Department of Civil and Environmental Engineering

Birla Institute of Technology, Mesra, Ranchi - 835215 (India)

Institute Vision

To become a Globally Recognized Academic Institution in consonance with the social, economic and ecological environment, striving continuously for excellence in education, research and technological service to the National needs.

Institute Mission

To educate students at Undergraduate, Post Graduate, Doctoral, and Post-Doctoral levels to perform challenging engineering and managerial jobs in industry.

- To provide excellent research and development facilities to take up Ph.D. programmes and research projects.
- To develop effective teaching and learning skills and state of art research potential of the faculty.
- To build national capabilities in technology, education and research in emerging areas.
- To provide excellent technological services to satisfy the requirements of the industry and overall academic needs of society.

Department Vision

To develop quality intellectuals through education, research and motivation so that they can bring a positive contribution to the society in area of Civil and Environmental Engineering

Department Mission

- To develop professional skills through quality education & research.
- To outreach various sectors of society through interdisciplinary programmes and practical oriented approach.
- To create dynamic, logical and effective leaders with inspiring mindsets.

Programme Educational Objectives (PEOs)

M. Tech. (Structural Engineering)

PEO 1: To impart students with strong knowledge base through theory courses and sessional that makes them suitable for industries, academics, research and consultancies.

PEO 2: To develop students analytical, computational and research skills through assignments, weekly presentations and modelling software.

PEO 3: To train the students on developing practical, efficient and cost-effective solutions on problems and challenges on structural engineering.

PEO 4: To inculcate among student's sensitivity towards social and corporate responsibilities.

Programme Outcomes (POs)

M. Tech. (Structural Engineering)

PO1: An ability to independently carry out research /investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery for designing and solving structural engineering problems.

PO4: An ability to use appropriate modern tools in structural engineering. In doing so he should demonstrate sufficient knowledge of competing tools and their relative merits and demerits.

PO5: An ability to demonstrate the traits of learning and unlearning throughout his professional career, and be willing to learn new techniques, methods and processes.

PO6: Tune his knowledge to be a responsible engineer adhering to all established practices of his profession.

COURSE INFORMATION SHEET

Course code: CE501
Course title: ADVANCED SOLID MECHANICS
Pre-requisite(s): B.E. /B. Tech in Civil with basic courses on Solid Mechanics and Engg. Mathematics
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: M.Tech.
Semester / Level: I/5
Branch: Civil Engineering
Name of Teacher:

Course Objectives
This course enables the students to:

1	Apply the concepts of elasticity and plasticity to analyse the engineering problems.

Course Outcomes
After the completion of this course, students should be able to:

CO1	Interpret the theory of elasticity including strain/displacement and Hooke's law relationships
CO2	Analyse principal stresses and strains using theories of failure
CO3	Analyse the two-dimensional problems using Airy's stress function
CO4	Explain linearly elastic bodies behaviour using Hooke's law
CO5	Asses torsional stresses developed in thin walled sections
CO6	Apply various failure criteria for general stress states at points

SYLLABUS

Module I

Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity. Elementary Concept of Strain, Stain at a Point, Principal Strains and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic and Deviatoric Components.

(8L)

Module II

Equations of Elasticity: Equations of Equilibrium, Stress- Strain relations, Strain Displacement and Compatibility Relations, Boundary Value Problems, Co-axiality of the Principal Directions.

(8L)

Module III

Two-Dimensional Problems of Elasticity: Plane Stress and Plane Strain Problems, Airy's stress Function, Two-Dimensional Problems in Polar Coordinates.

(8L)

Module IV

Torsion of Prismatic Bars: Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes.

(8L)

Module V

Plastic Deformation: Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.

(8L)

Books recommended:

TEXT BOOKS:

1. Advanced Mechanics of Solids, Srinath L.S., Tata McGraw Hill,2000.
2. Theory of Elasticity, Timoshenko S. and Goodier J. N., McGraw Hill, 1961.
3. Solid Mechanics, Kazimi S. M. A., Tata McGraw Hill,1994.
4. Theory of Elasticity, Sadhu Singh, Khanna Publishers, 2003.

REFERENCE BOOKS:

1. Elasticity, Sadd M.H., Elsevier, 2005.
2. Engineering Solid Mechanics, Ragab A.R., Bayoumi S.E., CRC Press,1999.
3. Computational Elasticity, Ameen M., Narosa,2005

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus: **PO5 & PO6**

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design: **PO5 & PO6**

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3	CO4	CO5	CO6
Continuous Internal Assessment						
Semester End Examination						

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	2	3	2
CO2	3	2	1	2	2	3
CO3	3	2	1	2	2	3
CO4	3	2	1	2	2	3
CO5	3	2	1	2	2	3
CO6	3	2	3	2	2	3

If satisfying and < 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1, CD2
CO3	CD1, CD2, CD3,CD4,CD6
CO4	CD1, CD2,CD6
CO5	CD1, CD2,CD6
CO6	CD7

COURSE INFORMATION SHEET

Course code: CE502
Course title: ADVANCED STRUCTURAL ANALYSIS
Pre-requisite(s): B.E. /B. Tech. in Civil with basic courses on Structural analysis
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class period per week: 3
Class: M. Tech.
Semester / Level: I/5
Branch: Civil Engineering
Name of Teacher:

Course Objectives:
This course enables the students to:

1.	Analyse the skeleton structures

Course Outcomes:
After the completion of this course, students will be able to:

CO1	Obtain the static and kinematic indeterminacy of structure.
CO2	Analyse the beam and plane frame using Matrix method.
CO3	Calculate displacements and internal forces of statically indeterminate structures
CO4	Analyse the behaviour of prismatic Beam-Column element.

SYLLABUS

Module -1:

Review of Analysis of Indeterminate Structures:

Static Indeterminacy, Kinematic Indeterminacy and Stability of Structures, Force Methods, Displacement Methods.

(8L)

Module -2:

Matrix Method of Analysis:
Basic Matrix Operations, Solution of Linear Simultaneous Equations, Coordinate Systems; Displacement and Force Transformation Matrices, Stiffness and Flexibility Approaches.

(8L)

Module -3:

Stiffness Matrix Method for Beams:

Conventional Beam Element Stiffness (Four DOF), Reduced Beam Element Stiffness (Two DOF), Generation of Stiffness Matrix for Continuous Beam; Dealing with Internal Hinges, Hinged and Fixed Supports, Solution Procedure.

(8L)

Module -4:

Stiffness Matrix Method for Plane Frames:
Conventional Element Stiffness (Six DOF), Reduced Element Stiffness (Three DOF), Generation of Structure Stiffness Matrix and Solution Procedure.

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(8L)

Module -5:

Analysis of Elastic Instability and Second-Order Effects: Buckling of Ideal Columns, Flexural Behaviour and Stiffness Measures For Beam-Columns - Braced And Unbraced. Stiffness Matrix for Prismatic Beam-Column Element, Estimation of Critical Elastic Buckling Loads, Second-Order Analysis.

