactor hydraulics, different bed reactors.
- Students will be able to learn different fusions and reactions.

Unit I

REVIEW OF NUCLEAR PHYSICS: Nuclear Equations – Energy from Nuclear Reactions and Fission – Thermal neutrons – Nuclear Cross Sections – Neutron Flux distribution in cores, slowing down – Neutron life cycle – Thermal Reaction Equation – Buckling Factors – Reactivity and Reactor Period – Radio activity – half life –neutron interactions- cross sections.

Unit II

Reactor Heat generation and Removal – Volumetric Thermal source Strength – Heat flow in and out of solid fuel element – Temperature variations across Fuel elements – Coolant channel orificing – Hot spot factors – Absorption of Core radiation – Total heat generated in the core.

Unit III

Heat removal in solids subjected to radiation – Thermal Shield quality and void fractions in flow and non-flow systems – Boiling water reactor hydraulics-Change of Phase reactor.

Unit IV

Fluidized Bed Reactor, Gas Cooled Reactor steam Cycle- Simple and Dual Pressure Cycle, Pebble Bed Reactors, Fluid Fuelled Reactors – Types – Corrosion and Erosion Characteristics.

Unit V

Energy From Nuclear fusion, Thermonuclear Fusion, D-T Reaction, P-P Reaction, Fuel Cycle, Conditions for Fusion, Plasma confinement and Heating- Magnetic Confinement fusion, Inertial Confinement Fusion,

Safety of Nuclear Plants: Nuclear plant safety – safety systems-changes and consequences of an accident-criteria for safety.

Text Books:

1. M.M.Ei.Wakil, 'Nuclear power Engineering', McGraw hill book Company, Newyork, 1987.
2. Samuel Glass tone and Alexander Setonske, 'Nuclear reactors Engineering', 3 rd Edition, CBS Publishers and Distributors, 1992.
3. Thomas J.Cannoly, "Fundamentals of Nuclear Engineering", John Wiley (1978)

Reference Books:

1. Suresh Sarg- eral., 'Physics of Nuclear Reactors' Tata McGraw hill Publishing Company Limited, 1985.
2. Thomas J.Connoly., 'Fundamentals of Nuclear Energy', John Wiley, 1978

12ME324 ADVANCED SURFACE ENGINEERING

Credits: 4:0:0

Objective:

- To understand the basics of surface engineering processes for improving wear and corrosion resistance,
- To learn the methods based on plating, atomic diffusion methods, high energy coatings based on plasma, laser, HVOF,PVD,CVD ,etc.
- To understand wear mechanisms and corrosion processes

Outcome:

- Students will develop a good understanding of wear and corrosion mechanisms,
- Students will design and select suitable processes and optimize parameters for optimum wear and corrosion resistance of different ferrous and non ferrous alloys.

Unit I

TRIBOLOGY: Friction, Wear and Lubrication, Types of wear and wear testing.

PLATING PROCESSES: Fundamentals of Electrode position, plating of nickel, chromium, tin and copper - pulsed plating – Hydrogen embrittlement, plating adhesion, electroless plating electrochemical conversion coating, metaliding, selective plating for repair, plating properties, Hard anodizing.

Unit II

HARDFACING PROCESSES: SMAW, GTAW, GMAW,FCAW,SAW, PAW, Oxy-Acetylene Welding, Furnace fusing, Thermal -spray, flame spray processes - HVOF, Detonation gun processes, hard facing consumables – chromium carbide - stellite - buffer layer materials.

Unit III

SPECIAL DIFFUSION PROCESSES: Flame and Induction Hardening, Carburising, Nitriding, Carbonitriding, Boriding, Aluminising, Siliconising, Chromising, Sursulf - Selection of diffusion processes. characteristics of diffused layer - micro structure and micro hardness evaluation -properties and applications.

Unit IV

THIN FILM COATINGS: Physical vapour deposition processes - Thermal evaporation - sputter coating - Ion plating - Chemical vapour deposition - reactive sputtering - TiC, TiN, Alumina , CBN, Diamond and DLC coatings. Structure, properties and applications.

Unit V

HIGH ENERGY MODIFICATION AND SPECIAL PROCESSES: Electron beam hardening, glazing, Laser beam hardening, glazing ion implantation , Composite surface created by laser and Electron beam. Surface cements, Wear tiles, Electro spark deposition, fused carbide, thermal, chemical, Ceramic coatings, centrifugal cast wear coatings, Wear sleeves and Wear plates

Text Book:

1. Ken G.Budinski, "Surface Engineering for Wear Resistance", Prentice Hall, Englewood Cliff, 1990.

Reference Books:

1. ASM Metals Handbook, Vol 5, "Surface Engineering", 1994
2. Ernest Rabinowicz," Friction and Wear of Materials", 2nd edition, John Wiley and Sons, NY, 1995.

12ME325 DRIVES AND CONTROL SYSTEMS FOR ROBOTS

Credits: 4:0:0

Objective:

- To make the students become familiar with various robot drive mechanisms.
- To impart knowledge on hydraulic, pneumatic and electric drives for robots.
- To impart knowledge on various control systems for robots.

Outcome:

- Students will be equipped with knowledge on various robot drives and mechanisms.
- Students will be well-versed in knowledge on working principles of various control systems for robots.

Unit I

ROBOT DRIVE MECHANISMS: Overview of a Robot, Basic components of a Robot system, Functions of drives systems, Mechanical System –Motion conversion, Rotary-to-Rotary : Ideal Gears, Harmonic drives, Belt and pulley drives, Rotary-to-Linear Motion: Lead Screws, Rack and Pinion ,The Roh'lix, Slider cranks, Cams; Linkages, Couplers, and Cyclo speed reducers.

Unit II

HYDRAULIC DRIVES: Introduction, hydraulic fluid considerations, Simple hydraulic system, hydraulic actuators Rotary and linear actuators, Direction control valves, servo control valves, Flapper type servo valve, Flow control valves, Pressure control valves ,Closed loop feedback servo system and Hydraulic servo system.

Unit III

PNEUMATIC DRIVES: Introduction, Laws of Gases, Advantages, Compressors ,Pneumatic conditioners and valves Pneumatic Actuators- Linear and rotary. Flapper motor, Geared motor, A typical pneumatic system, Pneumatic proportional controller, pneumatically controlled prismatic joint.

Unit IV

ELECTRIC DRIVES: Introduction, Types of electric drives , DC motors, AC motors, stepper motors, Types of stepper motors, half step mode operation, micro step mode and Direct drive actuator.

Unit V

CONTROL OF ROBOTIC MECHANISMS: Objective, motivation, closed loop control in a Position Servo – no velocity feedback and with Tach Feedback. Linear control of manipulator, non-linear control of manipulators and force control of manipulators.

Test Books:

1. Richard D. Klafter, Thomas. A, Chmielewski, Michael Negin, "Robotics Engineering an Integrated Approach", Prentice Hall of India Pvt. Ltd., 2008.
2. S R Deb, "Robotic Technology and Flexible Automation," Tata McGraw Hill Publishing company Ltd., New Delhi, 2003.

Reference Books:

1. P.A. Janaki Raman, Robotics and Image Processing an Introduction, Tata McGraw Hill Publishing company Ltd., 2002.
2. Mikell P. Groorer, Mitchell welss, Roger N. Nagel, Nicholas G.Odrey, Industrial Robotics, Technology programming and Applications, McGraw Hill International Edition, 2006.
3. Robert J. Schilling, Fundamentals of Robotics Analysis and Control, Prentice Hall of India Pvt. Ltd., 2001.
4. John J. Craig, "Introduction to Robotics Mechanics and Control", 3rd Edition, Dorling Kindersley(India) Pvt. Ltd., 2009

12ME326 ADVANCED TURBO MACHINERY

Credits: 4:0:0

Objective:
- To provide an introduction about turbines, pumps and compressors.
- To impart knowledge on dimensionless numbers.
- To analyse the performance and efficiency of turbines.

Outcome:
The students will be able to
- understand the types of turbine and their working principle .
- understand about the types of pump and compressor
- understand about the performance and applications of turbo machines

Unit I
Introduction, classification of turbo machinery, application of pi theorem, incompressible fluid in turbo machines , effects of Reynolds Number and Mach number, energy transfer between a fluid and a rotor, Euler turbine equation , components of energy transfer , impulse and reaction turbine, efficiencies.

Unit II
Radial flow pumps and compressors, head capacity relationship, axial flow pumps and compressors, degree of reaction, dimensionless parameters, efficiency and utilization factor in turbo Machinery.

Unit III
Centrifugal pumps and centrifugal compressors, inlet section, cavitations, NPSH, flow in the impeller channel, flow in the discharge casing, pump and compressor characteristics.

Unit IV
Thermodynamics of turbo machine processes, compression and expansion efficiencies, stage efficiency, Infinitesimal stage and finite stage efficiencies
Flow of fluids in turbo machines, flow and pressure distribution over an airfoil section, effect of compressibility, blade terminology, cascades of blades, blade spacing, radial pressure gradient, free vortex flow, losses in turbo machines.

Unit V
Radial flow turbines, inward flow turbines for compressible fluids, velocity and flow coefficients, gas turbine – performance and analysis of Kaplan turbine , Francis turbine and Pelton wheels, Types of gas turbine and steam turbine.

Text Books:
1. Lee, 'Theory and Design of Steam and Gas Turbine', McGraw Hill, 2001.
2. S.M Yahya., 'Turbines, Compressions and Fans', Tata McGraw Hill, 2009.
3. D.G. Stephard, 'Principles of Turbo machines', Macmillan Co., 2005.

Reference Books:
1. A.Valan Arasu, "Turbo machines" Vikas publishing house pvt Ltd, 2002
2. Kadambi.V., Manohar Prasad., "An Introduction to Energy Conversion, Volume III Turbomachinery" New Age International Publishers , 2005
3. William J Kerten, 'Steam Turbine Theory and Practice', CBS Publisher and distributors, 2003.
4. Bathe WN, 'Fundamentals of Gas Turbines', Willey and Sons, 2006.

12ME327 INTRODUCTION TO FUEL CELLS

Credits: 4:0:0

Objective:

- To provide knowledge about fuel cells
- To impart knowledge on mechanisms of fuel cell operation.
- To impart knowledge on the aspects of fuel cell characterization techniques.
- To impart knowledge on the thermodynamics of fuel cells.

Outcome:

- Students will be able to understand the operation and applications of fuel cells.
- Students will be able to understand the various types of fuel cells.

Unit I

Introduction to Fuel Cell – A simple Fuel cell – Advantage and disadvantage – Fuel cell types. Basic Fuel Cell operation – Applications of Fuel cells- Fuel cell performance –Environment Impact of Fuel Cell : Life Cycle assessment – Emissions related to Global warming – Emissions related to air pollution.

Unit II

Overview of fuel cell types and systems – construction and operation of Fuel cells: Phosphoric-Polymer Electrolyte Membrane – Alkaline – Molten Carbonate – Solid oxide Fuel cells – Fuel cell stack – Thermal management subsystem – Fuel delivery/processing system – Power electronics subsystem.

Unit III

Fuel Cell Thermodynamics – heat potential of a Fuel: Enthalpy of Reactions – Work Potential of a Fuel: Gibbs Free energy – Predicting Reversible Voltage of a Fuel Cell under Non – standard state Conditions – Fuel Cell Efficiency.

Unit IV

Charge and Mass Transport: Charge transport - in response to Forces, Voltage loss factor, Resistance – Physical Meaning of Conductivity – Classes of Fuel cell electrolytes – Transport in Electrodes Vs Flow structure – Diffusive Transport – Convective Transport.

