The growth in infrastructure requirements has posed a definite and critical need of qualified Structural as well as Construction Engineers. The aim of this program is to impart advanced fundamental concepts related to mechanics and dynamics of the structures. These coupled with courses related to recent developments in construction materials and technologies will impart cutting edge design methodologies and implementation strategies to students in both Sub and Superstructures of various infrastructure facilities. The course will also focus on laboratory work, industry oriented project exposure and dissertation based on research for all round development of Design & Construction Engineer.

The program’s goal is to provide students with advanced technical knowledge of evolving structural systems integrated with a solid grounding of design approaches. This programme is designed for students and industry professionals seeking to advance their careers, and for academics preparing for the challenges of research and teaching. The courses are designed to establish a fine balance between academic fundamentals and industry realities and requirements.

This programme will be able to find many employers from Government, private corporations, public sector undertakings, and teaching and/or research institutions in the country as well as abroad. The uniqueness of this course is the blend of exposure to strong theoretical foundation, practical design & construction approaches through adequate computational, analytical and execution skill development.
### CURRICULUM

#### First Semester

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Credits 19

*Non Credit Course

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Credits 16

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Credits 14

Total Credits 64
## List of Courses

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3
## Project Work

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Linear algebra: Review of matrices and linear systems of equations, Vector spaces and subspaces, linear independence, basis and dimensions, linear transformations, orthogonality, Orthogonal basis, Gram Schmidt Process, least-square applications, Differential equation with series solutions: Legendre’s equation, Legendre’s polynomial $P_n(x)$, Legendre’s function of the second kind $[Q_n(x)]$, General solution of Legendre’s equation, Rodrigue’s formula, Legendre polynomials, A generating function of Legendre’s polynomial, Orthogonality of Legendre polynomials, Recurrence formulae for $P_n(x)$ Green's function – Green’s Identities – Generalized functions.


TEXT BOOKS / REFERENCES:


Review of the concepts: Basic concepts of structural analysis; Basis for principle of virtual work; Principle of virtual forces - standard and matrix formulation; Force method for analysing skeletal structures; Principle of virtual displacements - standard and matrix formulation; Displacement method for analysing skeletal structures; Extension of displacement method to the generalised stiffness method; Basic concepts associated with computer implementation of stiffness method. - One-dimensional beam element : Basis for cross-sectional level formulation of flexibility and stiffness; Gauss quadrature numerical integration scheme; Flexibility approach for determining element stiffness; Stiffness approach for determining element stiffness; Special consideration of shear effects in stiffness approach; Consideration of torsional effects for thin-walled member; Special considerations for finite joints (both rigid and flexible); Consideration of local load (incl. temperature) effects; Formulation of geometric stiffness due to axial force; Linearised buckling analysis. - Structural dynamics- SDOF- introduction to MDOF- behavior of structures subjected to wind and earthquake loads.

TEXT BOOKS/ REFERENCES:


16SC611 THEORY OF ELASTICITY AND PLASTICITY 3-0-0-3

Introduction to Cartesian Tensors: Transformation laws of cartesian tensors, special tensors and tensor operations, the $e\cdot\delta$ identity, symmetry and skew-symmetry, contraction, derivatives and the comma notation, Gauss’ theorem, the base vectors and some special vector operations, eigenvalue problem of a symmetric second order tensor, equations of elasticity using index notation. - Introduction to the mathematical theory of elasticity: Two-dimensional idealisations, plane stress and plane strain problems, equations of equilibrium, strain-displacement relations, constitutive relations, compatibility conditions, displacement and traction boundary conditions. Two-dimensional problems in rectangular coordinates: Stress function, solution by polynomials, Saint Vénant’s principle, bending of a cantilever. Two-dimensional problems in polar coordinates: General equations, problems of axisymmetric stress distribution, pure bending of curved bars, effect of circular hole, concentrated force on a straight boundary. -Stress and strain problems in three dimensions: Principal stresses, principal strains, three-dimensional problems. Energy Theorems and Variational Principles of Elasticity, uniqueness of elasticity solution. - Torsion of straight bars, membrane analogy, narrow rectangular cross-section, torsion of rectangular bars, rolled profile sections, hollow shafts and thin tubes. Introduction to plasticity: One-dimensional elastic-plastic relations, isotropic and kinematic hardening, yield function, flow rule, hardening rule, incremental stress-strain relationship, governing equations of elastoplasticity.