(8L)

Books recommended:

TEXT BOOKS:

1. Devdas Menon, "Advanced Structural Analysis", Narosa Publishing House, 2009.
2. Asslam Kassimali, "Matrix Analysis of Structures", Brooks/Cole Publishing Co., USA, 1999.

3. Amin Ghali, Adam M Neville and Tom G Brown, "Structural Analysis: A Unified Classical and Matrix Approach", Sixth Edition, 2007, Chapman & Hall.

REFERENCE BOOK:

1. Matrix analysis of framed structures, Weaver and Gere.

Gaps in the syllabus (to meet Industry/Profession requirements) :
Design of real-time industrial projects.
POs met through Gaps in the Syllabus: **PO5 & PO6**

Topics beyond syllabus/Advanced topics/Design:
POs met through Topics beyond syllabus/Advanced topics/Design: **PO5 & PO6**

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment				
Semester End Examination				

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	1	2	2
CO2	3	2	3	1	2	2
CO3	3	2	3	1	2	2
CO4	3	2	3	1	2	2

If satisfying and < 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD6
CO2	CD1, CD2, CD6
CO3	CD1, CD2, CD6
CO4	CD1, CD2, CD6

COURSE INFORMATION SHEET

Course code: CE503
Course title: STRUCTURAL DYNAMICS
Pre-requisite(s): B.E. /B. Tech. in Civil with basic courses on Engineering mathematics
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class period per week: 3
Class: M.Tech.
Semester / Level: I/5
Branch: Civil Engineering
Name of Teacher:

Course Objectives:
This course enables the students to:

1.	To understand the response of structure to Earthquakes
2.	To acknowledge single degree of freedom and multi degree of freedom
3.	To have knowledge of various effects of earthquake

Course Outcomes:
After the completion of this course, students will be able to:

CO1	Calculate response of SDOF and MDOF system
CO2	Find out mode shape, frequencies and amplitude for motion of two/three DOF systems
CO3	Solve problem on earthquake steeping loading by Cauchy Euler and Trapezoidal method
CO4	Analyze structure for earthquake forces according to IS code provisions

SYLLABUS

Module -1:

Introduction: Overview of Structural Dynamics, Single Degree of Freedom Systems – Analysis of Free Vibrations – undamped and damped systems, estimation of damping by logarithmic decrement method.

(8L)

Module -2:

Formulation of equation of motion for generalized SDOF dynamic problems using virtual work method, Response of SDOFS systems to Harmonic, Periodic, Impulse Loads.

(8L)

Module -3:

Formulation of equation of motion for two/three DOF systems, finding mode shapes and frequencies by solving the determinant equation and iterative techniques, use of sweeping matrices for obtaining higher modes, Proof of Convergence, Modal superposition and Response Spectrum Methods.

(8L)

Module -4:

Response of single and multiple DOFS systems to Earthquake Loading using Time-Stepping Methods based on Forward Cauchy Euler, Backward Cauchy Euler and Trapezoidal Rule, Accuracy, stability and algorithmic damping in step-by-step methods..

(8L)

Module -5:

Earthquake response analysis of Multi-DOF systems subjected to earthquake ground motion, Concept of modal mass and mode participation factors, Newark & Hall's linear and inelastic response spectra for earthquakes, Introduction to IS code provisions regarding earthquake.

(8L)

Books recommended:

TEXT BOOK

1. Anil Chopra, "Dynamics of Structures ", Mc Graw Hill,2001.
2. Patrick Paultre, "Dynamics of Structures", John Willey & Sons,2008.

REFERENCE BOOK

1. Ray W. Clough & Penzien, "Dynamics of Structures", Mc Graw Hill,1993.

Gaps in the syllabus (to meet Industry/Profession requirements) :

Design of real-time industrial projects.

POs met through Gaps in the Syllabus: **PO5 & PO6**

Topics beyond syllabus/Advanced topics/Design:
POs met through Topics beyond syllabus/Advanced topics/Design: **PO5 & PO6**

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment				
Semester End Examination				

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	3	1	2
CO2	2	1	3	3	2	2
CO3	2	1	3	2	1	3
CO4	3	3	2	3	1	2

If satisfying and < 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD6
CO2	CD1, CD2, CD6
CO3	CD1, CD2, CD6
CO4	CD1, CD2, CD6

COURSE INFORMATION SHEET

Course code: CE506
Course title: FINITE ELEMENT METHOD
Pre-requisite(s): B.E. /B. Tech. in Civil with basic courses on Solid Mechanics
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: M.Tech.
Semester / Level: II/5
Branch: Civil Engineering
Name of Teacher:

Course Objectives

This course enables the students to:

1	Appreciate use of FE Methods for solving complex structural engineering problems.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Use Finite Element Method for structural analysis.
CO2	Execute the Finite Element Program/ Software.
CO3	Solve continuum problems using finite element analysis.

SYLLABUS

Module I

Introduction: History and Applications, **Spring and Bar Elements**: Minimum Potential Energy Principle, **Truss Structures**: Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress.

(8L)

Module II

Beam Elements: Flexure Element, Element Stiffness Matrix, Element Load Vector.
Method of Weighted Residuals: Galerkin Finite Element Method, Application to Structural Elements

(8L)

Module III

Interpolation Functions: Compatibility and Completeness Requirements, Polynomial Forms, Applications to Element Types: Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Iso-parametric Formulation, Axi-Symmetric Elements, **Numerical Integration**: Gaussian Quadrature.

(8L)

Module IV

Application to Solid Mechanics: Plane Stress: CST Element, Plane Strain: Rectangular Element, Iso-parametric Formulation of the Plane Quadrilateral Element, Axi- Symmetric Stress Analysis, Strain and Stress Computations.

(8L)

Module V

Computer Implementation of FEM procedures: Pre-Processing, Solution, Post-Processing, Use of Commercial FEA Software.

(8L)

Books recommended:

TEXT BOOKS:

1. Fundamentals of Finite Element Analysis, Hutton David, Mc-Graw Hill, 2004.
2. Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J ., New York, 1995.
3. Finite Element Method, Zienkiewicz O.C. & Taylor R.L. Vol. I, II & III, Elsevier, 2000.

REFERENCE BOOKS:

1. Finite Element Methods in Engineering, Belegundu A.D., Chandrupatla, T.R., Prentice Hall India, 1991.
2. Finite Element Analysis, Seshu P., Prentice-Hall of India,2005.
3. Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995.

Gaps in the syllabus (to meet Industry/Profession requirements) :
Design of real-time industrial projects.
POs met through Gaps in the Syllabus: **PO5 & PO6**

Topics beyond syllabus/Advanced topics/Design:
POs met through Topics beyond syllabus/Advanced topics/Design: **PO5 & PO6**

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3
Continuous Internal Assessment			
Semester End Examination			

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	2	1	2
CO2	3	1	2	3	1	2
CO3	3	1	3	2	1	2

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1
CO2	CD1
CO3	CD1, CD2

COURSE INFORMATION SHEET

Course code: CE507
Course title: THEORY OF PLATES AND SHELLS
Pre-requisite(s): B.E. /B. Tech. in Civil with basic courses on Solid Mechanics
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: M.Tech.
Semester / Level: II/5
Branch: Civil Engineering
Name of Teacher:

Course Objectives

This course enables the students to:

1	Analyse thin plates and shells using analytical and numerical methods.

Course Outcomes

After the completion of this course, students will be able to:

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.