Unit V

Essential Electrochemical Characterization Techniques for a Fuel cell: In Situ Fundamentals – Electrochemical Variables: Voltage, Current and Time – Basic Fuel Cell test station Requirements – Electrochemical Impedance Spectroscopy- Current Interrupt Measurement – Cyclic Voltammetry, Porosity Determination- BET surface area determination – Gas permeability – Structure Determinations – Chemical Determinations.

Text Books

1. Ryan O'Hayre, Suk-won Cha, Whitney Colella and Fritz B Prinz," Fuel Cell Fundamentals", John Wiley and Sons, New Jersey, 2005
2. Supramaniam Srinivasan, "Fuel Cell: From Fundamentals to Applications", Springer, NY, 2006

Reference Books

1. Allen. J. Bard and Larry. R. Faulkner, "Electrochemical Methods : Fundamentals and Applications", 2nd Ed., John Wiley and Sons NY, 2001
2. Geoffrey A Prentice, "Electrochemical Engineering Principles", Prentice-Hall,U.S.A., 1991
3. Gregor Hoogers, "Fuel Cell Technology Handbook (Mechanical Engineering Series)", CRC Press LLC, Florida, 2003

12ME328 THERMO CHEMICAL CONVERSION OF BIOMASS

Credits: 4:0:0

Objective:

To impart knowledge on

- the types of biomass, biogas plant and their environmental effects.
- energy plantations and biogas digesters.
- the thermo chemical conversion process, energy auditing and thermodynamics.

Outcome:

The students will be able to

- understand the Environmental impact of biomass.
- understand the application of biogas.
- understand about the gasifier, reactors, energy auditing and thermodynamic analysis of systems

Unit I

BIOMASS ENERGY: Biomass –definition, biomass resource, types, municipal and industrial wastes, agricultural crop residues, conversion technology, method for obtaining energy from biomass, some examples for thermo chemical conversion of biomass - environmental impacts – biomass based fuel reduce the potential for global warming, control of CO_x and NO_X emissions using biomass energy, biochemical Conversion, anaerobic digestion, biogas Production, Types of Biogas Plant, Gasification, types, Industrial Applications of gasifiers , environment Benefits

Unit II

ENERGY PLANTATION AND DIGESTOR: Energy plantations, Size reduction, briquetting, drying, Storage and handling of biomass, feedstock for biogas, microbial and biochemical aspects, operating parameters for biogas production, Kinetics and mechanism, high rate digesters for industrial waste water treatment.

Unit III

THERMO CHEMICAL METHODS: Thermo chemical conversion of lignocelluloses biomass, incineration, processing for liquid fuel production, pyrolysis, types of pyrolysis, effect of particle size, temperature, and nitrogen gas flow rate, types of Gasifiers, gasification types, Combustion of woody biomass, design of equipment, Cogeneration using bagasse, Case study: Combustion of rice husk.

Unit IV

THERMAL ENERGY AUDITING: Energy Audit-purpose, methodology with respect to process Industries, power plants, boilers. Various energy conservation measures, steam system, losses in boiler, methodology of upgrading boiler Performance, energy conservation in pumps, Fans and Compressors, gasifier, condenser, evaporators and reactors- Steam traps, types, function and necessity.

Unit V

AVAILABILITY ANALYSIS AND THERMODYNAMIC PROPERTY RELATIONS: Reversible work, availability, irreversibility and second law efficiency for a closed system and steady state control volume, availability analysis of simple cycles, thermodynamic potentials, Maxwell relations, generalized relations for changes in entropy, internal energy and enthalpy, generalized Relations for C_p and C_v, Clausius Clayperon equation, and Joule Thomson Coefficient.

Text Books:

1. Ruth Howes and Anthony Fainberg, “The Energy Sourcebook: A Guide to Technology, Resources and Policy”, American Institute of Physics, 2005.
2. D.O. Hall, "Biomass Energy", Energy Policy, October 2007.
3. Holman. J.P., Thermodynamics, 3rd edition, McGraw Hill, 2004.

Reference Books:

1. Chakraverthy. A, “Biotechnology and Alternative Technologies for Utilization of Biomass or Agricultural Wastes”, Oxford and IBH publishing Co, 2002.
2. Mittal K.M, “Biogas Systems: Principles and Applications”, New Age International publishers (P) Ltd., 2001.
3. Venkata Ramana P and Srinivas S.N, “Biomass Energy Systems”, Tata Energy Research Institute, 2008.
4. Khandelwal. K.C.and Mahdi(SS), “Bio-Gas Technology”, Tata McGraw-Hill Pub. Co. Ltd, 2010.
5. O.P.Chawls , “Advances in Bio-gas Technology” I.C.A.R., New Delhi, 2004.

12ME329 INDUSTRIAL TRIBOLOGY

Credits: 4:0:0

Objective:

- To introduce the concepts of tribology, wear and friction
- To introduce the lubricants, their properties and application
- To introduce the test methods to find the tribological properties

Outcome:

The students will be able to

- apply the concepts of tribology in design of the engineering products
- provide solution to overcome friction with the selection of lubricants
- evaluate the tribological properties and use them in engineering applications.

Unit I

INTRODUCTION: Definition, importance and history of tribology. tribological surfaces, wetting of solid surfaces, tribo contact surfaces and tribological loading.

Unit II

FRICTION AND WEAR: Kinetic and static friction, coefficient of friction, stick-slip, sliding and rolling friction, friction regimes: friction and lubrication conditions, hydrostatic, hydrodynamic and elasto-hydrodynamic lubrication. Wear mechanisms- Types of wear - wear parameters.

Unit III

TRIBOLOGICAL MATERIALS AND SURFACE ENGINEERING: Basic principles of materials science. metallic materials. non-metallic inorganic materials. organic materials. composite materials. introduction to surface engineering. processes of surface engineering.

Unit IV

LUBRICANTS: Lubricants and their market. mineral base oils. synthetic base oils. Rheology of lubricants. additives. lubricants for internal combustion engines. gear lubrication oils. hydraulic oils. turbine oils. compressor oils. metal-working fluids. lubricating greases. solid lubrication. laboratory methods for testing lubricants - lubricants in the environment. disposal of used lubricants, nano lubricants.

Unit V

MECHANICAL DYNAMIC TRIBOLOGY AND TESTING METHODS: Introduction. simple tribological mechanical dynamic test machines and test methods. dry sand-rubber wheel test, wet sand rubber wheel test, slurry abrasivity test, solid particle erosion test, pin-on-disk wear test, rolling wear test, drum wear test, drill wear test. tribology of IC engines.

Text Books:

1. Mang, Kirsten Bobzin and Thorsen Bartels, Industrial Tribology: Tribosystems, Friction, Wear and Surface Engineering, Lubrication-Theory . Wiley-VCH Verlag and Co., 2011.
2. Raymond G Bayer, Mechanical Wear prediction and preventions , Marcel Dekker, Inc, 1994.

References:

1. Engineering Tribology, Stachowiak and Batchelor, Butterworth-Heinmann, 2005.
2. S.K. Basu, S.N. Sengupta, B.B. Ahuja, Fundamentals Of Tribology, Prentice Hall of India, 2005.
3. John Austin Williams, Engineering Tribology, Cambridge University Press, 1994.

12ME330 CONTROL OF CNC MACHINE TOOLS

Credits: 3:1:0

Objective:

To impart knowledge on

- Drive systems and their control in a typical CNC machine.
- Concept of motion generation and control by interpolators
- CNC architecture from the control point of view.

Outcome:

Students will be able to

- appreciate the functions of various elements in a CNC machine tool.
- design controls systems and interpolator routines for specific purpose
- apply the latest developments while selecting/designing CNC machines

Unit I

INTRODUCTION TO CNC SYSTEMS: Need for NC/CNC machines, classification of NC systems, data feeding methods, Coordinate systems of CNC machines, difference between NC and CNC, Design consideration of CNC machine tools, Advantages of NC/CNC systems, Economic analysis of CNC machine tools, features of CNC machine tools. CNC programming- Interpolation, feed, tool and spindle functions (G-codes).

Unit II

CNC DRIVES: Hydraulic systems and servo valves, Dc motors- Types, servo motors-DC and AC, stepping motors, DC motor response analysis, Feedback devices- Tachometer, encoders, resolvers and inductosyns. ADC, DAC, Counters.

Unit III

CNC INTERPOLATION: Hardware interpolators- DDA integrator, exponential deceleration, linear, circular, complete interpolators, Software interpolators, Tustin method, NURBS and polynomial interpolators, Acceleration and deceleration control techniques.

Unit IV

CNC CONTROL: Types of CNC control, CNC control loops, PID control, servo controller, gain tuning, feed forward control, Mathematical analysis of control loops.

Unit V

CNC ARCHITECTURE: Implementation of CNC system, Numerical control kernel- types, implementation of interpolator, PLC- elements, programming, languages, Human-Machine Interface functions, structure, Introduction to Open CNC architecture.

Text Books:

1. Yoram Koren and Joseph Ben Uri, "Numerical Control of Machine Tools", Khanna Publishers, 2000
2. Suk-Hwan Suh and Ian Stroud,Gloud "Theory and Design of CNC Systems", Springer, 2008

Reference Books:

1. Yoram Koren, "Computer Control of Manufacturing Systems" McGrawHill, 1985
2. Bollinger, "Computer Control of Machines and Processes", Addison Wesley, 1989.

12ME331 COMBUSTION IN ENGINES

Credits: 3:1:0

Objective:
To impart knowledge on

- the combustion principles and chemical kinetics.
- combustion in SI and CI engines.
- combustion in gas turbine.

Outcome:
The students will be able to

- apply the principles of combustion in engines.
- analyze the types of combustion chamber and combustion generated pollutants.
- Determine the air fuel ratio under different load conditions.

Unit I
COMBUSTION PRINCIPLES: Thermodynamics concepts of combustion, first law and second law of thermodynamics applied to combustion process, heat of combustion, adiabatic flame temperature, stoichiometry and excess air, combustion calculations, minimum air required for complete combustion of fuel, chemical equilibrium and dissociation.

Unit II
CHEMICAL KINETICS: Theories of combustion, homogeneous and heterogeneous mixtures, laminar and turbulent flame propagation in engines, combustion generated pollutants, monitoring and control.

Unit III
COMBUSTION IN SI ENGINES: Initiation of combustion, stages of combustion, flame front propagation, factors influencing the flame speed, knocking in SI Engines, effect of engine variables on knock, combustion chambers for SI engine, stratified charge engine and heat balance test in SI engine.

Unit IV
COMBUSTION IN CI ENGINES: Various stages of combustion in CI engines, air fuel ratio in CI engines, delay period or ignition lag, variables affecting delay period, diesel knock, air swirl, general functions and characteristics of the combustion chamber, comparison of some basic design of CI Engine combustion chambers and heat balance test in CI engine.

Unit V
COMBUSTION IN GAS TURBINE: Flame stabilization, re-circulation, requirements of the combustion chamber, combustion process, combustible fuels for gas turbines, configuration of combustion chamber.

Text Books:

1. John B. Heywood., 'Internal Combustion Engine Fundamentals', McGraw Hill, International Edition, 2001.
2. Edward E. Obert., 'Internal Combustion Engines and Air Pollution', Internal Educational Publishers, New York, 2005.

Reference Books:

1. Cohen H. Rogers, GEC and Saravanamutto, H.I.H., 'Gas Turbine Theory', Longman Group Ltd., 2007.
2. Treager, 'Air Craft Gas Turbine Engine Technology', Tata McGraw Hill, 3rd Ed., 2006.
3. J.K. Jain, 'Gas Dynamics and Jet Propulsion', Khanna Publishers, 2004
4. Mathur M.L. and Sharma. 'A Course in Internal Combustion Engines', R.P. Dhanpat Rai Publications, 2009 .
5. Paul W. Gill, James H. Smith., 'Fundamentals of Internal Combustion Engines', Oxford and IBH Publishing Co., 2002.
6. V. Ganesan., 'Internal Combustion Engines', Tata McGraw Hill Publishing Company Ltd., 2010.