TEXT BOOKS/ REFERENCES:


16SC612 ADVANCED STRUCTURAL DESIGN 3-1-0-4

Stress-strain characteristics of concrete under multi-axial stresses- confined concrete- Effect of cyclic loading on concrete and reinforcing steel. Ultimate Deformation and ductility of members with flexure- strength and deformation of members with tension - Control of deflections- Control of cracking – Codal procedures on crack-width computation. Strut and
Tie Models- Design methodology- Applications - RCC beam – column joints- shear strength - design of exterior and interior joints- wide beam joints. Strength and ductility of concrete frames- analysis and design of shear walls- design of special RCC members – corbel, deep beam, ribbed slab.- Stress strain behaviour and strength of steel under static and cyclic loading; Buckling and post buckling behaviour of plates; Linear elastic, plastic, linear buckling and nonlinear and advanced analysis methods. Limit States Design: Uncertainties in load and resistance; Limit States and Load and Resistance Factor Design methods. Behaviour and design of members under combined forces. Fasteners: Methods of installation and behavior. Screws and rivets in cold formed steel construction. Types of connections, Behaviour of local elements, Analysis, Design and Detailing. Cold Formed Steel Members: Effective width and Direct Strength Design methods

TEXT BOOKS/ REFERENCES:


16SC613 CONSTRUCTION PROJECT MANAGEMENT 3-0-0-3


TEXT BOOKS/ REFERENCES:


16SC615 EXPERIMENTAL TECHNIQUES 1-0-1-2

Concrete mix proportioning, Study of High performance concrete -Introduction to Non Destructive Test methods.- Principles of operations of hydraulic loading systems, strain gauges, strain and force measuring devices, etc.-Utilization of Mechanical, electrical resistance and other types of strain gauges to study the behavior of structural members.-Use of static and dynamic data recording and processing systems. Demonstration on wind tunnel testing.

TEXT BOOKS / REFERENCES:

16SC602 FINITE ELEMENT ANALYSIS 3-0-0-3


TEXT BOOKS/ REFERENCES:

16SC603 ADVANCED CONSTRUCTION PRACTICES 3-0-0-3


TEXT BOOKS/ REFERENCES:


16SC614 ADVANCED FOUNDATION SYSTEMS 3-0-0-3

Foundation classification; Choice of foundations; Bearing capacity and settlement analysis of shallow foundations like footings and rafts, Deep foundations like piles, piers and Caissons; Foundations on expansive soils, laterites, fills and rock. Introduction to Limit State Design of reinforced concrete in foundations; Soil pressure for structural design; Conventional structural design of continuous footings, individual footings, combined footings and rafts of various types subjected to vertical and lateral loads and moments; Design of circular rafts; Soil-structure interaction and ‘flexible’ approach to the design of foundations. Analysis and design of pile foundations, piers, well foundations. Special foundations - ring foundations, offshore foundations.

TEXT BOOKS/ REFERENCES:

16SC616 STRUCTURAL DESIGN STUDIO 0-1-2-3


TEXT BOOKS/REFERENCES:

5. Relevant IS Codes.

16SC617 CONSTRUCTION SOFTWARE LABORATORY 0-0-1-1

Project management software - Project estimation, project planning, project scheduling, network analysis, project time reduction and optimization, resource leveling, project time, cost and finance management, earned value analysis. Visualization software – Exposure to BIM modelling.

16EN600 TECHNICAL WRITING P/F


TEXTBOOKS/REFERENCES


16SC618 LIVE-IN-LAB / INDUSTRIALSEMINAR 0-0-1-1

Live In Lab
The interested students will get an opportunity to work in any of the villages and solve the technical problems in areas related to the course by applying the engineering knowledge they have acquired through their study. The students can visit the village and identify the problem at the end of first year (summer vacation), start working on it and complete in the third semester.

INDUSTRIAL SEMINAR
The objective of the training is to expose the students to industry environment and practices.
The students can identify the problem with the support of experts from industry at the end of first year (summer vacation) and start working on it.
Apart from this, experts from the Civil Engineering industry are invited to deliver lectures on field related issues and share their professional experience including aspects of Professional ethics. Each student is required to prepare a detailed report and present the same for evaluation.

