# SCHEME OF SYLLABUS FOR M. TECH. IN STRUCTURAL ENGINEERING

## FIRST SEMESTER

### CORE COURSES

<table>
<thead>
<tr>
<th>Course No</th>
<th>Subject</th>
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<tr>
<td></td>
<td></td>
<td>Theory</td>
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<tr>
<td>CSE-101</td>
<td>Matrix Structural Analysis</td>
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<tr>
<td>CSE-102</td>
<td>Dynamics of Structures</td>
<td>3</td>
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<tr>
<td>CSE-103</td>
<td>Concrete Technology</td>
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### Electives

- **Elective I**
  - MTHM-104 Numerical Methods: 3
  - CSE-105 Pre Stressed Concrete: 3
  - CSE-106 Computer Applications: 3

- **Elective II**
  - CSE-107 Hydraulic structures: 3
  - CSE-108 Theory of Plates and Shells: 3
  - CSE-109 Seismic Microzonation: 3

**Total Credits**: 16

## SECOND SEMESTER

### CORE COURSES

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<tr>
<td>CSE-201</td>
<td>Finite Element Analysis</td>
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<tr>
<td>CSE-202</td>
<td>Earthquake Resistant Design</td>
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<tr>
<td>CSE-203</td>
<td>Advanced Concrete Design</td>
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### Elective –III

- CSE-204 Solid Mechanics: 3
- CSE-205 Foundation Engineering: 3
- CSE-206 Soil Structure Interaction: 3
**Elective-IV**

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<tr>
<td>CSE-207</td>
<td>Construction Techniques and Management</td>
<td>3 0 3</td>
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<td>CSE-208</td>
<td>Rock Mechanics and Tunneling</td>
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<tr>
<td>CSE-209</td>
<td>Design of Tall Buildings</td>
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**Total Credits**: 16

**3RD SEMESTER**

**CORE COURSES**

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<td>CSE-301</td>
<td>Design of Industrial Structures</td>
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<td>CSE-302</td>
<td>Bridge Analysis and Design</td>
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<td>CSE-303</td>
<td>Seminar</td>
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<tr>
<td>CSE-304</td>
<td>Mid Term Evaluation of Dissertation</td>
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**Total credits**: 16

**FOURTH SEMESTER**

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<tr>
<td>CSE-401</td>
<td>Dissertation</td>
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**Grand Total of Credits**: 60

**Dissertation**: The topic of dissertation must be primarily of Structural Engineering Related either theoretical or experimental or both which a student has to carry out under the supervision of a faculty member/s of the Department.

Part time students will be eligible to join the 3rd Semester regular in their 5th semester only after successful completion of 1st semester and second semester.

**SYLLABUS FOR M.TECH. IN STRUCTURAL ENGINEERING**

**MATRIX STRUCTURAL ANALYSIS**


**Books Recommended**

Matrix & Finite Element Displacement Analysis of Structures: D.J.Dawe.


Matrix Analysis of Framed Structures: Gere & Weaver.

Introduction to Matrix Methods of Structural Analysis: Martin,H.C.
DYNAMICS OF STRUCTURES

SEMESTER: IST  L  T  P  C
COURSE NO. CSE-102  3  0  0  3

Nature of dynamic loading: Harmonic, Earthquake and blast loading, Single degree of
freedom systems, Free vibrations and Forced vibrations: Harmonic force, Periodic force,
Impulse, and General type of loading.
Multi-degree of freedom system: Free and Forced vibrations of lumped MDOF Systems,
numerical techniques for finding natural frequencies and mode shapes, orthogonality
relationships of principal modes, Rayleighs Principal and its application for
determination of fundamental frequency. Evaluation of dynamic response by mode
superposition method.
of bars and beams.
Introduction to wind loads.

Books recommended:
- Dynamics of Structures  By  Anil K. Chopra
- Dynamics of Structures  By  Clough and Penzien
- Structural Dynamics  By  Mario Paz
- Dynamics of Structures  By  J. L. Humour

CONCRETE TECHNOLOGY

SEMESTER: IST  L  T  P  C
COURSE NO. CSE-103  3  0  1  4

Concrete Making Materials:
Aggregates – Classification, IS specifications, Properties, Grading, Methods of
combining aggregates, specified gradings, Testing of aggregates.
2. Cement:
Chemical composition, Hydration of cement, structure of hydrated cement, special
cements, water chemical admixtures.
Concrete:
Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep
and Shrinkage, Variability of concrete strength.
Mix Design:
Principles of concrete mix design, Methods of concrete mix design, Testing of
cement.
Special Concretes:
Light weight concrete, Fibre reinforced concrete, Polymer concrete, Super plasticized
concrete, Properties and applicatons.

