GOVERNMENT COLLEGE OF ENGINEERING, AURANGABAD

(An Autonomous Institute of Government of Maharashtra)

Department of Mechanical Engineering

Teaching and Evaluation Scheme(**w.e.f 2014-15)**

ME (Full-Time) in Mechanical Design

Course Code	Name of Subject	Scheme of Teaching (Hrs/Week)				Scheme of Evaluation (Marks)					
						Theory			Term Work	Practical/ Viva-voce	Total
		L	T	P	Total Credits	Test	TA	End sem			
SEMESTER I											
ME551	Machine Stress Analysis	4	-	-	4	20	20	60	-	-	100
ME552	Advanced Mathematical Methods	4	-	-	4	20	20	60	-	-	100
ME553	Design Engineering	4	-	-	4	20	20	60	-	-	100
	Elective – I (**ME554** to **ME556**)	4	-	-	4	20	20	60	-	-	100
	Elective – II (**ME557** to **ME559**)	4	-	-	4	20	20	60	-	-	100
ME560	Lab – I	-	-	2	2	-	-	-	50	-	50
ME561	Seminar – I	-	-	2	2	-	-	-	25	25	50
	Total of Semester - I	**20**	-	**4**	**24**	**100**	**100**	**300**	**75**	**25**	**600**
	Total Credit Points				**24**						
SEMESTER II											
ME562	Finite Element Methods	4	-	-	4	20	20	60	-	-	100
ME563	Mechanical Vibrations Analysis	4	-	-	4	20	20	60	-	-	100
ME564	Computer Aided Optimization	4	-	-	4	20	20	60	-	-	100
	Elective–III (**ME565** to **ME567**)	4	-	-	4	20	20	60	-	-	100
	Elective – IV (**ME568** to **ME570**)	4	-	-	4	20	20	60	-	-	100
ME571	Lab - II	-	-	2	2	-	-	-	50	-	50
ME572	Seminar – II	-	-	2	2	-	-	-	25	25	50
	Total of Semester - II	**20**	-	**4**	**24**	**100**	**100**	**300**	**75**	**25**	**600**
	Total Credit Points				**24**						
SEMESTER III											
GE 611 ET 561 CS 559 CS 560 EE 572 EE 675 AM 641	Institute Elective	4	-	-	4	20	20	60	-	-	100
GE 612	Environmental Studies	3	-	-	3	20	20	60			100
ME611	Dissertation Part - I	-	-	10	10	-	-	-	50	50	100
	Total of Semester - III	**4**	**-**	**10**	**17**	**20**	**20**	**20**	**50**	**50**	**300**
	Total Credit Points				**17**						
SEMESTER IV											
ME 612	Dissertation Part – II	-	-	10	14	-	-	-	50	150	200
	Total of Semester – IV	**-**	**-**	**10**	**14**	-	-	-	**50**	**150**	**200**
	Total Credit Points				**14**						
	GRAND TOTAL										**1700**

Elective – I

ME554 Modern Engineering Materials
ME555 Geometrical Modeling and Applications
ME556 Synthesis and Kinematics of Mechanism

Elective – II

ME557 Robotics and Automation
ME558 Engineering Experimental Techniques
ME559 Industrial Tribology

Elective – III

ME565 Machine Tool Design
ME566 Simulation and Mathematical Modeling
ME567 Engineering Economics

Elective – IV

ME568 Advanced Machine Design
ME569 Design and Analysis of Experiments
ME570 Material Handling Equipment Design

Open Elective

ET 561 Soft Computing
CS559 Professional Ethics & Cyber Law
CS560 Web Technologies
EE572 Renewable Energy Technology
EE675 Renewable Energy Technology
GE611 Research Methodology
AM 641 Finite element methods for engineers

Dr. R.K. Shrivastva
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GOVERNMENT COLLEGE OF ENGINEERING, AURANGABAD

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Department of Mechanical Engineering

Teaching and Evaluation Scheme(**w.e.f 2014-15)**

ME (Part-Time) in Mechanical Design

Course Code	Name of Subject	Scheme of Teaching (Hrs/Week)				Scheme of Evaluation (Marks)					
						Theory			Term Work	Practical/ Viva-voce	Total
		L	T	P	Total Credits	Test	TA	End sem			
SEMESTER I											
ME551	Machine Stress Analysis	4	-	-	4	20	20	60	-	-	100
ME552	Advanced Mathematical Methods	4	-	-	4	20	20	60	-	-	100
ME553	Design Engineering	4	-	-	4	20	20	60	-	-	100
	Total of Semester - I	**12**	**-**	**-**	**12**	**60**	**60**	**180**	**-**	**-**	**300**
	Total Credit Points				**12**						
SEMESTER II											
	Elective – I (**ME554** to **ME556**)	4	-	-	4	20	20	60	-	-	100
	Elective – II (**ME557** to **ME559**)	4	-	-	4	20	20	60	-	-	100
ME560	Lab – I	-	-	2	2	-	-	-	50	-	50
ME561	Seminar – I	-	-	2	2	-	-	-	25	25	50
	Total of Semester - II	**8**	-	**4**	**12**	**40**	**40**	**120**	**75**	**25**	**300**
	Total Credit Points				**12**						
SEMESTER III											
ME562	Finite Element Methods	4	-	-	4	20	20	60	-	-	100
ME563	Mechanical Vibrations Analysis	4	-	-	4	20	20	60	-	-	100
ME564	Computer Aided Optimization	4	-	-	4	20	20	60	-	-	100
	Total of Semester - III	**12**	**-**	**-**	**12**	**60**	**60**	**180**	**-**	**-**	**300**
	Total Credit Points				**12**						
SEMESTER IV											
	Elective–III (**ME565** to **ME567**)	4	-	-	4	20	20	60	-	-	100
	Elective – IV (**ME568** to **ME570**)	4	-	-	4	20	20	60	-	-	100
ME571	Lab - II	-	-	2	2	-	-	-	50	-	50
ME572	Seminar – II	-	-	2	2	-	-	-	25	25	50
	Total of Semester - IV	**8**	**-**	**4**	**12**	**40**	**40**	**120**	**75**	**25**	**300**
	Total Credit Points				**12**						
SEMESTER V											
ET 561 **CS559** **CS560** **EE572** **EE675** **GE611** **AM 641**	Institute Elective	4	-	-	4	20	20	60	-	-	100
GE 612	Environmental Studies	3			3	20	20	60			100
ME611	Dissertation Part - I	-	-	10	10	-	-	-	50	50	100
	Total of Semester - V	**4**	**-**	**10**	**17**	**20**	**20**	**20**	**50**	**50**	**300**
	Total Credit Points				**17**						
SEMESTER VI											

ME 612	Dissertation Part – II	-	-	10	14	-	-	-	50	150	200
	Total of Semester –VI	**-**	**-**	**10**	**14**	-	-	-	**50**	**150**	**200**
	Total Credit Points				**14**						
	GRAND TOTAL										**1700**

Elective – I
ME554 Modern Engineering Materials
ME555 Geometrical Modeling and Applications
ME556 Synthesis and Kinematics of Mechanism

Elective – II
ME557 Robotics and Automation
ME558 Engineering Experimental Techniques
ME559 Industrial Tribology

Elective – III
ME565 Machine Tool Design
ME566 Simulation and Mathematical Modeling
ME567 Engineering Economics

Elective – IV
ME568 Advanced Machine Design
ME569 Design and Analysis of Experiments
ME570 Material Handling Equipment Design

Institute Elective
ET 561 Soft Computing
CS559 Professional Ethics & Cyber Law
CS560 Web Technologies
EE572 Renewable Energy Technology
EE675 Renewable Energy Technology
GE611 Research Methodology
AM 641 Finite element methods for engineers

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ME551: MACHINE STRESS ANALYSIS

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:

To understand concepts of plain stress, strain, strain energy, two dimensional and octahedral stress conditions and applying it for numerical analysis. Enhancing torsion concepts for circular and non-circular cross sections and applying it to various experimental and numerical analysis. To understand concepts of shear centre and contact stresses in various geometric conditions and using it for numerical analysis.

Outcomes:

To develop ability of solving problems based on critical conditions of loading in two and three dimensional state, enhance the knowledge and ability of solving practical problems based on torsion, shear centre and contact stresses

Theory of Elasticity: Plane stresses and plane strain: plane stress, plane strain, stress and strain at a point, differential equations of equilibrium, boundary conditions, compatibility equations, Airy's stress function. Two-dimensional problems in rectangular coordinates: Solutions by polynomials, end effects, Saint Venant's principal. Two-dimensional problems in polar coordinates: General equations in polar coordinates, stress distribution symmetrical about axis, strain components in polar coordinates.

Applications of Energy Methods: First and second theorms, Castigliano's theorems, applications foe analysis of loaded members to determine deflections and reactions at supports.

Theory of Torsion: Torsion of prismatic bars of non-circular cross sections, Thin walled hollow and rectangular cross sections, Saint Venant's theory, Prandtle's membrane analogy, Kelvin's fluid flow analogy, warping of the cross sections.

Experimental Stress Analysis: Stress analysis by – mechanical, optical and electrical strain gauges, strain rosette, whole field methods, Moire fringe method, brittle coatings for strain indication.

Shear Center and Unsymmetrical Bending: Shear center for beams of different cross sections, bending and deflections of beams subjected to unsymmetrical bending.

Contact Stresses: Hertz's contact stresses, expression for principle stresses, deflection of bodies in point contact, stress in bodies in point and line contacts.

Reference Books

1. Timoshenko and Young, "Theory of Elasticity", TMH Publications.
2. Seely and Smith, " Advanced Mechanics of Materials", John Wiley, New York
3. Den Hartog J. P., "Advanced Strength of Materials", McGraw Hill Publications.
4. Nash W., "Strength of Materials", Schaum's outline series, McGraw Hill.

ME552: ADVANCED MATHEMATICAL METHODS

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:

We help the students to master their skills and improve their mathematical ability and maturity. The main objective of this course is to provide the student with a repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of engineering. In addition, this course is intended to prepare the student with mathematical tools and techniques that are required in advanced courses offered in the engineering programs.

Outcomes:

Application of the basic science systematization thought excavation, evaluation, diagnosis project question, and plans and carries out ability of the special study and the solution. Have independent research, collection of the data, standard problem development, acquire conclusion from data, and have development innovation and compose the ability of professional thesis. Use mathematics in engineering realm to do design and analysis, explanation of data obtained from experiments with independently ability to solve the problem.

Numerical Methods to Solve Partial Differential Equations: Hyperbolic equations, parabolic equations, Elliptic equations, solution of laplace equations, solution of poission's equations, solution of elliptic equations by relaxation method, solution of one dimensional heat flow equation, solution of two dimensional heat flow equation, solution of wave equation.

Matrices: Matrix inversion, Gauss elimination method, Gauss Jordan method, Crout's triangularisation method, Partition method, Iterative method, Homogeneous systems the eigen-value problem, the power method, Jacobi's method, eigen-values of symmetric matrices, transformation method, transformation of generalized eigen-value problem to standard.

Solution of Algebraic and Transcendental Equations: Basic properties of equations, Bisection method, False Position method, Secant method, Iteration method, Aitken's Δ^2 method, Newton Raphson method, Horner's method, Muller's method, Root squaring method and Comparison of iterative method.

Curve Fitting: Least square curve fitting procedures for straight line, Nonlinear curve fitting, weighted least square approximation, Method of least square for continuous function.

Finite Difference Methods: Formation of difference equation, linear difference equation, rules for finding out complementary function, rules for finding out particular integral, difference equations reducible to linear form, simultaneous difference equation with constant coefficients, application to deflection of a loaded string, loaded simply supported beams or cantilevers.

Reference Books

1. Kreyszig Erwin, "Advanced Engineering Mathematics",
2. Mathews John. H., "Numerical Methods", PHI, New Delhi.
3. Rajasekaran S., " Numerical Methods in Science and Engineering", Wheeler Publications
4. Grewal B. S., " Numerical Methods", Khanna Publication, New Delhi
5. Shastry S. S., "Introductory Methods of Numerical Analysis", PHI, New Delhi.
6. Chapra, Canal, "Numerical Methods for Engineers",

ME553: DESIGN ENGINEERING

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:

To understand concepts of principal stresses, principal strain in tri-axial state conditions and applying it for numerical analysis. To understand behavior of material in fracture and applying various laws of fracture and its numerical analysis. To understand fatigue phenomenon of material and effect of various factor in fatigue and its numerical analysis. Know the plastic bending of material at various conditions. To understand the phenomenon of creep under temperature and multi-axial loading.

Outcomes:

To develop numerical ability of solving critical problems under tri-axial state of stress. Enhance the knowledge and numerical ability of phenomenon of fracture and fatigue at micro level conditions of loading. To able to solve practical problems of creep under low and high temperature. To able to solve practical problems on plastic bending.

Fundamentals of Design Considerations: Principle planes and principle stresses, tri axial state of stresses, Mohr's circle for tri axial stresses and strains, volumetric strain, principle stresses computed from principle strains, principle strains due to perpendicular stresses and shear stresses, strain energy stored due to principle stresses in three directions, shear strain energy due to principle stresses.

Fracture Mechanics: Types, concepts, fracture criterion, strain energy release, fracture mechanics, stress analysis of cracks, stress around cracks, Irwin's approach, crack displacement, crack closure, Griffith theory of brittle fracture, Metallographic aspects of brittle fracture, ductile fracture, Notch effect in fracture, plastic zone correction, crack opening displacement, J – contour integral, R – curves, fracture toughness testing, fracture under combine stresses.

Fatigue of Metals: Fatigue phenomena, statistical nature, structural features, micro mechanisms: initiation and propagation, fatigue changes in different metals, fracture mechanism for fatigue, influential factors, effect of stress concentration, size effect, fatigue dislocation structure, fatigue crack growth, surface effects, corrosion fatigue, effect of mean stress on fatigue under multi-axial cyclic stresses, effect of metallurgical variables and temperature, fatigue of plastic and composites

Plastic Bending: The plastic flow process, shape factor, spring back, plastic bending with strain hardening material, plastic bending of wide plates, plastic hinges, and plastic deflection.

Creep: Creep of material at high temperature, exponential creep law, and hyperbolic sine creep law, true stress and true strain, estimation of time to rupture, creep rupture testing, theories of low temperature and high temperature creep, presentation of creep data, prediction of long time properties, creep during bending, creep under multiaxial stresses, stress relaxation, creep during variable load or temperature, creep fatigue interaction, viscoelasticity, creep behavior of plastics.

Reference Books:

1. Smith Seely, "Advanced Mechanics of Materials", John Willey & Sons Publications.
2. Timoshenko, " Strength of Materials"
3. Kocanda, , " Fatigue Failure of Metal", Sijthoff & Noordhoff International Publications.
4. Frost N. E., "Metals Fatigue", Oxford University Press, London.
5. Benhan & Crawford, "Mechanics of Engineering Materials", John Willey & Sons Pub.
6. Spotts M. F., "Mechanical Design Analysis", PHI Publications, New Delhi.

ME554: MODERN ENGINEERING MATERIALS

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:

(1) Understand and analyze the structure and properties of ferrous and non-ferrous materials and their heat treatment processes.
(2) Analyse the properties and applications of composite material for different applications.
(3) Understand the structure and application of organic materials.

Outcomes:

(1) Analyze and predict the heat treatment process for a particular ferrous and nonferrous material.
(2) Prediction and analysis of composite material for different applications.
(3) To be able to select a material for design and construction.

Ferrous Materials: Mechanical properties, heat treatments and applications; stainless steel and heat resisting steels, precipitation hardenable steels, valve steels, high strength low alloy steel (HSLA), micro alloyed steels, ball bearing steel, tool steels, high nitrogen steels, alloy cast iron.

Nonferrous Materials: Mechanical properties, heat treatments and applications; copper alloys (Brasses and Bronzes), Al –alloys (Al-Mg-Si, Al-Cu, Al-Si), designation system in Al – alloys.

Composites: Classifications, properties, application of composites, polymer matrix materials, metal matrix materials, ceramic matrix materials, carbon materials, glass materials, fiber reinforcements, types of fibers, whiskers, laminar composites, filled composites, particulate reinforced composites

Design of composites materials: Hybrid composites, angle plied composites, mechanism of composites, calculation of properties, unidirectional fiber composites, critical volume fraction, discontinuous fiber composites, rule of mixtures equation, critical angle. Analysis of an Orthotropic Lamina, strengths of orthotropic lamina, analysis of Laminated Composites, stress strain variations in laminates,

Organic Materials: Classification, properties, application of polymers, plastics and elastomers. Ceramics: Classification, properties, structures of refractories, abrasive materials, electronic ceramics, cement and concrete.

Reference Books

1 Jastrezebski Z.D., The nature and properties of engineering Materials, Wiley Newyork.
2 Aver S.H, Introduction to Physical Metallurgy, McGraw Hill,Tokyo.
2 Sharma S.C,Composite Material, Narosa Publishing House,New Delhi.
4 DeGarmo E.P.,Black J.T,Kosher R.A,Materials and processes in Manufacturing,Prentice Hall.
5 Rajput R.K.,Materials Science and Engineering,Kataria and sons.
6 Chawla K.K,Composite Materials,Springer.

ME555: GEOMETRICAL MODELING AND APPLICATIONS

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:

Acquire the knowledge of 2-D, 3-D transformations, projections and drawing of different curves. Enable to generate surfaces using algorithms. Use of algorithms for windowing, clipping, hidden line and surface removal

Outcomes:

Implementation of transformations in drawing projections and curves. Generate codes for surface generation, windowing, clipping, hidden line and surface removal.

Differential Geometry: 2D transformations: basic transformations, matrix representations and homogeneous coordinates, concatenated transformations, general pivot rotation and and scaling, general reflection through arbitrary line. 3D transformations: basic and general transformations, orthographic projections, auxiliary projections and perspective projections.

Curves: Plane curves: Curves representations, parametric and non-parametric representations of circle, ellipse parabola, hyperbola and cones. Space curves: representation of space curves, cubic splines, normalized cubic splines, parabolic bending, begnin curves and B-spline curves.

Surface Description and Generation: Surface revolution, sweep surfaces, quadric surfaces, piecewise surface representation, bilinear surfaces, ruled and developed surfaces, linear coons surfaces, coons bicubic surfaces, bezier surfaces, B-splines surfaces. Algorithms to draw 2-D primitives line and circle drawing algorithms and Bresenham's algorithm.

Windowing and Clipping: Clipping algorithms, two-dimensional clipping, sultherland-cohen subdivision, line clipping algorithm and polygon clipping. 2-D and 3-D viewing, 3-D solid representation, basic modeling, and geometric algorithms, data structures and Boolean set operations

Hidden Line and Surface Removal Algorithms: Hidden Line and Surface Removal Algorithms, light color and shading, animation, virtual reality environment. Orientation of a few CAD packages

Reference Books

1. Faux, Prat, "Computational Geometry for Design and Manufacture".
2. Rogers and Adams, "Mathematical elements for Computer Graphics" McGraw Hill Publications, New
3. Rogers and Adams, "Procedural elements for Computer Graphics", McGraw Hill Publications, New York.
4. Mortenson M. E., "Geometric Modeling", John Wiley and Sons, New York, 1985
5. Hearn, Paulin, "Computer Graphics"
6. Martti Mantylla, "An introduction to Solid Modeling", Computer Science Press.

ME556: SYNTHESIS AND KINEMATICS OF MECHANISMS

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:

(1) To acquire the knowledge of kinematics and dynamics for various mechanisms in mechanical engineering

(2) To study and analysis various methods for synthesis

Outcomes:

(1) Enhancement of knowledge to apply the kinematics and dynamics principles for real mechanisms
(2) Increment in ability to solve various real practical problems.

Kinematics Analysis: Four bar coupler point curves, center of path, curvature of coupler points, Euler savary equations, collineation axis, Bobilier construction method, velocity and acceleration analysis of complex mechanisms by using short-cut methods.

Dynamics of four-bar mechanism: Dynamic analysis for static and inertia forces for a four bar mechanism, center of percussion, dynamically equivalent systems.

Geometrical methods of synthesis of planar mechanisms: Function generation with four-bar linkages, synthesis with three accuracy points and four accuracy points.

Analytical Methods: Displacement equation of a four-bar mechanism, synthesis for function or path generation, synthesis with prescribed velocities and acceleration, synthesis with four accuracy points, structural error curve, re-spacing analysis of mechanical errors in linkages, coupler synthesis.

Synthesis of spatial mechanisms: Matrix methods of analysis, faction generation for symmetric function.

Reference Books

1. Hartenbere R. S., Denauil J., "Kinematics Synthesis of linkages"
2. Kuenzee Beyer, "Kinematics Synthesis of Mechanisms"
3. Bevan Thomas, "Theory of Machines"
4. Shigley J. E., "Theory of Machines"
5. Hirschhorn J., "Kinematics and Dynamics of the plane mechanisms"
6. Hall A. S., "Kinematics and Linkage Design"

ME557: ROBOTICS AND AUTOMATION

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:

To understand robot anatomy and characteristic of different type, dynamic performance of robotic system and its kinematics. To know the different sensors, gripers their selection and dynamic performance analysis. To accustom with robot programming and its use in casting, welding, machining industry. To know the CNC, PLC and DC servo systems and machine interfacing.

Outcomes:

To develop ability of analyzing robot performance, Applying knowledge for sensor and gripper selection, preparing for programming of PLC's for various industrial systems.

Automation and Robotics: Definition, need of the Robotics, market and future prospects, differentiation of Robots from other automation systems, near relations to robots, robot usages and conditions for its application, Robot Anatomy and Characteristics: Classification, point to point and continuous path system, control loops of robot system, work volume, speed of movement, dynamic performance, Accuracy and repeatability, drive system, sensors used in robotics, letter symbol, coding and kinematics arrangement

Sensors and End Effectors in Robotics: Tactile sensors, proximity and rear sensors, force and torque sensors in Robotics, End effectors: Functions, Types, Design of linkage type end effectors, Vacuum gripper, Magnetic gripper, Special gripper, Engelberger's principles in selection and design of grippers

Robot Programming And Application: Robot Language, Development, Feature of different languages and introduction to robot language softwares, Introduction to artificial intelligence, Robot Cell Design: Function, Types, Man-Machine-Robot system, interlocking Methods of robot programming, Lead through programming methods, A robot program for generating a path space motion, Interpolation wait signal and delay commands, Robot Application: Various applications of Robot in foundry and precision casting, welding, spray coating, Manufacturing by Machining, Assembly and inspection.

CNC Systems And Robotics: Various configurations, CPU, PLC'S, Servo control units, speed position feedback, Other peripheral devices, Tool monitoring controls, Softwares, User interface, PLC programming/DC servo motors, Relays and solenoid stepper motor, Introduction and configuration of the CNC system, Interfacing Monitoring diagnostics, Machine Data, Compensations for machine accuracies, Programming direct numerical control.

Machine Interfacing: Interfacing electro mechanical system to microprocessor, PC and PLC's, Basic flow charts and programming for controlling machine tools and process parameters with the above systems, Study of various mechanical elements used in CNC: Robotics system viz-linear bearings, ball screws couplings.

Reference Books

1. Groover M. P., Willis, "Industrial Robotics", McGraw Hill.
2. Aures R. U. and Miller S. M., "Robotics applications and implications", Ballinger Publishing Co., Cambridge
3. Groover M. P. and Zimmer E. W., "Computer Aided Design and Manufacturing", Prentice Hall of India Ltd, New Delhi
4. "Machatronics", HMT Limited, Tata McGraw Hill Publications, New Delhi
5. David G., "Machatronics", Tata McGraw Hill Publications, New Delhi
6. Handbook of Industrial Robotics

ME558: ENGINEERING EXPERIMENTAL TECHNIQUES

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:

To understand the concepts of calibrations, generalized measurement and experimental planning. To analyze the experimental data using various statistical techniques, writing reports. Measurement of parameters like force, torque, motion and vibration. Use of data acquisition system for processing the experimental data.

Outcomes:

Able to design, plan and execute experimental systems for particular engineering problems. Analyze and report performance of experimental systems.

Basic Concepts: Definition of terms, Calibration, Standards, Dimensions and units, the generalized measurement system, Basic concepts in dynamic measurements, system response, distortion, impedance matching, experimental planning.

Analysis of Experimental Data: Causes and types of experimental errors, uncertainty analysis, evaluation of uncertainties for complicated data reduction, Statistical analysis of experimental data, probability distributions, the Gaussian, normal error distribution, probability graph paper, the Chi-square test of Goodness of fit, The method of least squares, the correlation coefficient, standard deviation of the mean, *t*-distribution, Graphical analysis and curve fitting, general considerations in data analysis.

Force Torque and Strain Measurements: Mass balance measurements, elastic elements of force measurements, torque measurement, stress strain measurements, various types of strain gauges,

Motion and Vibration measurement: Simple vibration instruments, principles of the seismic instruments, practical considerations of seismic instruments, sound measurements.

Data Acquisition and Processing: The general data acquisition system, signal conditioning, data transmission, analog to digital and digital to analog conversions, data storage and display, the program as substitute for wired logic.

Reference Books

1. Holman J. P., "Experimental Methods for Engineers", 6th Ed, McGraw Hill Publications, New York.
2. Jain R. K., "Mechanical Measurements", Khanna Publishers, New Delhi.

ME559: INDUSTRIAL TRIBOLOGY

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:-
1. Understand different tribological properties and its behavior.
2. Study and analyze various lubrication methods under different loading conditions.
3. Study different types of lubricants, bearing material and its applications

Outcomes: - Students will be able to
1. Analyze effects of various tribological properties
2. Apply various lubrication methods under different loading conditions

Viscosity and Wear: Definition, Petroff's law, Hagen-Poiseuille law, variation of viscosity with temperature and pressure, viscosity index, effect of pressure on flow through slot. Types of wear, theories of friction and wear, dry friction and boundary friction, effects of bearing metal composition and wear.

Hydrodynamic Lubrication: Generalized Reynold's equation, solution for long-finite and short tapered bearings, flow rate, eccentricity, hydro-dynamic thrust bearings, plain tapered land bearing, Rayleigh's step bearings, behavior of hydro-dynamic bearings under variable loads, squeeze films, thermal equilibrium of sliding system, elasto- hydrodynamic lubrication.

Hydrostatic Lubrication: Pressure distribution in a simple hydrostatic thrust bearing, pumping power and pump capacity, hydrostatic formal bearings, hydrostatic thrust bearing with rotation and compensation.

Gas Lubrication: Merits and de-merits of gas lubrication, aerodynamic and aerostatic journal bearings, solution of Reynold's Equation for gas bearings, load carrying capacity of aerostatic bearings.

Lubricants and Bearing Materials: Types, lubricating oils, composition, additive properties, testing of lubricants and selection of lubricants for various conditions. Desirable properties, white metals, bronzes, silver, aluminum alloys, Teflon, rubber, graphite.

Reference Books

1. Shaw and Mack, " Lubrication and Bearings"
2. Fuller D. D., " Theory of Lubrication"
3. Cameron, " Lubrication"
4. Norton, " Industrial Tribology"
5. A.S.M.E. Handbooks

ME560: LABORATORY – I

Teaching Scheme
Tutorial: 2 hrs/week

Examination Scheme
Term Work – 50 marks

Objectives: Acquiring knowledge of writing codes for solving problems

Outcomes: Enhancing knowledge about writing codes for solving problems

The laboratory work will consist of development of codes for different numerical methods for learning purpose, chosen from those given in the contents of the Advanced Mathematical Methods syllabus.

Further, the lab hours shall be used for coding the algorithms developed for solution of any problem selected by student from the field of Mechanical Design.

ME561: SEMINAR – I

Teaching Scheme
Tutorial: 2 hrs/week

Examination Scheme
Term Work – 25 Marks
Viva voce – 25 marks

Seminar – I should be based on literature survey on any topic, which will lead to dissertation in that area. It will be submitted as a report of about 25 pages of 'A4' size sheets in either comb or hard bound.

The candidate will have to deliver a seminar presentation in front of the examiners, one of them will be guide and other will be the examiner appointed by DSB. The performance of the student will be evaluated by both examiners jointly based on the content of the seminar, delivery of seminar and answers to the queries of the examiners.

ME562 – FINITE ELEMENT ANALYSIS

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:-

1. Understand how and why finite element techniques work.
2. Learn how the finite element method is implemented.
3. Develop finite element formulations of engineering problems from a variety of application areas including structural mechanics, Heat transfer and fluid mechanics.
4. Understand how to use finite element analysis in design.

Outcomes: - Students will be able to

1. Develop finite element formulations of engineering problems and solve them.
2. Compute the Stiffness matrix, displacement transformation matrix.
3. Perform stress and thermal analysis using FEA.

Introduction: Basic concept, Historical background, engineering applications, general description, comparison with other methods, Need for weighted – integral forms, relevant mathematical concepts and formulae, displacement transformation matrix, stiffness matrix, weak formulation of boundary value problems, variational methods, Rayleigh –Ritz method and weighted residual approach

Finite Element Techniques: Model boundary value problem, finite element discretization, element shapes, sizes, and node locations, interpolation functions, shape functions, derivation of element equations, connectivity, boundary conditions, principal of potential energy,

FEM solution, post-processing, Compatibility and completeness requirements, convergence criteria, higher order and isoparametric elements, natural coordinates, Langrange and Hermit Polynomials

Applications to solid and structural mechanics problems: External and internal equilibrium equations, one-dimensional stress-strain relations, plane stress and strain problems, strain displacement relations, boundary conditions compatibility equations, analysis of trusses, frames and solids of revolution, computer programs.

Application to heat transfer problem: Variational approach, Galerkin approach, one-dimensional and two-dimensional steady state problems for conduction, convection and radiation

Application to fluid mechanics problems: In viscid incompressible flow, potential function and stream function formulation, incompressible viscous flow, stream function, velocity-pressure and stream function-vorticity formulation, solution of incompressible and compressible fluid film lubrication problems

Reference Books

1. Reddy J.N., "An Introduction to Finite Element Method", (2005), TMH, New Delhi
2. Seshu P., "Finite Element Analysis", (2006), PHI, New Delhi
3. Introductory Finite Element Method by Chandrakant S Desai, Tribikram Kundu
4. The Finite Element Method: Volume 2 by O C Zienkiewicz, R L Taylor

ME563: MECHANICAL VIBRATIONS AND ANALYSIS

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:-

1. Understand fundamental concepts of different types of vibrations.
2. Learn the behavior and response of various vibration systems.
3. Study and analyze continuous, self excited and non linear vibrations

Outcomes: - Students will be able to

1. Recognize and apply the fundamental concepts of vibrations to real systems
2. Analyze and find the solutions for different practical vibratory systems

Single Degree of Freedom Systems: Undamped vibrations, damped vibrations, forced vibrations. Types of damping, reciprocating and rotating unbalance, spring mass system, torsional vibrations, pendulums, transeverse vibrations

Two Degree of Freedom Systems: Systems with two degree of freedom, determination of natural frequencies, principle modes of vibration, node point systems with rectilinear and angular modes, dynamic and centrifugal pendulum vibration absorbers, response of systems to forced vibrations, viscous and coulomb dampers. Lagrange's equations and applications.

Multi Degree of Freedom Systems: Influence coefficients, well reciprocal theorem, frequencies of free vibrations, modes of vibrations, response to forced vibration, co-ordinate coupling, static and dynamic coupling, principle co-ordinates, orthogonality principle. Application of numerical methods for vibration analysis.

Vibrations Through Continuous Medium: Vibrations of systems having infinite degrees of freedom, vibrations of strings, longitudinal and transverse vibrations of rods and beams, torsional vibrations of shafts having different end conditions.

Self-Excited and Non-linear Vibrations: Criterion for stability, cause of instability, analysis of special cases of self excited vibrations.**:** Free vibrations with non-linear elasticity and damping, relaxation oscillations, sub-harmonic response, phase-plane plots, perturbation techniques, Duffing's equation, jump phenomenon etc.

Reference Books

1. Grover G. K., "Mechanical Vibrations"
2. Pujara Kewal, "Vibration and Noise for Engineering"
3. Tse, Morse, Hinkle, "Mechanical Vibrations"
4. Hartog Den, "Mechanical Vibrations"
5. Church, "Mechanical Vibrations"

ME564: COMPUTER AIDED OPTIMIZATION

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:

(1) Understanding and Analysis of optimisation problems.
(2) Understanding of single variable and multi variable optimisation.
(3) Analysis of problems within the defined limits.
(4) System development and problem solving by using specific algorithms.
(5) Modelling and performance analysis various optimisation methods.

Outcomes:

(1) Comparative analysis of optimisation methods.
(2) Analysis and use of single variable optimisation.
(3) Understanding and Analysis of constrains in optimisation.
(4) Selection and use of reliable optimisation method for problem solving.

Introduction: Optimal problem formulation, engineering optimization problems, optimization algorithms.

Single Variable Optimization Algorithms: Optimality criteria, bracketing methods, region elimination methods, point estimation methods, gradient based methods, root finding using optimization techniques.

Multivariable Optimization Algorithms: Optimality criteria, unidirectional search, direct search methods, gradient based methods, Computer programs on above methods.

Constrained Optimization Algorithms: Kuhn-Tucker conditions, transformation methods, sensitivity analysis, direct search for constrained minimization, linearised search techniques, feasible direction method, generalized reduced gradient method, gradient projection method, Computer programs on above methods.

Special Optimization Algorithms: Integer programming, Geometric programming, Genetic Algorithms, Simulated annealing, global optimization, Computer programs on above methods.

Optimization in Operations Research: Linear programming problem, simplex method, artificial variable techniques, dual phase method, sensitivity analysis

Reference Books

1. Deb Kalyanmoy, " Optimization in Engineering Design", PHI, New Delhi
2. Rao S. S. "Engineering Optimization", John Wiley, New Delhi.

3. Deb Kalyanmoy, " Multi-objective Algorithms using Evolutionary Algorithms", John Wiley, New Delhi.
4. Paplambros P. Y. and Wilde D. J., "Principles of Optimum Design: Modeling and Computation", Cambridge University Press, UK
5. Chandrupatla, "Optimization in Design", PHI, New Delhi.

ME565: MACHINE TOOL DESIGN

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:

Understand fundamental concepts machine tool drives, hydraulic transmission systems of machine tools, identify the forces in various machining operations, Carry out force Analysis professionally, Recognize and understand the standard speed and feed box design procedures for different machine tools. To acquire a skill to design and develop machine tool structure spindles and guide ways, CNC and DNC with practicing various analytical problems

Outcomes:

Recognize and apply the fundamental concepts of transmission system, Apply the knowledge of forces in machining to develop machine tool force diagrams, and improve analytical ability in professional practice in designing speed and feed boxes for various machine tools, Identify, Formulate Engineering problems in Machine tool Design, Enhance and develop professional skill of designing machine tool structures, spindles, guide ways of Universal, CNC and DNC machines

Machine Tool Drives and Mechanism: Machine tool drives, Hydraulic transmission, mechanical transmission, different types of driving mechanisms used in machine tools, requirements of machine tool design, force analysis in cutting in turning drilling and milling.

Regulation of Speed and Feed Rates in Machine Tools: Speed and feed rates regulation, design of speed box, design of feed box, Machine tool drives in multiple speed motors, special cases, gearing diagram, determination of number of tooth.

Design of Machine Tool Structures and Guide ways: Design criteria for machine tool structures, Static and Dynamic stiffness, Design procedure for design of bed, column, housing, bases and tables, Modern techniques in design of structures.

Design of Guide ways, Power screws and Spindles: Design of slide ways, design of aerostatic slide ways, combination guide ways, protecting devices of slide ways, design of power screws, design calculations of spindles. Antifriction bearings and sliding bearings, stability of machine tools, forced vibrations of machine tools

Machine Tool Control and Advance Design: Control systems for changing speed and feeds, automatic control of CNC machines, numerical control systems, design of NC and CNC machine tools

Reference Books

1. Basu S. K., "Design of Machine Tools", Allied Publishers
2. Acharkan, "Metal Cutting Machine Tools", Technical Publishing House
3. Bhattacharya A., Sen G. C., "Principles of Machine Tools",
4. Mehta N. K., "Machine Tool Design", Tata McGraw Hill
5. "Vibrations of Machine Tools", Machinery Publishing Co. Ltd., London
6. "Numerical Control", John Wiley, London

ME566: SIMULATION AND MATHEMATICAL MODELING

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:

To gain knowledge of system development and simulation procedure, use of statistical model in simulation, and random number generation. To select input model and Validation by simulation. Carry out output analysis for a single model

Outcomes:

To interpret the system environment and components, concepts of discrete simulation models. Illustrate the behavior of different simulation models, elaborate the characteristics and properties of random numbers using different techniques. Execution of input models with verification and validation by use of simulation. To do output analysis of single model

Introduction to Simulation: System and system environment, Components of the system, Type of systems, type of models, steps in simulation, study advantages and disadvantages of simulation, concept of discrete simulation, time-advance mechanisms, components and organization of a discrete-event simulation model.

Statistical models in simulation: Useful statistical models, discrete distribution, continuous distribution, Poisson process, empirical distribution.

Queuing Models: Characteristics of queuing systems, queuing notations, long run measures, of performance of queuing systems, steady state behaviour finite population model.

Random number generation: properties of random numbers, generation of pseudo random numbers, techniques for random numbers generation, tests for random numbers.

Random variate generation: Inverse transform techniques, convolution method, acceptance rejection techniques.

Input Modeling: Data collection, identifying the distribution of data, parameter estimation, goodness of fit tests, selection of input model without data, multivariate and time series input model.

Verification and Validation of Simulation Model: length of simulation runs, validation.

Output Analysis for a Single Model: Types of simulations with respect to output analysis, stochastic nature of output data, measure of performance and their estimation, output analysis of terminating simulators, output analysis for steady state simulation. Case studies in simulation, orientation of simulation software such as GPSS

Reference Books

1. Law A. W., Kelton D., "Simulation Modeling and Analysis", Tata McGraw Hill, 2003
2. Gordon Geoffrey, "System Simulation", 2nd Ed. PHI, New Delhi, 1990
3. Deo Narsingh, "System Simulation with Digital Computers", PHI, New Delhi, 1989
4. Zeigler B., Prachofer H., Kim T. G., "Theory of Modeling and Simulation", Academic Press
5. Body Donald W., "System Analysis and Modeling", Academic Press Harcourt India
6. Banks Jerry, Carson John, Nelson Barry, Nicole David, "Discrete Event System Simulation"
7. Kelton W. D. Sadowski R., Sadowski D., "Simulation with Arena", McGraw Hill Publications

ME567: ENGINEERING ECONOMICS

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:

To built up the knowledge of managerial economics and analysis of project considering economical concepts. Expertise in costing, finance and accounting related to the organization. Able to do corporate planning

Outcomes:

Implement the knowledge of managerial economics, costing, finance and cost accounting through analyzing engineering problems and economic analysis of projects.

Managerial Economics: The principle and use of economic analysis in engineering practice. Discounted cash flow analysis, corporate tax and investment, Depreciation and economic studies, replacement analysis, valuation of assets.

Economic analysis of projects, analysis of risks and uncertainty, elements of demand analysis and forecasting, theory of firm as owner and and a producer, economics of scale, market model, production function, output and pricing decisions, long run and short sun cost curves

Costing and Finance: Review of double entry book keeping, preparation of ledger accounts, trial balance profit and loss account, balance sheet, income and expenditure account, fund flow analysis, analysis and interpretation of final accounts, ration analysis and inter firm comparison,

Cost account: Material and human resource accounting, overhead, fixed and variable costs, marginal costing, process costs, cost estimation and cost control,

Corporate Finance: Cost of capital and sources of funds, working capital management, budgeting and budgetary control

Corporate Planning: Corporate objectives, goals and policies, process of corporate planning, SWOT analysis, GAP analysis, strategy formulation, investment evaluation, capital budgeting, risk analysis, industrial dynamics.

Reference Books

1. Owler W., Brown J. L., "Cost Accounting and Cost Methods", 14th Ed., McDonald and Evans Publications
2. Kuchal S. C., Financial Management - An Analytical and Conceptual Approach", 10th Ed., Chaitanya Publishing House
3. Shukla M. S. and Grewal T. S., "Advance Accounts", S. Chand and Co., New Delhi
4. Theusan and Theusan, "Engineering Economics", 5th Ed., PHI, New Delhi
5. Dean Joel, "Managerial Economics", PHI, New Delhi
6. Hussey D. D., "Introducing Corporate Planning", Pergamon Press, New York, 1982

ME568: ADVANCE MACHINE DESIGN

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:

Understand the concept of optimization like PDE, SDE and LE in respect of tensile bar, torsional bar, beam etc. Carry out design analysis of Belleville spring, torsional bar and rectangular spring in axial and fatigue loading, work out analysis of advance cam profile and dynamics of high speed cam and stress and strain analysis of flat plate, isotropic elastic plate with and without aperture. Understand the concept of advanced machine design, QFD, functional approach, problem formulation etc.

Outcomes:

Apply the fundamental concept of optimization and carry out the optimum design of tensile bar, torsional bar etc. Analyze and design and formulate engineering problems on Belleville, torsional and square spring, torsional spring, advance cam curve, cam profile, polydyne, dynamic cam. Design and analyze flat plates at different temperature and different types of supports and loading

Optimum Design of Mechanical Elements: Statistical consideration for factor of safety, relationship between actual load and load capability, selection of factor of safety based on percentage estimates for tolerances on actual load and load capability and where the occurrence of the failure phenomenon would be disastrous.