12ME332 ADVANCED REFRIGERATION AND AIR CONDITIONING SYSTEMS

Credits 3:1:0

Objective:
To impart knowledge on

- different types of refrigeration systems.
- psychometric concepts underlying air conditioning process.
- load estimation principles in air conditioning system.
- sorption cooling systems and air distribution systems

Outcome:

- The students will understand various aspects of the heating, ventilation and air-conditioning systems
- The students will be able to design HVAC Systems.

Unit I
REFRIGERATION SYSTEM AND CLASSIFICATIONS: Review of thermodynamic principles of refrigeration, Vapour compression cycle, theoretical and actual - cascade system, Bell Colemen cycle refrigeration, Thermo electric refrigeration, Vortex refrigeration, steam jet refrigeration, pulse tube refrigeration.

Unit II
APPLICATIONS OF REFRIGERATION: Study of air conditioning systems in automobiles, trains, ships, aircrafts. Study of refrigeration systems in cold storages, ice plant and dairy industry
Lubricants in refrigeration, refrigerants, secondary and mixed refrigerants. Eco-friendly refrigerants, Effect on ozone layer.

Unit III
VAPOUR ABSORPTION SYSTEMS: Theory of mixtures, enthalpy composition diagrams, absorption system calculation, aqua ammonia systems, LiBr water system, triple fluid absorption system, solar refrigeration system.

Unit IV
AIR-CONDITIONING SYSTEM: Review of psychometric process, sensible heat factor, by-pass factor, RSHF, GSHF, ESHF-problems. Comfort air conditioning, factors affecting human comfort, comfort chart – cooling load calculations.

Unit V
FAN AND DUCT SYSTEM: Pressure drop in straight, rectangular ducts, fittings – Design of duct systems – velocity method – equal friction method. Centrifugal fans for HVAC System and their characteristics – fan laws. Air distribution in rooms

Text Books:

1. Stocker W.F. and Jones J.W., ‘Refrigeration and Air-conditioning’, Tata McGraw Hill, 2008.
2. Manohar Prasad., ‘Refrigeration and Air Conditioning’, Willey Eastern Ltd., 2007.
3. C.P. Arora ‘Refrigeration and Air Conditioning’’, Tata McGraw-Hill Education, 2000

Reference Books:

1. Jordan and Priester., ‘Refrigeration and Air conditioning’, Prentice Hall of India, 1974.
2. ‘ASHRAE Hand Book’, 4 Vol., Current Ed.,2012.
3. Carrier Air Conditioning Co., ‘Hand Book of Air Conditioning’, Prentice Hall of India, 2008.
4. Lanqley Billy., ‘Refrigeration and Air Conditioning’, 3rd Ed., Englewood Cliffs (NJ), Prentice Hall, 1986.
5. Jones., ‘Air-conditioning Engineering’, Edward Arnold Pub., 2001.

12ME333 SOLAR ENERGY UTILIZATION

Credits: 3:1:0

Objective:
To impart knowledge on
- radiation principles and solar energy estimation
- different collector configurations and their performance analysis
- PV technology principles and its techniques

Outcome:
- The students will be able to apply the fundamentals of solar energy and its utilization for various applications

Unit I
INTRODUCTION: Energy alternatives – New energy technologies – Solar thermal process Solar Radiation – Solar constant – extra terrestrial radiation – clear sky irradiation – solar radiation measurement – estimation of average solar radiation – solar radiation on tilted surface.

Unit II
FLAT PLATE COLLECTORS: Energy balances equation and collectors efficiency – collector performance – collector improvements, effect of incident angle, dust and shading – thermal analysis of flat plate collector and useful heat gained by the fluid - collector design – heat transfer factors

Unit III
CONCENTRATION COLLECTORS AND REFLECTORS: Parabolic concentrators, non-imaging concentrators, other forms of concentrating collectors. Tracking – receiver shape and orientation – performance analysis – reflectors – reflectors orientation – performance analysis.

Unit IV
SOLAR ENERGY STORAGE: stratified storage – well mixed storage – comparison – Hot water system – practical consideration – solar ponds – principle of operation and description of Non-convective solar pond – extraction of thermal energy application of solar ponds.

Unit V
APPLICATIONS OF SOLAR ENERGY: Solar electric power generation, photo voltaic cells. Solar furnace, Solar Chimney, heaters – power generation system. Tower concept – solar refrigeration system, thermo electric refrigeration system.

Text Books:

1. John.A. Duffie and Willam A.Beckman., 'Solar Engineering of Thermal Processes', Wiley, 2006.
2. Suhatme, S.P., 'Solar Energy Principle of Thermal Collection and Storage', Tata McGraw Hill, 1996.
3. Kriender, J.M., 'Principles of Solar Engineering', McGraw Hill, 1999.

Reference Books:

1. Mangal, V.S., 'Solar Engineering', Tata McGraw Hill, 1992.
2. Bansal, N.K., 'Renewable Energy Source and Conversion Technology', Tata McGraw Hill, 1989.
3. Peter J. Lunde., 'Solar Thermal Engineering', John Willey and Sons, New York, 1985.

12ME334 DESIGN AND ANALYSIS OF HEAT EXCHANGERS

Credits 3:1:0

Objective:
To impart knowledge on
- the classification of Heat exchangers
- the basic design methods of heat exchangers
- the design of Shell and tube, Compact heat exchangers

Outcome:
- The students will be able to design the heat exchangers for different applications.

Unit I
CLASSIFICATION OF HEAT EXCHANGER: Introduction; Recuperation and regeneration; Transfer processors; Geometry of construction, tubular heat exchangers, plate heat exchangers, extended surface heat exchangers ; Heat transfer mechanisms, Flow arrangements; Selection of heat exchangers.

Unit II
BASIC DESIGN METHODS OF HEAT EXCHANGERS: Arrangement of flow path in heat exchangers; basic equations in design; Overall heat transfer coefficient; LMTD and NTU methods for heat exchanger analysis, Heat exchanger design calculation, Variable overall heat transfer coefficient, Heat exchanger design methodology.

Unit III
SHELL-AND-TUBE HEAT EXCHANGER: Basic components-shell types, tube bundle types, tubes and tube passes, tube layout, baffle type and geometry, allocation of stream; basic design procedure of a heat exchanger- unit size, performance rating.

Unit IV
COMPACT HEAT EXCHANGER: Plate-fin heat exchanger, tube-fin heat exchangers, Heat transfer, pressure drop in finned-tube and plate-fin heat exchanger.

Unit V
CONDENSERS AND EVAPORATORS: Shell-and-tube condensers-horizontal shell-side condensers, vertical tube-side condensers, horizontal in-tube condensers ; steam turbine exhaust condensers ; Plate condensers ; Air-cooled condensers ; Direct contact condensers ; Thermal design of shell-and-tube condensers, single and multi effect evaporators.

Text Books:
1. Kays, W.M. and London A.L., 'Compact Heat Exchangers', 3rd Ed., Krieger Publishing Company, 1998.
2. Afgan, N.H. and Schliinder., ' Heat exchangers, Design and Theory Source Books' McGraw Hill Book Company,1974.
3. Frass, A.P. and Ozisik, M.N., 'Heat Exchanger Design', John Wiley and Sons Inc., 1965.
4. Wlker G., 'Industrial Heat Exchangers', A basic guide, McGraw Hill V Book Co., 1980.

Reference Books:
1. Standards of the Tubular Exchanger Manufacturer Association', 6th Ed., Tubular Exchanger Manufacturers Association, New York, 1978.
2. Donold Q Kern., 'Process Heat Transfer', McGraw Hill Book Co., 1984.
3. E.A.D. Saunders., 'Heat Exchangers', Longman Scientific and Technical, New York, 1988.

12ME335 VEHICLE MAINTENANCE

Credits: 4:0:0

Objective:
To impart knowledge on

- basic maintenance principle of vehicle
- failure and reliability of vehicle components
- the diagnose of body and engine using various techniques

Outcome:
The student will be able to

- Know preventive and predictive techniques for vehicular maintenance
- Apply various techniques to diagnose body and engine problems

Unit I
MAINTENANCE TOOL, SHOP, SCHEDULE, RECORDS: Standard tool set, torque wrenches, compression and vacuum gauges, engine analyzer and scanner, computerized wheel alignment and balancing, gauges for engine tune up and pollution measurement, spark plug cleaner, cylinder re-boring machine, fuel injection calibration machine. Importance of maintenance. Schedule and unscheduled maintenance. Scope of maintenance. Equipment downtime. Vehicle inspection. Reports. Log books. Trip sheet. Lay out and requirements of maintenance shop.

Unit II
MAINTENANCE, REPAIR AND OVERHAULING OF THE CHASSIS: Maintenance, servicing and repair of clutch, fluid coupling, gearbox, torque converter, propeller shaft. Maintenance of front axle, rear axle, brakes, steering systems. Maintenance of Tyres.

Unit III
POWER PLANT REPAIR AND OVERHAULING: Dismantling of power plant and its components. Cleaning methods. Inspection and checking. Repair and reconditioning methods for all engine components. Maintenance of ignition system, fuel injection system, cooling system, lubrication system. Power plant trouble shooting chart.

Unit IV
MAINTENANCE AND REPAIR OF ELECTRICAL SYSTEMS: Care, maintenance, testing and trouble shooting of battery, starter motor, dynamo, alternator and regulator. Transistorized regulator problems.

Unit V
MAINTENANCE AND REPAIR OF VEHICLE BODY: Body panel tools for repairing, Minor body panel beating, Tinkering and painting, Polishing, Use of soldering, Metalloid paste.

Text Books:

1. John Dolce, Fleet maintenance, Mcgraw Hill, Newyork, 1984
2. A.W.Judge, Motor Vehicle Servicing, 3rd Edition, Pitman Paperpack, London ,1969.
3. W.Crouse, Everyday Automobile repair, Intl.student edition, TMH, New Delhi,1986.
4. Ernest Venk., Edward spicer, Automotive maintenance and trouble shooting,D.B. Taraporevala Sons, Bombay, 1963

Reference Books:

1. Stator Abbey, Automotive steering, braking and suspension overhaul, pitman publishing, London, 1971.
2. Frazee, fledell, Spicer,-Automobile collision Work, American technical publications, Chicago, 1953.
3. Service Manuals from Different Vehicle Manufacturers
4. S. Abbey, Automotive Transmission servicing and overhaul, Sir Issac Pitman, London, 1971.

12ME336 VEHICLE DYNAMICS

Credits: 4:0:0

Objective:
To impart knowledge on
- vibrating systems and its analysis, modeling and simulation and modal analysis
- various Suspension systems, selection of springs and dampers
- the Stability of Vehicles
- tyres, ride characteristics and effect of camber, camber thrust
- vehicle handling under different steering conditions and directional stability of vehicles

Outcome:
The student will be able to:
- Understand and analyze the various dynamic aspects of the vehicle

Unit I
INTRODUCTION TO VIBRATION: Classification of vibration, definitions, mechanical vibrating systems, mechanical vibration and human comfort. Modeling and simulation studies. Single degree of freedom, free, forced and damped vibrations. Magnification factor and transmissibility. Vibration absorber. Vibration measuring instruments. Two degree of freedom system. Modal analysis

Unit II
SUSPENSION: Requirements, Spring mass frequency. Wheel hop, wheel wobble, wheel shimmy, Choice of suspension spring rate. Calculation of effective spring rate. Vehicle suspension in fore and aft directions. Hydraulic dampers and choice of damper characteristics. Independent, compensated, rubber and air suspension systems. Roll axis and vehicle under the action of side forces.

Unit III
STABILITY OF VEHICLES: Load distribution. Stability on a curved track and on a slope. Gyroscopic effects, weight transfer during acceleration and braking, overturning and sliding. Rigid vehicle – stability and equations of motion. Cross wind handling.

Unit IV
TYRES: Tyre forces and moments, rolling resistance of tyres, relationship between tractive effort and longitudinal slip of tyres, cornering properties of tyres, ride properties of tyre.

Unit V
VEHICLE HANDLING : Over steer, under steer, steady state cornering. Effect of braking, driving torques on steering. Effect of camber, transient effects in cornering. Directional stability of vehicles.

Text Books:
1. Rao J.S and Gupta. K “Theory and Practice of Mechanical Vibrations”, Wiley Eastern Ltd., 2002.
2. Dr. N. K. Giri, “Automobile Mechanics”, Seventh reprint, Khanna Publishers, Delhi, 2005

Reference Books:
1. J. Y. Wong, ‘Theory of Ground Vehicles’, John Wiley and Sons Inc., New york 2001.
2. Thomas D.Gillespie, Fundamentals of vehicle dynamics,SAE,1992
3. J.G. Giles, ‘Steering, Suspension and Tyres, Illiffe Books Ltd., 1968.
4. Groover, “Mechanical Vibration”, 7th Edition, Nem Chand andBros, Roorkee,India, 2003

12ME337 AUTOMOTIVE ELECTRICALS AND ELECTRONICS

Credits : 4:0:0

Objective:
To impart knowledge on
- application of electrical and electronic systems in Automobile engineering
- various sensor systems used in automobiles.
- the applications of actuators for automobiles

Outcome:
The student will be able to:
- Understand the electronic ignition and fuel injection system, lightning system and starting system.

Unit I
BATTERIES AND STARTING SYSTEM: Different types of Batteries – Principle, Construction and Electrochemical action of Lead – Acid battery, Electrolyte, Efficiency, Rating, Charging, Testing and Maintenance. Starting System, Starter Motors – Characteristics, Capacity requirements. Drive Mechanisms. Starter Switches.

Unit II
CHARGING SYSTEM, LIGHTING SYSTEM AND ACCESSORIES: D.C. Generators and Alternators their Characteristics. Control cutout, Electrical, Electro-mechanical and electronic regulators. Regulations for charging. Wiring Requirements, Insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods. Lighting design, Dash board instruments, Horns, wiper, Trafficators, Warning system and safety devices.

Unit III
ELECTRONIC IGNITION AND FUEL INJECTION SYSTEMS: Spark plugs, Advance mechanisms. Different types of electronic ignition systems - variable ignition timing, distributor less ignition. Spark timing control. Electronic fuel injection systems. Engine mapping.

Unit IV
SENSORS AND ACTUATORS: Basic sensor arrangement. Types of sensors – Oxygen sensor, fuel metering/Vehicle speed sensor, mass air flow sensor, temperature sensor, exhaust oxygen level, manifold pressure, crankshaft position, pressure sensor and detonation sensor. Various actuators and its application in automobiles.

Unit V
FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS: Current trends in automotive electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system

Text Books:
1. Young A.P. and Griffiths. L. “Automotive Electrical Equipment”, ELBS and New Press, 1999.
2. William B.Riddens “Understanding Automotive Electronics”, Fifth Edition, Butter worth Heinemann Woburn, 1998

Reference Books:
1. Ganesan.V. “Internal Combustion Engines”, Tata McGraw-Hill Publishing Co., Fifth Edition 2005.
2. Bechhold “Understanding Automotive Electronics”, SAE, 1998.
3. Crouse, W.H “Automobile Electrical Equipment”, Third Edition, McGraw-Hill Book Co., 1986.
4. Judge A.W “Modern Electrical Equipment of Automobiles”, Chapman and Hall, 1992.
5. Kholi.P.L “Automotive Electrical Equipment”, Tata McGraw-Hill Co., Ltd., 2000
6. Robert Bosch “Automotive Hand Book”, Fifth Edition, SAE, 2000.

12ME338 ALTERNATIVE FUELS FOR IC ENGINES

Credits: 4:0:0

Objective:
To impart knowledge on
- Various types of alternative fuels.
- the performance characteristics of alternative fuels.

Outcome:
The student will be able to:
- Determine the performance of alternative fuels.
- Analyze performance of single and multicylinder diesel and petrol engine.
- Analyze the performance and Emissions of alternative fuels.

Unit I
INTRODUCTION: Structure of petroleum, Refining process, Products of refining process, Fuels for spark ignition, Knock rating of SI engine fuels, Octane number requirement, Diesel fuels and Numerical Properties of Petroleum products ,Specific gravity, Density, Molecular weight , Vapour Pressure, Viscosity, Flash point, Fire point, Cloud Point, Pour point, Freezing Point, Smoke Point and Char value, Aniline point, Octane number, performance number, Cetane number, Emulsification, Oxidation Stability, Acid value/Number, Distillation Range and sulphur content. Need for alternate fuel, availability and comparative properties of alternate fuels.

Unit II
GASEOUS FUELS: CNG, LPG and Hydrogen- Availability, properties, modifications required in SI and CI engines, performance and emission characteristics, storage, handling and dispensing, safety aspects. - Manufacture of Ethanol and Methanol, properties, blending of Methanol and Ethanol, engine design modifications required and effects of design parameters, performance and emission characteristics, durability. Detailed study about Methane and Bio-Gas.

Unit III
VEGETABLE OILS: Introduction to straight vegetable oil, C.I Engine basic principles, straight vegetable oils as diesel engine fuel, Engine modification to run on SVO, Fuel Modification, Combustion chamber Modification, Injector pump, Injectors-Pilot Injection, Throttle Pintle, Hole Type Pintle, Flat cut Pintle, Heating the SVO, The Twin Tank or Dual Fuel System, straight vegetable oil properties, Environmental performance of SVO Vehicles.

Unit IV
DUAL FUEL ENGINE: Need and advantages, working Principle , Combustion in dual fuel engines, Factors affecting combustion in dual fuel engine, use of alcohols, LPG, CNG, Hydrogen, Bio gas and producer gas in CI engine in dual fuel mode, Engine modification required, performance and emission characteristics of alternative fuels(mentioned above) in dual fuel mode of operation v/s diesel operation.

Unit V
BIODIESEL AND FUEL CELLS: biodiesel, Need, Properties of biodiesels v/s Petrol diesel, Performance and emission characteristics of biodiesel. Working principle, classification and description of fuel cell systems, fuel cell components and properties of fuel cell, general performance characteristics, emission characteristics, merits and demerits.

Texts Books:
1. R.P.Sharma and M.L.Mathur : "A course in Internal Combustion Engines", D.Rai and sons. 2002
2. Ganesan.V, Internal Combustion Engines, Tata McGraw Hill, 1994.

Reference Books:
1. Bechtold, R., Alternative fuels guidebook, 1998.
2. Watson, E.B., Alternative fuels for the combustion engine, ASME, 1990
3. Domkundawar V.M : "Internal Combustion Engines", I Edition, Dhanpat Rai and Co., 1999
4. Holt and Danniel, Fuel cell powered vehicles: Automotive technology for the future, SAE, 2001.

12ME339 ENGINEERING PRODUCT DESIGN AND DEVELOPMENT STRATEGIES

Credits: 4:0:0

Objective:
To impart knowledge on

- the important practices followed during designing and developing a product in industries.
- the entire product life cycle right from its conceptual stage to its development stage.
- various concepts like modelling, simulation, material selection and GD&T.

Outcome:

- Students will have the knowledge of designing and developing a product in industries.
- Students will know the importance of mathematical modeling , simulation tools and its application.

Unit I
INTRODUCTION: Nature and scope of product engineering - creative thinking and organizing for product innovation criteria for product success in life cycle of a product. Importance of product design, Design Constraints, Safety and reliability considerations, The Design process-A simplified approach, Consideration of a Good Design, Detailed description of Design process (Morphology of Design)

Unit II
MODELLING AND SIMULATION: The role of Models in Engineering Design-Mathematical modeling, Similitude and scale modeling, Simulation, Finite-Difference, Finite-volume, boundary element method, Monte Carlo method, Geometric modeling on the computer, Finite Element Analysis.

Unit III
MATERIAL SELECTION: Relation of Materials Selection to Design, Performance Characteristics of materials, The Materials Selection process – Design process and materials selection, Ashby charts, Material selection in Embodiment design, Economics of materials, Methods of material selection- Selection with Computer-Aided database, Weighted Property Index, Value analysis, Design examples- Materials systems, Material substitution.

Unit IV
DESIGN CONSIDERATIONS: Functional and production design- Form design- Influence of basic design, Mechanical loading and material on Form design- Form design of Grey castings, Malleable iron castings, Aluminum castings, Pressure die castings, Plastic moldings, Welded fabrications, Forging and Manufacture by machining methods. Influence of Space, Size, Weight, etc., on Form design, Aesthetic and Ergonomic considerations

Unit V
DIMENSIONING AND TOLERANCE ANALYSIS: Dimensioning and Tolerancing a product- Functional production and inspection datum, Tolerancing types, Tolerance analysis. Dimensioning systems, Dimensioning Rules, Geometric tolerancing, introduction to statistical tolerancing.

Text Books:

1. Dieter. G. E, “Engineering Design", McGraw Hill, 2000.
2. David A. Madsen, “Engineering Drawing and Design”, Delmar Thomson Learning Inc. 2002, 3rd Edition.
3. Buhl, H.R., "Creative Engineering Design", Iowa State University Press,1960

Reference Books:

1. Jones J.C., "Design Methods", Interscience, 1970
2. Kevin Otto and Kristin Wood, “Product Design”, Pearson Educational Inc. 2004.
3. Karl T Ulrich, Steven D Eppinger, “Product Design and Development”, Irwin Homeward Boston Publishers, 2004.

12ME340 METAL CUTTING THEORY AND PRACTICE

Credits: 3:1:0

Objective:

To impart knowledge on

- basic mechanisms of metal cutting
- cutting tool such as material, geometry and tool failure
- Measuring of cutting force and cutting temperature

Outcome:

- Students can easily comprehend the mechanisms in metal cutting research.
- Students can design a cutting tool based on tool life and wear mechanism
- Students will be able to analyze cutting forces and cutting temperature and control them by adjusting the parameters affecting them

Unit I

MECHANICS OF METAL CUTTING: Mechanism of chip formation, types of chips, built-up edge, Orthogonal Vs Oblique cutting, Determination of shear plane angle, forces in orthogonal cutting, Merchant's circle diagram-Force and Velocity relationship, Energy considerations in machining - Theories of Mechanics of cutting - Merchant and Lee Shaffer Theories.

Unit II

MATERIAL AND GEOMETRY OF CUTTING TOOLS: Characteristics of tool materials, types of tool materials- Cutting tool geometry –Tool angle specification system - Effect of cutting parameters on tool geometry, ISO specifications for inserts and tool holders, Chip breakers.

Unit III

THERMAL ASPECTS OF MACHINING AND CUTTING FLUID: Sources of heat generation - Heat distributions in machining - Experimental determination of tool temperatures: tool-work thermocouple, embedded thermocouple, infrared photographic technique –Cutting fluid: functions and properties-methods of applying-Types and composition of cutting fluid.

Unit IV

TOOL WEAR AND TOOL LIFE: Tool wear mechanisms, types of tool damage, tool failure criteria, tool life equations, effect of process parameters on tool life– machinability - machinability criteria - Economics of machining elements of total production cost, optimum cutting speed and tool life for minimum cost, optimum cutting speed and tool life for maximum production.

Unit V

CUTTING FORCES AND CHATTER IN MACHINING: Forces in turning, drilling and milling Measurement of cutting forces- Reasons for measuring cutting forces- requirements of tool dynamometers-construction and principle of operation of piezoelectric, and strain gage type dynamometers. Chatter – causes of chatter in machining – Avoidance of chatter

Text Books:

1. Shaw .M.C., “Metal cutting Principles", Oxford University Press, Inc., 2^{nd} edition, 2005.
2. Juneja. B. L, Sekhon.G.S and Nitin Seth "Fundamentals of Metal Cutting and Machine Tools", New Age International (p) Ltd., 2^{nd} edition, 2003.

Reference Books:

1. Geoffrey Boothroyd and Knight. W.A "Fundamentals of Machining and Machine tools", Crc Press, New York, 2006.
2. Bhattacharya. - "Metal Cutting Theory and Practice ", New central Book Agency pvt. Ltd., Calcutta, 2000.

12ME341 PRINCIPLES OF MECHANICAL VIBRATIONS

Credits: 3:1:0

Objective:

To impart knowledge on

- Formulating mathematical models for problems in vibrations
- ways to reduce unwanted vibration
- the equipment used for collecting response data.

Outcome:

The student will be able:

- To solve for the motion and the natural frequency for free, forced vibration of undamped motion and damped motion.
- To solve vibration problems that contains multiple degrees of freedom.
- To reduce unwanted vibration and to handle equipment used for collecting response data.

Unit I

VIBRATION OF SINGLE DEGREE OF FREEDOM SYSTEM: Introduction –equation of motion – frequency and period – free vibration- forced vibration – damping - resonance solutions of problems by Newton's law of motion- Solutions of problems for one degree of freedom systems for transient and harmonic response. Energy methods – Rayleigh's method – mechanical impedance method - isolation of vibrations and transmissibility.

Unit II

VIBRATION OF TWO - MULTI DEGREES FREEDOM SYSTEM: Equations of motion of Two Degree of freedom system. Vibration absorber – LaGrange's equation, influence coefficients- mode of vibration principle modes-principle of orthogonal generalized coordinates – dynamic vibration absorber – semi definite systems. Vibration of multi degrees of freedom system.

Unit III

VIBRATION OF CONTINUOUS SYSTEMS: Vibration of strings- vibration of rods- Vibration equation for beams. Normal mode of vibration- Flexibility matrix and stiffness matrix- Eigen value and eigenvector- Orthogonal properties – Modal analysis.

Unit IV

NUMERICAL METHODS IN VIBRATION PROBLEMS: Numerical methods in vibration problems - Methods of finding natural frequencies for problems including on torsional vibrations matrices-matrix iteration –Stodola's method, Holzer's method -mechanical impedance method –Matrix iteration technique.

Unit V

EXPERIMENTAL METHODS IN VIBRATION TESTING AND ANALYSIS: Vibration instruments- vibration exciters - measuring devices- analysis- vibration Tests- Free, forced environmental vibration tests. Example of vibrations test-data acquisition – Modal and FFT analysis– Industrial case studies.

Text Books:

1. Singiresu.S.Rao., "Mechanical Vibrations", Addison Wesley Longman ,2003.
2. Benson H Tongue, " Principles of vibration"(2nd edition)Oxford University Press, 2002

Reference Books:

1. Thomson, W.T.,"Theory of Vibration with Applications" CBS Publishers and Distributers,NewDelhi,2002
2. Kelly, "Fundamentals of Mechanical Vibrations", Mc Graw Hill Publications, 2000.
3. Rao, J. S . , and Gupta K."Ind. Course on Theory and Practice Mechanical Vibration", NewAge International (P) Ltd.,2005.
4. Rao V. Dukkipati, J. Srinivas., Vibrations : problem solving companion, Narosa Publishers, 2007.

12ME342 INDUSTRIAL VIBRATION AND NOISE ENGINEERING

Credits: 4:0:0

Objective:
To impart knowledge on

- to analyze the vibration, noise and acoustics related problems of real life complex systems
- the effects of vibrations and noise and the methods to control them in engineering applications.
- the scientific vocabulary specific to the field of noise and vibration control

Outcome:
The student will be able to:

- understand and study the ways to reduce unwanted vibration and noise
- Apply noise and vibration control methods to make machines quieter
- become proficient with instrumentation used in noise and vibration control tests

Unit I
INTRODUCTION TO ENGINEERING ACOUSTICS: Basic physical acoustics- acoustic levels and spectra- decibels, sound power, Sound pressure, power and intensity -- Character of noise – Addition of two noise sources -Noise source identification. Noise radiation from vibrating bodies sound- properties of the various sources that create noise - Noise in machines and machine elements. Fan and flow noise. Combustion noise. Noise in piping systems. Industrial noise... Characteristics of Duct and Cabin Noise. Stationary modes. Random noise.

Unit II
INDUSTRIAL NOISE AND NOISE CONTROL METHODS: Basic source of machine noise character - Fans and blowers- gas-jet noise- gear noise- Jet noise Response of structures -Noise control methods -Acoustic materials- sound silencers mufflers and active noise control Noise absorber design. Acoustic enclosures - Design of silencers, mufflers. Importance of reverberations time -Acoustic Design of Buildings. Environmental acoustics Sound Intensity Mapping Noise isolation design Human factors in noise engineering

Unit III
INDUSTRIAL VIBRATION PROBLEMS: Vibrations and their manifestations in real life systems. Experimental and theoretical routes to vibration engineering. Applications of numerical procedures to determine natural frequencies and mode shapes – Harmful effects of mechanical vibrations - Dynamic instability control - Introduction to Modal testing, model updating and structural dynamic modification to improve dynamic design of machine structures.. Vibration Reduction Measures, Unconstrained and constrained layer damping treatment, add on dampers, and stiffeners.

Unit IV
VIBRATION CONTROL: Vibration control strategies- Application of damping treatment for vibration control in machines and structures. Vibration Absorber Design -Vibration control solutions - Active control of vibrations. Design of vibration isolators. Auxiliary mass systems including tuned dampers for vibration control - Changing the dynamic characteristics of a structure, Structural dynamics modification. Predicting the modification (dynamic design) Design of Isolators in machine foundations. Role of materials damping. Balancing of rotating machinery. Rigid and flexible rotor balancing. Active control of Vibration.

Unit V
VIBRATION AND NOISE MEASUREMENTS, TESTING AND ANALYSIS: Introduction to Acoustic Standards, Acoustic / Noise sensors, instrumentation, measurement and noise control

instruments and noise propagation -Various types of acoustic testing chambers reverberation control-vibration control -Vibration sensors – vibration instrumentation, measurement and analysis -Vibration Testing. Spatial, Modal and Response models of vibrating systems. Balancing of rotating and reciprocating machines.

Text Books:

1. Leo N Bernak, Istvan L., “Noise and Vibration control Engineering”, Ver J and W Publication, 2006
2. Denis Karczub ., M.P. Norton., Fundamentals of Vibration and Noise Analysis for Engineers”, Cambridge University Press, 2003

Reference Books:

1. Clarence W De Silva, “Vibration Fundamentals and Practice”, CRC Press, 2000
2. Amberkar.A.G. “Mechanical Vibrations and Noise Engineering”, Prentice Hall of India, New Delhi,2006
3. Kewal Pujara, “Vibrations and Noise for Engineers”, Dhanpat Rai and Co, 4^{rth} Edition, 2007.

12ME343 DESIGN OF THERMAL POWER EQUIPMENTS

Credits: 3:1:0

Objective:

To impart knowledge on

- The design of boiler, furnace, condenser and cooling tower
- boiler performance and their accessories
- water and steam purification methods and equipments

Outcome:

The students will be able to

- design boiler , furnaces, condenser and cooling tower
- design economizer, super heater, reheater and analyse their performance
- design air preheater, draft system and chimney

Unit I

BOILER AND FURNACE DESIGN: Parameters to be considered in boiler and furnace design, type of high pressure boilers, IBR Code, different types of furnaces for solid and liquid fuels, heat transfer in furnaces, types of refractory walls, water wall arrangements, furnace bottoms, slag removal, cold primary air system, wind box assembly, fluidized bed boilers, types.

Unit II

BOILER WATER SIDE DESIGN: Types of circulation, design of condenser, types, selection of condenser, vacuum efficiency, air leakage into the condenser, air removal system, cooling tower, types and design for power plant application.

Unit III

PERFORMANCE OF BOILER: Equivalent evaporation, boiler efficiency, boiler trail, heat balance, feed water heaters, economizer, super heater, desuperheater, and reheater- types, design, and performance, steam mass flow, gas mass flow and pressure drop in super heater, super heat temperature control.

Unit IV

WATER AND STEAM PURIFICATION: Water treatment methods, chemical treatment, mechanical carry over, silica carry over, gravity separation, drum internals , steam washing, typical arrangements of boiler drum internal in high pressure boilers.

Unit V

AIR PREHEATER AND DRAUGHT SYSTEMS: Types– design considerations, high temperature and low temperature applications, Draught system – types, design, power requirement for draught fans, pressure losses – Chimney design, ash removal, electrostatic precipitator.

Text Books:

1. P.K. Nag., 'Power Plant Engineering (Steam and Nuclear)', Tata McGraw Hill, New Delhi, 2007.
2. C.D. Shields., 'Boilers', McGraw Hill, 1982.

Reference Books:

1. Homi, P. Serval., 'Boilers and Pressure Vessels', Multitech Publishing Company, Bombay, 1989.
2. Skrotzki and W.A. Vepot., Power Station Engineering Economy, Tata McGraw Hill, New Delhi, 1987.
3. Morse, T.F., 'Power Plant Engineering', Van Nostrand East West Press, Revised Edison, 1983.
4. David Sunn, Robert Houston, 'Industrial Boilers', Longman Science and Technology, 1986.
5. 'Modern Power Station Practice', Vol. 8, Central Electricity Generating Board, UK, Pergamon Press, 1971.

12ME344 INDUSTRIAL ROBOTICS

Credits: 4:0:0

Objective:

To impart knowledge on

- automation and brief history of robot and applications.
- kinematics of robots.
- robot end effectors and their design.
- Robot Programming methods and Languages of robot.
- various Sensors and their applications in robots.

Outcome:

Students will be able to

- familiarized with the kinematic motions of robot.
- Know about robot end effectors and their design concepts.
- Know the Programming methods and various Languages of robots.
- Know the principles of various Sensors and their applications in robots.

Unit I

INTRODUCTION: Automation and robotics –History of robotics, Robot anatomy ,Robot configurations, Robot Components, Types of Robot drives – pneumatic, hydraulic and electrical drive systems, Robot Applications – Manufacturing and others, CIM and hostile environments - safety considerations.

Unit II

TRANSFORMATIONS AND KINEMATICS: Coordinate transformation -Vector operations – Basic transformations matrices - Properties of transformation matrices-Homogeneous transformations– Forward solution, DH algorithm - Inverse kinematic solution, Robot dynamics.

Unit III

CONTROLS AND END EFFECTORS: Control system concepts - Analysis - control of joints - Adaptive and optimal control – End effectors - classification - Mechanical - Magnetic -Vacuum - Adhesive - Drive systems and controls- Force analysis and Gripper design.

Unit IV

ROBOT PROGRAMMING AND AI: Methods - Languages -Computer control and Robot Software - VAL Language – Trajectory Planning, Basic robot motions - Point to point control and continuous path control and interpolations AI – Basics – Goals-AI Techniques – AI and Robotics.

Unit V

SENSORY DEVICES: Non optical and optical position sensors - Velocity and Acceleration - Range - Proximity -touch - Slip - Force -Torque - Machine vision - Image components - Representation - Hardware - Picture coding - Object recognition and categorization - Software consideration.

Text Books:

1. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering – An Integrated Approach”, Prentice Hall India, 2002.
2. Saeed B Niku, "Introduction to Robotics", John Wiley and Sons, 2010.

Reference Books:

1. S.K Saha, "Introduction to Robotics", Tata McGraw-Hill, Publishing Co., Ltd., 2008.
2. Mikell P Groover,Mitchel Weiss,Roger N Nagel,Nicholas G OdreyAshish Dutta, “Industrial Robotics: Technology, Programming, and Applications”, Tata-McGraw Hill Publisher, 2012

12ME345 DESIGN FOR MANUFACTURING AND ASSEMBLY

Credits: 4:0:0

Objective:

To impart knowledge on

- the design principles , the needs of product functionality, product design, and production planning and Product Assembly.
- a quality product by incorporate the reliability, safety functions and robustness of the product.

Outcome:

Students will be able to

- Identify and describe how the integrated design, manufacturing, and assembly process works.
- Identify and describe how the details of example production plans affect the product and can be designed for the ease of manufacturing and assembly besides reducing the overall costs of the product.

Unit I

INTRODUCTION: General Design principles for manufacturing – strength and mechanical factors, mechanisms selection, Process capability – Feature tolerances – Geometric tolerances – assembly limits – Datum Features – Functional datum, Machining sequence, manufacturing datum, changing the datum. Examples.

Unit II

FACTORS INFLUENCING FORM DESIGN: Working Principle, Material, Manufacture Design – Possible solutions – Materials choice –Influence of materials on form design – form design of welded members, forgings and castings.

Unit III

COMPONENT DESIGN – MACHINING CONSIDERATION: Design features to facilitate machining – drills – milling cutters – keyways – Doweling-procedures, counter sunk screws – Reduction of machined area - simplification by separation – simplification by amalgamation – Design for machinability – Design for economy – Design for clampability – Design for Accessibility – Design for Assembly.

Unit IV

COMPONENT DESIGN – CASTING AND WELDING CONSIDERATIONS: Redesign of castings based on parting line considerations – minimizing core requirements, machined holes, Redesign of cast members to obviate cores. Redesign of weld members based on Weld joints-Material thickness-Specifying Welds-cost of welding-Weld distortion-Weld Strength-Finishing and Tolerancing considerations.

Unit V

REDESIGN FOR MANUFACTURE AND CASE STUDIES: Identification of uneconomical design – Modifying the design – group technology –Design for reliability and safety- Robust and quality design. Computer Application for DFMA.

Text Books:

1. Harry Peck, " Designing for Manufacture", Pitman Publications, 1983.
2. Robert Matousek, " Engineering Design- A Systematic Approach" Blackie and Son Ltd., London.1963
3. George E.Dieter, " Engineering Design: A Materials and Processing Approach", 3rd ed., 2000 McGraw-Hill,

Reference Books:

1. James G,.Bralla, " Hand Book of Product design for Manufacturing", McGraw Hill publications, 1998
2. Swift K.G., "Knowledge based design for manufacture", Kogan page Ltd., 1987.

12ME346 MANUFACTURING SYSTEM AND SIMULATION

Credits: 3:1:0

Objective:

To impart knowledge on

- modeling of systems using discrete event simulation.
- To learn the various modeling techniques.

Outcome:

Students will be able to

- create model of the real system.
- resolve the practical problems in manufacturing sectors using simulation.

Unit I

MANUFACTURING SYSTEMS AND MODELS: Types and principles of manufacturing systems, types and uses of manufacturing models, physical models, mathematical models, model uses, model building.

Unit II

MATERIAL FLOW SYSTEMS: Assembly lines-Reliable serial systems, approaches to line balancing, sequencing mixed models. Transfer lines and general serial systems – paced lines without buffers, unpaced lines. Shop scheduling with many products. Flexible manufacturing systems - System components, planning and control. Group technology-Assigning machines to groups, assigning parts to machines. Facility layout- Quadratic assignments problem approach, graphic theoretic approach

Unit III

RANDOM NUMBERS GENERATION AND RANDOM VARIABLE GENERATION: Techniques for generating random numbers- mid square method-the mid product method constant multiplier technique-additive congruential method linear congruential method. Random variable generation - Inverse transform technique-exponential distribution-uniform distribution – Weibull distribution. Empirical continuous distribution.

Unit IV

DISTRIBUTION AND EVALUATION OF EXPERIMENTS: Discrete Uniform distribution - Poisson distribution - Geometric distribution – Acceptance rejection technique for Poisson distribution - Gamma distribution - Simulation Experiments – Variance reduction techniques - Antithetic variables -Verification and validation of simulation models.

Unit V

DISCRETE –EVENT SYSTEM SIMULATION: Concepts in discrete event simulation, Manual simulation using event scheduling, single channel queue, two server queue simulation of inventory problems. Programming for discrete event systems in GPSS-Case studies

Text Books:

1. Ronald G Askin, "Modeling and Analysis of Manufacturing Systems", John Wiley and Sons, Inc,1993
2. Jerry Banks and John S. Carson, " Discrete –Event System Simulation", Prentice Hall Inc,1984

Reference Books

1. Gordon G, "System Simulation", Prentice Hall of India Ltd,1991
2. Mengchu Zhou, "Modeling, Simulation, and Control of Flexible Manufacturing Systems: A Petri Net Approach", World scientific Publishing Company Pvt Ltd., 2000

12ME347 MANUFACTURING INFORMATION SYSTEMS

Credits: 4:0:0

Objective:
To impart knowledge on

- Creation and storage of technical information for decision making.
- Manage and plan the manufacturing resources

Outcome:
Students will be able to

- manage the information system in manufacturing Environment.
- apply various tools involved in database administrations.

Unit I
INTRODUCTION: The evolution of order policies, from MRP to MRP II, the role of Production organization, Operations control.

Unit II
DATABASE: Data Bank Concepts, CAD/CAM databases, Data-Bank-Information storage and retrieval, Data life cycle, Desirable characteristics of data processing system, Level of decision making and Information requirements, Data Dictionaries in Manufacturing, Integrated Information System, Object Oriented Models. Trends in database.

Unit III
DESIGNING DATABASE: Hierarchical model - Network approach - Relational Data model -concepts, principles, keys, relational operations - functional dependence -Normalisation, types - Query languages.

Unit IV
MANUFACTURING CONSIDERATION: The product and its structure, Inventory and process flow - Shop floor control – Data structure and procedure -various model - the order scheduling module, input / output analysis module the stock status database – the complete IOM database - Tracebility.

Unit V
INFORMATION SYSTEM FOR MANUFACTURING: Parts oriented production information system - concepts and structure-computerised production scheduling, online production control systems, Computer based production management system, computerised manufacturing - information system - case study.

Text Books:

1. Luca G. Sartori, " Manufacturing Information Systems ", Addison-Wesley Publishing Company, 1988.
2. Elmasri Navathe, “Fundamentals of Database Systems”, Pearson Education Asia, 2001.

Reference Books:

1. Date.C.J., " An Introduction to Database systems ", Narosa Publishing House, 1997.
2. Orlicky.G., " Material Requirements Planning ", McGraw-Hill Publishing Co., 1975.
3. Kerr.R, " Knowledge based Manufacturing Management ", Addison-wesley, 1991.

12ME348 MATERIALS CHARACTERIZATION

Credits: 4:0:0

Objective:
To impart knowledge on

- To provide knowledge about various analytical instruments, their principles, practice and applications

Outcome:
Students will be able to

- Select the appropriate instruments for various material characterization purposes.

Unit I
OPTICAL MICROSCOPY AND MECHANICAL TESTING: Bright field and dark field microscopy, resolving power and numerical aperture, depth of field and depth of focus, phase contrast, polarised light and interference microscopy, quantitative metallography. Microhardness testing.

Unit II
X RAY DIFFRACTION:: continuous and characteristic spectrum, Bragg's law, X-ray diffraction methods-Laue, rotating crystal and powder methods, diffractometer, filters and counters, Applications in material characterization-crystal structure and lattice parameter determination, stress measurement, phase transformations.

Unit III
ELECTRON OPTICAL TECHNIQUES: Electron Probe Microanalysis(EPMA), Scanning Electron Microscopy(SEM) with energy dispersive X Ray analysis(EDAX), Transmission Electron Microscopy(TEM) and selected area diffraction, Scanning Transmission Electron Microscopy(STEM), Atom Force Microscopy, High resolution TEM(HRTEM), Field Ion Microscopy(FEM)

Unit IV
SPECTROSCOPY: Electron Spectroscopy for Chemical Analysis(ESCA), X Ray Fluorescence, X Ray Photoelectron Spectroscopy (XPS), UV, Visible and IR spectroscopy,
SURFACE ANALYSIS: Auger electron spectroscopy, Secondary Ion mass spectroscopy, X ray photoelectron spectroscopy.

Unit V
THERMAL METHODS AND ELECTROCHEMICAL METHODS: Differential Thermal Analysis (DTA), Thermogravimetry (TG), Differential Scanning Calorimetry (DSC)
Electrochemical methods, pH, Gas chromatography

Text Books:

1. Hebbar,K.R.,Basics of X Ray Diffraction and its Applications, IK International Publishing House, New Delhi,2007.
2. Philips V.A., Modern Metallographic Techniques & its applications, Wiley Eastern, 1971.

Reference Books:

1. Whan,R.E., ASM Handbook on Materials Characterization, Vol 10, American Society of Metals, 9th edition, 1996.
2. Van der Voort, Metallography, Principles and Practice, McGraw Hill,1984.

12ME349 DESIGN OF MECHANICAL SYSTEM ELEMENTS

Credits: 3:1:0

Objective:
To impart knowledge on
- design of mechanical systems.
- the step by step design procedure of mechanical systems.
- use of design data books and data sheets.
- design of mechanical systems and making them as industry ready design Engineers.

Outcome
Students will be able to
- solve and design industrial mechanical systems problems and can involve in product design and development .

Unit I
MATERIAL HANDLING EQUIPMENT AND STRESSES IN PRESSURE VESSELS: Types, Selection and applications. Method for determining stresses –Terminology and ligament efficiency-Application. Stresses In Pressure Vessels -Introduction: Theory of Stresses in a circular ring, cylinder-Membrane stress analysis of vessels shell Components - Cylinder shells, spherical heads, conical heads under internal pressure-Thermal stresses-Discontinuity stresses in hemispherical head and cylindrical shell juncture.

Unit II
DESIGN OF PRESSURE VESSELS: Design of tall cylinder -self supporting process columns-Supports for short vertical vessels. Stress concentration at a variable thickness transition section in a cylindrical vessel about a circular hole, elliptical openings. Theory of reinforcement. Pressure vessel design-Wall thickness of thin cylinder, thick cylinder and thin spherical vessel.

Unit III
DESIGN OF AUTOMOTIVE TRANSMISSION SYSTEM: Design of automotive transmission system – clutches – single plate clutch and cone clutch. Cams –acceleration, contact stress of cycloidal and simple harmonic cams, Gear box.

Unit IV
DESIGN OF HOISTING ELEMENTS: Welded and roller chains- Design of ropes -Hemp and wire ropes. – pulley system for a gain in force, multiple pulley system-sprockets for welded and roller chains-Rope drums . Load handling attachments- Design of forged standard hooks and triangular eye hooks .crane grabs-lifting magnets-Grabbing attachments. Design of arresting gear-Brakes: Shoe brake-drum type internal and external shoe brake, band brake –differential ,band and block brake .

Unit V
CONVEYORS: Types-description of screw, pneumatic, apron, screw conveyors and escalators-Design and applications of belt conveyors and vibratory conveyors.

