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ELECTIVE COURSE - 1

CIE-581 - ADVANCED DESIGN OF RCC STRUCTURES  
CIE-582 - OFFSHORE STRUCTURAL ENGINEERING  
CIE-583 - MASONRY STRUCTURES  
CIE-584 - GROUND IMPROVEMENT TECHNIQUES.

ELECTIVE COURSE - 2

CIE-585 - RELIABILITY ANALYSIS AND DESIGN OF STRUCTURES  
CIE-586 - ADVANCED DESIGN OF STEEL STRUCTURES  
CIE-587 - SOIL STRUCTURE INTERACTIONS  
CIE-588 - STRUCTURAL STABILITY

ELECTIVE COURSE - 3

CIE-589 - MECHANICS OF COMPOSITE LAMINATES  
CIE-590 - EARTHQUAKE RESISTANT DESIGN OF STRUCTURES  
CIE-591 - ANALYSIS, DESIGN AND CONSTRUCTION OF SHELL STRUCTURES  
CIE-592 - ADVANCED FOUNDATION ENGINEERING

OPEN ELECTIVE

CIE – 554 – ADVANCED STRENGTH OF MATERIALS  
CIE – 556 – NON - DESTRUCTIVE TESTING OF MATERIALS  
CIE–558– ENERGY AND ENVIRONMENT

Method of Regression: Linear and non-linear regression – Application to Structural Engg.

Introduction to optimization - Engineering applications of optimization - classification of optimization problems.


Linear and Non Linear Programming - One dimensional minimization - Elimination methods - Interpolation methods - unconstrained optimisation techniques - direct search methods - Descent methods - constrained optimisation - Direct and indirect methods.

References:


Theory of Plates: Slopes and curvatures of slightly bent plates - principal curvatures - moment-curvature relationships - small deflections of laterally loaded plates - boundary conditions - strain energy of bending of plates - bending of orthotropic plates.

Theory of Shells: Differential geometry of curves and surfaces - classification of shells - membrane action and bending action - force resultants and moment resultants in terms of mid-surface strains and changes in curvatures - analysis of simple shells of revolution subjected to symmetrical loading.

References:

Introduction - Brief general description of the method, theory of elasticity - constitutive relationships - plane stress and plane strain.

Concept of an element, types of elements, displacement models - compatibility and convergence requirements, displacement models by generalised coordinates, Lagrangian polynomials and Hermitian polynomials. Natural coordinates, formulation of shape functions for different types of elements.

Variational method of formulation - Minimization of potential energy approach, formulation of element stiffness and consistent load vector.

Application of Finite element method to pin jointed and rigid jointed framed structures.

Natural co-ordinates, Isoparametric elements, Numerical Integration. Application to plane stress and plane strain problems.

References:

**CIE 545 STRUCTURAL DYNAMICS [3 1 0 4]**


**Single Degree of Freedom Systems:**

a) Components of the system, un-damped and damped free vibrations, logarithmic decrement.
b) Forced vibrations due to harmonic excitation – steady state and transient response, transmissibility, vibration isolation, evaluation of damping – half power band width method.
c) Forced vibrations due to general dynamic loading – Duhamel's integral, response of SDOF system to impulsive loading, numerical methods – direct integration (constant and linear acceleration) of Duhamel's integral, trapezoidal rule and simpson's rule.
d) Response to periodic loading – Fourier Analysis.

**Multi-Degree of Freedom Systems:**

a) Equations of motion, un-damped and damped free vibration, eigenvalues and eigen vectors, orthogonality conditions.
b) Free vibration of shear buildings with and without damping. (Harmonic and impulse loads only)


**Continuous Systems:**

Free longitudinal vibration of bars, flexural vibration of single span beams, forced vibration of beams.

**References:**

Design criteria, design philosophy, loading, sequential loading, and materials – high performance concrete, fiber reinforced concrete, light weight concrete. Structural planning of tall buildings, floor systems, dead loads, live loads, earthquake load and wind load on buildings, building frames, shear walls, frame-shear wall interaction, tubular structures, outriggers, braced and hybrid mega system. Approximate analysis of framed structure and framed with shear wall structures for lateral loads on buildings. Temperature stress in buildings, high mast towers pylons and their supporting structures; chimneys hoists and cranes, foundation of tall structures.

References:

2. Hill. G.M. Pinfold, Reinforced Concrete Chimneys and Towers, View point publisher.
3. Byran Statford Smith and Alex Coull, Tall building structures-
Mechanics of Research Methodology: Types of research, Significance of research, Research framework, Case study method, Experimental method, Sources of data, Data collection using questionnaire, Interviewing, and experimentation.