SYLLABUS

Module I

Introduction: Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions.

(8L)

Module II

Static Analysis of Plates: Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions.

(8L)

Module III

Circular Plates: Analysis under Axi-Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. **Approximate Methods of Analysis**- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates.

(8L)

Module IV

Static Analysis of Shells: Membrane Theory of Shells - Cylindrical, Conical and Spherical Shells.

(8L)

Module V

Shells of Revolution with Bending Resistance - Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels.

(8L)

Books recommended:

TEXT BOOKS:

1. Stresses in Plates and Shells, Ugural Ansel C., McGraW Hill.
2. Theory of Plates and Shells, Timoshenko S. and Krieger W., McGraw Hill.

REFERENCE BOOKS:

1. Thin Elastic Shells, Kraus H., John Wiley and Sons.
2. Theory of Plates, Chandrashekhara K., Universities Press.
3. Design and Construction of Concrete Shells, Ralnaswamy G.S.

Gaps in the syllabus (to meet Industry/Profession requirements) :

POs met through Gaps in the Syllabus: **PO5 & PO6**

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design: **PO5 & PO6**

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2
Continuous Internal Assessment		
Semester End Examination		

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	1	2
CO2	3	2	3	3	2	2

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1
CO2	CD1

COURSE INFORMATION SHEET

Course code: CE508
Course title: EARTHQUAKE ENGINEERING
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: M. Tech
Semester / Level: II/ 5
Branch: Civil Engineering
Name of Teacher:

Course Objectives

This course enables the students:

1.	Apply the concept of earthquake engineering in seismic analysis and design of structures.

Course Outcomes

After the completion of this course, students will be:

CO1	Determine the response of SDOF & MDOF structural system due to earthquake.
CO2	Determine the lateral forces generated in the structure due to earthquake.
CO3	Apply the concepts of Earthquake Resistant Design to real life structures.

SYLLABUS

Module I

Seismology: Earth's Interior and Plate Tectonics, Causes of Earthquakes and Seismic Waves, Measurement of Earthquakes, Seismic Hazard Analysis.

(8L)

Module II

Dynamics for Earthquake Analysis: Equations of Motion for SDOF and MDOF Systems; Undamped Free Vibration of SDOF and MDOF Systems, Mode Shapes and Frequencies of MDOF System, Rayleigh Damping Matrix.

(8L)

Module III

Response Spectrum Method of Analysis: Concept of Equivalent Lateral Force for Earthquake. Response Spectrum Method of Analysis of Structures and Codal Provisions.

(8L)

Module IV

Seismic Soil - Structure Interaction: Fundamentals of Seismic Soil-Structure Interaction, Direct Method of Analysis of Soil-Structure Interaction using FEM, Sub-structuring Method of Analysis of Soil-Structure Interaction.

(8L)

Module V

Base Isolation for Earthquake Resistant Design of Structures: Base isolation concept, isolation systems, stability of elastomeric bearings, codal provisions for seismic isolation.

(8L)

Books recommended:

TEXT BOOKS:

1. Pankaj Agarwal and Manish Shrikhande, 'Earthquake Resistant Design of Structures', PHI, 2008
2. Newmark N.M. and Rosenblueth E., 'Fundamentals of Earthquake Engg.,' Prentice Hall, 1971.
3. S.K.Duggal; Earthquake resistance design of structures; Oxford University Press, New Delhi.
4. IS 10262-2004, ACI Code for Mix Design

REFERENCE BOOKS:

1. Proc. of World Conferences on Earthquake Engg., 1956-2008.
2. Ellis L. Krinitzsky, J.M. Gould and Peter H. Edinger, 'Fundamentals of Earthquake Resistant Construction', John Wiley, 1993

Gaps in the syllabus (to meet Industry/Profession requirements) :
Design of real-time industrial projects.
POs met through Gaps in the Syllabus: **PO5 & PO6**

Topics beyond syllabus/Advanced topics/Design:
POs met through Topics beyond syllabus/Advanced topics/Design: **PO5 & PO6**

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3
Continuous Internal Assessment			
Semester End Examination			

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	2	2
CO2	3	1	2	1	2	2
CO3	3	2	2	1	2	2

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1
CO2	CD1
CO3	CD1, CD2

COURSE INFORMATION SHEET

Course code: CE511
Course title: ADVANCED CONCRETE TECHNOLOGY
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: M.Tech.
Semester / Level: III/ 5
Branch: Civil Engineering
Name of Teacher:

Course Objectives

This course enables the students to:

1	Update latest developments in concrete technology globally.
2	Develop interest in concrete technology area by providing information regarding innovative developments on special concretes, eco-friendly and smart concretes, sustainable development in concrete technology.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Discuss about concrete ingredients and its influence on gaining strength
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.

SYLLABUS

Module I

Bogue's compounds, Hydrated Cement Paste structure and volume, porosity of paste and concrete, transition Zone, factors affecting strength and elasticity of concrete, Rheology of concrete.

(8L)

Module II

Chemical and Mineral admixtures, Effect of admixtures on concrete property in fresh and hardened state, Optimum dosage of admixtures.

(8L)

Module III

Design of concrete mix as per IS10262 and current American (ACI)/ British (BS) methods. NDT Tests on concrete

(8L)

Module IV

Permeability of concrete, chemical attack, acid attack, efflorescence, Corrosion in concrete. Thermal conductivity, thermal diffusivity, specific heat. Alkali Aggregate Reaction, IS456-2000 requirement for durability.

(8L)

Module V

Fiber reinforced concrete, High volume fly ash concrete, Self-compacting concrete, Light weight concrete

Utilization of industrial wastes in concrete.

(8L)

Books recommended:

TEXT BOOKS:

1. Concrete Technology, A.R. Santhakumar,-Oxford University Press.
2. Concrete- P.K. Mehta, P J M Monteiro,- Prentice Hall, New Jersey
3. Non-Destructive Test and Evaluation of Materials, J.Prasad, C G K Nair-Mc Graw Hill.
4. Concrete Technology Theory & Practice, M.S. Shetty, S.Chand and Co, 2004
5. IS 10262-2004, ACI Code for Mix Design

REFERENCE BOOKS:

1. Advanced Concrete Technology Constituent materials- John Newman, Ban Seng Choo-London
2. Properties of Concrete- Neville, A.M., Longman Publishers, 2004.
3. Properties of Fresh Concrete, Power T.C.- E and FN, London

Gaps in the syllabus (to meet Industry/Profession requirements) :
POs met through Gaps in the Syllabus: **PO5 & PO6**

Topics beyond syllabus/Advanced topics/Design:
POs met through Topics beyond syllabus/Advanced topics/Design: **PO5 & PO6**

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment				
Semester End Examination				

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	3	2	3	3
CO2	3	3	3	3	2	3
CO3	3	3	3	3	2	3
CO4	3	3	3	2	2	3

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1,CD2, CD7
CO2	CD1,CD2, CD7
CO3	CD1,CD2, CD7
CO4	CD1,CD2, CD7

COURSE INFORMATION SHEET

Course code: CE541
Course title: ANALYTICAL AND NUMERICAL METHODS IN STRUCTURAL ENGINEERING
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: M.Tech.
Semester / Level: /5
Branch: Civil Engineering
Name of Teacher:

Course Objectives

This course enables the students:

1.	To use analytical and numerical methods for solving complex structural engineering problems.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Analyse and asses the accuracy of common numerical methods.
CO2	Apply numerical methods to obtain approximate solutions to mathematical problems.
CO3	Create programming code and present numerical results in an informative way.

SYLLABUS

Module I

Modeling, Computers and Error Analysis: Mathematical Modeling, Numerical Methods, and Problem Solving, Roundoff and Truncation Errors

(8L)

Module II

Roots and Optimization: Bracketing methods, open methods, optimization

(8L)

Module III

Linear system and Curve fitting: Linear algebraic equations and Matrices, Gauss elimination, LU factorization, Matrix inverse and condition, Iterative methods, Curve fitting.

(8L)

Module IV

Integration and Differentiation: Numerical integration formulas, Numerical integration of functions, Numerical differentiation.

(8L)

Module V

Ordinary Differential equations: Initial-Value problems, Adaptive methods and stiff system, Boundary value problems.

(8L)

Books recommended:

TEXT BOOKS:

1. An Introduction to Numerical Analysis, Atkinson K.E., J. Wiley and Sons, 1989.
2. Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998.

REFERENCE BOOKS:

1. Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (Shaum Series), 1988.

Gaps in the syllabus (to meet Industry/Profession requirements) :

Design of real-time industrial projects.

POs met through Gaps in the Syllabus: **PO5 & PO6**

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design: **PO5 & PO6**

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3
Continuous Internal Assessment			
Semester End Examination			

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	3	2	3	2	2
CO2	2	3	1	3	2	2
CO3	3	3	3	2	2	2

If satisfying and < 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD6
CO2	CD1, CD2, CD6
CO3	CD1, CD2, CD6

COURSE INFORMATION SHEET

Course code: CE542
Course title: BRIDGE ENGINEERING
Pre-requisite(s): Structural Analysis, Design of RC Structures and Steel Structures.
Co- requisite(s): Linear Algebra
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: M.Tech.
Semester / Level: /5
Branch: Civil Engineering
Name of Teacher:

Course Objectives:

This course enables the students to:

1.	understand bridge deck behavior with the help of classical and numerical analysis approaches
2.	impart knowledge needed for design of R.C. and pre-stressed concrete bridges.
3.	have knowledge of secondary effects on bridges.

Course Outcomes:

At the end of the course, a student should be:

CO1	Able to calculate design loads for bridges.
CO2	Able to design RC and Pre-stressed Concrete Slab Bridges.
CO3	Able to design RC and Pre-stressed Concrete Girder Bridges.
CO4	Able to analyze Box-Girder Bridges, Arch Bridges, Suspension and Cable Stayed Bridges.

SYLLABUS

Module I:

Structural Forms and Design Loads for Bridges, Effective Width Concept and Load Distribution in Multi-Beam Bridges, Grillage Analogy.

(8L)

Module II:

Design of R.C. and Pre-Stressed Concrete Slab Bridges.

(8L)

Module III:

Design of R.C. and Pre-Stressed Concrete Girder Bridges.

(8L)

Module IV:

Behaviour of Box-Girder Bridges, Introduction to Arch Bridges, Suspension and Cable Stayed Bridges.

(8L)

Module V:

Different Types of Bearings and Design of Elastomeric Bearings, Introduction to Secondary Effects, Temperature, Shrinkage, Creep. Construction Techniques and Effects of Construction Sequence on Design.

(8L)

Books recommended:

TEXT BOOKS

1. N. Rajagopalan, "Bridge Superstructure", Narosa Publishing House,2010.
2. Code of Practice for Concrete Road Bridges - IRC:112-2011, Indian Road Congress.
3. Standard Specifications and code of Practice for Bridges, Section II- Loads and Stresses - IRC:6-2010, Indian Road Congress.

REFERENCE BOOKS

1. D.J. Victor, "Essentials of Bridge Engineering" Oxford & IBH Publishing,2001.
2. E.C. Hambly, "Bridge Deck Behaviour", Chapman and Hall, London,1976.

Gaps in the syllabus (to meet Industry/Profession requirements) :
Design of real-time industrial projects.
POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:
POs met through Topics beyond syllabus/Advanced topics/Design:

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment				
Semester End Examination				

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	2	1	3
CO2	3	1	1	3	1	3
CO3	3	1	3	3	2	3
CO4	3	2	3	3	2	2

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1
CO2	CD1
CO3	CD1, CD2
CO4	CD1

COURSE INFORMATION SHEET

Course code: CE543
Course title: DESIGN OF HIGH RISE STRUCTURE
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: M.Tech.
Semester / Level: /5
Branch: Civil Engineering
Name of Teacher:

Course Objectives:

This course enables the students to:

1.	analyse and design high rise structures such as towers, chimneys and multi-storeyed buildings

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Analyse, design and detail Transmission/ TV Tower, Mast and Trestles with different loading conditions.
CO2	Analyse, design and detail the RC and Steel Chimney.
CO3	Analyse, design and detail the tall buildings subjected to different loading conditions using relevant codes.

SYLLABUS

Module I:

Design of Transmission/ TV Tower, Mast and Trestles: Configuration, bracing system, analysis and design for vertical, transverse and longitudinal loads.

(8L)

Module II:

Analysis and Design of RC and Steel Chimney: Foundation design for varied soil strata.

(8L)

Module III:

Tall Buildings: Structural concepts, configurations, various systems, wind and siesmic loads.

(8L)

Module IV:

Tall Buildings: Dynamic approach, structural design considerations and IS code provisions, fire fighting design provisions.

(8L)

Module V:

Application of software: Analysis and design.

(8L)

Books recommended:

TEXT BOOK

1. Structural Design of Multi-storeyed Buildings, Varyani U.H., 2nd Ed., South Asian Publishers, New Delhi, 2002.
2. Structural Analysis and Design of Tall Buildings, Taranath B.S., Mc GrawHill, 1988.
3. Illustrated Design of Reinforced Concrete Buildings (GF+3Storeyed), Shah V.L. &Karve S.R., Structures Publications, Pune, 2013.

REFERENCE BOOK

1. Design of Multi-storeyed Buildings, Vol.1 & 2, CPWD Publications, 1976.
2. Tall Building Structures, Smith Byran S. And Coull Alex, Wiley India, 1991.
3. High Rise Building Structures, Wolfgang Schueller, Wiley., 1971.
4. Tall Chimneys, Manohar S.N., Tata Mc GrawHill Publishing Company, New Delhi.