Text Books:

1. John.F.Harvey, “Theory and Design of Pressure Vessels”, “CBS Distributors”, 2003.
2. Rudenko.N, “Materials Handling Equipments”, Elnvee Publishers, 2000.
3. Prabhu T.J., ‘Design of Transmission elements’, 2003

Reference Books:

1. Alexandrov.M. “Materials Handling Equipments”, MIR publishers, 2000.
2. Henry.H.Bedner “Pressure Vessels”, Design Hand Book, CBS Publishers and Distributors, 1987.
3. Joseph Edward Sighley , “Mechanical Engineering Design”, McGraw Hill, 2000

12ME350 VACUUM TECHNOLOGY

Credits: 3:1:0

Objective:
To impart knowledge on
- the fundamental concepts of vacuum technology.
- common vacuum system hardware and instrumentation, including pumps, gauges, flanges, valves, and feed through.
- vacuum fundamentals necessary to undertake effective leak detection
- applications and processes involving vacuum technology.

Outcome:
The student will be able to
- recognize the importance of vacuum in modern technology and research
- apply procedures for addressing vacuum leaks

Unit I
INTRODUCTION: Ideal and real gas laws, Kinetic theory of gases, Mean free path, Transport proprieties in-viscous state, molecular state. Thermal diffusion and energy transport. Gas flow at low pressure-Flow regimes, Conductance and throughput. Pumping speed. Viscous and turbulent flow, molecular flow and Intermediate flow, Conductance of pipelines, fittings.

Unit II
VACUUM SYSTEMS: Pumping speed, pump down time in viscous and molecular range. Evaluation of the gas load and pumping requirements. Vapors in vacuum system, Vapour pressure and rate of evaporation. Out gassing, out gassing rates, Factors influencing out gassing. Gettering-principles, methods, materials.

Unit III
PUMPS AND EJECTORS: Production of Low pressures- Principles of pumping, selection of pumps. Rough and medium range pumps-Oil sealed rotary pump, Dry pumps, Roots Pumps. High vacuum pumps- Diffusion pumps, Cryopumps. Sealing techniques-classification, permanent seals,
demountable seals.
Ejectors-working principle-water jet ejector, steam ejectors, air ejectors. Single and multistage ejectors, advantages of multi-stage ejectors.

Unit IV
LOW PRESSURE MEASUREMENTS: classification and selection of vacuum gauges, Total pressure measurement –Direct measurement, indirect measurement. Partial pressure measurement. Calibration of vacuum gauges. Leak rate, Leakage measurement, Leak detectors, Design of vacuum chamber- cylindrical chamber.

Unit V
APPLICATIONS: vacuum Technology for Space and Cryogenic applications. Application in chemical and process industries-Vacuum drying-Food preservation-Distillation units.

Text books:

1. Roth.A, Vacuum Technology, North-Holland, 3rd Ed., 1998.
2. Gehard Lewin, Fundamentals of vacuum science and Technology, McGraw Hill, 1965.

Reference Books:

1. J.F. O'Hanlon, A users guide to vacuum technology, Wiley-Interscience, 3rd Ed., 2005.
2. D.M.Hoffman, B.Singh and J.H.Thomas (Eds), Handbook of vacuum science and technology, Academic Press, 1998.
3. L.Holland ,W.Steckelmacher, J.Yarwood , Vacuum Manual, Halsted Press, 1974 (Division of J. Wiley and Sons)

12ME351 MICROMANUFACTURING AND NANOTECHNOLOGY

Credits: 4:0:0

Objective:
To impart knowledge on
- microfabrication and micromachining techniques towards nanotechnology
- MEMS and MOEMS
- LASER micromachining, nano finishing techniques and also about materials in nanoscale
- the essentials of carbon nanotubes, production and also about societal implications of nanotechnology

Outcome:
The student will be able to
- familiar about microfabrication ,micromachining mems and moems
- understanding on LASER micromachining,nano finishing nano technology and also about nanoscale materials

Unit I
Micro Fabrication and Micro Manufacturing: Introduction-Photo lithography-ion implantation-Diffusion-Oxidation-Chemical vapour deposition physical vapour deposition-depolition by Epitaxy-Etching-Micro manufacturing-Introduction-Bulkmicromanufacturing-Isotropic and Anisotropic Etching-wet etchants-Etch stop-Dry Etching-Surface micromanufacturing-Mechanical problems associated with Surface Micromachining-The LIGA process general description-Materials for substrates and photoresists-The SLIGA process.

Unit II
INTRODUCTION TO PRINCIPLES OF MICRO ELECTRO MECHANICAL SYSTEMS AND MICRO OPTO ELECTRO MECHANICAL SYSTEMS (MOEMS): Introduction- Micro Electro Mechanical Systems (MEMS) –microelectronics fabrication methods- Micro instrumentation-Micro instrumentation -Micro Mechatronics-Nano finishing- Optically variable devices-MECS-Micro propulsion-e beam Nano lithography-Nanotechnology-Carbon nano tubes-Molecular Logic Gates- Micro devices-Bio sensors,-Principles of MEMS-introduction-Mechanical MEMS-thermal MEMS-Magnetic MEMS-and MOEMS

Unit III
LASER MICROMACHINING AND NANO FINISHING TECHNIQUES: Laser technology in Micro manufacturing- Introduction - Generation of laser- properties of laser-Practical Lasers-Applications –Nano Finishing Techniques-Introduction-Traditional and advanced finishing process-Abrasive Flow machining-Magnetic Abrasive finishing- Magnetorheologial Finishing-Magnetorheologial Abrasive Flow Finishing-Magnetic Float Polishing- Elastic Emission Machining-Ion Beam Machining- Chemical Mechanical Polishing

Unit IV
INTRODUCTION TO NANOTECHNOLOGY AND INVESTIGATING MATERIALS IN NANOSCALE: Introduction to Nanotechnology-Experimental methods-Introduction-Electron Microscopy-Scanning probe microscopy-Optical microscopy for Nanoscience and Technology

Unit V
CARBON NANOTUBES , THEIR PRODUCTION ,APPLICATION AND SOCIETAL IMPLICATIONS OF NANO SCIENCE AND NANO TECHNOLOGY: Introduction-Carbon nanotubes-structures-properties-production of carbon Nano tubes-Chemical Vapor deposition-Arc

discharging-Laser ablation-Mechanisms of growth-purification-Applications of carbon Nanotubes-Electrical transport of carbon nanotubes-applications in computers, biomedical applications- X-ray equipments-Nano mechanical actuators-Societal implications of Nano science and Nanotechnology-Issues-Nanopolicies -nanotechnology for economic and social development

Text Books:

1. N.P Mahalik, “Micro manufacturing and Nanotechnology,” Springer Verlag, Berlin Heidelberg 2006
2. T Pradeep, “NANO The Essentials” Tata McGraw-Hill New Delhi 2007
3. Tai-Ran Hsu “MEMS and Microsystems Tata McGraw-Hill New Delhi 2005

Reference Books:

1. V K Jain “Advanced Machining Processes” allied Publishers (P) Ltd. 2008
2. Charles P.Poole, Jr. and Frank J.Owens, Introduction to Nanotechnology Wiley, 2003
3. Michael Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and Burkhard Raguse, “Nanotechnology – Basic Science and Emerging Technologies”, Chapman and Hall(CRC), 2004

12ME352 ADVANCED INSTRUMENTATION IN THERMAL ENGINEERING

Credits 3:1:0

Objective:
To impart knowledge on
- advanced instrumentation, experimental methods and measurement techniques.
- operation and specific functional characteristics of thermal instruments.
- analytical calculations and their uncertainties which may arise in the various instruments and their measurement techniques.

Outcome:
The student will be able to
- verify the analytical work that injects new life and vitality into the theories.
- do the theoretical analysis and the compare the same with experimental results which cannot be generated in any other way.

Unit I
REVIEW OF STATIC AND DYNAMIC MEASUREMENTS : kinds of errors and uncertainty – their analysis – Planning the experiments from error analysis. Pressure cells – Dynamic characteristic LVDT, piezo electric pressure gauge.

Unit II
FLOW MEASUREMENTS: Pitot tubes – magnetic flow visualization methods – shadowgraph – schlieren and interferometry – smoke methods – impact of pressure in supersonic flow – Hot wire anemometer – Laser Doppler anemometer – Holographic flow motors, NMR flow meter.

Unit III
TEMPERATURE MEASUREMENTS AND CHEMICAL ANALYSIS : Measurement by Mechanical effect and by electrical effects- Thermocouples, pyrometry, transient response of thermal systems – calibration methods. Thermo electric effect instruments – varying resistance device quartz Thermometers. Thermal property measurements: measurement of Thermal conductivity. Emissivity – Gas composition analysis, gas chromotography – Infrared analyzer and Mass spectrometer.

Unit IV
DATA ACQUISITION AND PROCESSING: Analysis of experimental Data – Measurement of Heat flow by Electrical analog – use of computers. Digital transducers, intelligent temperature measuring instruments and application of program logic controllers in boilers and turbines.

Unit V
SOLAR RADIATION MEASUREMENT AND ENERGY DEVICES: Pyrhekuimeters and phyrheliometric scales. Pyranometers – Measurement of duration – sun shine recorder. Instrumentation of I.C. Engines, Gas and Steam Turbines and Boilers.

Text Books:

1. Doebelin O.E., 'Measurement Systems and Design', McGraw Hill Co., 2003.
2. Holman J.P., 'Experimental Methods for Engineers', McGraw Hill Co, 2001.

Reference Books:

1. Beckwit T.G. and Buck M.L., 'Mechanical Measurements', Addition Welsly, 2011.
2. Rangan, C.S., Sharma G.S. and Mani V.S., 'Instrumentation Devices and Systems', Tata McGraw Hill Pub. Co., 1993.
3. Johnson C.D., 'Process Central Instrumentation Technology', John Willey and Sons Inc., 1988.
4. R.S. Sirohi and H.C. Radhakrishanan., 'Mechanical Measurements', Willey Eastern Ltd., 1983.

12ME353 ENERGY CONSERVATION AND MANAGEMENT

Credits: 3:1:0

Objective

To impart knowledge on

- the concept of Energy Conservation.
- the ways and means of Energy conservation and Auditing
- about energy pricing and Optimization.

Outcome

The student will be able to

- analyse environment aspects of energy utilization
- analyse energy conservation, management and Energy Technologies
- analyse optimization of energy consumption and auditing.

Unit I

ENERGY RESOURCES: Energy use patterns and scope for conservation, world energy supply and demand, national energy systems, policies, programmes and decisions.

Unit II

ENERGY AUDITING IN ENGINEERING AND PROCESS INDUSTRY: Identification of areas for energy conservation, review of conservation technologies, conservation through maintenance, lubrication and tribological innovations, predictive and preventive maintenance.

Unit III

ENERGY CONSERVATION IN BUILDINGS: Heating, cooling, lighting and ventilation, electrical energy conservation, energy efficient electric motors and power factor improvement in power systems. Energy conservation in thermal systems: combustion systems, refrigeration and air-conditioning system, furnaces and boilers.

Unit IV

ENERGY MANAGEMENT PRINCIPLES: Need for organization and goal setting, Basic discounting, life cycle costing and other methods, factors affecting economics, energy pricing and incentives for conservation, financial management.

Unit V

ENERGY POLICIES: Policies regarding non-conventional energy system, energy resource management, availability, needs and cost benefits of energy sources. Conflicting goals and decision under uncertainty, energy technology assessment.

Text Books:

1. David H.U., Handbook of Industrial Energy Conservation Van Nostrand Reinhold Company, 1983.
2. W.R. Murphy and G.Mc Kay, Energy Management, Elsevier, BSP Publishers 2007.
3. Raikhy P.S. and Parmindar Singh., Energy Consumption in India, Deep and Deep Publication, 1990.

Reference Books:

1. Vogt F., Energy Conservation and use of renewable sources of Energy in the Bio- Industries, Pergamon Press, 1981.
2. Albert Thumann,Scott Dunning , " Plant Engineers and Managers Guide to Energy Conservation", Fairmont Press, 2010.
3. Ray D.A., Industrial Energy Conservation, Pergamon Press, 1980.
4. Kreith F. and West R.E (Eds), Economics of Solar Energy Conservation Systems, Vol. I and III CRC Press, 1980.
5. Shinskey E.G., Energy Conservation through Control, Academic Press, 1980.

12ME354 VIBRATION LABORATORY

Credit: 0:0:1

Objective:

To impart knowledge on

- sensors, signal conditioning and associated instrumentation for vibration measurement
- digital data acquisition, signal processing, data reduction and display.
- To use the vibration measurement equipments.

Outcome:

The students will be able to

- understand and study the ways to measure vibration.
- become proficient with instrumentation used in vibration control tests

List of Experiments

1. Hand held vibration measurement using vibrometer
2. Real Time PC based vibration measurement
3. Vibration measurement using Impact Hammer
4. Tri-axial vibration measurement
5. Real time FFT Analysis
6. Measurement of crack propagation using Acoustic Emission

12ME355 FLUIDISED BED SYSTEMS

Credits: 3:1:0

Objective:

To impart knowledge on

- fluidized bed behavior, different modes of heat transfer, heat recovery systems, Fluidized Bed Combustion and Gasification.
- system design, industrial applications like Pollution control and Environmental Effects and also Cost Analysis.

Outcome:

The students will be able to

- apply the principles of combustion and gasification phenomenon in fluidized beds.
- design fluidized beds for various applications and would be able to analyze the costs.
- evaluate Pollution control and Environmental Effects.

Unit I

FLUIDIZED BED BEHAVIOR: Fluidization Phenomena - Regimes of Fluidized Bed Behavior - Characterization of Fluidized Particles – Two Phase and Well Mixed Theory of Fluidization - Solids Mixing, Particle Entrainment and Carryover

Unit II

HEAT TRANSFER: Different modes of Heat Transfer in Fluidized Bed-Use of Immersed Tubes - Finned Tubes - Heat Recovery Systems

Unit III

COMBUSTION AND GASIFICATION: Fluidized Bed Combustion and Gasification, Pressurised Systems, Sizing of Combustion and Gasification Systems, Start-up Methods, Fast Fluidized Beds, Different Modes of Heat Transfer in Fluidized Beds

Unit IV

SYSTEM DESIGN : Design of Distributors, Fluidized Bed Furnaces for fossil and Agricultural Fuels, Fluidized Bed Heat Recovery Systems, Fluidized Bed Dryers.

Unit V

INDUSTRIAL APPLICATIONS: Sulphur Retention - Nitrogen Emission Control - Furnaces, Dryers, Heat Treatment, etc, Pollution control and Environmental Effects-Cost Analysis.

Text Books:

1. Howard, J.R., Fluidized Bed Technology: Principles and Applications, Adam Hilger, NewYork, 2001

Reference Books:

1. Geldart, D, Gas Fluidization Technology, John Wiley and Sons, NewYork, 1999
2. Howard, J.R. (Ed), Fluidized Beds: Combustion and Applications, Applied Science Publishers, NewYork,2001
3. Yates, J.G.Fundamentals of Fluidized bed Chemical Processes, Butterworths, 2000
4. Reed, T.B., Biomass Gasification: Principles and Technology, Noyes Data Corporation, New Jersey, 2000

12ME356 HUMAN FACTORS ENGINEERING

Credits: 4:0:0

Objective:

- To introduce advanced concepts of human factors
- To discuss anthropometric, biomechanical and physiological principles and their usage in optimizing the human well-being and overall performance.
- To identify, analyze, setup and implement solutions to solve human factor problems.
- To analyze human factors in workplace design-environment and productivity.

Outcome:

Upon Completing the course, students will be able to

- Perform as Ergonomists who can apply the Ergonomic aspects in the design of office workstation and machinery to fit and accommodate humans.
- Analyze problems faced by different kinds of people and to design suitably to reduce the discomfort experienced by them.

Unit I

RESEARCH METHODS:

Introduction to research methods- Basic and applied research, Overview of research methods. Experimental research methods-Steps in conducting an experiment, experimental designs, Example of a simple factorial design, Selecting the apparatus and the context, Selecting the experimental participants, Experimental control and confounding variables, Conducting the study, Data analysis, Drawing conclusions, Statistical significance versus practical significance. Descriptive Methods- Observation, Surveys and Questionnaires, Incident and accident analysis, Data analysis for descriptive measures, Complex modeling and simulation, Literature surveys, Ethical Issues.

Unit II

ENGINEERING ANTHROPOMETRY AND WORKSPACE DESIGN:

Human variability and statistics- Human variability, Statistical Analysis. Anthropometric Data-Measurement devices and methods, Civilian and military data, structural and functional data, Use of anthropometric data in design. General principles for work space design- Clearance requirements of the largest users, Research requirements of the smallest user, Special requirements of the maintenance people, Adjustability requirements, Visibility and normal line of sight, Component arrangement. Design of Standing and seated work areas-Choice between Standing and seated work areas, Work surface height, Work surface depth, Work surface inclination. Work related musculoskeletal Disorders (WRMSD).

Unit III

STRESS AND WORKLOAD:

Environmental stressors- Motion, Thermal stress, Air quality. Psychological stressors- Cognitive Appraisal, Ethical issues, Level of arousal, Performance changes with Overarousal, Remediation of psychological stress. Life stress. Workload Overload- Remediations, Mental workload measurement, Fatigue and sleep disruption- Vigilance and under arousal, sleep disruption, sleep deprivation and performance effects, Circadian Rhythms

Unit IV

HUMAN COMPUTER INTERACTIONS:

The trouble with computers and software design- Design criteria for usable software. Software design cycle- Understand design and evaluate. Understand system and user characteristics. Design using theories and models- Seven stages of action, Models for user performance design: GOMS. Design using principles and guidelines- General usability guidelines, Basic screen design, Dialog styles. Design of user – support Software manuals, Online help systems. Evaluate with usability heuristics. Evaluate with usability tests and metrics- Prototypes, Usability metrics, Number of users and data interpretation, Pitfalls of usability testing. Information Technology- Hypertext, hypermedia and the internet, Information database access, Virtual and augmented reality, Affective computing, Information appliances. Computer vision syndrome.

Unit V

METHODS AND MEASURING SYSTEMS:

Electric Goniometer – strain gauge based force measurement, Surface Electromyography (SEMG),3D motion Analyzer. Ergonomic Checklists: OSHA. Investigation Methods: OCRA, Strain Index, Body Discomfort Analysis (Corlett and Bishop).

Text Books:

1. Christopher D. Wickens, John D. Lee, Yili Liu, Sallie E. Gordon Becker, “Introduction to Human Factors Engineering”, PHI Learning Private Limited, New Delhi-110001, 2011.

Reference Books

1. Karl Kroemer, Henrike Kroemer, Katrin Kroemer-Elbert, “ERGONOMICS” How to Design for Ease & Efficiency, Prentice Hall International Editions, 2001.
2. Alexander.D, “Applied Ergonomics”, Taylor and Francis Group, 2004.
3. R. S. Bridger, “Introduction to Ergonomics”, Taylor & Francis, 2003.
4. The Eastman Kodak Company, “Kodak's Ergonomic Design for People at Work”, John Wiley & Sons, 2004.
5. OCRA -http://www.ergonomiesite.be/arbeid/ocra_checklist.htm.

13ME101 ENGINEERING DRAWING

Credits: 0:0:2

Objective:

- To impart and inculcate proper understanding of the theory of projection.
- To improve visualization skills.
- To enable students to understand various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient.
- To understand the usage of various line types, arcs, and methods to draw using AutoCAD.
- To understand standard, modify, draw, layers and properties tool bars and use it to draw 2D drawings and plotting
- To understand suitable hatching methods, dimensioning, and apply orthographic and isometric views

Outcome:

- Students will be able to understand the theory of projection.
- Students will be able to know and understand the conventions and the methods of engineering drawing.
- Students will be able to improve their visualization skills so that they can apply these skills in developing new products.
- To apply usage of various line types, arcs, and circles to draw using AutoCAD .
- To apply, modify, draw, layers and properties tool bars and use it to draw 2D drawings.
- To apply suitable hatching methods , dimensioning , orthographic and isometric drawings and plotting.

The faculty conducting the Laboratory will prepare a list of experiments [10/5 for 2/1 credit] and get the approval of HoD and notify it at the beginning of each semester.

13ME102 WORKSHOP PRACTICE

Credits: 0:0:2

Objective:

- To enable students to practice soldering techniques
- To facilitate students to practice characterization of electronic devices.
- To familiarize wiring of tube lights and lights used in stair case
- To train students in the assembly of PC and trouble shooting of the same.
- To give basic training on fitting joints and Carpentry joints as well as on plumping practices.

Outcome:

- Students will be able to use their skills during their project work
- Students will be able to understand the practical difficulties encountered in industries during any assembly work
- Students will be able to do simple electronic and electrical work throughout their carrier.
- Students will be able to rectify simple problem related with fitting works, carpentry works and pipe fittings

The faculty conducting the Laboratory will prepare a list of experiments [10/5 for 2/1 credit] and get the approval of HoD and notify it at the beginning of each semester.

13ME103 BASIC MECHANICAL ENGINEERING

Credits: 3:0:0

Objective:

- To provide basic knowledge about IC Engines, External combustion Engines, boilers, power plants, metal forming, metal joining, machining process and materials.

Outcome:

- Students will be able to get general view about Mechanical Engineering field.

Unit I

ENGINE: External combustion engine – Working of steam engine – Steam Turbine –Impulse and reaction turbines.
BOILERS: Fire tube and water tube boilers – Cochran boiler – Babcock & Wilcox boiler.
INTERNAL COMBUSTION ENGINE: Working of petrol and Diesel engines – Difference between two stroke and four stroke engines.

Unit II

CONVENTIONAL POWER PLANTS : Hydro, thermal, nuclear, Diesel and gas turbine power plants.
NON-CONVENTIONAL POWER PLANTS: Solar, wind, tidal and geothermal power plants.

Unit III

STRESSES AND STRAIN: Load – Types of load –stress and strain – Types of stresses -tensile, compressive, shear stress–Stress strain curve of ductile and brittle materials-problems in simple stresses and strains.
BASIC ENGINEERING MATERIALS: Mechanical properties of materials – ferrous metals and alloys –Nonferrous metals and alloys - Introduction to composites.

Unit IV

METAL CASTING AND FORMING PROCESS – Introduction – advantages of casting –various steps in moulding process- patterns – melting of cast iron –cupola and induction furnaces- principles of forging, extrusion and rolling.
METAL JOINING PROCESS: Introduction - welding – arc welding, gas welding.

Unit V

METAL MACHINING: Working principles and specifications of lathe, drilling and milling machines.
CAD/CAM: Introduction to CAD, CAM and CNC machines.

Text Books:

1. K.Venugopal and V.Prabhuraja," Basic Mechanical Engineering", Anuradha Agencies,2000
2. S.R.J.Shantha Kumar, "Basic Mechanical Engineering", HiTech Publications,2001.

Reference Books:

1. I.E. Paul Degarmo, J.T. Black, Ronald A. Kosher, "Material and Processes in Manufacturing", 8th Edition, John Wiley and sons, inc., 1999.
2. S S Rattan ," Strength of materials", Tata McGraw-Hill,2008
3. G. Shunmagam, "Basic Mechanical Engineering", Tata McGraw Hill, 2001.