DE-501 (PCC)  
STRESS ANALYSIS  Revised in 2011

Teaching Scheme

Lectures: 3 hrs/week

Examination Scheme

Mid-Sem – 30, Assignments/Quiz - 20

End Sem exam – 50 marks

Prerequisites:
1. Strength of Materials
2. Matrix Algebra
3. Differential Equations and Calculus

Outcomes:
1. Students will have an understanding of the concept of continuum in solids and tensor.
2. Student will understand the concepts of strain, compatibility, laws of conservation and constitutive relations.
3. Students will learn linear elasticity and will be able to solve two dimensional problems in torsion, bending by energy method.
4. Students will understand concept of plasticity and design of thick cylinders, disks

Topics:
Unit 1: Continuum & Tensors, Stress tensor,
Unit 2: Displacement and strains, compatibility,
Unit 3: Conservation Laws, Constitutive relations and Linear Elasticity,
Unit 4: Two dimensional problems, Torsion, Bending, Energy methods,
Unit 5: Plasticity in structures,
Unit 6: Thick cylinders and Disks, Contact stresses

Reference Books:
Sadd, Martin H., Elasticity: Theory applications and Nemerics, Academic Press 2005 (Text Book)
TEACHING SCHEME

Lectures: 3 hrs/week

EXAMINATION SCHEME

Mid-Sem – 30, Assignments/Quiz- 20
End Sem exam – 50 marks

Prerequisites:
1. Matrix Algebra
2. Basic Knowledge of Strength of Materials for FEM part

Outcomes: At the end of the course students will
1. Have a conceptual understanding of the principles of CAD systems, the implementation of these principles, and its connections to CAM and CAE systems.
2. understand 2D, 3D transformations and projection transformations
3. get knowledge of various approaches of geometric modeling
4. understand mathematical representation of 2D and 3D entities
5. understand basic fundamentals of FEM

Topics:
CAD Hardware and Software, Types of systems and system considerations, input and output devices, hardware integration and networking, hardware trends, Software modules, Computer Communications, Principle of networking, classification networks, network wiring, methods, transmission media and interfaces, network operating systems, Computer Graphics Introduction, transformation of geometric models: translation, scaling, reflection, rotation, homogeneous representation, concatenated transformations; mappings of geometric models, translational mapping rotational mapping, general mapping, mappings as changes of coordinate system; inverse transformations and mapping; projections of geometric models, orthographic projections, Geometric Modeling, curve representation: Parametric representation of analytic curves, parametric representation of synthetic curves, curve manipulations. Surface representation, Fundamentals of solid modeling, boundary representation (B-rep), Constructive Solid Geometry (CSF), sweep representation, Analytic Solid Modeling (ASM), other representations; solid manipulations, solid modeling based applications: mass properties calculations, mechanical tolerancing, etc. Finite Element Modeling and Analysis, Finite Element Analysis, finite element modeling, mesh generation mesh requirements, semiautomatic methods, fully automatic methods, design and engineering applications, System Simulation, Need of simulation, areas of applications, when simulation is appropriate tool / not appropriate, concept of a system, components of a system, discrete and continuous systems, model of a system, types of models, types of simulation approaches
References Books
1. Ibrahbim Zeid, “CAD / CAM Theory and Practice”.

DE-503
(PCC)  ADVANCED VIBRATION AND  ACOUSTIC

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
Mid-Sem – 30, Assignments/Quiz- 20
End Sem exam – 50 marks

Prerequisites:
1. Basic Knowledge of Vibrations (Dynamics of Machinery)
2. Matrix Algebra
3. Differential Equations and Calculus

Outcomes:
1. The students will be able to model a given vibratory system as SDOF or MDOF system, with or without damping. He would also identify the type of given base or force excitation as periodic or aperiodic. He would be able to write, mathematically, the excitations of the types such as impulse, step, ramp, half sinusoidal, or such simple arbitrary excitations.
2. The student will be able to predict response of a SDOF system, damped or undamped, subjected to simple arbitrary base or force excitations mentioned above using convolution integral; They will be able to obtain Shock Response Spectrum of SDOF systems for such excitations and understand use of the SRS.
3. The students will be able to write differential equations of motion for MDOF systems, and through the technique of decoupling and orthogonal properties of natural modes, should be able to obtain the eigen-values and mode shapes of natural vibrations and response to harmonic and arbitrary excitations.
4. The students will be able to obtain the eigen-values and mode shapes of natural vibrations and response to harmonic excitations using orthogonal properties of natural modes.
5. Student will be able to obtain natural frequencies and mode shapes of MDOF and continuous systems using computational methods such as Rayleigh-Ritz method, Holzer method, Dunckerley's method, and Stodola's method.
6. The student should be able to obtain natural frequencies and mode shapes of MDOF and continuous systems and their response to harmonic excitation using MATLAB.
7. Student will know various terminologies used in acoustics and acoustic wave transmission.
8. The student will able to derive plane and spherical wave equations, and will be able to obtain sound pressure level at a given distance from a simple sound source of known strength.
9. Students will be able to understand the mechanism of hearing by human and principles of Psychoacoustics and noise control.
10. The student will be able to measure and analyze signals received from vibrating and/or noise radiating structure by use of accelerometers, microphones and signal analyzer. They should be able to carry out FFT analysis and know the dominant frequency components in the signal and their correlation with the vibration of the structure. They should be able to identify correlation between two signals being received from two sources.

**Topics:**
Transient Vibrations, Response of a single degree of freedom system to step and any arbitrary excitation, convolution (Duhamel’s) integral, impulse response function, Multi degree of freedom systems, Free, damped and forced vibrations of two degree of freedom systems, Eigen values and Eigen vectors, normal modes and their properties, mode summation method, use of Lagrange’s equations to derive the equations of motion, Continuous Systems, Vibrations of strings, bars, shafts and beams, discretised models of continuous systems and their solutions using Rayleigh – Ritz and Galerkin’s methods, use of Lagrange’s equation. Mode summation method, Vibration Control, Methods of vibration control, Non-linear vibrations, Systems with non-linear elastic properties, principle of superposition, Numerical and computer methods in vibrations: Rayleigh, Rayleigh-Ritz and Dunkerley’s methods, matrix iteration method for eigen-value calculations, Holzer’s method, introduction to finite element method for vibration analysis, Self excited vibrations, Introduction to Random Vibrations, Vibrations of strings and bars, Circular membranes and plates, Vibrations of a plane surface, Plane and Spherical acoustic waves, Transmission Phenomena, transmission from one fluid medium to another, normal incidence, reflection at the surface of a solid, standing wave patterns, transmission through three media, Resonators and filters, Absorption of sound waves in fluids : Phase log between pressure and condensation, viscous absorption of plane waves, heat conduction as a source of acoustic attenuation, Loudspeakers and Microphones, Ultrasonic and Sonar transducers, Speech, Hearing and Noise, The voice mechanism, acoustic power output of a speech, anatomy of the year, mechanism of hearing, thresholds of the ear, loudness, pitch and timbre, beats, aural harmonics and combination tones, masking by pure tones, masking by noise, binaural localization.
Reference Books:


DE-513
(PSEC) ADVANCED MACHINE DESIGN Revised in 2011

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
Mid-Sem – 30, Assignments/Quiz- 20
End Sem exam – 50 marks

Prerequisites:
1. Machine Design
2. Differential Equations
3. Industrial Engineering and Management
4. Quality Control
Outcomes:

1. Students will understand the importance of creativity in Design while designing / modifying existing design of a product in the highly competitive, dynamic and customer centered market.

2. Students will be able to generate different ideas after identifying the need and determining the specifications and constraints of a product for a particular purpose.

3. Students will know various methods of rapid prototyping the products to test and modify the designs.

4. Students will know how to incorporate the reliability, quality and maintainability aspect in design.

5. Students will understand the importance of benchmarking and value engineering in design.

Topics:

Unit 1: Development processes and organizations, Product Planning
Unit 2: Need Identification and problem definition, product specification, concept generation and selection, evaluation, creativity methods, Concept testing
Unit 3: Design for manufacture and assembly and maintenance, design for casting, forging and welding, robust design, Prototyping.
Unit 4: Reliability, strength based reliability, parallel and series systems
Unit 5: Industrial design: Design for Emotion and experience, Introduction to retrofit and Eco design, Human behavior in design
Unit 6: Design to Indian Standard

Reference Books:

6. Product Design and development Karl T. Ulrich, Steven Eppinger
IS-501 (OEC)  

Advanced Mathematics

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
Mid-Sem – 30, Assignments/Quiz- 20
End Sem exam – 50 marks

Prerequisites:

1. Numerical Methods
2. Basics of Optimization and Simplex Method for multi-variable optimization
3. Basics of Reliability

Outcomes:

At the end of the course students will understand
1. the basic optimization techniques
2. importance of reliability theory
3. numerical methods used to solve ordinary and partial differential equations which will help them to solve many application problems in engineering, especially those which involve experimental data
4. use of statistical quality control in engineering

Topics:

Numerical Methods for Differential Equations

Numerical solutions to the ordinary differential equations of first and second order with intial and boundary conditions, Picard’s Method, Taylor’s Method, Euler’s Method, modified Euler’s Method, Milne’s Method and Runge-Kutta Method

Numerical solutions to the partial differential equations: Finite difference equivalence to partial derivatives, elliptical, parabolic and hyperbolic equations, applications to one dimensional and two dimensional equations, Schmidt and Crank-Nicholson’s Method.
Optimization Techniques:

Introduction, Statement of optimization problem, Engineering Applications, classification of optimization, Single variable and Multivariable of Optimization with no constraints, Multivariable of Optimization with Equality constraints, Multivariable of Optimization with Inequality constraints

Linear Programming Problems:

Introduction and formulation of the problem, graphical method, simplex method, duality concept in LPP and solution of the dual.

Statistical Quality Control: Introduction, control charts of all types, ISO 9000 series and their importance, OC curves advantages and limitations of SQL in industries.

Reliability Theory:

Theory of reliability, maintainability, availability, failure distribution, MTTF, MTBF, Hazard rate, Bath tub curve, state dependent systems, series and parallel connections, redundancy of systems

Reference Books:

1. Numerical Methods – S. S. Sastry
2. Statistical methods- S. P. Gupta
3. Reliability and Maintainability Engineering-Charles Ebeling
4. Operations Research- S. D. Sharma
DE 509  SEMINAR  Course category: LC
Teaching: 1hr/week  Assessment: End Sem 100

Seminar shall consists of the in depth study of a topic, should be related to the field of Design engineering and should have research orientation. The student should know recent developments and applications in the chosen field of study. The study/research is mutually decided by the student and the supervisor and the preparation of report. The topic to be presented in front of the committee of examiners, faculty and students of the department. The committee of examiners to be decided by the PG coordinator and the Head of the department of Mechanical engineering.

DE511  Lab Practise I  Course category: LC
Teaching: 2hrs/week  Assessment: 60

The lab practice consists of experiments, tutorials and assignments decided by the course supervisors of the program core courses and program specific elective courses.
IS-502 (OEC)

FINITE ELEMENT AND BOUNDARY ELEMENT METHODS

Teaching Scheme

Lectures: 3 hrs/week

Examination Scheme

Mid-Sem – 30, Assignments/Quiz- 20

End Sem exam – 50 marks

Prerequisites:

1. Matrix Algebra
2. Differential Equations and Calculus
3. Strength of Materials and Material Properties
4. Fluid Mechanics
5. Heat Transfer

Outcomes:

For one and two dimensional, linear, static and dynamic problems in Structural Mechanics and Heat Transfer, the student will be able to demonstrate the learning outcomes as mentioned below:

1. The student will be able to classify a given problem on the basis of its dimensionality as 1-D, 2-D, or 3-D, time-dependence as Static or Dynamic, Linear or Non-linear.