Gaps in the syllabus (to meet Industry/Profession requirements) :
Design of real-time industrial projects.
POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:
POs met through Topics beyond syllabus/Advanced topics/Design:

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3
Continuous Internal Assessment			
Semester End Examination			

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	2	3
CO2	3	3	3	2	2	3
CO3	3	3	3	2	2	3

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1
CO2	CD1
CO3	CD1, CD2

COURSE INFORMATION SHEET

Course code: CE544
Course title: DESIGN OF INDUSTRIAL STRUCTURE
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: M.Tech.
Semester / Level: /5
Branch: Civil Engineering
Name of Teacher:

Course Objectives:

This course enables the students to:

1.	Analyse and design various industrial structures.

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Design Steel Gantry Girders, Portal & Gable Frames, Bunkers, Silos, Chimneys and water tanks
CO2	Use relevant IS codes for design of industrial structures.

SYLLABUS

Module I:

Steel Gantry Girders: Introduction, loads acting on gantry girder. Permissible stress. Types of gantry girders and crane rails. Crane data. Maximum moments and shears. Construction detail. Design procedure.

(8L)

Module II:

Portal Frames: Design of portal frame with hinge base. Design of portal frame with fixed base. Gable Structures — Lightweight Structures.

(8L)

Module III:

Steel Bunkers and Silos: Design of square bunker — Jansen's and Airy's theories — IS Code provisions — Design of side plates — Stiffeners — Hooper — Longitudinal beams. Design of cylindrical silo — Side plates — Ring girder— stiffeners.

(8L)

Module IV:

Chimneys: Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder. Loading and load combinations. Design considerations. Stability consideration.

Design of base plate. Design of foundation bolts. Design of foundation.

(8L)

Module V:

Water Tanks: Design of rectangular riveted steel water tank - Tee covers — Plates — Stays — Longitudinal and transverse beams —Design of staging — Base plates — Foundation and anchor bolts.

(8L)

Books recommended:

TEXT BOOK

1. Design of Steel Structure, Punmia B. C., Jain Ashok Kr., Jain Arun Kr., 2nd Ed., Lakshmi Publishers, 1998.
2. Design of Steel Structures, Ram Chandra. 12th E.d., Standard Publishers. 2009.

REFERENCE BOOK

1. Design of Steel Structures, Subramaniyam.

Gaps in the syllabus (to meet Industry/Profession requirements) :
Design of real-time industrial projects.
POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:
POs met through Topics beyond syllabus/Advanced topics/Design:

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2
Continuous Internal Assessment		
Semester End Examination		

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	3
CO2	2	3	3	1	1	3

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1
CO2	CD1

COURSE INFORMATION SHEET

Course code: CE545
Course title: DESIGN OF PLATES AND SHELLS
Pre-requisite(s): CE507-Theory of Plates and Shells
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: M.Tech.
Semester / Level: /5
Branch: Civil Engineering
Name of Teacher:

Course Objectives:

This course enables the students to:

1.	Design various plate and shell structures.

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Analyse and design prismatic folded plate systems.
CO2	Analyse and design shells using approximate solutions
CO3	Analyse and Design Cylindrical Shells
CO4	Design Doubly Curved Shells using Approximate Solutions.

SYLLABUS

Module I:

Prismatic folded plate system

(8L)

Module II:

Shell Equations

(8L)

Module III:

Approximate Solutions for shells

(8L)

Module IV:

Analysis and Design of Cylindrical Shells

(8L)

Module V:

Approximate Design methods for Doubly Curved Shells.

(8L)

Books recommended:

TEXT BOOK

1. Theory of Plates and Shells, Timoshenko and Woinowsky-Krieger S., Tata Mc Graw Hill Edition, 2010.
2. Design and Construction of Concrete Shell Roofs, Ramaswarny G. S., 1st Edition. 2005.

REFERENCE BOOK

1. Design of Reinforced Concrete Shells & Folded Plate, Varghcse P. C., lst Edition, PIII.
2. Design of Plate and Shell Structures, Jawad Maan H., Springer Science.

Gaps in the syllabus (to meet Industry/Profession requirements) :
Design of real-time industrial projects.
POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:
POs met through Topics beyond syllabus/Advanced topics/Design:

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment				
Semester End Examination				

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	3	2	2	2
CO2	2	3	3	2	2	2
CO3	2	3	3	2	2	2
CO4	2	2	3	2	2	2

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1
CO2	CD1
CO3	CD1
CO4	CD1, CD2

COURSE INFORMATION SHEET

Course code: CE546
Course title: FRACTURE MECHANICS
Pre-requisite(s): CE501-Advanced Solid Mechanics
Co- requisite(s): Finite Element Method
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: M.Tech.
Semester / Level: /5
Branch: Civil Engineering
Name of Teacher:

Course Objectives:

This course enables the students to:

1.	Develop an understanding of the mechanics of fracture of engineering materials and structures under static and dynamic loading.
2.	Have a solid foundation in the theory, concepts and principles of fracture mechanics

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Develop physical intuition necessary to idealise a complicated practical Fracture problem.
CO2	Possess the analytical and computational tools needed to solve the idealised problem.
CO3	Interpret the results of the solutions for the idealised problem.
CO4	Use the solutions to guide a corresponding design, manufacture, or failure analysis.

SYLLABUS

Module I:

Introduction: Fracture Phenomena in Nature and Engineering, Brittle and Ductile Fracture, Modes of Fracture Failure, Damage Tolerance, Energy Release rate.

Stress Intensity Factor: Introduction, Stress and Displacement Fields in Isotropic Elastic Mater, Stress Intensity Factor, Westergaard's Approach and its application, Edge Cracks, Embedded Cracks, The Relation between G1 and K1, Critical Stress Intensity Factor, Bending and Twisting of Cracked Plates

(8L)

Module II:

Anelastic Deformation at the Crack Tip: Investigation at the Crack Tip, Approximate Shape and Size of the Plastic Zone, Effective Crack Length, Effect of Plate Thickness J-Integral: Relevance and Scope, Applications to Engineering Problems

Crack Tip Opening Displacement: Relationship between CTOD, Kr and Gr for Small Scale Yielding, Equivalence between CTOD and J- Integral

(8L)

Module III:

Test Methods: KIc-Test Technique, Test Methods to Determine J1c, Test Methods to Determine G1c and GIIc, Determination of Critical CTOD.

Fatigue Failure and Environment-assisted Fracture: Fatigue Failure, Environment-assisted Fracture, Environment-assisted Fatigue Failure

(8L)

Module IV:

Finite Element Analysis of Cracks in Solids: Direct Methods to Determine Fracture Parameters, Indirect Methods to Determine Fracture Parameters

(8L)

Module V:

Mixed Mode Crack Initiation and Growth: Fracture Surface, Mixed Mode Crack Propagation Criteria. Crack Detection through Non-Destructive Testing: Examination through Human Senses, Liquid Penetration Inspection, Ultrasonic Testing, Radiographic Imaging, Magnetic Particle Inspection

(8L)

Books recommended:

TEXT BOOK

1. Elements of Fracture Mechanics, Prashant Kumar, Tata McGraw Hill, New Delhi, India, 2009.
2. Fracture Mechanics for Modern Engineering Design, K. R.Y.Simha, Universities Press (India) Limited, 2001
3. e-Book on Engineering Fracture Mechanics, K. Ramesh, IIT Madras, 2007.

REFERENCE BOOK

1. Elementary Engineering Fracture Mechanics, D.Broek, Kluwer Academic Publishers, Dordrecht, 1986.
2. Fracture Mechanics - Fundamentals and Applications, T.L.Anderson, 3rd Edition, Taylor and Francis Group, 2005.

Gaps in the syllabus (to meet Industry/Profession requirements) :

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design:

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment				
Semester End Examination				

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	2	2
CO2	3	2	3	3	2	2
CO3	3	3	2	2	1	2
CO4	3	3	3	2	1	3

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD2,CD3,CD8
CO2	CD1, CD2,CD8
CO3	CD1, CD2,CD8
CO4	CD1, CD2, CD3, CD8

COURSE INFORMATION SHEET

Course code: CE547
Course title: PRE-STRESSED CONCRETE
Pre-requisite(s): B.E. /B. Tech. in Civil with basic courses on R.C.C. design.
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: M.Tech.
Semester / Level: /5
Branch: Civil Engineering
Name of Teacher:

Course Objectives:

This course enables the students to:

1.	Analyse and design prestressed concrete structural element

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Understand the basic aspects of prestressed concrete
CO2	Find out losses in the prestressed concrete
CO3	Analyse the prestressed concrete beam, deck slab and girders.
CO4	Design the prestressed concrete beam, deck slab and girders.

SYLLABUS

Module I:

Introduction to Prestressed Concrete: Types of Prestressing, Systems and Devices, Materials, Losses in Prestress. Analysis of Flexural Members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure

(8L)

Module II:

Statically Determinate Beams: Design for Ultimate and Serviceability Limit States for Flexure, Analysis and Design for Shear and Torsion.

(8L)

Module III:

Statically Indeterminate Structure: Analysis and Design of Continuous Beams and Frames, Choice of Cable Profile, Linear Transformation and Concordancy.

(8L)

Module IV:

Composite Construction: Analysis and Design of Composite Sections, Partial Prestressing: principles, analysis and design concepts, crack width calculations

(8L)

Module V:

Circular Prestressing: Analysis and Design of Prestressed Concrete Pipes and Liquid Storage Tanks.

(8L)

Books recommended:

TEXT BOOK

1. Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981.(**T1**)
2. Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 1955.(**T2**)

REFERENCE BOOK

1. Limited State Design of Prestressed Concrete, GuyanY., Applied Science Publishers. (**R1**)
2. IS: 1343- Code of Practice for Prestressed Concrete. (**R2**)

Gaps in the syllabus (to meet Industry/Profession requirements) :

Design of real-time industrial projects.

POs met through Gaps in the Syllabus: **PO5 & PO6**

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design: **PO5 & PO6**

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment				
Semester End Examination				

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	1	2
CO2	3	2	3	3	2	2
CO3	3	2	3	3	2	2
CO4	3	2	3	3	2	2

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1,CD2,CD6
CO3	CD1,CD2,CD6
CO4	CD1,CD2,CD6

COURSE INFORMATION SHEET

Course code: CE548
Course title: SOIL STRUCTURE INTERACTION
Pre-requisite(s): CE503- Structural Dynamics
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: M.Tech.
Semester / Level: /5
Branch: Civil Engineering
Name of Teacher:

Course Objectives:

This course enables the students to:

1.	To understand basics of soil structure interaction.
2.	To model structure, boundaries and soil using FEM.
3.	To apply knowledge of SSI in various engineering application.

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Able to model structure, soil and boundary.
CO2	Able to solve problem on wave propagation for SSI.
CO3	Able to solve dynamic stiffness matrix for out of plane and in-plane motion.
CO4	Able to analyze soil and structure considering nonlinearity in material of soil and structure.
CO5	Able to analyze SSI for engineering application like nuclear power plant, bridges, dams,multi storey buildings etc.

SYLLABUS

Module I:

Fundamentals of Soil-Structure Interaction: Objectives and practical significance and importance of soil structure interaction (SSI); Fixed base structure, structures on soft ground; Modeling of unbounded media,: Direct and substructure methods of analysis; Equation of motion for flexible and rigid base;Kinematic interaction, inertial interaction and effect of embedment.
Modeling of Structure: Temporal and spatial variation of external loads (including seismic loads); Continuous models, discrete models (lumped mass) and finite element models.

(8L)

Module II:

Wave Propagation for SSI: Waves in semi-infinite medium – one, two and three-dimensional wave propagation; Dynamic stiffness matrix for out-of plane and in-plane motion.
Free-Field Response of Site: Control point and control motion for seismic analysis; Dispersion and attenuation of waves; Half-space, single layer on half-space; Parametric studies.

(8L)

Module III:

Modeling of Boundaries: Elementary, local, consistent and transmitting boundaries.
Modeling of Soil: Green's influence functions, boundary-element method, finite element model; Dynamic stiffness coefficients for different types of foundations – surface foundation, embedded foundation, shallow (strip) foundation and deep (piles) foundations.

(8L)

Module IV:

Soil Structure Interaction in Time Domain: Direct method; Substructure method (using dynamic stiffness and Green's functions of soil); Hybrid frequency-time domain approach.
Nonlinear Analysis: Material nonlinearity of soil (including plasticity and strain hardening), geometrical nonlinearity (slip and separation of foundation with soil); Nonlinear structure with linear soil considering both soil and structure nonlinearity.

(8L)

Module V:

Engineering Applications of Dynamic Soil-Structure Interaction: Low rise residential buildings, multi story buildings, bridges, dams, nuclear power plants, offshore structures, soil-pile-structure interactions.

(8L)

Books recommended:

TEXT BOOK

1. Cakmak, A.S. – Editor, "Soil-Structure Interaction", Developments in Geotechnical Engineering 43, Elsevier and Computational Mechanics Publications, 1987.(**T1**)
2. Kramer, S.L., "Geotechnical-Earthquake Engineering", Pearson Education, 1996. (**T2**)
3. Hall, W.S. and Oliveto G., "Boundary Element Method for Soil-Structure Interaction", Kluwer Academic Publishers, 2003. (**T3**)
4. Wolf, J. P., "Dynamic Soil-Structure Interaction", Prentice-Hall, 1985. (**T4**)

REFERENCE BOOK

1. Wolf, J.P., "Soil-Structure Interaction in the Time-Domain", Prentice-Hall, 1988. (**R1**)
2. Chen, Wai-Fah and Duan Lian, "Bridge Engineering (Seismic Design)", CRC Press, 2003. (**R2**)
3. Wolf, J.P. and Song C. "Finite Element Modelling of Unbounded Media", John Wiley & Sons, 1996. (**R3**)

Gaps in the syllabus (to meet Industry/Profession requirements) :
Design of real-time industrial projects.
POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:
POs met through Topics beyond syllabus/Advanced topics/Design:

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	3	2
CO2	3	2	2	3	3	2
CO3	1	2	2	3	2	2
CO4	3	2	3	3	2	3
CO5	3	3	3	2	3	3

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1,CD2,CD6
CO3	CD1,CD2,CD6
CO4	CD1,CD2,CD6
CO5	CD1,CD2,CD6

COURSE INFORMATION SHEET

Course code: CE549
Course title: STRUCTURAL DESIGN OF FOUNDATION
Pre-requisite(s): Reinforced Concrete Design
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: M.Tech.
Semester / Level: /5
Branch: Civil
Name of Teacher:

Course Objectives

This course enables the students to:

1	Maintain an all-round knowledge of the art and science of foundation design for safety of structure.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Select a suitable foundation from the myriad choices available for a tricky structure on difficult ground.
CO2	Design safe, cost-effective, durable and buildable Foundation.
CO3	Create, communicate and execute designed foundation at site.
CO4	Analyse and design real time complex foundation problem and give its solution.

Module I

Foundation types selection and Design: Types of foundation, Foundation selection, Foundation design calculation procedure

(8L)

Module II

Design of Pads, Strips and Continuous Foundations: Unreinforced concrete pads and strips, Reinforced concrete pads and strips, Pad foundations with axial loads and bending moments, Rectangular and Tee-beam continuous strips, Floating slabs (ground slabs)

(8L)

Module III

Tied and Balanced Foundations: Tied foundations, Balanced foundations (rectangular, cantilever, trapezoidal and holed)

(8L)

Module IV

Raft Foundations: Design procedures for semi-flexible rafts, Nominal crust raft – semi-flexible, Crust raft, Blanket raft, Slip sandwich raft, Cellular raft, Lidded cellular raft, Beam strip raft, Buoyancy raft, Jacking raft

(8L)

Module V

Piles: Types of piles, Methods of piling, Choice of pile, Design of piled foundations, Pile caps, Design of foundations at pile head

(8L)

Books recommended:

TEXT BOOKS:

1. Foundation Engg. ,P.C.Verghese, PHI Learning Pvt.Ltd
2. Analysis & Design of sub structures, Swamisaran, oxford & IBH Pub. Co.Pvt.Ltd
3. Theory and practice of foundation design, N.N.Som&S.C.Das, PHI learning pvt.Ltd

REFERENCE BOOKS:

1. Foundation Designers' Manual, W. G. Curtin, Gerry Shaw, Gary Parkinson, J. Golding, Norman Seward-Structural, Blackwell Publishing (2006)
2. Foundation analysis & design, Bowels J.E, Mc Graw Hill international Edition
3. Foundation Design, Wayne C. Teng, Prentice-Hall, 1962

Gaps in the syllabus (to meet Industry/Profession requirements) :

POs met through Gaps in the Syllabus: **PO5 & PO6**

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design: **PO5 & PO6**

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment				
Semester End Examination				

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	1	2	3
CO2	3	2	3	2	2	3
CO3	2	3	3	1	2	3
CO4	3	2	3	3	3	3

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1,CD2, CD7
CO2	CD1, CD7
CO3	CD2, CD7
CO4	CD1,CD2, CD7

COURSE INFORMATION SHEET

Course code: CE550
Course title: STRUCTURAL HEALTH MONITORING
Pre-requisite(s): CE503- Structural Dynamics
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: M.Tech.
Semester / Level: /5
Branch: Civil Engineering
Name of Teacher:

Course Objectives:

This course enables the students to:

1.	To learn the fundamentals of structural health monitoring
2.	To study the various vibration-based techniques for structural health monitoring.
3.	To understand the structural health monitoring using fiber-optic and Piezoelectric sensors.
4.	To study the structural health monitoring using electrical resistance and electromagnetic techniques

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Able to understand the fundamentals of maintenance and repair strategies
CO2	Able to diagnose for serviceability and durability aspects of concrete and know the materials and techniques used for repair of structures.
CO3	Able to decide the appropriate repair, strengthening, rehabilitation and retrofitting technique required for a case study building.
CO4	Able to use an appropriate health monitoring technique and demolition technique.

SYLLABUS

Module I:

Introduction to Structural Health Monitoring Definition of structural health monitoring (SHM), Motivation for SHM, SHM as a way of making materials and structures smart, SHM and biomimetics, Process and pre-usage monitoring as a part of SHM, SHM as a part of system management, Passive and active SHM,NDE, SHM and NDECS, Variety and multi disciplinarity: the most remarkable characters of SHM, Birth of the SHM Community

(8L)

Module II:

Vibration-Based Techniques for SHM Basic vibration concepts for SHM, Local and global methods, Damage diagnosis as an inverse problem, Model-based damage assessment, Mathematical description of structural systems with damage, General dynamic behavior, State-space description of mechanical systems, Modeling of damaged structural elements, Linking experimental and analytical data, Modal Assurance Criterion (MAC) for mode pairing, Modal Scaling Factor (MSF), Co-ordinate Modal Assurance Criterion (COMAC), Damping, Expansion and reduction, Updating of the initial model, Damage localization and quantification, Change of the flexibility matrix, Change of the stiffness matrix, Strain-energy-based indicator methods and curvature modes, MECE error localization technique, Static displacement method, Inverse eigen sensitivity method

(8L)

Module III:

Fiber-Optic Sensors Classification of fiber-optic sensors, Intensity-based sensors, Phase-modulated optical fiber sensors, or interferometers, Wavelength based sensors, or Fiber Bragg Gratings (FBG), The fiber Bragg grating as a strain and temperature sensor, Response of the FBG to uniaxial uniform strain fields, Sensitivity of the FBG to temperature, Response of the FBG to a non-uniform uniaxial strain field, Response of the FBG to transverse stresses, Photoelasticity in a plane stress state, Structures with embedded fiber Bragg gratings, Orientation of the optical fiber optic with respect to the reinforcement fibers, Ingress/egress from the laminate, Fiber Bragg gratings as damage sensors for composites, Measurement of strain and stress variations.

(8L)

Module IV:

SHM with Piezoelectric Sensors The use of embedded sensors as acoustic emission (AE) detectors, Experimental results and conventional analysis of acoustic emission signals, Algorithms for damage localization, Algorithms for damage characterization, Available industrial AE systems, New concepts in acoustic emission, State-the-art and main trends in piezoelectric transducer-based acousto-ultrasonic SHM research, Lamb wave structure interrogation, Sensor technology, Tested structures (mainly metallic or composite parts), Acousto-ultrasonic signal and data reduction methods, The full implementation of SHM of localized damage with guided waves in composite materials, Available industrial acousto-ultrasonic systems with piezoelectric sensors, Electromechanical impedance, E/M impedance for defect detection in metallic and composite parts, The piezoelectric implant method applied to the evaluation and monitoring of viscoelastic properties.

(8L)

Module V:

SHM Using Electrical Resistance Composite damage, Electrical resistance of unloaded composite, Percolation concept, Anisotropic conduction properties in continuous fiber reinforced polymer, Influence of temperature, Composite strain and damage monitoring by electrical resistance, 0°

unidirectional laminates, Multidirectional laminates, Randomly distributed fiber reinforced polymers, Damage localization.

(8L)

Books recommended:

TEXT BOOK

1. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, Structural Health Monitoring, Wiley-ISTE, 2006.(**T1**)
2. Douglas E Adams, Health Monitoring of Structural Materials and Components-Methods with Applications, John Wiley and Sons, 2007.(**T2**)
3. Structural Health Monitoring: Current Status and Perspectives, Fu Ko Chang.(**T3**)

REFERENCE BOOK

1. J.P. Ou, H.Li and Z.D. Duan, Structural Health Monitoring and Intelligent Infrastructure, Vol-1, Taylor and Francis Group, London, U.K, 2006.(**R1**)
2. Victor Giurglutiu, Structural Health Monitoring with Wafer Active Sensors, Academic Press Inc, 2007. (**R2**)

Gaps in the syllabus (to meet Industry/Profession requirements) :
Design of real-time industrial projects.
POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:
POs met through Topics beyond syllabus/Advanced topics/Design:

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment				
Semester End Examination				

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	2	3	2	2
CO2	2	2	3	2	3	2
CO3	2	2	3	2	3	2
CO4	2	2	3	3	2	2

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1,CD2,CD6
CO3	CD1,CD2,CD6
CO4	CD1,CD2,CD6

COURSE INFORMATION SHEET

Course code: CE551
Course title: STRUCTURAL OPTIMIZATION
Pre-requisite(s): B.E. /B. Tech. in Civil with basic courses on Structural Analysis
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: M.Tech.
Semester / Level: /5
Branch: Civil Engineering
Name of Teacher:

Course Objectives:

This course enables the students to:

1.	To learn the optimization techniques and linear optimization.
2.	To study the non-linear optimization and non-linear constrained optimization.
3.	To understand the dynamic programming, decision theory and simulations.

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Able to develop optimization techniques, linear optimization, algorithm.
CO2	Able to solve problem of nonlinear optimization-I,non-linear optimization-II and one dimensional minimization methods(by different methods).
CO3	Able to use optimization techniques for simple structures.

SYLLABUS

Module I:

Introduction: Introduction of optimization, basic theory and elements of optimization, Terminology and definitions, Basic principles and procedure of optimization. Classical Methods of Optimization: Trial and error method, Monte-Carlo method, Lagrangian multiplier method. Linear Programming: Introduction, terminology, formulation of LPP, graphical and algebraic methods of solving LPP, standard form and canonical form of linear programming, geometrical interpretation.

(8L)

Module II:

Linear Programming: Simplex methods, artificial variable techniques, solution of simultaneous equations, Dual formulations. Network analysis: Modifications and improvements on CPM/PERT. Transportation and Assignment problem: Introduction, terminology, formulation and solution of mathematical models, illustrative examples and reduction.

(8L)

Module III:

Non-Linear Programming: local and global optimum, problem formulation, Unconstrained and constrained methods of optimization-Kuhn Tucker conditions, Lagrangian Multiplier methods, graphical method, Univariate search method, Steepest Descent Methods, quadratic programming problem, Wolfs modified simplex method.

(8L)

Module IV:

Dynamic programming: Introduction, terminology, need and characteristics of dynamic programming, formulation, solution of LPP, applications, illustrative examples.Decision theory: Introduction, types, decision trees. Simulation : Introduction, advantages, limitations, types, applications.

(8L)

Module V:

Structural Optimization: Optimum structural design of rectangular timber beam, reinforced concrete rectangular, T and L beams, concrete mix proportioning, reinforced concrete deep beams, planner trusses, Procedure of optimization for structural grid and slab.

(8L)

Books recommended:

TEXT BOOK

1. S.S.Rao, Engineering Optimization‖, New Age Internationals,1999. (**T1**)
2. S.S.Bhavikatti ,Fundamentals of Optimum Design in Engineering, New Age Jersey International Publishers,2012. (**T2**)
3. S.Kalavathy, Operation Research, Vikas Publishing house Pvt Ltd,2004. (**T3**)

REFERENCE BOOK

1. Paul, J.O., Systems Analysis for Civil Engineers, John wiley& Sons ,1988. (**R1**)

Gaps in the syllabus (to meet Industry/Profession requirements) :
Design of real-time industrial projects.
POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:
POs met through Topics beyond syllabus/Advanced topics/Design:

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3
Continuous Internal Assessment			
Semester End Examination			

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	1	2
CO2	3	2	3	3	2	2
CO3	3	2	3	3	2	2

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1,CD2,CD6
CO3	CD1,CD2,CD6

COURSE INFORMATION SHEET

Course code: CE552
Course title: THEORY OF STRUCTURAL STABILITY
Pre-requisite(s): B.E. /B. Tech. in Civil with basic courses on Structural Analysis
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: M.Tech.
Semester / Level: /5
Branch: Civil Engineering
Name of Teacher:

Course Objectives:

This course enables the students to:

1.	To analyse and design structures keeping in mind stability considerations.

Course Outcomes:

At the end of the course, a student should be able to:

CO1	Determine stability of columns and frames
CO2	Determine stability of beams and plates
CO3	Use stability criteria for analysing and designing discrete and continuous systems.

SYLLABUS

Module I:

Criteria for Design of Structures: Stability, Strength and Stiffness, Classical concept of stability of discrete and continuous Systems. Linear and non-linear behaviour.

(8L)

Module II:

Stability of columns and beams: Axial and Flexural Buckling. Lateral Bracing of Columns. Combined Axial, Flexural and Torsion Buckling. Stability of beams: lateral torsional buckling.

(8L)

Module III:

Stability of Frames: Member Buckling versus Global Buckling, Slenderness ratio of frame members.

(8L)

Module IV:

Stability of Plates: axial flexural buckling, shear flexural buckling, buckling under combined loads.

(8L)

Module V:

Introduction to Inelastic Buckling and Dynamic Stability.

(8L)

Books recommended:

TEXT BOOK

1. Theory of elastic stability. Timoshenko and Gere. Tata Mc Graw Hill.l98l (**T1**)
2. Principles of Structural Stability Theory. Alexander Chajes. Prentice Hall, New Jersey (**T2**)

REFERENCE BOOK

1. Structural Stability of columns and plates. Iyengar, N. G. R. Eastern west press Pvt. Ltd (**R1**)
2. Strength of metal Structures, Bleich F. Bucking, Tata McGraw Hill, New York (**R2**)

Gaps in the syllabus (to meet Industry/Profession requirements) :

Design of real-time industrial projects.

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design:

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS AND EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes	30 (3 X 10)
Assignment(s)	10
Seminar before a Committee	10

Assessment Components	CO1	CO2	CO3
Continuous Internal Assessment			
Semester End Examination			

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	1	1	2
CO2	2	2	2	1	1	2
CO3	3	3	3	2	1	2

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1,CD2,CD6
CO3	CD1,CD2,CD6