16SC 798 DISSERTATION 8
16SC 799 DISSERTATION 14

16SC701 MECHANICS OF COMPOSITE MATERIALS 3-0-0-3


TEXTBOOKS/REFERENCES:


16SC702 ADVANCED CONCRETE TECHNOLOGY 3-0-0-3

Concrete as a composite material; Materials science aspects of the properties and behavior of Cement Concrete: physical and chemical aspects of cement hydration, type and morphology of hydrates; Chemical and Mineral admixtures for concrete. Rheological behaviour of fresh Concrete - Fresh and hardened concrete properties; elastic behavior, shrinkage, creep, behavior under various stress states. Durability - Permeability, chemical attack, acid attack, corrosion in concrete. -Modern trends in concrete manufacture and placement techniques, Methods of transportation, placing and curing-extreme whether concreting, Special concreting methods -Vacuumdewatering of concrete-Under water concreting. High performance and High Strength concrete; Self compacting concrete - Light weight concrete, Heavy weight and mass concrete, Heat resisting concrete, Fiber reinforced concrete. Nondestructive evaluation of concrete structures; Cement based composites; Fracture mechanics of concrete

TEXT BOOKS/ REFERENCES:

3. A RSanthakumar, “Concrete Technology” Oxford University Press, 2006

16SC703 CONSTRUCTION METHODS AND EQUIPMENT 3-0-0-3

Planning Process for Equipment and Methods; Cost of Owning and Operating Construction Equipment - Ownership cost, Depreciation, Operating cost, and Ownership and operating costs calculation methods; Equipment Life and Replacement Procedures - Physical, profit and economic life, Replacement analysis; Engineering Fundamentals of Moving Earth - Rolling

TEXT BOOKS/ REFERENCES:


16SC704 STRUCTURAL DYNAMICS 3-0-0-3


TEXT BOOKS/ REFERENCES:


16SC705 THEORY OF PLATES AND SHELLS 3-0-0-3

Introduction – Formulation of governing equations and associated boundary conditions by equilibrium and energy methods, Rectangular plates- Solution of equation by double and

TEXT BOOKS/ REFERENCES:


16SC706 SYSTEM INTEGRATION IN CONSTRUCTION 3-0-0-3


TEXT BOOKS/ REFERENCES:

16SC707 QUALITY CONTROL AND SAFETY IN CONSTRUCTION 3-0-0-3

Introduction to quality; Importance of quality; Quality transition - quality control and inspection, quality assurance, total quality management; Evolution of quality management; Planning and control of quality during design of structures; Tools and techniques for quality management; Inspection of materials and machinery; Quality assurance in construction; Formwork planning and design for quality. Systems quality management; Quality standards/codes in design and construction; (ISO:9000); Total quality management (TQM) - principles, tools and techniques. - Introduction to safety; Safety and health programs in construction industry; Planning for safety provisions; Analysis of construction hazards and accidents; Construction hazards and safety guidelines; Prevention techniques for construction accidents; Safety requirements for scaffolding; Site management with regard to safety recommendations; Training for safety awareness and implementation; Construction safety and health manual.

TEXT BOOKS/ REFERENCES:


16SC708 PRE-STRESSED CONCRETE DESIGN 3-0-0-3

Introduction to prestressed concrete: types of prestressing, systems and devices, materials, losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provisions. - Statically determinate PSC beams: design for ultimate and serviceability limit states for flexure, and flexure combined with axial compression or tension; analysis and design for shear and torsion, code provisions. Transmission of prestress in pretensioned members; Anchorage zone stresses for post tensioned members. Statically indeterminate structures Analysis and design continuous beams and frames; choice of cable profile, linear transformation and concordancy. - Composite construction with precast PSC beams and cast insituRC slab Analysis and design, creep and shrinkage effects. Partial prestressing principles, analysis and design concepts, crack-width calculations. Analysis and design of prestressed concrete pipes, tanks and spatial structures slabs, grids, folded plates and shells.

TEXT BOOKS/ REFERENCES:

16SC709 ANALYSIS AND DESIGN FOR WIND AND EARTHQUAKE FORCES 3-0-0-3


TEXT BOOKS/ REFERENCES:


16SC710 FORENSIC ENGINEERING AND REHABILITATION OF STRUCTURES 3-0-0-3


TEXT BOOKS/ REFERENCES:


16SC711 GEOTECHNICS FOR INFRASTRUCTURE 3-0-0-3

Site investigation for infrastructure projects; Principles of exploration; Modern methods of boring and sampling; Sampling records, Soil profiles, various types of field tests; Excavation scheme. - Engineering properties of soft, weak and compressible deposits; Methods of soil improvement lime stabilization and injection; thermal, electrical and chemical methods; - Dynamic consolidation; Vibroflotation - Types of foundations for industrial structures; Design of deep foundations for heavy structures, railway and highway bridges; Foundations for transmission line towers, storage tanks, silos, chimneys etc., Sheet piles and cofferdams; Design of dewatering systems. Preloading and vertical drains, Introduction to Geotextiles and Geomembranes,Grouting (along with injection).Recent trends in infrastructure projects like soil nailing, reinforced earth, gabion walls.