2. The students will be able to develop system level matrix equations from a given mathematical model of a problem following the Galerkin weighted residual method or principle of stationary potential.

3. While demonstrating the process mentioned in 2 above, he will be able to identify the primary and secondary variables of the problem and choose correct nodal degrees of freedom and develop suitable shape functions for an element, implement Gauss-Legendre scheme of numerical integration to evaluate integrals at element level, and assemble the element level equations to get the system level matrix equations. He will also be able to substitute the essential boundary conditions correctly and obtain the solution to system level matrix equations to get the values of the field variable at the global nodes.

4. The student will be able to state three sources of errors in implementing FEM and suggest remedies to minimize the same for a given problem, viz. Modeling errors, Approximation errors, and numerical errors.

5. The student will be able to obtain consistent and lumped mass matrices for axial vibration of bars and transverse vibration of beams and obtain fundamental frequency of natural vibration using the methods mentioned in the curricula.

6. The students will be able use MATLAB for implementation of FEM to obtain elongations at nodes of a bar subjected to traction and concentrated loads and prescribed boundary conditions.
7. The students will be able use ANSYS or ABAQUS for implementation of FEM to obtain stress concentration due to a small hole in a rectangular plate subjected to traction on edges and concentrated loads at points on the edges and prescribed boundary conditions

**Topics:**

Introduction, steps in finite element method, discretisation, types of elements used, Shape of functions, Linear Elements, Local and Global coordinates, Nodal degrees of freedom, Finite element formulation, variational, weighted residual and virtual work methods, Field problems, irrotational flow, conduction heat transfer, electromagnetic and electrostatic fields, Quasi harmonic equation, Axisymmetric field problems, computer implementation, higher order elements, isoparametric version, Application to non-linear problems, solution to Nervier Strokes equations, phase change, radiation, temperature dependant materials, stress analysis in simple cases, axisymmetric solids, stress concentration factors, Boundary element approach, numerical implementation, analyzing time domain, boundary element formulation, discretisation and matrix formulation, adaptive mesh refinement.

**References Books :**


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**DE-502 (PCC) ANALYSIS AND SYNTHESIS OF MECHANISMS**

**Teaching Scheme**

Lectures: 3 hrs/week

**Examination Scheme**

Mid-Sem – 30, Assignments/Quiz- 20

End Sem exam – 50 marks

**Prerequisites:**

1. Theory of Machines
2. Vector Algebra
3. Derivatives

Outcomes:

1. Develop an understanding of basic motion analysis and synthesis application concepts.
2. Demonstrate proficiency in kinematics and kinetics, as well as vector mathematics.
3. Identify Degrees of Freedom and working condition of various common mechanisms.
4. Apply synthesis methods to construct mechanisms to achieve desired motions
5. Utilize analysis techniques to find mechanism positions, velocities, accelerations.
6. Apply synthesis and analysis techniques to solve open ended mechanism design problems
7. Communicate experimental findings in appropriate written report form
8. Learn to make engineering judgments

Topics:
Basic Concepts; Definitions and assumptions; planar and spatial mechanisms; kinematic pairs; degree of freedom; equivalent mechanisms; Kinematic Analysis of Planar Mechanisms. Review of graphical and analytical methods of velocity and acceleration analysis of kinematically simple mechanisms, velocity-acceleration, analysis of complex mechanisms by the normal acceleration and auxiliary-point methods, Curvature Theory: Fixed and moving centrodes, inflection circle, Euler-Savary equation, Bobillier constructions, cubic of stationary curvature, Ball’s point, Applications in dwell mechanisms, Kinematic Synthesis of planar mechanisms, accuracy (precision) points, Chebyshev spacing, types of errors, Graphical synthesis for function generation and rigid body guidance with two, three and four accuracy points using pole method, centre and circle point curves, Analytical synthesis of four-bar and slider-crank mechanisms, Freudenstein’s equation, synthesis for four and five accuracy points, compatibility condition, synthesis of four-bar for prescribed angular velocities and accelerations using complex numbers, three accuracy point synthesis using complex numbers, Coupler Curves : Equation of coupler curve, Robert-Chebychev theorem, double points and symmetry, Kinematic Analysis of Spatial Mechanisms, Denavit-Hartenberg parameters, matrix method of analysis of spatial mechanisms

References Books. :

DE-504 (PCC)  FRACTURE MECHANICS

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
Mid-Sem – 30, Assignments/Quiz- 20
End Sem exam – 50 marks

Prerequisites:

1. Design Procedures and Failure Mechanisms
2. Basics of Strength of Materials
3. Differential Equations and Calculus

Outcomes:

1. Students will understand different modes of failure and understand difference between brittle fracture and ductile fracture.
2. Students will be able to determine the damage tolerance of a component with a crack by analyzing the problem by various methods such as energy release rate, stress intensity factor, J-integral.
3. Students will understand the test methods for determining critical energy release rate, critical stress intensity factor, J Integral.
4. Students will be able to analyze stress and displacement fields at the tip of edge crack and embedded crack.
5. Students will be able to analyze variable amplitude fatigue in a component when a crack is present in it.
6. Students will understand crack propagation, effect of overload, crack closure at the overload and environment assisted cracking.
7. They will also understand various crack detection techniques.

Topics:

References Books. :

1. Brook D, "Elementary engineering fracture mechanics".
2. Liebowitz H., "Fracture" Volume I to VII.

DE-506 (PCC) OPTIMIZATION TECHNIQUES IN DESIGN

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
Mid-Sem – 30, Assignments/Quiz- 20
End Sem exam – 50 marks

Prerequisites:

1. Basics of Optimization
2. Numerical Methods
3. Differential Equations and Calculus

Outcomes:

At the end of the course:

1. Students will know the principles of optimization.
2. Students will have knowledge of algorithms for design optimization
3. Students will be able to formulate an optimization problem.
4. Students should be able to find the optimum solution of their problems using optimization techniques.

Topics:

Introduction to optimization, classification of optimisation problems, classical optimisation techniques, Linear programming, simplex method and Duality in linear programming, sensitivity or post-optimality analysis, Karmarkar’s methods, Non-Linear Programming: - One dimensional minimization, unconstrained and constrained minimization, direct and indirect methods, Geometric programming, Optimum design of mechanical elements like beams, columns, gears, shafts, etc. Introduction to Genetic Algorithms, Operators, applications to engineering optimization problems.
Reference Books:


**MECHANICS OF COMPOSITE MATERIALS**

**Teaching Scheme**

Lectures: 3 hrs/week

**Examination Scheme**

Mid-Sem – 30, Assignments/Quiz- 20
End Sem exam – 50 marks

**Prerequisites:**

1. Strength of Materials and Stress Analysis
2. Matrix Algebra

**Outcomes:**

The student should be able to

1. Student will be able to understand the basic concepts and difference between composite materials with conventional materials.
2. Students will be able to understand role of constituent materials in defining the average properties and response of composite materials on macroscopic level.
3. Students will be able to apply knowledge for finding failure envelopes and stress-strain plots of laminates.
4. Students will be able to develop a clear understanding to utilize subject knowledge using computer programs to solve problems at structural level.
Topics:

**Unit 1. Introduction**
Definition and characteristics, Overview of advantage and limitations of composite materials, Significance and objectives of composite materials, Science and technology, current status and future prospectus

**Unit 2. Basic Concepts and Characteristics**
Structural performance of conventional material, Geometric and physical definition, Material response, Classification of composite materials, Scale of analysis; Micromechanics, Macromechanics, Basic lamina properties, Constituent materials and properties, Properties of typical composite materials

**Unit 3. Elastic Behavior of Unidirectional Lamina**
Stress-strain relations, Relation between mathematical and engineering constants, transformation of stress, strain and elastic parameters

**Unit 4. Strength of Unidirectional Lamina**
Micromechanics of failure; failure mechanisms, Macromechanical strength parameters, Macromechanical failure theories, Applicability of various failure theories

**Unit 5. Elastic Behavior of Laminate**
Basic assumptions, Strain-displacement relations, Stress-strain relation of layer within a laminate, Force and moment resultant, General load–deformation relations, Analysis of different types of laminates

**Unit 6. Hygrothermal Effects**
Hygrothermal effects on mechanical behavior, Hygrothermal stress-strain relations, Hygro-thermoelastic stress analysis of laminates, Residual stresses, Warpage

**Unit 7. Stress and Failure Analysis of Laminates**
Types of failures, Stress analysis and safety factors for first ply failure of symmetric laminates, Micromechanics of progressive failure; Progressive and ultimate laminate failure, Design methodology for structural composite materials

**References:**


**ML504 Intellectual Property Rights Course category: MLC**

Teaching: 1hr/week  
Assessment: End Sem 100

Patent as an intellectual property right; Patent act and patent rules, patent for process, product, product-process together; jurisdiction of patent, Invention as an intellectual property, Patent offices, Submission of application for patents, Patent of addition, granted on convention application, applicants for patents, application for ordinary patents, applicant working in government, Patentable invention, Term of patent, procedure to obtain patent in India, Overview of patenting abroad.

**DE512 Mini project/Internship Course category: LC**

Teaching: 2hrs/week  
Assessment: End Sem 100

Students can take up small problems in the field of design engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

The mini project should not be related to the Dissertation to be done in III rd and IVth semester.

**DE511 Lab Practise II Course category: LC**

Teaching: 2hrs/week  
Assessment: 60

The lab practice consists of experiments, tutorials and assignments decided by the course supervisors of the program core courses and program specific elective courses.
SEMESTER III
ML-601 (MLC) CONSTITUTION OF INDIA

Teaching Scheme
Lectures : 1 hr/week

Examination Scheme
End-Sem Exam- 50

Unit 1 (02)
Preamble to the constitution of India. Fundamental rights under Part – III, details of Exercise of rights, Limitations & Important cases.

Unit 2 (02)
Relevance of Directive principles of State Policy under Part – IV, Fundamental duties & their significance.

Unit 3 (03)
Union Executive – President, Prime Minister, Parliament & the Supreme Court of India.

Unit 4 (02)
State executive – Governors, Chief Minister, State Legislator and High Courts

Unit 5 (02)

Unit 6 (02)
Electoral process, Amendment procedure, 42nd, 44th, 74th, 76th, 86th and 91st Constitutional amendments.

Text Books

Reference Books
### Teaching Scheme
Lectures: 1 hr/week

### Examination Scheme
End-Sem Exam: 50

#### Unit 1 (02)
Multidisciplinary nature of Environmental studies: Definition, scope and importance, need for public awareness.

#### Unit 2 (03)
Natural Resources:
Renewable and non-renewable resources: Natural resources and associated problems.
Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.

#### Unit 3 (02)

#### Unit 4 (03)
Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste Management.

#### Unit 5 (03)
Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns.

### Text Books
3. Environmental Chemistry by De A.K., Wiley Eastern Ltd.
5. Global Biodiversity Assessment by Heywood, V.H & Waston, R.T. 1995.. Cambridge Univ. Press

### Reference Books
1. The Biodiversity of India by Bharucha Erach, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email: mapin@icenet.net

### DE 601 Dissertation I

#### Course category: Project Work

#### Teaching Scheme

#### Assessment
The project work starts at semester III and should involve scientific study or research of an engineering problem involving design and development, experimentation, analysis of experimental results, mathematical modeling of the studied problem, simulation etc.

The student has to submit a detailed report on his work in the format prescribed by the department and has to present it in front of the panel of examiners comprising of guide, co guide, external and internal examiners, as decided by the pg coordinator and the Head of the department.

**SEMESTER IV**

**DE 602  Dissertation II**  
Course category: Project Work

**Teaching Scheme**  
Assessment

2hr/week  
End Sem : 100

It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar in front of the panel of examiners comprising of guide, co guide, external and internal examiners, as decided by the pg coordinator and the Head of the department.