Optimum design for mechanical elements by considering adequate design, optimum design, P.D.E., S.D.E., limit equations, principles of optimum design with normal specifications, redundant specifications, incompatible specifications, optimum design of tensile bar, torsion shaft, beams, step shafts and with combined loading.

Mechanical Springs: Design of square or rectangular bar helical springs, Belleville springs, ring springs, torsion bar springs, theory of square or rectangular bar helical springs under axial loading, cone or flat disc spring theory.

Cams: Basic curves, cam size determination, calculating cam profiles, advance curves, polydyne cams, dynamics of high speed cam systems, surface materials, stresses and accuracy, ramps.

Flat plate: Stress resultants in a flat plate, kinematics strain- displacement, relations for plates, equilibrium equation for small displacement, theory of plates, stress-strain temperature relations for isotropic elastic plates, strain energy of a plate, boundary conditions for plates, Circular plates with hole and without hole with different types of support and loading

Advances in machine design: Defining design, creativity, invention and innovation, design methodology, patterns of evaluation, design patents, functional approach, performance specifications, Quality Function Deployment, improvement of ideality, design strategy, problem definition, objective, top down and bottom up approaches, system, problem formulation, substance field analysis, morphological analysis, creative problem solving, inventive principle, evaluation of ideas or concepts, product design specifications, selection of best design,

Reference Books

1. Johnson R.C., "Optimum Design of mechanical elements"
2. Wahl A.M., "Mechanical springs"
3. Rothbart John, "Cams", Wiley & sons.
4. Sidebottom Borosi, "Advance mechanics of materials", John Wiley & sons.
5. Hirani H., "Advances in Machine design", IIT Bombay, Mumbai

ME569: DESIGN AND ANALYSIS OF EXPERIMENTS

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:

Able to understand the fundamental concepts and principles of designing of experiments, sampling and sample selection as per DOE methods, carry out analysis of variance for single factor. Recognize and perform statistical analysis by using different methods. Acquire a skill of second and third factorial design by fitting response curve and surfaces at two and mixed level, analyze and form mathematical model by using DOE technique.

Outcomes:

Recognize and apply DOE guidelines for sampling, sample distribution etc. Apply the knowledge of analysis of variance, factorial design of second and third level parameters for building mathematical model. Enhance and develop professional skill and mixed level for experimental analysis

Introduction: Applications of experimental design, basic principles and guidelines for designing experiments, simple comparative experiments, sampling and sampling distribution, inferences about the differences, in means, randomized designs, paired comparison designs, variances of normal distribution.

Experiments with single factor: The Analysis of Variance, analysis of Fixed Effects Model, model adequacy checking, practical interpretation of results, determining sample size, regression approach to analysis of variance.

Randomized Blocks, Latin Squares, and related designs: The randomized complete block design, statistical analysis of the RCBD, the Latin square design, the Graeco-Latin square design, balanced incomplete block design.

Factorial Designs: the advantages of factorial designs, 2^k and 3^k factorial design, model accuracy checking, estimating the model parameters, fitting response curves and surfaces, blocking in factorial design, blocking and compounding in the 2^k and 3^k factorial design, two level fractional factorial design, factorials with mixed levels.

Fitting Regression Models: Linear regression models, estimation of parameters in LRM, hypothesis testing and confidence intervals in multiple regressions, regression model diagnostics, testing for lack of fit.

Taguchi Method: Taguchi method as a new approach to DOE, application procedures, analysis and areas of application.

Reference Books

1. Montgomery D. C., "Design and Analysis of Experiments", 5th Ed, John Wiley, Publications, New York.
2. Roy R. K., "Design of Experiments Using Taguchi Approach", John Wiley, Publications, New York.
3. Kothari C. R., "Research Methodology", Wishwa Prakashan, New Delhi

ME570: MATERIAL HANDLING EQUIPMENT DESIGN

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teacher's Assessment – 20 marks
End Sem Exam – 60 marks

Objectives:

Understand functions, characteristics and applications of different material handing systems. Carry out kinematic and dynamic analysis of cranes, elevators and conveyors

Outcomes:

Implement the knowledge of material handling systems in industries. Analyze the kinematic and dynamics of cranes, elevators and conveyors

Introduction: Objectives of material handling systems and the basic principles, classification and selection of material handling equipment, Characteristics and applications

Description of various material handling equipments, functions and parameters, effecting service, packaging and storage of materials and their relations with material handling

Theory construction of various components, parts of mechanical handling devices, wire ropes, chains, hooks, shackles, grabs, ladles and lifting electromagnets, pulleys, sheaves, shears, sprockets, and drums, winches, brakes and ratchet stops, gears and power transmission systems, runner wheels and rails, buffers and controls of travel mechanisms

Kinematic and dynamic analysis of various types of cranes and elevators, stability and structural analysis, discussion of principles and applications of conveyors and related equipments

Design of various types of conveyors and their elements, fault finding and failure analysis of material handling systems, system design and economics

Reference Books

1. Rudenko N., "Materials Handling Equipments", Peace Publishers, Moscow
2. Spivakowsky and Dyachke V., "Conveyors and Related Equipments", Peace Publishers, Moscow
3. Immer R. John, "Materials Handling", McGraw Hill, 1953

ME571: LABORATORY – II

Teaching Scheme
Tutorial: 2 hrs/week

Examination Scheme
Term Work – 50 marks

Objectives: Acquiring knowledge of report writing

Outcomes: Enhancing knowledge about writing reports

The laboratory work will consists of assignment on report writing, various norms to be followed for report writing, paper writing and presentations.

The use of report writing software shall be followed for writing reports.

ME572: SEMINAR – II

Teaching Scheme
Tutorial: 2 hrs/week

Examination Scheme
Term Work – 25 Marks
Viva voce – 25 marks

Seminar – II should be based on literature survey on any topic preferably in continuation with the Seminar – I. It will be submitted as a report of about 25 pages of 'A4' size sheets in either comb or hard bound.

The candidate will have to deliver a seminar presentation in front of the examiners, one of them will be guide and other will be the examiner appointed by DSB. The performance of the student will be evaluated by both examiners jointly based on the content of the seminar, delivery of seminar and answers to the queries of the examiners.

GE611: RESEARCH METHODOLOGY

Teaching Scheme:
Theory: 4 hours/week

Examination Scheme:
Class Test: 20 Marks
Teacher's Assessment: 20 Marks
End Sem Exam: 60 Marks

Objectives:

The objective of this course is to expose the post graduate students to basic methodologies and techniques of carrying out research work which will be helpful for Dissertation work.

Outcomes:

Selection of research problem, formulation, analysis and report writing of work undertaken

Unit-I

Objectives of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Defining the Research Problem, Selecting the Problem, Technique Involved in Defining a Problem, Research Design, Important Concepts Relating to Research Design, Developing a Research Plan, Literature review.

Unit-II

Basic Concepts of Probability, Probability Axioms, Measures of Central Tendency, Measures of Dispersions, Measures of Symmetry, Measures of Peakedness. Regression Analysis – Simple Linear Regression, Multiple linear Regression, Correlation. Tests of Hypothesis and Goodness of Fit: Definition of null and alternative hypothesis, students't' distribution: properties, application with example. Chi-square distribution: definition, constants of Chi-square distribution. Application with example. F-test: example of application.

Unit-III

Optimization Techniques: Linear Programming, Simplex Method, Dual Simplex, Sensitivity Analysis. Artificial Variable Technique, Dynamic Programming, Introductory concepts of non-linear programming.

Or

Unit-III

Modeling and simulation:

Introduction to modeling: Concept of system, continuous and discrete systems.
Experimental Methods:
Importance of experimental analysis, guidelines for designing experiments, uncertainty and error analysis, concept of uncertainty, propagation of uncertainty, planning experiments from uncertainty analysis.

Unit-IV

Fuzzy logic: Introduction, Concepts, Basic Fuzzy Mathematical Operations, Fuzzy databases, Membership Functions, Fuzzy Linear Programming, Neural Networks: Artificial Neural Networks, architectures and algorithms, Basic neuron models, Neural network models, Learning algorithms, Genetic Algorithms: Introduction to genetic algorithm, Operators, Applications.

Unit-V

Interpretation and Report Writing: Meaning of Interpretation, Techniques of Interpretation, Significance of Report Writing, Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Writing a technical paper, plagiarism and its implications.

References:

1. S.P.Gupta, " Statistical Methods", S. Chand & Sons.
2. Kothari C.R.(2011), " Research Methodology-Methods and Techniques", New Age International Publishers, New Delhi.
3. Gupta S.L. and Gupta Hitesh (2011), "Research Methodology-Text and cases with SPSS applications" International Book House Pvt. Ltd., New Delhi.
4. Rao V and H. Rao, (1996), "C^{++}, Neural Networks and Fuzzy Logic", BPB Publications, New Delhi.
5. Goldberg, D.E. (2000), "Genetic Algorithms in Search, Optimization & Machine Learning", Addison Wesley Longman (Singapore) Pte. Ltd., Indian Branch, Delhi.
6. George J. Klir and Bo Yuan (2010), "Fuzzy Sets and Fuzzy Logic", PHI Learning Pvt. Ltd, New Delhi

ME611: DISSERTATION PART-I

Teaching Scheme
Tutorial: 20 hrs/week

Examination Scheme
Term Work – 50 marks
Practical – 50 Marks

The dissertation shall consist of a report on any research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a design and / or development work that the candidate has executed. The dissertation will consist of two parts as dissertation part- I and dissertation II

Term work

The dissertation part I will be in the form of seminar report on the dissertation work being carried out by the candidate and will be assessed by two examiners appointed by the DSB, one of whom will be the guide and other will be a senior faculty member from the department.

Practical /Oral

The oral examination will be based on presentation on the dissertation work being carried out by the candidate and will be assessed by two examiners appointed by the DSB, one of whom will be the guide and other will be a senior faculty member from the department.

GE 612: ENVIRONMENTAL STUDIES

Unit 1: The multidisciplinary nature of environmental studies

Definition, scope and importance, Need for public awareness.

Unit 2: Natural Resources

Renewable and non renewable resources:

a) Natural Resources and associated problems
   - Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, Dams and their effects on forests and tribal people.
   - Water resources: Use and over utilization of surface and water, floods, drought, and conflicts over water, dam's benefits and problems.
   - Food Resources: World food problems, changes caused by agriculture and over grazing, effects of modern agricultures, fertilizers-pesticides problems, water logging, salinity, case studies.
   - Energy Resources: Growing energy needs, renewable energy sources, use of alternate energy sources, case studies.
   - Land Resources: land as resources, land degradation, man induces landslides, soil erosion, and desertification.

b) Role of individuals in conservations of natural resources.

c) Equitable use of resources for sustainable life styles.

Unit 3: Eco systems

- Concepts of an Eco systems
- Structure and function of Eco systems
- Procedure, consumers, decomposers.
- Energy flow in the Eco systems
- Ecological suggestions
- Food chain, food webs and ecological pyramids
- Introduction, types, characteristics features, structure and function of the following eco systems
- Forest eco systems
- Grass land eco systems
- Desert eco systems
- Aquatic eco systems(ponds, streams, lake, rivers, oceans, estuaries)

Unit4: Biodiversity and its conservation

- Introduction**-** Definition: genetics, species and eco systems diversity
- Biogeographically classification of India
- Value of biodiversity: Consumptive use, productive use, social, ethical,ascetics and option values
- Biodiversity at global, national and local level.
- India as a mega diversity nation.
- Hot-spots of Biodiversity
- Threats to Biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts
- Endangered and endemic spaces of India
- Conservation of Biodiversity: in-situ and ex-situ conservation of Biodiversity

Unit 5: Environmental Pollution

Definition Causes, effects and control measures of:

a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear Hazards

Solid waste management: Causes, effects and control measures of urban and industrials wastes

Role of an individual in prevention of pollution

Pollution case studies
Disaster management: Floods, earthquake, cyclone and land slides

Unit6: Social issues and the environment

- Form unsustainable to sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, water shed management
- Resettlement and rehabilitation of people; its problems and concerns, case studies
- Environmental ethics: issues and possible solutions
- Climate change, global warming, acid rain,ozone layer depletion, nuclear accidents and holocaust, case studies
- Waste land reclamation
- Consumerism and waste products
- Environment protection act
- Air (prevention and control of pollution) act
- Water (prevention and control of pollution) act
- Wild life protection act
- Forest conservation act
- Issues involved in enforcement of environmental legislations
- Public awareness

Unit 7: Human population and the environment

- Population growth and variation among nations
- Population explosion – family welfare program
- Environment and human health
- Human rights
- Value education
- HIV/AIDS
- Women and child welfare
- Role of information technology in environment and human health
- Case studies

Unit 8: Field work

Visit to a local area to document environment Assets River / forest / grassland / hill / mountain. Visit to a local polluted site – urban / rural / industrial / agricultural. Study of common plants, insects, birds. Study of simple ecosystems – pond, river, hills lopes, etc. (field work equal to 5 lecture works)

Recommended Books:

1. Textbook of Environmental studies, Erachbharucha, UGC
2. Fundamental concepts in Environmental Studies, D D Mishra, S Chand & Co. Ltd.

ME612: DISSERTATION PART – II

Teaching Scheme
Tutorial: 24 hrs/week

Examination Scheme
Term Work – 50 marks
Viva voce – 150 marks

The dissertation part – II will be in continuation of dissertation part – I and shall consist of a report on the research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a design and / or development work that the candidate has executed. The examinee shall submit the dissertation in triplicate to the head of the institution duly certified by the guide and the concerned head of department and the principal that the work has been satisfactorily completed.

Term work

The dissertation will be assessed by two internal examiners appointed by the DSB, one of whom will be the guide and other will be a senior faculty member from the department.

Viva voce

It shall consists of a defense presented by the examinee on his work in the presence of examiners appointed by the DSB, one of whom will be the guide and other will be an external examiner.