



SARDAR PATEL UNIVERSITY, BALAGHAT (MP)

School of Engineering and Technology

Syllabus

Course: M. Tech.

Branch: Structural Engineering

Semester: IInd

Academic Session: 2024-25

w.e.f - Date-02-09-2024

MSE201 Structural Dynamics

Course Contents

Course Objectives:

1. Learning methods to analyze structures subjected to any kind of dynamic excitation and computing quantities like displacements, forces, stresses, etc.
2. Understanding the analytical methods and procedures in a way that emphasize physical insight.
3. Ability to apply the structural dynamics theory to real-world problems like seismic analysis and design of structures.

UNIT 1

Single Degree of Freedom System: Free and forced vibrations, Linear Viscous Damper, Coulomb Damper: Response to harmonic excitation, rotating unbalance and support excitations, Vibration isolation and transmissibility, single degree of freedom system as vibro-meter and accelerometer, response to periodic and arbitrary excitation.

UNIT-II

Duhamel's integral. Impulse response function, Laplace transform Fourier transform methods. Frequency response function. Phase-Plane Techniques. Critical Speed of rotors. Energy methods, Rayleigh's method, Equivalent viscous damping.

UNIT-III

Two Degree of Freedom System. Matrix Formulation, Free Vibration, Beat phenomenon. Principle of damped and un-damped vibration absorbers.

UNIT-IV

Multi Degree of Freedom System: Matrix formulation, stiffness and flexibility influence coefficients, Eigen value problem, normal modes and their properties. Matrix iteration technique for Eigen value, and Eigen vectors, Free and forced vibration by modal analysis.

UNIT-V

Continuous System: Axial vibration of bar, torsion of shafts, transverse vibration of strings and bending vibration beams. Forced vibration. Normal mode method. Lagrange's equation. Approximate methods of Rayleigh-Ritz, Galerkin etc.

Course Outcome:

- CO1- Identify vibration analysis of systems/structures with different degrees of freedom.
- CO2- Analyze lumped mass systems for their dynamic behavior.
- CO3 -Understand the behavior of structures subjected to dynamic loads under free vibration
- CO4- Apply structural dynamics theory to earthquake analysis, response, and design of structures.
- CO5 -Analyze structure for earthquake forces according to IS code provisions

Reference Books:

1. RW Clough, J Penzien, Dynamics of structures
2. D G Fertia, Dynamics and vibration of Structures
3. J M Biggs, Introduction to structural dynamic



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MSE202 FEM in Structural Engineering

Course Contents

Course Objectives:

1. To research fundamental concepts of finite detail evaluation procedure.
2. To research the idea and traits of finite factors that constitute engineering structures.
3. To research and practice finite detail answers to structural, thermal, dynamic hassle to increase the understanding and capabilities had to efficaciously compare finite detail analyses.

UNIT-I

Introduction to Finite Element Method: General Applicability and Description of Finite Element Method
Comparison with other methods.

UNIT II

Solution of Finite Element Method: Solution of Equilibrium Problems, Eigen value problems, propagation problems, computer implementation of Gaussian eliminations, Choleski decomposition, Jacobins and Ranga Kutta Method.

UNIT III

General Procedure of Finite Element Method: Discretization of the domain, Selection of Shapes, Types and Number of elements, node numbering technique, Interpolation Polynomials, their selection and derivation in terms of global and local coordinates, Convergence requirements. Formulation of Element Characteristic matrices and vectors, Variational approach. Assembly of Element matrices and Vectors and Derivation system equations, computation of element resultants.

UNIT-IV

Iso-parametric Formulation: Lagrange and Hermite interpolation functions, Isoparametric Elements, Numerical Integration.

UNIT-V

Static Analysis: Formulation of equilibrium equation, Analysis of truss, Frames, Plane Stress and Plane Strain Problems Plates and Shells.

Course Outcome :

CO1- Use Finite Element Method for structural analysis.

CO2- Execute the Finite Element Program/ Software.

CO3- Solve continuum problems using finite element analysis.

CO4- Interpret displacements, strains and stress resultants

CO5- Compute the stiffness matrices of different elements and system

Reference Books:

1. Weaver, Johnson, Finite element and structural analysis
2. HC Martin, Matrix structural analysis
3. CF Abel, CS Desai, Finite element methods
4. Buchanan, Finite element Analysis (schaum Outline S), TMH
5. Krishnamurthy, Finite element analysis, TMH)



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MSE203 Advance Concrete Technology

Course Contents

Course Objectives:

1. This course can give the scholars with state-of-the art data on sturdy and property cement and concrete.
2. This course can empower students to become technical leaders within the concrete.
3. The course is wide acknowledged by trade because the beginning in getting a recognized qualification for candidates with some previous data or expertise within the field.

UNIT- I

Cement & its properties, properties of fresh concrete compaction of concrete, curing of concrete.

UNIT-II

Properties of hardened concrete, strength characteristic, shrinkage, creep, durability, fatigue.

UNIT-III

Permeability & durability of concrete in detail. Special concrete and their properties.

UNIT-IV

Concrete at low & high temp. Air entrained concrete, high performance concrete.

UNIT-V

Mix Design, Non destructive Testing of Concrete.

Course Outcome:

CO1- Understand the testing of concrete materials as per IS code

CO2 -Determine the properties of fresh and hardened of concrete

CO3 -Design the concrete mix using ACI and IS code methods.

CO4 -Provide solutions related with concrete and concreting problems.

CO5- Know the procedure to determine the properties of fresh and hardened of concrete.

Reference Books:

1. A.M. Nobile, Concrete Technology , ELBS, London
2. M.L. Gambir, Concrete Technology, Tata Mc Graw Hill Book Co.
3. Peurifoy R.L., Construction Planning Equipment & Methods, TMH
4. Verma Mahesh, Construction Equipments and its Planning & Application, Metropolitan Book Company New Delhi. _



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MSE204 Experimental Stress Analysis

Course Contents

Course Objectives:

1. Understand the principles of stress and strain, including the relationship between them in different materials.
2. Understand how experimental results can be integrated with computational models, including FEM for validation purposes.
3. Develop skills in effectively communicating experimental findings through reports and presentations.
4. Familiarize students with various experimental techniques for measuring stress and strain, such as strain gauges, optical methods, and photoelasticity.

UNIT- I

Introduction to stress analysis by strain measurement, mechanical strain gages, Moire fringe method, Brittle coatings for stress indication, circuitry for resistance strain gages, calibrating strain gages, temperature compensation of circuitry, indication and recording equipments, unbalance of bridge systems, balanced bridgesystems, reference bridge systems, constant current strain indicators, multichannel recording systems.

UNIT- II

Introduction to stress analysis by photo elasticity, optical theory, stress optical relationship, equipment and models, static stress analysis (2-D, 3-D techniques), stress analysis by photo elastic strain gages

UNIT- III

Conditions for crack growth, fracture mechanics and strength of solids, stress and displacement fields in the vicinity of crack tip, the Griffith Orowan-Irwin concept, stable and unstable crack growth, the integral variation principle in crack theory, some more model representations, cracks in linearly elastic bodies, stress intensity factor, basic numerical methods for calculating the stress intensity factor, calculation of stress intensity factor for double cantilever beam specimen by FEM, the method of section for an approximate calculation of stress intensity factor, some material characteristics used for evaluation of crack propagation resistance.

UNIT- IV

Solution of some plane and three dimensional problems, constructional crack arrest, system of cracks, stress intensity factors for some practical important cases, shell with a crack trajectory.

Course Outcome:

CO1- Perform the structural analysis of determinate and indeterminate structures using classical compatibility methods, such as method of consistent displacements, force and equilibrium Methods

CO2- Perform structural analysis using the stiffness method.

CO3 - Solve multiple degree of freedom two and three dimensional problems involving trusses, beams, frames and plane stress

CO4- Understand basic finite element analysis

Reference Books:

1. Dove, Adams, Experimental stress analysis and motion
2. Heteny, Experimental stress analysis
3. Dally, Rilay, Experimental stress analysis
4. VZ Panon, M Morozove, Elastic-plastic fracture mechanics



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MSE205 Theory of Plates and Shells

Course Contents

Course Objectives:

1. To understand the basic concept, mathematical modeling, behavior
2. Analysis of plate and shell structures.

UNIT-I

Theory of Plates: Bearing of long rectangular plates to the cylindrical surface with different edge conditions. Pure bending of plates - Differential equations of equilibrium. Theory of small deflections of laterally loads plates. Boundary conditions, moment curvature relationship.

UNIT-II

Analysis of rectangular plates, Napier's and Levy solutions, exact theory of plates, symmetrical bending of circular plates, continuous rectangular plates

UNIT-III

Special and approximate methods of theory of plates, singularities, use of influence surfaces, use of infinite integrals and transforms, strain energy methods, experimental methods.

UNIT-IV

Theory of Shells: Classification of shells, Gaussian curvature, General theory of cylindrical shells, membrane theory and bending theory for cylindrical shells, long and short shells, shells with and without edge beams, Fourier loading.

UNIT-V

Equation of equilibrium for shells of surface of revolution, Reduction to two differential equations of second order. Spherical shells, membrane theory for shells of double curvature-syn-elastic and anti-elastic. Cylindrical shells, Hyperbolic-parabolic shells, funicular shells.

Course Outcome:

CO1- Use analytical methods for the solution of thin plates and shells.

CO2 -Apply numerical techniques for the complex problems in thin plates and shells.

CO3- Analyze and design prismatic folded plate systems.

CO4 -Analyze and design shells using approximate solutions

CO5 -Analyze and Design Cylindrical Shells

Reference Books:

1. S Timoshenko, S Woinowsky K, Theory of Plates and Shells



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MSE206P Lab-III Non Destructive Testing Laboratory

List of Experiments:

Laboratory work shall be based on the topics of Non-destructive testing and as per the facility available in the institution.

1. To find compressive strength of concrete using Schmidt Rebound Hammer.
2. To calibrate Rebound Hammer.
3. To check the quality of concrete in the structures using Ultrasonic Pulse Velocity meter.
4. To measure the depth of cover in RCC structures using cover meter.
5. To detect corrosion in reinforcement by Half Cell Potentiometer.
6. To determine the permeability of cement mortar and concrete in RCC structures.
7. To find rate of corrosion in reinforcement in RCC structures.
8. To find compressive strength of concrete using CAPO test.
9. To perform various destructive tests on concrete specimen.
10. To perform chloride test on RCC structures.
11. To perform carbonation test on RCC structures.

Reference Books:

1. Lab Manual Concrete – M.L. Gambhir (Tata McGraw Hill)
2. Concrete Technology – M.S. Shetty (S. Chand & Co.)
3. Concrete Technology – M.L. Gambhir (Tata McGraw Hill)



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MSE207P Lab-IV Structural Software Engineering Laboratory

List of Experiments:-

Computer Aided Drafting - Basic 2D objects – line, polyline, circle, ellipse – Dimensioning – Preparation of plan, elevation and section drawings of simple structural objects – Introduction to 3D – Data Base Management System concepts - Civil Engineering Databases – Data entry & Reports. Spreadsheet concepts – Worksheet calculations in Civil Engineering - Regression & Matrix Inversion. Development of C programs to solve problems using numerical techniques

1. Roots of an equation using Newton – Raphson method.
2. Solution of linear simultaneous equations using Gauss elimination.
3. Matrix inversion using GJ method (Octave Computing software)
4. Linear regression line of given points.
5. Curve fitting using Polynomial Regression.
6. Eigen value extraction power method Computer methods of structural analysis - Finite Element programming - Analysis through application packages. Design of steel and RC Structural elements.

References Books:-

1. Rajaraman , V., Computer Oriented Numerical Methods, Prentice – Hall of India, 2004.