Sampling Methods: Introduction to various sampling methods and their applications. Data Analysis- Sources of data, Collection of data, Measurement and scaling technique, and Different techniques of Data analysis.


References:

Concrete mix design by IS Code and other methods.
Strain measurement using mechanical and electrical strain gauges.
Study on flexural behaviour of reinforced concrete, pre-tensioned and post-tensioned pre-stressed rectangular concrete beams.
Study on structural behaviour of columns
Non-destructive tests on concrete.
Demonstration of photo-elastic analysis
Analysis of axially loaded bar
Analysis of plane trusses
Analysis of space trusses
Analysis of plane rigid frame
Analysis of Grids

References:

Application of finite element method for three dimensional analysis.

Application of Finite element method for the analysis of plates.

Non-linear Analysis - Techniques for problems involving material and geometric non-linearity - Incremental and iterative methods.

Application of Finite element method for Dynamic analysis - Dynamic analysis of pin and rigid jointed plane frames, plane stress/strain and plates.

Application of Finite element method for elastic stability problems.

Finite element analysis of soil structure interaction problems.

Memory management techniques.

References:

CIE 544 ADVANCED PRE-STRESSED CONCRETE [3 1 0 4]

Concept of pre-stressing, materials for pre-stressed concrete, analysis of pre-stress, losses of pre-stress, deflections.

Design of pre-stressed concrete simply supported beams, continuous beams, slabs, portal frames.

Design of pre-stressed concrete pipes, poles, sleepers, pressure vessels.

Fire resistance, bond, handling and transportation of pre-stressed concrete elements.

References:

CIE 581 ADVANCED DESIGN OF RCC STRUCTURES [3 1 0 4]

Analysis and Design of the following Reinforced Concrete Structures:

a) Continuous Beams
b) Multistorey Frames
c) Bunkers and Silos
d) Overhead water tanks: Rectangular and Intze type water tanks

Design of deck and beams of T beam deck Slab Bridge.

Pre fabricated construction: Requirements for pre-fabricated R.C. members – design and erection of pre-fabricated members – general erection principles – transportation and storage – joints in pre-fabricated structures – analysis and design of embedded parts.

References:


References:

3. Design and Construction of Offshore Structures, Institution of Civil Engineers (ICE), London, 1977
Material properties, masonry units, clay and concrete blocks, mortar, grout and reinforcement, bonding patterns, shrinkage and differential movements; Masonry in compression, prism strength, eccentric loading, kern distance; Masonry under lateral loads, in-plane and out-plane loads, analysis of perforated shear walls, lateral force distribution for flexible and rigid diaphragms; Behaviour of masonry members, shear and flexure, combined bending and axial loads, reinforced vs. un-reinforced masonry, cyclic loading, ductility of masonry walls for seismic design, infill masonry; Structural design of masonry, working and ultimate strength design, in-plane and out-plane design criteria infill, connecting elements and ties, consideration of seismic loads, code provision; Seismic evaluation and retrofit, in-situ and non-destructive tests for masonry; properties, repair and Strengthening of existing masonry structures for seismic loads; Construction practices and new materials.

References:

Necessity of ground improvement, methods.

**Reinforced Earth:** Introduction, principle and advantages of reinforced earth, behaviour of reinforced earth, design methods, material specifications, application. Soil nailing-construction procedure, design and specifications. Civil Engineering applications of geo-synthetics.

**References:**

CIE 585 RELIABILITY ANALYSIS AND DESIGN OF STRUCTURES [3 1 0 4]


References:

Plastic Analysis.
Limit state method of design of steel frames (upto two storeys and two bays and gable frames).
Analysis and Design of Pressed steel rectangular water tank.
Design of Steel Truss Bridges (Deck and Through Type).
Design of steel girder bridges.
Analysis and Design of Composite beams and columns:
Steel with Plain Concrete / Reinforced Concrete.

**References:**

5. Steel Tables.

References:

CIE 588 STRUCTURAL STABILITY [3 1 0 4]

**Buckling of Columns**: Stability criteria by different approaches, Governing differential equation, Analysis for various boundary conditions, Energy method, Inelastic buckling of columns.

**Lateral Buckling of Beams**: differential equation for lateral buckling, Lateral stability of different types of beams.

**Beam - Columns and Frames**: Magnification factors for forces and displacements in beam columns subjected to different types of loads, Buckling of simple frames.

**Elastic Buckling of Plates and Shells**: Equilibrium approach and energy approach for buckling of plates, post buckling behaviour of plates, failure of cylindrical shells.

**Dynamic Stability of Structures**: Discrete systems, Lagrange Hamilton formulation for continuous systems, stability of continuous systems and energy approach for buckling of plates, post buckling behaviour of plates, Failure of cylindrical shells. Finite element formulation of stability problems for both discrete and continuous systems.

**Code specifications for design**: Discussion on code provisions for the design of columns, beam columns, beams and stiffeners in girders.

**References**:

Types and classification of composite materials. Composite Laminates, Lamina stress-strain relationship – classification of laminates-Failure theories-Classical lamination theory-Stress strain variation in a laminate-Stress analysis-Intra and inter laminar stresses in laminates-First and higher order deformation theories – bending, vibration and buckling analyses using the above theories-Equilibrium equation using PMPE-Boundary conditions-Solution methods.

References:

Introduction: Importance of earthquake resistant Design – ground motion in an earthquake – Types of seismic waves; Earthquake intensity – modified Mercalli scale – comprehensive intensity scale.


Codal provisions (I.S. 1893 - 1984, IS 4326 -1976 and SP 22 - 1982) and earthquake resistant design.

Earthquake Zones: Terminology – Design criteria: multi-storey buildings, elevated structures like, elevated tanks, and stack like structures, bridges and dams (Emphasis on Design of multi-storey buildings and Dams.)

References:

Classification of Shells – Properties of curves – Polynomial equations – Cylindrical shell – Membrane Theory – Beam Theory – Arch analysis.

Cylindrical shells – Bending Theory – North light shells.

Membrane Theory for shells of revolution - Domes – Paraboloids – Conical shell – Rotational Hyperboloids

Synclastic shells – Elliptic paraboloids

Anticlastic shells – Hyperbolic paraboloid – umbrella roof.

Conoids - Folded plates.

Construction of concrete shell roofs

References:


WELL FOUNDATIONS: Forces acting on well foundation – Analysis of well foundation using Terzaghi’s method.


FOUNDATIONS FOR TALL STRUCTURES: Water tanks, Chimneys, Antenna towers and Radar Units.

SPECIAL FOUNDATIONS: Hyperbolic Parabolic shells etc.

References:
10. Relevant IS codes
Torsion: Torsion of non-circular sections - Torsion of thin walled sections.

Unsymmetrical bending of straight beams - stress distribution - shear centre - shear flow in thin walled beam cross sections - shear centre for thin walled sections.

Bending of Curved Beams: Crane hooks, closed rings - correction factor for flanged cross sections.

Bending of beams curved in plan.

Beams on Elastic foundation - Infinite beams - Semi - infinite beams - short beams.

References:

CIE 556 NON-DESTRUCTIVE TESTING OF MATERIALS [3 0 0 3]

Introduction, Need, Tensile test, Fatigue test, creep test, hardness test, impact test, Basic elements of NDT, Rebound hammer test, Magnetic particle test, liquid Particle test, ultrasonic test, Radiography, Acoustic Emission Test, Eddy current test, Leak test, New methods, reliability, case studies.

References:

4. George Dicter, Mechanical Metallurgy
5. Warren J. McGonnagle, Non Destructive Testing
7. TMEH Hand Book.
Introduction: Global energy, Environmental resources, energy needs, energy crisis.
Indian scenario - Energy consumption, needs and crisis.
Energy production, utilization, Laws and Principles
Renewable sources of energy and Environmental aspects - Bio gas, Bio-Mass,
Hydro power, ocean energy, solar energy, geothermal energy, wind energy
Urban waste derived energy, agricultural waste derived energy.
Non-renewable sources of energy and Environmental aspects – energy norm, coal, oil, natural gas, Nuclear energy,
Global temperature, Green house effects, global warming.
Acid rain - Causes, effects and control methods.
Regional impacts of temperature change.

References:
CIE 552 COMPUTER LAB

1. Dynamic analysis of plane trusses
2. Dynamic analysis of rigid jointed plane frames
3. Stability analysis of rigid jointed plane frames
4. Introduction to STAAD Software / modelling
5. Problem related to plane frame/ space frame
6. Analysis and design of space frame / Industrial truss
7. Analysis and design of multi-storey building / grid floor
8. Design of RCC Element
9. Design of Steel Structures – Beam and column
10. Design of PSC members

References: