Master of Technology in Structural Engineering
Department of Civil Engineering

Subject Code	Course Title	Credit
Semester 1 (Core Courses)		
CE581	Advanced Structural Analysis	4(3 1 0)
CE582	Finite Element Methods	4(3 1 0)
CE583	Structural Dynamics	3(2 1 0)
CE584	Design of Advanced Concrete Structures	4(3 1 0)
CE585	Concrete Technology	3(2 1 0)
CE598	Structure Lab I	2(0 0 4)
	Total Semester Credits	**20**
Semester 2 (Elective Courses)#		**Credits**
CE586	Bridge Engineering	3(2 1 0)
CE587	Advance Solid Mechanics	3(2 1 0)
CE588	Tall Buildings	3(2 1 0)
CE589	Prestressed Structures	3(2 1 0)
CE590	Earthquake Engineering	3(2 0 2)
CE591	Structural Optimization	3(2 1 0)
CE592	Design of Composite Structures	3(2 1 0)
CE593	Plate & Shells	3(2 1 0)
CE594	Computational Methods	3(2 1 0)
CE595	Advanced Foundation Design	3(2 1 0)
CE596	Ground Improvement Techniques	3(2 1 0)
CE597	Soil Structure Interaction	3(2 1 0)
CE599	Structural Lab.-2	2(0 0 4)
	Total Semester Credits	**18-21**
Semester 3		**Credits**
CE601	Seminar	4(0 0 8)
CE602A	Dissertation	16(0 0 32)
	Total Semester Credits	**20**
Semester 4		**Credits**
CE602B	Dissertation	16(0 0 32)
	Total Semester Credits	**16**
	Total Credits of all semesters	**74-77**

#These courses will be floated by the faculty of Department.

#The students may opt for any of the elective course offered in the Institute on recommendation of supervisor

M. Tech. (Structural Engineering)

SYLLABUS

Course code: CE581

Course Name: Advanced Structural Analysis

Credits: 4

L-T-P: 3-1-0

Detailed syllabus:

Matrix methods in skeletal structural analysis : force and displacement methods; Structure on elastic foundation; Direct stiffness method; Formation of member stiffness matrix; Transformation of load vector and displacement vector; Formation of global stiffness matrix; Analysis of continuous beams, plane frames, plane trusses.

Course code: CE582

Course Name: Finite Element Method

Credits: 4

L-T-P: 3-1-0

Detailed syllabus:

Finite element technique, discretization, energy and variational approaches. Basic theory, displacement and force models, slope function theory, use of parametric and local coordinates, convergence criteria, numerical integration. Applications, plane stress and plain strain problems, axi-symmetric solids, three dimensional problems, plate and shell structures, temperature problems. Nonlinear problems, introduction to iterative and incremental procedures for material and geometrically nonlinear problems, examples from plane stress and stability. Applications to Civil Engineering problems

Course code: CE583

Course Name: **Structural Dynamics**

Credits: 3

L-T-P: 2-1-0

Detailed syllabus:

Single degree of freedom System: Equation of motion; undamped and damped Free vibration; undamped and damped forced vibration; Harmonic load; Evaluation of damping; Periodic load; General load; Response spectrum Analysis. Analysis of multi degree of freedom System; Generation of damping matrix, modal analysis; Continuous Systems; Numerical Evaluation of Dynamic Response. Introduction to a seismic analysis.

Course code: CE584

Course Name: **Design of Advanced Concrete Structures**

Credits: 4

L-T-P: 3-1-0

Detailed syllabus:

Basic philosophy of concrete materials, Concrete Mix Design, Basic philosophy of Design of concrete structures, Design of single and multibay structures in concrete, Portal Frames, Space frames, large span roof structures, Bunkers and Silos, pressure vessels and chimneys, Folded Plates, Reinforcement detailing for members and joints detailing; Codal provisions.

Basic philosophy of foundation design, raft foundations, pile foundations & well foundations,

Prestressing of concrete structures, Analysis and design of determinate & indeterminate beams, Concordant Cables, Design of end blocks.

Course code: CE585

Course Name: Concrete Technology

Credits: 3

L-T-P: 2-1-0

Detailed syllabus:

Review of constituent materials and mix design, admixtures, properties of concrete in fresh state and hardened state, special concretes, durability of concretes subjected to extreme environment, deterioration mechanisms, assessment and control of corrosion in concrete structures, insitu assessment of concrete structures, various NDT techniques and their applications, repair of concrete structures.

Course code: CE586

Course Name: Bridge Engineering

Credits: 3

L-T-P: 2-1-0

Detailed syllabus:

Types of Bridges, choice of bridge type, criteria for selection of bridge site, economic span, bridge loadings, slab bridges, effect of skew, load distribution theories for multi beam bridges, design of R.C. and prestressed T beam bridges, behavior and structural action of box girder bridge, bridge bearings, methods of construction, inspection and maintenance procedures, rehabilitation of bridges.

Course code: **CE587**

Course Name: Advanced Solid Mechanics

Credits: 3

L-T-P: 2-1-0

Detailed syllabus:

Linear elasticity, Stress, strain, constitutive relations; Boundary conditions, Description of an Elasticity problem as a boundary value problem, Plane stress, strain, axi-symmetric problems, Large displacements and large strains; Cartesian, cylindrical and spherical coordinates; Introduction to curvilinear coordinates; Thermal strains. Introduction to plasticity; Yield condition; Ideal elasto-plastic material.

Course code: **CE588**

Course Name*:* Tall Buildings

Credits: 3

L-T-P: 2-1-0

Detailed syllabus:

Structural systems of tall buildings; Moment resistant frames, braced frames, eccentrically braced frames, shear walls, coupled shear walls, frame shear wall interaction, tubular structures; approximate and matrix oriented methods of design of tall buildings; design of pile and raft foundation for tall buildings.

Course code: CE589

Course Name: Pre-Stressed Structures

Credits: 3

L-T-P: 2-1-0

Detailed syllabus:

Basic philosophy of prestressing: Various techniques of prestressing with and without prestressing cables, different systems of prestressing, materials and design concepts, Prestressing of concrete structures, Analysis and design of beams, Design of end blocks, Ultimate strength in flexure and shear, Statically indeterminate structures, Tension members, tanks, compression members, partial prestressing, composite construction, precast prestressed elements.

Course code: **CE590**

Course Name: **Earthquake Engineering**

Credits: 3

L-T-P: 2-1-0

Detailed syllabus:

Characterization of ground motion, Earthquake intensity and magnitude; Recording instruments and base line correction; Predominant period and amplification through soil; Earthquake spectra for elastic and inelastic systems; Idealization of structural systems; Lateral force evaluation by mode superposition and direct integration; Effect of foundation/soil on earthquake response; Analysis for torsion; Review of damages during past earthquakes and remedial measures; Reinforcement detailing for members and joints detailing; Codal provisions.

Course code: CE591

Course Name: Structural Optimization

Credits: 3

L-T-P: 2-1-0

Detailed syllabus:

Formulation of different types of structural optimization problems; Optimality criteria based structural optimization; Computation of derivatives of response quantities with respect to design variables; Classical optimization; Lagrange multiplier technique and Kuhn-Tucker conditions; Solution of NLP by direct methods and by series of unconstrained optimization problems and by series of unconstrained optimization problems and by series of linear programming problems.

Course code: CE592

Course Name Design of Composite Structures

Credits: 3

L-T-P: 2-1-0

Detailed syllabus:

Composite Systems: Materials, loadings, composite floor systems, composite building systems, methods of analysis.

Composite Beams: Components and systems, fundamentals of composites action, shear connection, design for flexure, serviceability, prestressed beams.

Composite Columns: Types of composite compression members, behavior of composite columns, special considerations.

Lateral Resisting System: Types of bracing, moment resisting frames, braced frames, shear-wall design and horizontal diaphragms, joints.

Time dependent effects: Creep, shrinkage, thermal effects.

Course code: CE593

Course Name: Plates and Shells

Credits: 3

L-T-P: 2-1-0

Detailed syllabus:

Plate equation and behaviour of thin plates in Cartesian, polar and skew coordinates; Curvilinear coordinates and coordinate transformation; Isotropic and orthotropic plates, bending and twisting of plates; Navier and Levy solutions and energy methods; rectangular, circular plates and plates with variable rigidity in Cartesian and polar coordinates; Numerical solutions. Shell behaviour, shell surfaces and characteristics, classifications of shells, equilibrium equations in curvilinear coordinates, force displacement relations; Membrane analysis of shells of revolution and cylindrical shells under different loads, shallow shells, concept of pseudo stresses, membrane solution of elliptic paraboloids and hyperboloids, solutions of typical problems.

Course code: CE594

Course Name: Computational Methods

Credits: 3

L-T-P: 2-1-0

Detailed syllabus:

SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS: Error analysis; the roots of nonlinear equations, solutions of large system of linear equations and Eigenvalue problem of a matrix; Pascal's triangle for one and two dimensions, divided differences; Newton's forward and backward difference formulas; Differentiation using interpolation formulae; Numerical integration by trapezoidal and Simpson's rules; Romberg's method; Two and Three point Gaussian quadrature formulae.

INTERPOLATION AND APPROXIMATION: Solution of equation; Fixed point iteration: x=g(x) method; Newton's method; Solution of linear system by Gaussian elimination and Gauss-Jordon method; Iterative method-Gauss Seidel method, Inverse of a matrix by Gauss Jordon method; Eigen value of matrix by power method and by Jacobi method for symmetric matrix.

NUMERICAL DIFFERENTIATION AND INTEGRATION: Advanced numerical linear algebra; Direct and iterative methods for linear systems; Decompositions and SVD factorizations; stability and accuracy of numerical algorithms; Nonlinear ordinary differential equations & partial differential equations; Nonlinear optimization, FFTs, and wavelet analysis.

Note: Problem sets will involve use of MATLAB® or any other programming language.

Course code: CE595

Course Name: Advanced Foundation Design

Credits: 3

L-T-P: 2-1-0

Detailed syllabus:

Critical study of conventional methods of foundation design, analysis of settlement of soil and foundations, foundations of in-expensive and swelling soils, raft foundations, well foundations, pile foundations, theory of vibrations, liquefaction of soils, coffer dams, types and design principles, underpinning of foundations, design of bridge abutments, three dimensional consolidation and theory of sand drains, reinforced earth and its applications.

Course code: CE596

Course Name: Ground Improvement Techniques

Credits: 3

L-T-P: 2-1-0

Detailed syllabus:

Ground improvement potential, drainage methods, precompression and vertical drains, vibration methods, grouting and injection, mechanical cementing and chemical stabilisation; granular piles, stone columns, diaphragm walls, Soil reinforcement, Geosynthetics and their application cost effective design of retaining walls with geosynthetics, civil engineering applications of extruded polymer grids, Geomembranes with landfill closures, Thermal methods of ground improvement, Improving Rock stability and Quality.

Course code: CE597

Course Name: Soil Structure Interaction

Credits: 3

L-T-P: 2-1-0

Detailed syllabus:

Critical study of conventional methods of foundation design, nature and complexities of soil structure interaction, application of advanced techniques of analysis;. Interaction problems based on the theory of sub grade reaction such as beams, footings, rafts etc. Analysis of different types of frame structures founded on stratified natural deposits with linear and nonlinear stress strain characteristics, Determination of pile capacities, group action of piles; design of retaining structures.

Course code: CE598

Course Name: Structure Lab-I

Credits: 2

L-T-P: 0-0-4

Detailed syllabus:

Basic test for materials, Mix Design, Non-destructive and other relevant tests of concrete quality. Determination of various parameters for steel & concrete and other related parameters using computer programs.

Course code: CE599

Course Name: Structure Lab-II

Credits: 2

L-T-P: 0-0-4

Detailed syllabus:

Introduction to soft computing, Programming for structural analysis (MATLAB, FORTRAN, Excel and C^{++} Platforms), and use of other software for structural analysis and geo-technical engineering.