FACULTY OF ENGINEERING

Syllabus for the

M.E. Mechanical Engineering (General)

(w.e.f. 2011-2012)

NORTH MAHARASHTRA UNIVERSITY, JALGAON.

THE SYLLABUS IS PREPARED BY:
BOS-Mechanical Engineering
North Maharashtra University, Jalgaon

Note: This Syllabus is subjected to change without prior notice by the concerned BOS

NORTH MAHARASHTRA UNIVERSITY JALGAON

Program Structure for

M.E. Mechanical Engineering (General)
(w.e.f. – 2011-12)

FIRST YEAR

Semester-I

Sr. No	Subject Name	Teaching Scheme Per Week		Examination Scheme				
		L	P	Paper Hrs	Paper Marks	TW	PR	OR
1	Advanced Heat Transfer	3	-	3	100	-	-	-
2	Refrigeration & Air conditioning	3	-	3	100	-	-	-
3	Mechanical Vibration	3	-	3	100	-	-	-
4	Finite Element Analysis	3	-	3	100	-	-	-
5	Elective -I	3	-	3	100	-	-	-
6	Laboratory Practice-I	-	6	-	-	100	-	50
7	Seminar-I	-	4	-	-	100	-	-
	Total	15	10		500	200	-	50
	Grand Total	25		750				

Semester-II

Sr. No	Subject Name	Teaching Scheme Per Week		Examination Scheme				
		L	P	Paper Hrs	Paper Marks	TW	PR	OR
1	Optimization Techniques	3	-	3	100	-	-	-
2	Instrumentation & Automatic Control	3	-	3	100			
3	Mechanical Design Analysis	3	-	3	100	-	-	-
4	Advanced Fluid Mechanics	3	-	3	100	-	-	-
5	Elective -II	3	-	3	100	-	-	-
6	Laboratory Practice-II	-	6	-	-	100	-	50
7	Seminar-II	-	4	-	-	100	-	-
	Total	15	10		500	200	-	50
	Grand Total	25		750				

Elective for First Year (Sem.-I & Sem.-II)

Sr. No	Elective-I	Sr. No	Elective-II
1	Advance Machine Design	1	Advance Robotics
2	Measurement Techniques & Data Analysis	2	Computational Fluid Dynamics
3	Internal Combustion Engine	3	Process Equipment Design
4	Analysis & Synthesis of Mechanisms	4	Alternate Energy Sources
5	Computer Aided Manufacturing	5	Design of Heat Exchanger
6	Theory of Elasticity & Plasticity	6	Design of Pumps & Compressors

SECOND YEAR

Semester-III

Sr. No	Subject Name	Teaching Scheme Per Week		Examination Scheme				
		L	P	Paper Hrs	Paper Marks	TW	PR	OR
1	Seminar-III	-	4	-	-	50	-	50

2	**Project Stage-I**	**-**	**18**	**-**	**-**	**100**	**-**	**-**
	Total	**-**	**22**	**-**	**-**	**150**	**-**	**50**
	Grand Total	**22**		**200**				

Sr. No	**Subject Name**	**Teaching Scheme Per Week**		**Examination Scheme**				
		L	**P**	**Paper Hrs**	**Paper Marks**	**TW**	**PR**	**OR**
1	**Progress Seminar –IV**	**-**	**-**	**-**	**-**	**50**	**-**	
2	**Project Stage-II**	**-**	**18**	**-**	**-**	**100**	**-**	**100**
	Total	**-**	**18**	**-**	**-**	**150**	**-**	**100**
	Grand Total	**18**		**300**				

L – Lectures per week
P – Practical per week
TW – Term Work Maximum Marks
PR – Practical Maximum Marks
OR – Oral Maximum Marks

*The Term work of project stage II of semester IV should be assessed jointly by the pair of Internal and external examiners, along with oral examination of the same.

Advanced Heat Transfer

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

Modes of heat transfer.
Conduction, Factors affecting thermal conductivity of solids, liquids & gases, General three dimensional heat conduction equation in Cartesian, Cylindrical & spherical coordinates,

Initial condition and various boundary conditions. Heat source systems, Critical thickness of insulation. Different types of fins & their analysis, Two -dimensional steady state conduction. Electrical analogy,

Graphical & numerical methods. Transient heat conduction with & without temperature gradients within the system, Heat flow in semi infinite solids. Application of Heisler charts.

Free & forced convection, Similarity & simulation of convection heat transfer, Boundary layer theory.

Turbulent flow heat transfer. Analogy between momentum & heat transfer. Heat transfer with liquid metals. Heat transfer in high velocity flow. Recent development s in the theory of turbulent heat transfer. Natural convection under different situations. Empirical relations in convection heat transfer.

Boiling & condensation.
Regimes of boiling heat transfer. Heat transfer in condensation. Drop wise & film condensation.
Empirical equations.

Radiation heat transfer properties. Laws of thermal radiation. Shape factors. Radiation heat transfer
between black, diffuse & gray surface. Electrical network method of solving radiation problems.
Radiosity approach. Gas emission & absorption, Bulk radiations.

Lab. Practice-I

Assignments:
(Any Four)

1. Heat pipes
2. Numerical method in heat conduction & convection.
3. Combined heat transfer.
4. Passive heat transfer augmentation techniques.
5. Electronic cooling
6. One problem on network method (Radiation).
7. Heat transfer during melting and solidification

Reference Books

1. J.P.Holman, “Heat Transfer”, McGraw Hill Book Co. Special Indian 9th Edition, 2008.
2. Oziski, M. N. “Heat Transfer – A Basic Approach”, McGraw Hill, N. Y., 2001.
3. Roshenow, W., Hartnett, J., Ganic, P., “Hand Book of Heat Transfer ”, Vol.1 & 2, McGraw Hill, N. Y., 2002.
4. Incropera & Hewitt, “Fundamentals of Heat and Mass Transfer”, John Wiley , 2000.
5. S.P.Sukhatme, “Heat Transfer”, Orient Longman, 2001.

Refrigeration & Air Conditioning

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

Refrigeration:

Various Refrigerants,
(a)Their properties, study of mixtures of refrigerants azeotrops, secondary refrigerants.
(b) Refrigerators using solids as working media. Magnetic cooling; thermodynamic aspects of magnetic cooling; magnetic refrigeration systems, nuclear demagnetization.

(c) Low temperature applications.

Food refrigeration:

(a) Theories and methods of chilling, freezing and dehydration; Microbiology of foods.

(b) Processing a storage of chilled and frozen food; (i) Meat, (ii) Poultry, (iii) Fishes, (iv) Dairy, (v) Vegetables.

(c)Commercial and house hold refrigerators, cold storages; and deep freezers.

Design:

1.Compressor rating and selection- reciprocating, screw, Scroll and centrifugal compressors based on applications.

2.Evaporators: types, thermal design, effect of lubricants accumulation, draining of lubricants, selection and capacity control.

3. Condenser: types, thermal design, purging, selection and capacity control.

4. Selection of expansion devices, Design of refrigerant piping refrigeration system controls and safety devices, Solenoid valves, suction and evaporator pressure regulators, Thermal Insulation.

5. Motor selection: Single phase, Three phase, Starters, Constant speed and Variable speed drive.

Air conditioning

Load calculation and applied psychometrics' :

Review of heat gains from solar and other sources and cooling load calculations, psychometrics of various air conditioning processes.

Air handling equipment such as fans, fitters, air conditioning apparatus and unitary quipment Air conditioning systems and Air conditioning applications such as residences, stores, public buildings and facilities, educational facilities etc. Ventilation of the Industrial Environment.

Design: Design of various components of an air conditioning plant such as fans, cooling coils, heating coils, ducts, air distributing systems.

Lab. Practice-I

Any four

1. Visit report on (Any One)

(a) Cold Storage

(b) Dairy

(c) Pharmaceutical

2. Thermal Analysis of (Any One) using Ansys / Nastran / LS –DYNA / any suitable software

(a) Cold Storage

(b) Dairy

(c) Pharmaceutical

3. Design Project for system selection, load estimation, duct design, equipment selection, Control systems, cost estimation, lay out diagrams (line sketches) for any one application from: Hospital, Hotel, Auditorium, Computer lab, Operation Theater etc.

4. Thermal Analysis of Hospital/ Mall / Auditorium Hall / Theater using Ansys / Nastran / LS –DYNA / any suitable software.
5. Draw Psychometric chart for a non standard pressure.
6. Trial on VCC as Heat pump.
7. Trial on VCC- Effect of condensing and evaporator temperature on performance.

Reference Books

1. Arora S.C. &Domkundwar S. : A Course in Refrigeration and Air conditioning, Dhanpat Rai and Sons, (1997).
2. Thrakeld J.L. : Thermal Environmental Engineering, Prentice Hall, (1982).
3. Stoecker W.F. : Refrigeration and Air conditioning, McGraw Hill, (1986).
4. Dossat R.J. : Principles of Refrigeration, John Wiley and Sons, (1988).
5 Cryogenics Engineering, by Baron.
6. Corroier, Hand Book of Air - Conditioning system Design.
7. ASHRAE Fundamentals, applications, systems and equipment volumes.
8. Jones W. P., Air conditioning Engineering - Applications, Edward Arnold Publishers Ltd, London, 1984
9. Hainer R. W., Control System for Heating, Ventilation and Air conditioning, Van Nastrand Reinhold Co., New York, 1984.
10. Refrigeration and Air conditioning- C P Arora, Tata McGraw Hill Publication, New Delhi.
11. McQuiston, Faye; Parker, Jerald; Spitler, Jeffrey 2000, Heating, Ventilating and Air Conditioning-Analysis and Design, 5th ed. John Wiley & Sons.
12. ISHRAE Handbook.
13. Handbook of Air Conditioning System Design, Carrier Incorporation, McGraw Hill Book Co., USA.
14. Trane air conditioning manual,
15. Refrigeration and Air conditioning, ARI Prentice Hall, New Delhi.
16. Norman C. Harris, Modern air conditioning
17. Jones W. P., Air conditioning Engineering, Edward Arnold Publishers Ltd, London, 1984.

Mechanical Vibration (Common with M.E.CAAD)

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

1. (A) Multi Degree Freedom System:-
Free Vibration equation of motion. Influence Coefficient i) Stiffness Coeff. (ii) Flexibility Coeff. Generalized co ordinates, and Coordinate couplings. Lagrange's Equations Matrix Method Eigen Values Eigen Vector problems. Modal Analysis. Forced Vibrations of undamped system and modal analysis.
(B) Multi Degree System Numerical Methods:-

(i)Rayleigh`s Method, (ii)Rayleigh-Ritz Method (iii) Holzer`s Method (iv)Methods of Matrix iterations (v) Transfer Matrix Method, Impulse response and frequency response functions.

2. Continuous System: -

Vibrations of String, Bars, Shafts and beams, free and forced vibration of continuous systems.

3. Transient vibrations:-

Response of a single degree of freedom system to step and any arbitrary excitation, convolution (Duhamel's) integral, impulse response functions.

4. Vibration Control:-

Balancing of rotating machine, In-situ balancing of rotors, control of natural frequency introduction of damping, vibration isolation & vibration absorbers.

5. Vibration Measurement:-

FFT analyzer, vibration exciters,Signals analysis. Time domain & Frequency domain analysis of signals. Experimental modal analysis, Machine Conditioning and Monitoring, Fault diagnosis. Example of Vibration tests - Industrial case studies

6. Random Vibrations:- Expected values auto and cross correlation function, Spectral density, response of linear systems, analysis of narrow band systems.

7. Non Linear Vibrations:-

Systems with non-linear elastic properties, free vibrations of system with non-linear elasticity and damping, phase-plane technique, Duffing's equation, Jump phenomenon, Limit cycle, Perturbation method.

8. Noise and Its Measurement :-

Sound waves, governing equation its propagation**,** Fundamentals of Noise , Decibel, Sound Pressure level, Sound Intensity, Sound fields, reflection, absorption and transmission .Noise measurement , Sound meter , Allowed exposure levels and time limit by B.I.S., Octave Band analysis of sound, Fundamentals of Noise control, source control, path control ,enclosures, noise absorbers, noise control at receiver.

Lab. Practice –I

(Any Four)

1. Determination of Natural Frequencies of Machine Components by Experimental Modal Analysis, Equipments to be used: FFT Analyzer, with Impact Hammer or Exciter, Necessary Transducers etc.
2. Determination of Natural Frequencies and mode shapes of Machine Components by using software's like Ansys/ Nastran/ LS-DYNA / any suitable software.
3. Condition Monitoring & Fault finding of Machines by using FFT Analyzer, Vibration Meter, Vibration Pickups, Transducers etc.
4. Noise measurement & Analysis, Equipment to be used: Noise measurement & analysis Instruments.
5. Perform the practical for Damped vibration of single rotor system using different viscosity fluids.
6. Perform the practical for to find natural frequency of Spring mass system using different springs stiffness's and different masses.

7. Problems of Numerical Methods of Vibrations.
8. Assignment on solving vibration problems using MATLAB

Reference Books

1 Theory of Vibrations with Applications: W T Thomson ,Pearson Publications.
2 Mechanical Vibrations : S S Rao Pearson Publications.
3 Fundamentals of Vibration : Leonard Meirovitch , McGraw Hill International Edison.
4 Principles of Vibration Control : Asok Kumar Mallik, Affiliated East- West Press.
5 Mechanical Vibrations : A H Church ,John Wiley & Sons Inc.
6 Mechanical Vibrations : J P Den Hartog ,McGraw Hill.
7 Mechanical Vibration Analysis : Srinivasan ,McGraw Hill.
8 Mechanical Vibrations : G K Groover.
9 Vibration and Noise for Engineers: Kewal Pujara , Dhanpat Rai & co.
10. C.Sujatha "Vibration & Acoustics" TMH New Delhi.

Finite Element Analysis (Common with M.E.CAAD)

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

Fundamental concept of finite element method
Introduction, Historical Background, Stress and equilibrium, Boundary conditions, Strain Displacement relations, Stress strain relations, Temperature effects, Potential Energy and equilibrium, Rayleigh-Ritz Method, Galerkin's Method,Saint Venant's Principle, von Mises Stress, Computer Programs.

One –Dimensional problems
Introduction, Finite Element Modeling, Coordinates and Shape Functions, The Potential-Energy Approach, The Galerkin Approach, Assembly of the Global Stiffness Matrix and Load vector, Properties of K, The Finite Element Equations; Treatment of Boundary Conditions, Quadratic Shape Functions, Temperature Effects.

Trusses
Introduction, Plane Trusses, Three-Diamensional Trusses, Assembly of Global Stiffness Matrix for the Banded and Skyline solutions.

Two-dimensional problems using constant strain triangles
Introduction, Finite Element Modeling, Constant-Strain Triangle, Problem Modeling and Boundary Conditions, Orthotropic Materials.
Axis symmetric solids subjected to axis symmetric loading
Introduction, Axis symmetric Formulation, Finite Element Modeling: Triangular Element, Problem Modeling and Boundary Conditions.
Two-dimensional isoparametric elements and numerical integration
Introduction , The Four-Node Quadrilateral, Numerical Integration, Higher Order Elements, Four-Node Quadrilateral for Axisymmetric Problems, Conjugate Gradient Implementation of the Quadrilateral Element.
Beams and frames
Introduction, Finite Element Formulation, Load Vector, Boundary Considerations, Shear Force and Bending Moment, Beams on Elastic Supports, Plane Frames, Three-Dimensional Frames, Some Components.
Three-dimensional problems in stress analysis
Introduction, Finite Element Formulation, Stress Calculation, Mesh Preparation, Hexahedral Elements, and Higher Order Elements, Problem Modeling, Frontal Method for Finite Element Matrices.
Scalar field problems
Introduction, Steady State Heat Transfer, Torsion, Potential Flow, Seepage, Electric and Magnetic Fields, and Fluids Flow in Ducts.
Dynamic considerations
Introduction, Formulation, Element Mass Matrices, Evaluation of Eigen values and Eigenvectors, Interfacing with Previous Finite Element Programs and a Program for Determining Critical Speed of Shafts, Guyan Reduction, Rigid Body Modes.

Lab. Practice –I

(Any Four)

Using analysis software like Ansys / Nastran / LS-DYNA/ Abacus / any suitable software perform the following practical

1. Analysis of 2D truss
2. Analysis of 2D frame
3. Analysis of any one machine component .
4. Analysis of composite Structure.
5. Finding analysis results for 2D truss & 2D frame using MATLAB

Reference Books:

1) J.N. Reddy, an Introduction to Nonlinear Finite Element Analysis, OUP.
2) C.S.Krishnamoorthy.,Finite element analysis TMH
3) J.N.Reddy, Finite element methods,Mc graw hill publition ltd.
4) Robert Cook, Concept an application of Finite element analysis
5) Klaus-Jurgen Bhate, finite element analysis, PHI
6) C.S. Desai and J.F.Abel.,Introduction to finite element methods ,CBS
7) Tirapati R. Chandrupatla and Belegundu, Finite element analysis by, PHI.

9) Kenneth Lt. Huebner," The FEM for Engineers", Wiley India Pvt.Ltd. New Delhi

(* Question Paper- 50% to 60% of marks are kept for the quantitative questions)

Elective-I

1. Advance Machine Design

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

1. **Engineering statistics**:-
Analysis of variance (ANOVA), factorial design and regression analysis. Reliability theory, design for reliability, Hazard analysis, fault free analysis

2. **Fatigue and Creep:-**
Introduction, Fatigue strength, factors affecting fatigue behavior, Influence of super imposed static stress, Cumulative fatigue damage, fatigue under complex stresses, Fatigue strength after over stresses, True stress and true strength, mechanism of creep of material at high temperature, Exponential creep law, hyperbolic sine creep law, stress relaxation, bending etc.

3 **Optimization:-**
Introduction, multivariable search methods, linear & geometric programming, structural and shape optimization and simplex method.

4 Composite materials:-
Composite materials and structures, classical lamination theory, elastic stress analysis of composite material, Fatigue strength improvement techniques, stresses , stress concentration around cutouts in composite laminates, stability of composite laminate plates and shells, Hybrid materials, applications.

5 Design for Materials and Process:-

Design for brittle fracture, Design for fatigue failure, Design for different machining process, assembly & safety etc.

6 Design of Mechanical components :-

a) Gear Design:- Involute gears, tooth thickness, interference, undercutting, rackshift etc. Profile modification, S and So spur, helical gears etc.

b) Spring Design:- Vibration and surging of helical springs, helical springs for maximum space efficiency , analysis of Belleville springs, ring spring, volute spring & rubber springs. Design for spring suspension.

c) Design of Miscellaneous components (to be detailed) Cam shaft with valve opening mechanism, piston, cylinder, connecting rod etc.

Reference Books

1. Mechanical Design Analysis – M.F. Spotts
2. Machine Design - Robert Norton
3. Practical Gear design - D.W. Dudley
4. Optimum design - R.C.Jhonson
5. Mechanical Springs – A.M. Wahl.
6. An introduction to composite materials – D. Hull and T.W. Clyne.

Elective-I

2. Measurement Techniques & Data Analysis

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

1) Introduction to measurements for scientific and engineering application need and goal. Broad category of methods for measuring field and derived quantities.

2) Principles of measurement, parameter estimation, regression analysis, correlations, error estimation and data presentation, analysis of data.

3) Measurement of field quantities, thermometry, heat flux measurement, measurement of force, pressure, flow rate, velocity, humidity, noise, vibration, measurement of the above by probe and non instructive techniques.

4) Measurement of derived quantities, torque, power, thermo physical properties, radiation and surface properties.

5) Analytical methods and pollution monitoring, mass spectrometry, chromatography, spectroscopy.

6) Basics of P, PI, PID controllers, pneumatic and hydraulic controllers, electronic controllers, applications to machine tools, furnaces, material handling etc.

Lab. Practice –I

1) Calibration of pressure gauge
2) Computer aided experimentation for temperature measurement.
3) Design of control system for boiler/compressor/pumps/turbines

4) Problem of analysis of data and error estimation.

Reference Books

1) Doebelin E.O: Measurement Systems-Application and Design, McGraw Hill Publication Co.
2) Beckwith TG. N. Lewis Buck and Marangoni R.D: Mechanical Measurements, Narosa Publishing House, New Delhi.
3) Liptak B.G. Instrument Engineers' Handbook.
4) Bolton W, Mechatronics-Electronics Control Systems in Mechanical and Electrical Engg.
5) Modern Electronic Instrumentation and Measurement Technique by A.D. Helfrick and W.D. Cooper.
6) Johnson C.D., Process Control Instrumentation.
7) J.P.Holman: Experimental Methods For Engineers, McGraw Hill International Edition, Seventh Edition.

(* Question Paper- 50% to 60% of marks are kept for the quantitative questions)

Elective-I

3. Internal Combustion Engine

Teaching Scheme **Examination Scheme:**
Lectures: 3 Hrs per week **Paper: 100 Marks**
Paper Duration: 3 Hrs.

1)Measurement & Testing: Introduction ,engine performance parameters, measurement and testing, engine operating characteristics, performance maps.
2)Engine Materials: Various engine components, cylinder head, spark plug, gaskets, cylinder block, piston ,piston rings, gudgeon pin ,connecting rod, crankshaft, bearings , crankcase ,fuel injector.
3)Engine Design: Preliminary analysis, cylinder number, size and arrangement, experimental development.
4)Electronic Injection System: Gasoline injection, EFI system, MPFI system , electronic control system ,injection timing, electronic diesel injection system and control.
5) Engine Emissions & Control: Air pollution due to IC engines , norms ,engine emissions, HC, CO, NOx , particulates ,other emissions, emission control methods, exhaust gas recirculation ,modern methods, crankcase blow by.
6)Simulation Technique: Application of simulation technique for engine tuning, engine selection parameters, recent trends in IC engines.

Lab. Practice –I

(Any Four)
1. Performance trial on 4-cylinder 4-stroke petrol engine.
2. Performance trial on diesel engine.
3. Emission measurements by using gas analyzer and smoke meter.

4. Case study for engine selection.
5. Visit to research organization.

Reference Books

1. The Internal Combustion Engine in Theory and Practice Volume I & II by Charles Fayette Taylor, The MIT Press.
2. Internal Combustion Engines- V Ganesan, 2nd edition, TaTa McGraw Hill.
3. Automotive Technology, Jack Erjavec,3rd edition, Delmar Thomson Learning.
4. Design and Simulation of four stroke engines, Gordon P Blair, SAE International.
5. Gasoline Engine Management, Bosch handbook,2nd edition, Professional Engineering Publication.
6. Internal Combustion Engines, C.R. Ferguson & A.R. Kirkpatrick,Delhi,2001.

Elective-I

4. Analysis & Synthesis of Mechanisms

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

1. Basic Concepts: Definitions and assumptions, planar and spatial mechanisms, kinematic pairs, degree of freedom.
2. Kinematic Analysis Of Complex Mechanisms: velocity-acceleration analysis of complex mechanisms by the normal acceleration and auxiliary point methods.
3. Dynamic Analysis of Planar Mechanisms: - Inertia forces in linkages, kinetostatic Analysis of mechanisms by matrix method. Analysis of elastic mechanisms, beam element, displacement fields for beam element, element mass and stiffness matrices, system matrices, elastic linkage model, equations of motion.
4. Curvature theory: Fixed and moving centrodes, inflection circle, Euler- Savy equation, Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwell Mechanisms.
5. Graphical Synthesis of Planar Mechanisms: Type, number and dimensional synthesis, function generation, path generation and rigid body guidance problems, accuracy (precision) points, Chebychev Spacing, types of errors, Graphical synthesis for function generation and rigid body guidance with two, three and four accuracy points using pole method, center point and circle point curves, Bermester points, Synthesis for five accuracy points, Branch and order defects, Synthesis for path generation.
6. **Analytical synthesis of Planar Mechanisms**:- Analytical synthesis of four-bar and slider-crank mechanism, Freudenstein's equation, synthesis for four accuracy points, compatibility condition, synthesis of four-bar for prescribed angular velocities and accelerations using complex numbers. Complex numbers method of synthesis, The dyad, center point and circle

point circles, ground pivot specifications, three accuracy point synthesis using dyad Method, Robert Chebychev theorem, Cognates.
7. Kinematic Analysis of Spatial Mechanisms : Denavit-Hartenberg parameters, matrix method of analysis of spatial mechanisms.

Lab. Practice –I

The term work comprises of assignments on the following topics.
1. Complex Mechanism Analysis.
2. Dynamic Analysis.
3. Graphical and Analytical Synthesis.
4. Curvature Theory.
Use of software's such as 'ADAMS' and 'Working Model' or any suitable software.

Reference Books

1. Theory of Machines and Mechanisms, A. Ghosh and A.K.Mallik, Affiliated East- West Press.
2. Kinematic Synthesis of Linkages, R. S. Hartenberg and J. Denavit, McGraw-Hill.
3. Mechanism Design - Analysis and Synthesis (Vol.1 and 2), A. G. Erdman and G. N. Sandor, Prentice Hall of India.
4. Theory of Machines and Mechanisms, J. E. Shigley and J. J. Uicker, 2nd Ed., McGraw-Hill.
5. Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines, Robert L.Norton, Tata McGraw-Hill, 3rd Edition.
6. Kinematics and Linkage Design, A.S.Hall, Prentice Hall of India.

Elective-I

5. Computer Aided Manufacturing

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

Introduction

Introduction to Control, Open loop and Closed Loop control Systems, Drives and Controls Interpolators for CNC machine tools. Numerical Control, Types of CNC systems.

NC / CNC machines

Components of NC/CNC system, Specification of CNC system, Classification of NC /CNC machines, Tape, Tape codes and tape readers used in NC machines constructional details of CNC machines, axis designation, NC/CNC tooling. Fundamentals of manual part programming, types of format, word address format manual part programming for drilling, lathe and milling machine operations, subroutines, do loops, canned cycles, parametric subroutines. Computer assisted part programming: need, list of computer assisted programming languages, Automated Programmed Tools language - its types of statement, command and programming CAD based CNC programming using CAM software.

Flexible manufacturing system

Introduction of FMS, Need of FMS, General Considerations for FMS, types of FMS, flexibilities, their measurements, various mathematical techniques for flexibility measurements. Manufacturing cells, cellular v/s flexible manufacturing, Application of JIT and GT to FMS.

Computer integrated manufacturing systems

Basic information of CIMS, hardware and software requirement for CIMS, benefits, scope and needs, CIMS wheel, elements of CIMS and their role, computer technology and manufacturing, database requirement, fundamentals of communication, data base management, database models, DBMS architecture, SQL, Steps to implement CIM, its management, Personnel, emerging technologies like expert systems, Computer vision, lasers in manufacturing (machinery and metrology), Multimedia communications, etc. CAD/CAM, Integration programming, Post processors, CNC part programming with CAD/CAM systems.

Lab. Practice –I

(Any Four)

1. Demonstration of CNC Milling machine with user interface and calculating the coordinates of given geometry in absolute end increment mode for cutter path.
2. Introduction of G codes and M codes and write the CNC part programming for a given geometry using linear, Circular interpolation .
3. Write the CNC programming for a given geometry using Mirror and Subroutine.

4. Write the CNC programming for a given geometry using Polar Co -ordinate for drilling cycles.
5. Write the CNC programming for a given geometry using Tool Radius Compensation and Repeat loop for Peck drilling cycles.
6. Introduction and programming of all canned cycle of milling machine .
7. Demonstration and study of CNC Lathe machine with sample programming .
8. Demonstration of HINUMERIK-2000 T Control system with sample programming.
9. Write CNC programming for given geometry (Lathe) using stock removal cycles for HINUMERIK-2007 T.
10. Demonstration of As /Rs and AVG operation.

Reference Books

1. David Bedworth, “Computer Integrated Design and Manufacturing” Tata McGraw Hill, New Delhi, 1998.
2. Ranky, Paul G., “Computer Integrated Manufacturing” Prentice Hall International, 1986.
3. William W. Luggen, “Flexible Manufacturing Cells and System” Prentice Hall, England Cliffs, Newjersy, 1991.
4. Radhakrishan P., Subramaniyam S., “CAD CAM and CIM”, New Age International, 2002.
5. Vajpayee S. Kant, “Computer integrated Manufacturing ” Prentice Hall of India, 1995.

Elective-I

6. Theory of Elasticity & Plasticity

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

Plane stress and plane strain, stress and strain at a point. Equilibrium and compatibility equations. Two dimensional problems in rectangular and polar co-ordinates. Three dimensional problems. Torsion and Bending of bars.
Principles of Plastic Flow Theory
Stress & Strain relationship & Condition of initiation of plastic deformation. Failure Criterion Strain or work hardening. Large elongations & their components.
Experimental strain analysis
Uniaxial tension of a perfect & an imperfect strip.
Plastic Anisotropy
Necking in continuous bar, sheets.
Ductile fracture & reduction of area
Determination of Forming Limit Strains for an Anisotropic material by Neck of growth. Methods for testing material properties.
Workability Definition, Testing & Analysis.

Reference Books:

1. E. G. Thomsen, C. T. Yang, , Kobayashi, "Mechanics of Plastic Deformation in Metal Processing" The MacMilan Co., New York.
2. E. M. Mielnik, "Metal Working Science & Engineering", McGraw - Hill, Inc., New York.
3. Z. Marcinialy & J. L. Dancan,"The Mechanics of Sheet Metal Forming", Edword Arnold, London.
4. Timoshenko & Goodier, "Theory of Elasticity", McGraw Hill.

FIRST YEAR

(Semester-I)

LABORATORY PRACTICE – I

Exam Scheme :
Practical's – 06 hours/week. **Term-work – 100 marks**
Oral- 50 marks

Experiments/Assignments based on
Any Three subjects for Experimental work and two subjects for Assignments

1. Advanced Heat Transfer
2. Refrigeration & Air conditioning
3. Mechanical Vibration
4. Finite Element Analysis
5. Elective - I

For those subject lab. practice is not given for that, the concerned subject in-charge should frame minimum of four laboratory Experiments /Assignments.

Note: Oral will be based on the prescribed term-work presented in the form of certified journal.

FIRST YEAR

(Semester-I)

SEMINAR-I

Practical's – 04 hours/week. **Term-work – 100 marks**

Seminar-I should be based on the literature survey on any topic relevant to Mechanical Engineering. It may be leading to selection of a suitable topic of dissertation. Each student has to prepare a write-up of about 25 pages.

The report typed on A4 sized paper and bound in the necessary format should be submitted after approved by the guide and endorsement of the Head of Department. The student has to deliver a seminar talk in front of the teachers of the department and his classmates. The Guide based on the quality of work and preparation and understanding of the candidate shall do an assessment of the seminar.

The report copies must be duly signed by the guide and Head of Department (one copy for institute, one copy for guide and one copy for the candidate for certification). Attendance of all students for all seminars is compulsory.

Optimization Techniques (Common with M.E.CAAD)

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

Introduction to Optimization: Engineering applications of optimization, statement of optimization problem, classification of optimization problem

Classical Optimization Techniques: Introduction, single variable optimization, multi variable optimization with no constraint, equality constraint, in equality constraint, convex programming problems

Linear programming: Standard form of linear programming, geometry of linear programming, solutions of system of linear simultaneous equations, pivotal reduction of general system of reduction and simplex algorithms

Non-linear programming: One dimensional Minimization methods, elimination methods, unrestricted search, exhaustive search, half interval method, golden section method, Interpolation methods, Newton method, Quasi Newton method, secant method

Non-linear programming (Unconstrained optimization techniques): Direct search method, random search method, grid search method, Powell's method, Simplex method. Indirect Search method, gradient of functions, descant method, conjugate gradient method, Newton's method, Quasi Newton method

Non-linear programming (Constrained Optimization): Direct methods, random search method, complex method, sequential linear programming, sequential quadratic programming and generalized reduced gradient method, Indirect method- Penalty function methods

Lab. Practice-II

1.Assignments / problems on classical optimization techniques
2. Assignments / problems on Non linear programming for one dimensional minimization methods
3. Assignments / problems on Non linear programming for unconstrained optimization techniques
4. Assignments / problems on Non linear programming for constrained optimization techniques .

Reference Books:

1. Engineering Optimization – Theory & practice, S.S. Rao, New Age Int. Publication
2. Optimization concepts and application in engineering, Besequndle. A.D., Pearson,Edu.
3. Practical Methods of optimization, Fletcher, R., John Wiley
4. Principles of Optimization Design, Paphlambros & Wilde

Instrumentation & Automatic Control

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme:
Paper: 100 Marks
Paper Duration: 3 Hrs

1) Introduction to measurements for scientific and engineering application need and goal. Broad category of methods for measuring field and derived quantities.
2) Principles of measurement, parameter estimation, regression analysis, correlations, error estimation and data presentation, analysis of data.

3) Measurement of field quantities , thermometry, heat flux measurement, measurement of force, pressure, flow rate, velocity ,humidity, noise, vibration, measurement of the above by probe and non instructive techniques.
4) Measurement of derived quantities, torque, power, thermo physical properties, radiation and surface properties.
5) Analytical methods and pollution monitoring, mass spectrometry, chromatography, spectroscopy.
6) Basics of P,PI,PID controllers, pneumatic and hydraulic controllers, electronic controllers, applications to machine tools, furnaces, material handling etc.

Lab. Practice-II

Exercise/Assignment
1) Calibration of pressure gauge.
2) Computer aided experimentation for temperature measurement.
3) Design of control system for boiler/compressor/pumps/turbines.
4) Problem of analysis of data and error estimation.

Reference Books

1) Doebelin E.O, Measurement Systems-Application and Design,McGraw Hill Publication Co.
2) Beckwith T.G. N. Lewis Buck and Marangoni R.D: Mechanical Measurements,Narosa Publishing House,New Delhi
3) Liptak B.G. Instrument Engineers' Handbook
4) Bolton W, Mechatronics-Electronics Control Systems in Mechanical and Electrical Engg.
5) Modern Electronic Instrumentation and Measurement Technique by A.D. Helfrick and W.D. Cooper
6) Johnson C.D., Process Control Instrumentation
7) J.P.Holman: Experimental Methods For Engineers, McGraw Hill International Edition, Seventh Edition.

Mechanical Design Analysis

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme:
Paper: 100 Marks
Paper Duration: 3 Hrs.

1. Introduction: Failure Analysis, Limit design, Fundamentals of fracture mechanics. Fatigue designing for finite life, contact stresses and surface failures, oil films and their effects.

2. Impact: Energy methods, longitudinal stress waves in elastic media impact on beams, torsional impact on shafts and longitudinal impacts on helical springs,
3. Thermal properties and stresses: Effect of short term and long term properties of materials on design, creep and stress relaxation. Elementary analysis of thermal stresses, thermal fatigue.
4. Design with composite materials: Polymers and F.R.P. as materials for mechanical components.
5. Reliability based design: Definition normal exponential and Weibull distributions system reliability. Reliability based on strength.
6. Optimum design: Basis concepts, introduction to various techniques of optimization, optimum design of simple mechanical components.
7. Analysis and design of power transmission systems and elements such as : Spur, helical, bevel and worm gear drives, speed reducers and gear boxes, epicyclic gear drives, selection of ball and roller bearings.

Lab. Practice-II

(Any four)

1. Cad modeling of any two machine components using Catia /Pro-E/ Solidedge / any suitable modeling software
2) Mini project:-
On FEM analysis of any two machine members by using reputed commercial software for stress distribution, stress concentration and report writing on results of analysis. Using Ansys/Nastran/ Hypermesh/ LS-DYNA / any suitable analysis software.
3. Two assignments (Design with composite materials & Analysis and design of power transmission systems)
4. Analysis of spur gear using Ansys/Nastran/ Hypermesh/ LS-DYNA / any suitable analysis software.
5. Analysis of carbon fiber composite tube using Ansys/Nastran/ Hypermesh/ LS-DYNA / any suitable analysis software.

Reference Books:

1. Arthur H. Burr & Johj B. Cheatham, "Mechanical Analysis and Design", Prentic -Hall of India (1997).
2. Kenneth Edwards & Robert B. Makee, "Fundamentals of Mechanical Component Design", Mc. Graw Hill international ed. (1991).
3. Joseph Edward Shigley & Charles R. Mischke, "Mechanical Engineering Design", Mc. Graw Hill (1989).
4. M. F. Spotts, "Mechanical Design Analysis", Prentice Hall.
5. Aaron D. Deutschman etal, "Machine Design", Collier Macmillan Publishers international edition.

Advanced Fluid Mechanics

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

1. Basic Concepts : Types of fluids and basic equations of flow, basic concepts in laminar and turbulent flows.
2. Equations Governing Fluid Motion : Navier stokes equations, Boundary layer equations. Exact solutions of N-S equations, Flow between concentric rotating cylinders, parallel flow of a powder - law fluid.
3. Potential Theory : Kelvin's theorem, source, sink, vortex and doublet, development of complex potentials by super position, conformal transformation thin airfoil theory.

4. Laminar Boundary Layers : Blasius solution, Boundary -layers with non-zero pressure gradient, separation and vortex shedding.
5. Turbulent Flow : Mechanism of turbulence, derivation of governing equations for turbulent flow, K-E model of turbulence, universal velocity distribution law and friction factor, kinetic energy of the mean flow and fluctuations, relaminarization.
6. Experimental Techniques : pressure tubes, thermal anemometers, laser – Doppler anemometers, P_I velocimeter.
7. Computational Fluid Dynamics : Philosophy of CFD, governing equations, thin derivation and physical meaning, mathematical behavior of P.D.E. and thin impent on CFD, Finite difference scheme, grid generation and transformation. Introduction to FEM and finite volume method.

Lab Practice –II

(Any four)
*** All experiments should be performed using suitable CFD Software**

1. Flow over a cylinder/sphere at different Re. Pressure variation over the body and drag estimation.
2. Flow past an aerofoil: Pressure measurements, calculation of lift.
3. Flow through a converging-diverging nozzle: subsonic and supersonic flows.
4. Friction factor determination: incompressible flow through pipes/ducts.
of variable cross-section.
5. Laminar/Turbulent boundary layer over a flat plate.

Reference Books:

1. H. Schlichting, "Boundary layer Theory", McGraw Hill, 1987.
2. Jo. Hinze, "Turbulence", McGraw Hill, 1975.
3. P. Bradshaw, "Turbulence", Springer -Verleg, 1976.
4. Anderson, Tamehill and Pletcher, "Computational Fluid Mechanics and Heat Transfer", Hemispher Pub. Co., 1984.
5. K. Muralidhar and T. Sunderajan, "Computational Fluid Flow and Heat Tra nsfer", Narosa Pub. House, New Delhi, 1997.

Elective-II

1. Advance Robotics

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

Robot Fundamentals:-
Definitions, History of robots, present and future trends in robotics, Robot classifications, Robot configurations, Point to Point robots, Continuous Path robots, Work volume, Issues in design and controlling robots Repeatability, Control resolution, spatial resolution, Precision, Accuracy, Robot configurations, Point to Point robots, Continuous Path robots, Work volume, Applications of robots. Drives used in robots- Hydraulic, Pneumatic and Electric drives, Comparison of drive systems and their relative merits and demerits.

Manipulator Kinematics:-
Matrix Algebra, Inverse of matrices, rotational groups, matrix representations of coordinate transformation, transformation about reference frame and moving frame Forward & Inverse Kinematics examples of 2R, 3R & 3P manipulators, Specifying position and orientation of rigid bodies Euler's angle and fixed rotation for specifying position and orientation Homogeneous coordinate transformation and examples D-H representation of kinematics linkages Forward kinematics of 6R manipulators using D-H representations Inverse kinematics of 6R manipulators using D-H representations, Inverse Kinematics geometric and algebraic methods.

Robotics Dynamics :-
Velocity Kinematics, Acceleration of rigid body, mass distribution Newton's equation, Euler's equation, Iterative Newton–Euler's dynamic formulation, closed dynamic, Lagrangian formulation of manipulator dynamics, dynamic simulation, computational consideration.

Trajectory planning:-
Introduction, general considerations in path description and generation, joint space schemes, Cartesian space schemes, path generation in runtime, planning path using dynamic model point to point and continuous trajectory , 4-3-4 & trapezioidal velocity strategy for robots.

Robot Sensors:-
Internal and external sensors, position- potentiometric, optical sensors ,encoders - absolute, incremental ,touch and slip sensors velocity and acceleration sensors, proximity sensors, force & torque sensors, laser range finder, camera. Micro-controllers, DSP, centralized controllers, real time operating systems.

Robot Controllers:-
Essential components-Drive for Hydraulic and Pneumatic actuators, H-bridge drives for Dc motor Overload over current and stall detection methods, example of a micro-controller/ microprocessor based robot Controller.

Robot Vision:-
Introduction, Image acquisition, Illumination Techniques, Image conversion, Cameras, sensors, Camera and system interface, Frame buffers and Grabbers, Image processing, low level & high level machine vision systems.

Robot Programming languages:-
Introduction the three level of robot programming, requirements of a robot programming language, problems peculiar to robot programming languages.

Futuristic topics in Robotics:-
Micro-robotics and MEMS (Microelecto mechanical systems), fabrication technology for Micro-robotics, stability issue in legged robots, under-actuated manipulators, telecheirs.

Reference Books:

1) S.R.Deb, " Robotics Technology and Flexible Automation ", Tata Mc Graw Hill 1994.
2) M.P.Groover, M. Weiss R.N. Nagel, N.G. Odrey " Industrial Robotics (Technology , Programming and applications) , McGraw, Hill 1996
3) K.S.Fu, R.C.Gonzalez and C.S.G.Lee, " Robotics : Control , sensors , vision and inintlligence ", MCGraw-Hill.1987.

4) J.J.Craig , Introduction to Robotics , Addision-wesely 1989.
5) Klafter , Richard D., et al " Robotics Engineering",PhI,1996.
6) Zuech,Nello,"Applying Machine Vision "John Wiley and sons, 1988.

Elective-II

2. Computational Fluid Dynamics (Common with M.E.CAAD)

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

Review of Governing Equations Fluid Flo w and Heat Transfer

Conservation of Mass, Newton's Second Law of Motion, Expanded Forms of Navier stokes equations, Conservation of Energy Principle, Special Forms of the Navier Stokes Equations, Classification of Second order Partial Differential Equation s, Initial and Boundary Conditions, Governing Equations in Generalized Coordinates.

Finite Difference, Discretizatison, Consistency, Stability and Fundamental ofFluid Flow Modeling.

Elementary Finite Difference Quotients, Basic Aspects of Finite Differen ce Equations, Errors and Stability Analysis, Some Nontrivial Problems with Discretized Equations, Applications to Heat Conduction and Convection.

Solution of Viscous Incompressible Flows by Stream Function –Vorticity Formulation

Two Dimensional Incompressible Viscous Flow, Incorporation of Upwind Scheme, Estimation of Discretization Error, Application to Curvilinear Geometries, Derivation of Surface Pressure and Drag.

Solution of Navier -Stokes Equations for Incompressible Flows Using MACand SIMPLE Algorithms

Staggered Grid, Solution of the Unsteady Navier -Stokes Equations, Solutions of Energy Equation, Formulation of the Flow Problems, SIMPLE Algorithm. Introduction to FVM: Integral Approach, discretization & Higher order scheme

Reference Books:

1. Anderson D.A., Tannehill J.C., Pletcher R.H., Computational Fluid Mechanics and Heat Transfer, Hemisphere Publishing Corporation, New York, U.S.A. 1984.
2. Murlidhar K. Sunderarajan T., Computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi, 2003.
3. Anderson J.D., Jr., Computational Fluid Dynamics McGraw Hill, Inc New York, 1996.
4. Ankar S.V., "Numerical Heat Transfer and Flow" Hemisphere Publ.,Corporation, 1985.
5. Anderson J.D., Jr., Computational Fluid Dynamics" McGraw Hill, Inc New York, 1995.
6. Anderson D.A., Tannehill J.C. Pletcher R.H., "Computational Fluid Mechanics and Heat Transfer" Hemisphere Publ. Corp. N.Y. 1984.
7. Sturt P.A., "Introduction to Numerical Methods", The Macmillan Company, London, 1985.
8. Pratap R., "Getting Started with MATLAB", Sounders Coll ege Publ. 1995.
9. H.K.Versteag and W.Malalsekara, "An Introduction to Computational Fluid Dynamics", Longman, 1995.
10. Carnahan B., "Applied Numerical Methods", John Wiley & Sons 1969.
11. Lewis R.W., "Numerical Methods in Thermal Problem", Vol Vi Part -II, Pine Ridge Press Ltd., 1989.
12. Jain M.k., "Numerical Methods for Scientific and Engineering", 3 rd Edi., New Edge International, 1995.
13. Mathews J.H. "Numerical Methods for Mathematics, Science & Engineering," 2 nd Ed. Prentice Hall of India Pvt. Ltd., New Delhi, 1994.

Elective-II

3. Process Equipment Design

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

1) **Process Design Parameters** : Basic concepts in process design, block diagrams for flow of processes, material flow balance. Design pressures -–temperatures, design stresses, factory of safety, minimum shell thickness and corrosion allowance, weld joints efficiency, design loading, stress concentration and thermal stresses, failure criteria, Optimization technique such as Lagrange's multiplier and golden section method, cost and profitability estimation. Introduction to design codes like IS-2825, ASME-SECT, EIGHT-DIV-II TEMA.API-650, BS-1500 & 1515.

2) **Design of Cylindrical and Spherical Vessels** : Thin and thick walled cylinder analysis, design of end closers, local stresses due to discontinuity or change of shape of vessel, vessel opening compensation, design of standard and non-standard flanges, design of vessels and pipes under external pressure, design of supports for process vessels.

3) Design of Tall Vessels and Large Storage Tanks : Determination of equivalent stress under combined loadings including seismic and wind loads application of it to vertical equipment like distillation column.

4) **Design of Thick Walled High Pressure Vessels** : Design by various theories of failure, construction of these vessels with high strength steel and other special methods.

5) **Process Equipment Design** : Storage vessels, reaction vessels, agitation and mixers, heat exchangers, filters and driers, centrifuges. Code practices, selection and specification procedures used in design. Selection of pumps, compressors, electrical equipments and auxiliary services, safety, etc.

6) **Process Piping Design** : Flow diagrams and pipe work symbols, design of layout of water, steam and compressed air pipes work, pipe fitting, linings and flanged connections. Types of valves used on pipe line. Fabrication of pipe lines, expansion joints and pipe supports.

7) Planning, manufacture, inspection and erection of process equipment like pressure vessels, chimneys, ducting, heat exchangers, pulverizing equipment, etc. protective coatings, lining of vessels.

8) **Process Control** : Fundamentals of process measurements and control modern control devics and other controls of major unit operation and processes.

9) Applications of CAD to process Equipment Design.

Lab Practice –II

(Any Four)

Following assignments / experiments comprise the laboratory practice :-

1) Design and optimisation of tall vessels and large tanks.
2) Design of Heat exchangers used in industries.
3) Design of crystallisers.
4) Design and development of equipment useful to process industries such as sugar, cement, chemical industries.
5) Preparing flow diagrams of processes, piping layout, etc.
6) Report based on visit to industries such as sugar, cement, chemical industries.

Reference Books:

1) Process Equipment Design : By Dr. M.V. Joshi, Mc-Millan.
2) Process Equipment Design : By Browell and Young, John Wiley.
3) Plant Design and Economics : Max and Timasulaus Kalus – McGraw Hill.
4) Industrial Instrumentation servicing Hand Book : Cannel Grady, McGraw Hill.
5) Handbook of Instrumentation and Control : Kellen Heward, McGraw Hill.
6) Chemical Engineering Handbook : Perry John, McGraw Hill.
7) Chemical Equipment Design : B.C. Bhattacharya.
8) Industrial Pipe Work : D.N.W. Kentish, McGraw Hill.
9) Chemical Engineering : J.M. Coulson, Richardson, Sinnott Vol. VII, Maxwell, McMillan.
10) Pressure Vessel Design Hand Book : H. Bedna.
11) Dryden's outlines of Chemical Technology for the 2 : By Roa M. Gopala, Sitting M., East West Press Pvt. Ltd., New Delhi.
12) Applied Process Design for Chemical and Petrochemical, Vol. I, II and III : By E.E. Ludwig, Gulf Publication Co., Houston.
13) Chemical Process Control : An Introduction to Theory and Practice : By Stephanopoulos G., Prentice Hall of India, New Delhi.
14) Chemical Process Equipment Selection and Design : By Stanley M.Walas, Butterworth-Heinemann Series in Chemical Engineering.

15) Process System Analysis and Control : By D.R. Coughanowr, McGraw Hill, New York.
16) Engineering Optimsiation : Theory and Practice : By Rao S.S., New Age Publishing Co., New Delhi.
17) Optmisation of Chemical Processes : By Edgar T.F., Himmelblau D.M., McGraw Hill Book Co., New York.
18) Control Devices, Vol. I and II : Liptak
19) Analysis, synthesis and design of Chemical Processes : Richard Turton, Richard C. Bailie, Wallace B. Whiting, Josheph A. Shaewitz, Prentice Hall Int. Series in Physical and Chemical Science.

Elective-II

4. Alternate Energy Sources

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

1. Estimation of Solar Radiation: Basic definitions, Estimation of monthly average of daily global radiation on horizontal and inclined surfaces - Page's co-relation, Reddy's correlations. Prediction of daily diffuse radiation on horizontal & inclined surfaces - Liu-Jordan co-relation Sukhatme's co-relation & Gupta's co-relation, ASHRAE model for prediction of instantaneous radiation.
2. Theory of Flat Plate Collectors Radiation transmission through covers - product, Basic Energy Equation of Collector, Temperature Distribution - Overall loss coefficients - thermal analysis of collectors - overall design methodology - performance test of collector.
3. Solar Air Heaters, Cookers & Cabinet Drives. Geometry & thermal analysis of solar air heaters - Channiwala's Correlation - Transient Analysis of solar cooker - Design concepts for cooker - Energy balance of cabinet driver.
4. Concentrating Collectors: Ideal concentration ratios for line & point focusing collectors, Basic energy equation for cylindrical parabolic collector - Performance Testing – Compound Parabolic collector & its performance evaluatic, Solar Tower Concepts, Solar Chimney concept.

5.Cogeneration Definition, need, application, advantages, classification, energy saving, performance terms and definitions, field testing procedure, diesel generating system-factors affecting selection, energy performance assessment of diesel conservation avenues, trends in different cogeneration power plants. Cogeneration: Concept options (steam / gas / turbine / diesel engine bases), selection criteria, control strategy.
6. Environmental impacts, Economic and social considerations, Financing mechanisms, Carbon credits, clean development mechanisms

Reference Books:

1. Peter Auer "Advance in Energy Technologies vo1 1&2" Academic Press, 1977.
2. Twidell J.W., Weir A.D., Renewable Energy Resources, ELBS Pub., 1986.
3. Chawla, O.P. "Advances in Biogas Technology, Indian Council of Agricultural Research, New Delhi, 1986.
4. Mani. A. and Mooley D.A., "Wind Energy Data for India".
5. Sukhatme S.P., "Solar Energy Principles of Thermal a Collection and Storage", 2nd Edi, Tata MC- Graw hill, New Delhi, 1996
6. Duffie, J.A. and Beckman, W.A. "Solar Engineering of Thermal Processes" 2nd Edi, John Wiley & Sons, N.Y., 1991.
7. Tiwari G.N., JunejaSaneeta. "Solar Thermal Engineering Systems", Narosa Publishing House, New Delhi,1997.
8. Sayigh A.A.M "Solar Energy Engineering" Academic Press, N.Y., 1977.
9. Kreith F. and Kreider J.F. "Handbook of Solar Energy" McGraw Hill, N.Y., 1980.

Elective-II

5. Design of Heat Exchanger

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

Review of heat transfer principles & convection correlation.
Introduction to heat exchangers and classification .
Basic design methodologies, Net Transferable Units method and Logarithmic Mean Temperature deference method.
Design of double pipe heat exchangers .Shell & tube type heat exchangers, nomenclature, J-factors, conventional design methods, bell, Delware method.
Compact heat exchangers, J-factors, design method.
Condensers classification and design methods for surface condensers
Evaporators – Classification and design methods.
Plate type – Heat exchangers.
Regenerators.
Furnace design.

Reference Books:

1. Saunders, E.A.D., “Heat Exchangers – Selection Design and Construction”, Longmann Scientific and
Technical, N.Y., 2001.
2. Kays, V.A. and London, A.L., “Compact Heat Exchangers” , McGraw Hill, 2002.
3. Holger Martin, “Heat Exchangers” Hemisphere Publ. Corp. , Washington, 2001.
4. Kuppan, T., “Heat Exchanger Design Handbook”, Macel Dekker, Inc., N.Y. , 2000
5. Seikan Ishigai, “Steam Power Engineering , Thermal and Hydraulic Design Principles”, Cambridge Univ. Press, 2001.

Elective-II

6. Design of Pumps & Compressors

Teaching Scheme
Lectures: 3 Hrs per week

Examination Scheme
Paper: 100 Marks
Paper Duration: 3 Hrs.

Centrifugal Pump Design : Selection of speed, impeller design, blade geometry, meridional geometry, volute and vaned diffuser design.

Axial Flow Pumps : Casing geometry, No. of blades, cascade solidity, selection of blade profile, diffuser design.

Centrifugal Compressors : Inlet sections, impeller passages, blade shape, vane less and vaned diffuser, Mach number consideration.

Axial Flow Compressors : Stage design parameters, blade loading, blading efficiency, lift coefficient and solidity, three dimensional design consideration.

Reference Books:

1. A. Kovats, " Design and Performance of Centrifugal and A xial Flow Pumps and Compressors, Pergamon.
2. Stapanoff A.J., "Centrifugal and Axial Flow Pumps, John Wiley,
3. Horlock J.H., "Axial Flow Compressors, Butterworth,
4. Yahya S.M., "Turbines, Compressor and Fans, Tata McGraw Hill.

FIRST YEAR

(Semester-II)

LABORATORY PRACTICE – II

Exam Scheme :
Practical's – 06 hours/week. **Term-work – 100 marks**
Oral- 50 marks

Experiments/Assignments based on
Any Three subjects for Experimental work and two subjects for Assignments

1. Optimization Techniques
2. Instrumentation & Automatic Control
3. Mechanical Design Analysis
4. Advanced Fluid Mechanics
5. Elective -II

For those subject lab. practice is not given, for that the concerned subject in-charge should frame minimum of four laboratory Experiments / Assignments.

Note: Oral will be based on the prescribed term-work presented in the form of certified journal.

FIRST YEAR

(Semester-II)

SEMINAR-II

Practical's – 04 hours/week. **Term-work – 100 marks**

Seminar-II should be based on the literature survey on any topic relevant to Mechanical Engineering. It may be leading to selection of a suitable topic of dissertation. Each student has to prepare a write-up of about 25 pages.

The report typed on A4 sized paper and bound in the necessary format should be submitted after approved by the guide and endorsement of the Head of Department. The student has to deliver a seminar talk in front of the teachers of the department and his classmates. The Guide based on the quality of work and preparation and understanding of the candidate shall do an assessment of the seminar.

The report copies must be duly signed by the guide and Head of department (one copy for institute, one copy for guide and one copy for the candidate for certification). Attendance of all students for all seminars is compulsory.

SECOND YEAR

(Semester-III)

SEMINAR-III

Exam Scheme :
Practical's – 04 hours/week. **Term-work – 50 marks**
Oral – 50 marks

Seminar - III should be based on the literature survey on any topic relevant to Mechanical Engineering. It may be leading to selection of a suitable topic of dissertation. The report shall contain some contribution by the candidate in the form of experimental results, deductions, compilation and inferences etc.

Each student has to prepare a write-up of about 25 pages. The report typed on A4 sized paper and bound in the necessary format should be submitted after approved by the guide and endorsement of the Head of Department. The student has to deliver a seminar talk in front of the teachers of the department and his classmates. The Guide based on the quality of work and preparation and understanding of the candidate shall do an assessment of the seminar.

The report copies must be duly signed by the guide and Head of department (one copy for institute, one copy for guide and one copy for the candidate for certification). Attendance of all students for all seminars is compulsory.

SECOND YEAR

(Semester-III)

PROJECT STAGE-I

Exam Scheme :
Practical's – 18 hours/week. **Term-work – 100 marks**

The candidate shall submit the synopsis of the dissertation work to the evaluation committee at the starting of Second year **(Semester-III)** It shall include the problem definition, literature survey, approaches for handling the problem, finalizing the methodology for the dissertation work and design calculations/ experimental design etc.

A report of the work shall be submitted at the end of Semester III after approval by the Guide and endorsement of the Head of Department. It will be assessed for term work, by the evaluation committee appointed by the Head of the Department, for appropriateness, sufficiency of contents and offer suggestions if any.

The candidate shall prepare a report of about 50 pages. The report typed on A4 sized paper and bound in the prescribed format shall be submitted after approval by the Guide and endorsement of the Head of Department. It will be assessed for term work by the evaluation committee appointed by the Head of the Department. The report copies must be duly signed by the guide and Head of department (one copy for institute, one copy for guide and one copy for the candidate for certification). Attendance of all students for all seminars is compulsory.

SECOND YEAR

(Semester-IV)

PROGRESS SEMINAR- IV

Exam Scheme :

Term-work – 50 marks

Progress Seminar shall be based on topic of the Dissertation Work. It may include literature review, required theoretical input, study and comparison of various approaches for the proposed dissertation work. The candidate shall prepare a report of about 25 pages. The report typed on A4 sized sheets and bound in the prescribed format shall be submitted after approval by the Guide and endorsement of the Head of Department. It will be assessed for term work by the evaluation committee appointed by the Head of the Department.

The report copies must be duly signed by the guide and Head of department (one copy for institute, one copy for guide and one copy for the candidate for certification). Attendance of all students for all seminars is compulsory.

SECOND YEAR

(Semester-IV)

PROJECT STAGE-II

Exam Scheme:
Practical's –18 hours/week. **Term-work – 100 marks**
Oral - 100 marks

The candidate shall submit the detailed report as per the synopsis approved by the evaluation committee, of the dissertation work in the prescribed format after approval by the Guide and endorsement by the Head of the Department. It will be assessed for term work by the evaluation committee appointed by the Head of the Department, for completion of the proposed work.

Note: - The evaluation committee shall consist of the Guide, one senior expert faculty member and the Head of the Department or his/her representative.