TEXT BOOKS/ REFERENCES:


16SC712 OPTIMIZATION TECHNIQUES 3-0-0-3

TEXTBOOKS/REFERENCES:


16SC713 SMART MATERIALS AND STRUCTURES 3-0-0-3


TEXT BOOKS/ REFERENCES:

**16SC714 STABILITY OF STRUCTURES 3-0-0-3**


**TEXT BOOKS/ REFERENCES:**


**16SC715 INDUSTRIAL STRUCTURES 3-0-0-3**


**TEXT BOOKS/ REFERENCES:**

16SC716 BRIDGE ENGINEERING 3-0-0-3


TEXT BOOKS/REFERENCES:


16SC717 PREFABRICATION ENGINEERING 3-0-0-3

Types of prefabrication, prefabrication systems and structural schemes - Disuniting of structures - Structural behaviour of precast structures. Handling and erection stresses - Application of prestressing of roof members; floor systems two way load bearing slabs, Wall panels, hipped plate and shell structures - Dimensioning and detailing of joints for different structural connections; construction and expansion joints. Production, Transportation & erection - Shuttering and mould design Dimensional tolerances -Erection of R.C. Structures, Total prefabricated buildings - Designing and detailing prefabricated units for 1) industrial structures 2) Multistorey buildings and 3) Water tanks, silos bunkers etc., 4) Application of prestressed concrete in prefabrication.

TEXT BOOKS/REFERENCES:


TEXT BOOKS/ REFERENCES:


Introduction - Comparison between Flexible & Rigid Pavements - Highway and Airport pavements – Types and Component layers of Pavements – their functions - A brief study on aggregates, bitumen and modified bitumen like cutback, emulsion, polymer modified bitumen - Factors affecting Design and Performance of Pavements - Various Methods of Assessment of Subgrade Soil Strength for Pavement Design - Causes and Effects of variation in Moisture Content and Temperature. Bituminous mix design methods, specifications and


TEXT BOOKS/REFERENCES:


16SC720 SUSTAINABLE DESIGN AND CONSTRUCTION PRACTICES  3-0-0-3


TEXT BOOKS/REFERENCES:

16SC721 CHARACTERISATION OF MATERIALS 3-0-0-3

Characterization Techniques: Structure of solids: crystal systems and space groups, Bravais lattices, direct and reciprocal lattice, Bragg law, powder diffraction and phase identification, single crystal diffraction, structure factor, X-ray crystal structure determination. Fundamental principles and application to Material characterization: Macroscopic and microscopic techniques— visual examination-optical and electron microscopy (SEM,TEM); chemical and mineralogical analysis techniques – X-ray and neutron diffraction; spectroscopic techniques- image analysis, and nondestructive techniques. Methods for Structure Determination-X-ray diffraction; Analytical techniques for the determination of Structure of construction materials- FTIR, AFM and thermal analyses (sample preparation), energy dispersive analysis (EDAX) - Characterisation of rheological behavior: Rheological parameters; Classifications of fluids, time independent and time-dependent fluids, elastic viscous fluids. Constitutive equation of rheology, shear and extensional viscosities, dependence of viscosity on temperature, pressure, molecular weight, strain rate and time. Flow curve. Viscoelasticity - effect of rate of strain, temperature and time on mechanical behavior; Creep, creep compliance, stress relaxation; Dynamic mechanical properties. Flow analysis using rheological models. Measurement of rheological properties. Application of rheology in cement-based materials.

TEXT BOOKS/ REFERENCES:

Seismology and Earthquakes: Internal Structure of the Earth, Continental Drift and Plate Tectonics, Faults, Elastic rebound theory, Different sources of Seismic Activity, Geometric Notation, Location of Earthquakes, Size of Earthquakes.


Ground Response Analysis: Ground Response Analysis, One Dimensional Linear, Evaluation of Transfer Function, Uniform undamped soil on rigid rock, Uniform damped soil on Rigid Rock, Uniform damped soil on elastic rock, layered damped soil on elastic rock, Equivalent linear Approximation, Deconvolution.

Site characterization and Design: Different methods and experiments. Local site effects: ground motion amplifications, Development of response /design spectrum, Liquefaction hazard assessments, Landslide hazard assessment, Seismic slope stability analysis, Seismic Analysis and Design of Various Geotechnical Structures.

TEXT BOOKS/ REFERENCES:


SOIL DYNAMICS AND MACHINE FOUNDATIONS

Wave propagation: Types of waves, Waves in unbound media, Waves in semi-infinite media, Waves in layered media. Dynamic soil properties: Laboratory tests, Field tests, Correlation of different parameters.


TEXT BOOKS/ REFERENCES: