NORTH MAHARASHTRA UNIVERSITY
JALGAON (M.S.)

MASTER OF ENGINEERING

M.E. (MECHANICAL)

WITH SPECIALIZATION IN

COMPUTER AIDED ANALYSIS AND DESIGN

(W.E.F. 2011 – 2012)

North Maharashtra University Jalgaon

M.E. MECHANICAL ENGINEERING - COMPUTER AIDED ANALYSIS & DESIGN (CAAD)

(W.E.F: 2011 – 12)

SYLLABUS STRUCTURE:

FIRST YEAR: TERM – I

Sr. No	Subject Name	Teaching Scheme per Week		Examination Scheme				
		L	P	Paper Hr.	Paper	TW	PR	OR
1	Finite Element Analysis	3	-	3	100	-	-	-
2	Computer Aided Design	3	-	3	100		-	-
3	Machine Design	3	-	3	100		-	-
4	Mechanical Vibration	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			

FIRST YEAR: TERM –II

Sr. No.	Subject Name	Teaching Scheme per Week		Examination Scheme				
		L	P	Paper Hr.	Paper	TW	PR	OR
1	**Optimization Techniques**	**3**	**-**	**3**	**100**	**-**	**-**	**-**
2	**System Dynamics & Simulation**	**3**	**-**	**3**	**100**	**-**	**-**	**-**
3	**Design of Experiments & Analysis**	**3**	**-**	**3**	**100**		**-**	**-**
4	**Design & synthesis of Mechanism**	**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 TERM I & II

Sr. No	Elective – I	Sr. No	Elective – II
1	Design of Pressure Vessel	1	Design for Manufacturing & Assembly
2	Computer Aided Engineering	2	Machine tool Design
3	Tribology	3	Computational Fluid Dynamics

SECOND YEAR: TERM –I

Sr. No	Subject Name	Teaching Scheme per Week		Examination Scheme				
		L	P	Paper Hr	Paper	TW	PR	OR
1	Seminar – III	-	4	-	-	50	-	50
2	Project Stage - I	-	18	-	-	100	-	-
	Total	-	22	-	-	150		50
	Grand Total	22		200				

SECOND YEAR: TERM –II

Sr. No	Subject Name	Teaching Scheme per week		Examination Scheme				
		L	P	Paper Hr.	Paper	TW	PR	OR
1	Progress Seminar	-	-	-	-	50	-	-
2	Project Stage-II	-	18	-	-	150		100
	Total	-	18	-	-	200	-	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

SYLLABUS FOR THE COURSE:

M.E. MECHANICAL - COMPUTER AIDED ANALYSIS & DESIGN (CAAD)

FIRST YEAR (TERM – I)

FINITE ELEMENT ANALYSIS

(Common with M.E. Mechanical (General))

Teaching Scheme	Examination
Scheme:	
Lectures: 3 Hrs per week	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

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)

COMPUTER AIDED DESIGN

Teaching Scheme
Lectures: 3 Hrs Per week

Examination Scheme
Paper: 100 Marks
Duration: 3 Hrs

BASICS OF CAD

Fundamentals of CAD, Phase of CAD, benefits, applications, Display techniques, Hardware and software of CAD, programming and tools in CAD

COMPUTER GRAPHICS

Role of computer graphics in CAD / CAM, Fundamentals of 2-D graphics, Menu design and graphical user interfaces, graphic elements, raster scan technique, LED Liquid Crystal Display, Graphic elements drawing, algorithms for line, circle, ellipse, arc, rectangle etc.. Drawing of 2-D elements, filling of object, programming methods, Transformation in 2-D as scaling, rotation, rotation about any point, scaling about any point, orthographic projection and drawing of 2-D elements.

MODELLING IN 3-D

Translation, mirror and shear, transformation in 3-D as scaling , translation and rotation, mirror, shear, isometric, oblique and perspective projection method. Surface, wire frame and solid modeling, B-rep, CSG and Hybrid modeling Planer and space curve design, analytical and synthetic approaches, surface of revolution, Sweep surfaces, ruled and developed surfaces, Benzier and B-spline curves and surface.

DESIGN OF MACHINE

Component Application for design of vehicle components and mathematical modeling with program on design problems like shaft, axles, gear, spring, brake, clutch etc..

OPTIMIZATION

Implementation, techniques for reducing weight and cost of the components using computer program.

THERMAL SYSTEM DESIGN

Application of CAD for design of thermal system like heat exchanger, furnaces design etc.

NUMERICAL METHODS

Modeling and Programming gauss elimination method, numerical integration, finite differences, curve fitting, Newton Raphson technique

Reference Books:-

1 Krishnamurthy , Computer Aided Design
2M. P. Groover and Zimmer, CAD-CAM
3.I. Zeid, CAD-CAM and Automation
4.Khandare, Computer Aided Design
5.A. Ravindra, K. M. Ragesdell, G. V. Reklaitis, Engineering Optimization – Methods and Application, Willey India Publications

6Chapra Canale, Numerical Methods for Engineers
7.V. B. Bhandari, Design of Machine Elements, McGraw Hill Publication
8.W. F. Stoecker, Design of Thermal System, McGraw Hill Publication

MACHINE DESIGN

Teaching Scheme
Lectures: 3 Hrs Per week

Examination Scheme
Paper: 100 Marks
Duration: 3 Hrs

INTRODUCTION
Review of failure theories; their scope of applications under different loading and environmental conditions; Hertzian contact stresses and their effect on load carrying capacities of members; effect of small inelastic strains and residual stresses on load carrying capacity; theory of limit design; Machinery construction principles.

DESIGNING AGAINST FRACTURE
Linear elastic fracture mechanics approach; theories of brittle fracture; fundamental aspects of crack growth and fractures; use of fracture in design

DESIGNING AGAINST FATIGUE AND CREEP
Causes and interpretation of failures, influence of various factors; low cycle and high cycle fatigue; cumulative damage theories; acoustical and thermal fatigue; corrosion and fretting fatigue; pitting of gears; fatigue strength of joints, components and structures; creep behavior; the mechanical equation of state; an elastic and plastic creep; rupture theory; analysis of tensile creep data, creep in high temperature low cycle fatigue; creep analysis of thick walled cylinders and rotating discs.

DESIGN FOR RELIABILITY
Application of statistics to material properties; fatigue and reliability, early chance and wear out failures; reliability prediction against chance and wear out failures; probabilistic approach to design and its comparison with safety factor approach; reliability prediction of series, parallel and stand by systems.

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.

DESIGN TECHNIQUES
Black Box Design, Design For Assembly, Design For Manufacturing, Design For Quality, Design For Reliability, Design For Safety, Design for Simplicity, Product Design Using Design For Six Sigma, Taguchi Technique, Product Based Design.

Reference Books

1 Faupel, J.H., and Fisher, F.E., “Engineering Design”, Wiley-Interscience. 1981
2 Burr, A.H., “Mechanical Analysis and Design”, Elsevier. 1982
3 Smith, N., “Advances in Creep Design”, Applied Science. 1971
4 Bazovsky, I., Reliability Theory & Practice, Courier Dover Publications. 2004
5 Haugen, E.B., Probabilistic Approach Design, John Wiley. 1968

6 Yotaro Hatamura and Yoshio Yamamoto, “The Practice of Machine Design” Oxford University Press.
7. An introduction to composite materials – D. Hull and T.W. Clyne
8. Boothroyd G. “Design For Assembly “ Department of Mechanical Engineering, University of Massachusetts, USA, 1979.
9. Boothroyd G. Knight W. “Design For Assembly”, Spectrum IEEE, September 1993,pp 53 – 55.
10. Dodd C. W. “Desgn For X, IEEE Potentials, October 1992, pp. 44 – 46.
11. Iredale R. “Automatic Assembly – Components and products” Metalwork Production, April 8, 1964.
12. Ullman D.G. “The Mechanical Design Process” McGraw-Hill 1997.
13. C. M. Crevelling, J. L. Slutsky and Antis Jr. Design For Six Sigma, Pearson Edition Corporation, 2003.
14. Kai Yaung, Baseem EI-Haik, Design For Six Sigma, McGraw-Hill Publication, 2003.

MECHANICAL VIBRATION

(Common with M.E. Mechanical (General))

Teaching Scheme
Scheme:
Lectures: 3 Hrs per week

Examination
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. Langranges 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, signal 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.

Reference Books

1 Theory of Vibrations with Applications: W T Thomson CBS Publishers Delhi
2 Mechanical Vibrations : S S Rao Addison-Wesley Publishing Co.
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

DESIGN OF PRESSURE VESSEL (Elective – I)
(Common with M.E. (Machine Design))

Teaching Scheme
Lectures: 3 Hrs Per week

Examination Scheme
Paper: 100 Marks
Duration: 3 Hrs

INTRODUCTION

Revision of stress and strain in thick and thin cylinder and pressure vessel. Criteria in vessel design, excessive elastic deformation, plastic instability, brittle, rupture, creep Design of pressure vessel, internal pressure, construction feature, code, design of shell, types of heads, thickness of heads.

Design of storage vessel, storage of non volatile liquids and gases, code for storage, bottom and shell design Design of vessel under external pressure, vacuum stress analysis, stiffness , design of circumferential stiffeners, design of covers, pipes and tubing Design of High Pressure Vessel, autoclave Support for vessel, types, leg support skirt, support design.

Reference Books:

1) Process Equipment Design by N.V .Joshi
2) Process equipment design by L.E.Browr ,E.H.Yovng
3) Introduction to process Equipment Design by B.C. Bhattacharya
4) Pressure Vessel Design Manual by Dennis Moss, Elsevier
5) Theory and Design of Pressure Vessels by John F. Harvey, P. E., CBS Publication

COMPUTER AIDED ENGINEERING (Elective – I)

Teaching Scheme	Examination Scheme
Lectures: 3 Hrs Per week	Paper: 100 Marks
	Duration: 3 Hrs

INTRODUCTION TO CUSTOMIZATION
Customization, Application Programming Interface (API), macros, scripts.

TOOLS FOR CUSTOMIZATION
Object Oriented Programming (OOP), OLE interfaces in CAD/CAM software, Use of general programming interfaces like VB, VBS, VC++, OpenGL programming and System dependent programming interfaces like, Visual LISP (AutoCAD), GRIP (Uni-graphics), Pro-Programming (Pro-Engineer), CATIA etc.

COMPUTER-BASED SYSTEM ENGINEERING
System engineering process, Software product development life cycle, software processes, software development project management, software prototyping

RAPID DEVELOPMENT
Core issues in rapid development, rapid development languages, life cycle planning and customer oriented development

SOLID MODELING ALGORITHMS
Euler operations, basic solid modeling algorithms

AUTOMATED SOLID MODELING USING CUSTOMIZATION
Creating 2D, 3D and solid entities through API, Editing 2D, 3D and solid entities through API, Design and development of user interfaces- icons, menus, dialog boxes, integrating databases with CAD, creating bill of material or parts list, automated assembly modeling through customization, automated drafting and dimensioning using customization, creating automated animations using API and animation software.

Reference Books:

1. Rapid Development,- Steve McConnel, Microsoft Press
2. Software Engineering – Ian Sommerville, Pearson Education
3. Computer Gtraphics – Foley, Van Dam, et al, Pearson Education
4. Open GL Programming Guide – Mason Woo et al,
5. Advanced AutoCAD – George Omura
6. Customizing AutoCAD – Shyam Tickoo, Thomson Learning
7. CATIA - Shyam Tickoo, Thomson Learning
8. Solid Modelling – Martti Mantilya, Computer Science Press
9. Solid Works API Using VB and C++ - Custom Programming Unlimited LLC
10. GRIP Programming Manuals for Unigraphics – Vol. I & II
11. User Function Programming Manuals for Unigraphics– Vol. I, II & III
12. User Manuals for CATIA

TRIBOLOGY (Elective-I)
(Common with M.E. (Machine Design))

Teaching Scheme
Lectures: 3 Hrs Per week

Examination Scheme
Paper: 100 Marks
Duration: 3 Hrs

FRICTION & WEAR
Types of wear ,theories of friction & wear, dry friction & boundary friction

VISCOSITY
Petroff's law, Hagen Poisenille law, variation of viscosity ,

HYDRODYNAMIC LUBRICATION
Reynold's Eq. Solution for short & long finite bearing, load carrying capacity, flow rate, hydrodynamic thrust bearing, behaviour under variable laod, squeeze film, thermal equilibrium of sliding system, elasto hydrodynamic lubrication

HYDROSTATIC LUBRICATION
Pressure distribution in hydrostatic thrust bearing, pumping power & capacity, hydrostatic formal & thrust bearing

GAS LUBRICATION
Merits & Demerits, aerodynamic and aerostatic journal bearing, Reynolds equation

Reference Books:

1) Principles of tribology by J.Hamrock
2) Tribology in machine Design by T A solarski
3) Principles of Tribology by J.Hasting

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) Computer Aided Design
2) Machine Design
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.

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 CAAD 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 sheets 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

FIRST YEAR (TERM – II)

DESIGN OF EXPERIMENTS & ANALYSIS

Teaching Scheme
Lectures: 3 Hrs Per week

Examination Scheme
Paper: 100 Marks
Duration: 3 Hrs

INTRODUCTION
Defining Research, Scientific Enquiry, Hypothesis, Scientific Method, Types of Research, Research Process and steps in it. Research Proposals – Types, contents, sponsoring agent's requirements, Ethical, Training, Cooperation and Legal aspects

RESEARCH DESIGN
Meaning, Need, Concepts related to it, categories; Literature Survey and Review, Dimensions and issues of Research Design, Research Design Process – Selection of type of research, Measurement and measurement techniques ,Selection of Sample, Selection of Data Collection Procedures, Selection of Methods of Analysis, Errors in Research.

RESEARCH PROBLEM
Problem Solving – Types, Process and Approaches – Logical, Soft System and Creative; Creative problem solving process, Development of Creativity, Group Problem Solving Techniques for Idea Generation – Brain storming and Delphi Method.

RESEARCH MODELLING
(a) Mathematical – Classification of Models, Development of Models, Stages in Model building, Principles of Modelling, Use of Analogy, Models as Approximations, Data consideration and Testing of Models (b) Heuristics and Simulation – Definition, Applications and reasons for using Heuristics, Heuristic Methods and approaches, Meta-Heuristics; Simulation – Meaning, Applications and Classification of Simulation Models, Process of Simulation, Steps and Features of Simulation Experiments and their Validation.

EXPERIMENTATION
Objective, Strategies, Factorial Experimental Design, Applications of Experimental Design, Basic Principles – Replication, Randomization and Blocking, Guidelines for designing experiments; Laboratory Experiments, Methods of manipulating Variables, Errors in Experiments, Steps in Design of Experiments, Basis

PROCESS OPTIMIZATION
Factorial Design principles, two factor Factorial Design, General Factorial Design, Fitting response Curves and Surfaces, Blocking, Taguchi Approach to Parameter Design, Robust Design

ANALYSIS
Analysis of Variance and Co-variance, Hypothesis Testing – Parametric and Non-Parametric Tests, Uni-variate and Bi-variate analysis

REPORT WRITING
Pre-writing Considerations, Principles of Thesis Writing, Format of Report Writing, Format of Publication in Research Journals, Oral Presentations (Briefing)

Reference Books

1. Krishnaswamy, K.N., Sivakumar, Appa Iyer & Mathirajan M., (2006) - Management Research Methodology: Integration of Principles, Methods & Techniques (New Delhi, Pearson Education)
2. Montgomery, Douglas C. (2004) – Design & Analysis of Experiments, 5/e. (New York, John Wiley & Sons)
3. Kothari, C.K. (2004) – Research Methodology, Methods & Techniques, 2/e. (New Delhi, New Age International Ltd. Publishers)
4. Ross, Phillip J. (1996) – Taguchi Techniques for Quality Engineering, 2/e. (New York, McGraw Hill)
5. Rao S. S. (2004) – Engineering Optimization Theory & Practices, 3/e (New Delhi, New Age International Ltd., Publishers)
6. Handbook of Industrial Automation – Richard L. Shell & Ernest L. Hall (Marcel Decker Inc.)
7. Trochim, William M.K. (2003), - Research Methods 2/e, (New Delhi, Biztantra, Dreamtech)
8. J. P. Hollman, Experimental Methods for Engineers, McGraw Hill, International Edition

OPTIMIZATION TECHNIQUES
(Common with M.E. Mechanical (General))

Teaching Scheme
Scheme:
Lectures: 3 Hrs per week

Examination
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 alogorithms

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

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

SYSTEM DYNAMICS AND SIMULATION

Teaching Scheme
Lectures: 3 Hrs Per week

Examination Scheme
Paper: 100 Marks
Duration: 3 Hrs

SYSTEM DYNAMICS

Learning in and about complex systems, The modeling process. Structure and Behavior of dynamic systems. Causal Loop Diagrams, stocks and flows, dynamics of stocks and flows, dynamics of simple structure. The dynamics of growth: S shaped growth, path dependence, delays. Modeling, decision making, formulating nonlinear relationship, model testing, Case Studies.

SIMULATION

System and System Environment: Components of a system, Continuous and discrete systems, Models of a system, Modeling. Random Number Generation: Methods and Tests for random number generation, Random Variable Generation, Simulation of Systems: Simulation of continuous system, Simulation of discrete system, Simulation of event occurrences using random numbers. Simulation of component failures using Exponential and weibull models. Input modeling and output analysis, Simulation Applications: Single server queue problems and multi-server queue problems, Inventory system, Network problem, Shop Floor problems in a manufacturing environment.

Text Books

1. Banks J., Carson. J.S., and Nelson B.L., Discrete Event System Simulation, Prentice Hall of India, New Delhi, 1996.
2. Gottfried B.S., Elements of Stochastic Process Simulation, Prentice Hall, London, 1984.

Reference Books:

1. Geoffrey Gordon., System Simulation, Prentice Hall of India, 1984.
2. Narsingh Deo., System simulation with Digital Computer, Prentice Hall of India, 1979

DESIGN & SYNTHESIS OF MECHANISM

(Common with M.E. (Machine Design))

Teaching Scheme
Lectures: 3 Hrs Per week

Examination Scheme
Paper: 100 Marks
Duration: 3 Hrs

Kinematics analysis of planer mechanism, graphical & analytical methods of velocity & acceleration analysis.Curvature Theorem, fixed & moving centroids, inflection circle, Euler Savary equation, Bobillier construction, cubic & stationary curvature, dwell mechanism Kinematic synthesis,

Dimensional synthesis, function generation, path generation, accuracy point, Chebychev spacing, graphical synthesis for function generation with two, three, four accuracy points, Bermester points Analytical Synthesis of four bar and slider crank mechanism, Frendenstein equation.

Coupler Curves: - Equation of coupler curves, Robber Chebychev theorem, kinematics analysis of spatial mechanism, Denavit Hartenberg parameters, matrix method.

Reference Books:

1) Design of Machaniry- An introduction to synthesis & analysis of mechanics & machines by R.L.Norton
2) Mechanism Design - Analysis & synthesis by A.G.Edman & G.N.Sandor

3) Theory of Mechanics & Mechanism by J.E.Shigley & J.J.Ucker

DESIGN FOR MANUFACTURE AND ASSEMBLY (Elective – II)

(Common with M.E. (Machine Design))

Teaching Scheme
Lectures: 3 Hrs Per week

Examination Scheme
Paper: 100 Marks
Duration: 3 Hrs

Life cycle of mechanical equipment design, Requirement of life cycle personnel like customer, management, marketing, manufacturing, transportation etc. Need to meet constraints of manufacturing, Advantages of designing for manufacturing and assembly to improve product quality, cost and time to market,

Design for manufacture & assembly (DFMA) strategies, DFMA application and case studies, product design for manual assembly,

Design for high speed automatic & robot assembly, design for machining, design for injection moulding, die casting and powder metal processing, Design for sheet metal for mechanical system design.

Reference Books:

1) Process and Design for manufacturing by Sherif D EL Wakil
2) Manufacturing, Planning and control systems by Thomas E Vollmann, Willam L Beroy
3) Automation, Production System and Computer Integrated Manufacturing by Mikell P Groover.

MACHINE TOOL DESIGN (Elective-II)
(Common with M.E. (Machine Design))

Teaching Scheme
Lectures: 3 Hrs Per week

Examination Scheme
Paper: 100 Marks
Duration: 3 Hrs

Introduction, trends in machine tool design, design specification, working principle, Kinematics of machine tool, different drives, cutting speeds, gear boxes, ray diagram, Force analysis, forces for different machining operation, design of beds, columns, tables, support, rigidity consideration, Vibration in machine tool, vibration of column beds, vibration damping, Design of side ways & guide ways, types of guide, pressure distribution, wear, accuracy, lubrication.

Design of power screws, design features, strength, rigidity, efficiency, backlash, Design of spindles, balancing of spindles, strength & wear resistance, CNC machine tool, CAD/CAM system, programming.

Reference Books:

1) Machine tool design by N.K.Mehta
2) Design principles of metal cutting—machine tool by F Koenigs Berger
3) Machine Tool Design Handbook, Central Machine Tool Institute

COMPUTATIONAL FLUID DYNAMICS (Elective-II)
(Common with M.E. Mechanical (General))

Teaching Scheme **Examination Scheme:**
Lectures: 3 Hrs per week **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 of Fluid **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 -VorticityFormulation
Two Dimensional Incompressi ble 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.

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. System Dynamics & Simulation
3. Design of Experiment & Analysis
4. Design & synthesis of Mechanisms
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.

SEMINAR-II

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

Seminar-II should be based on the literature survey on any topic relevant to CCAD. 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 sheets 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

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 Design 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 sheets 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

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 FIRST YEAR TERM 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 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

PROGRESS SEMINAR

Exam Scheme :
Practical's – 04 hours/week. **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

PROJECT STAGE - II

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