Concreting Methods:
Process of manufacturing of concrete, Methods of Transportation, placing and curing.
Extreme weather concreting, Special concreting methods.

REFERENCES:

NUMERICAL METHODS (ELECTIVE-I)

SEMESTER: IST  L  T  P  C
COURSE NO. MTHM-104  3  0  0  3

Numerical analysis, finite differences, interpolation, numerical solution of algebraic and
transcendental equations, iterative algorithms, convergence, Newton-Raphson procedure,
solution of polynomial and simultaneous linear equations, numerical integration, Euler-
Maclaurin formula, Newton-Cotes formula, error estimates, numerical solutions of
ordinary differential equations: method of Euler, Taylor, Adams Runge-Kutta and
predictor-corrector procedures, stability of solution, solution of boundary value problems,
finite differences techniques, stability and convergence of solution, finite element
method. Special functions. Legendre’s special function, Rodrigue’s formula, generating
functions for Legendre’s polynomials and recurrence formulae, Bessel’s function,
recurrence formulae, Bessel’s function of integral order.

Books recommended:
Numerical methods for Scientists and Engineers by M.K. Jain, S.R. Iyengar & R.K. Jain,
Wiley Eastern Ltd.
Mathematical Numerical Analyis By S.C. Scarborough, Oxford and IBH Publishing
Company.
Introductory methods in Numerical Analysis by S.S. Sastry, Prentice Hall of India.
Theory and problems in Numerical Methods by T. Veeranjan and T. Ramachandran, Tata
Numerical Methods for Mathematics Sciences and Engineering 2nd ed. By John H.
**PRE-STRESSED CONCRETE  (ELECTIVE-I)**

SEMESTER: IST  L  T  P  C  
COURSE NO. CSE-105 3 0 0 3

Pre-stressing systems and end anchorages, losses of pre-stress.
Analysis and design of members for flexure, shear, bond and bearings. Cable layouts.
Design of circular systems, domes and slabs.
Design of Pre-stressed Bridges, (Super-structure only).
Design of continuous beams.

**Books recommended:**
- Design of Pre-stressed Concrete Structures  By  Lin, T.Y. and Burns, N.H
- Design of Pre-stressed Concrete Structures  By  Krishna Raju

**COMPUTER APPLICATIONS  (ELECTIVE-I)**

SEMESTER: IST  L  T  P  C  
COURSE NO. CSE-106 3 0 0 3

**Introduction:**
Digital Computer Systems, problem solving techniques, introduction to programming languages, computer language and C++, source programme, Compilation and debugging.

**C++ Programming Basics:**
Using Turbo C++, Basic program construction, preprocessor directive, #include, #define, Header and Library functions, Keywords, INPUT-OUTPUT Statements, comments, Constants, Variables, and operators, Formatting statements, ENDL and SETW manipulators.

**Loops, Decision and Arrays:**
WHILE, DO-WHILE and FOR loops, general structure and control. IF, IF-ELSE statements, SWITCH, BREAK, CONTINUE statements, GOTO and labels, ARRAY fundamentals, types, use and manipulation of 2-D arrays as Matrices.

**FUNCTIONS:**
Concept of modularization of structured programming. Basics of functions, their types declaration, definition and structure.

**Object Oriented Programming Concept:**
General concepts of Object Oriented Programming, Objects and Classes, Member Functions, user defined data, Pointers, etc.
**File Processing:**
Streams, String I/O, Character I/O, Object I/O, input-output with Multiple objects, File Pointers, Disk I/O with Member Functions, Error Handling, Printer Output.

**Practical Applications:**
Programming for mathematical models of Civil Engineering problems and Management information systems, use of general purpose programmes.

**Books recommended:**
1. Object Oriented Programming with C++ by Robert Lafore

**HYDRAULIC STRUCTURES (ELECTIVE-II)**

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Design procedure for irrigation channels, Irrigation outlets, Canal masonry works, - principles of design, use of flow net, Khosla’s theory, Regulation works - Falls, distributory head regulators, Cross regulators, Cross drainage works, Canal head Works, Earth Dams, Gravity Dams, Spillways and Energy dissipators , Escapes , Trench weirs , Supply channel and head regulator.

**Books recommended:**

**THEORY OF PLATES AND SHELLS (ELECTIVE-II)**

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Prismatic folded plate systems, governing equations, analysis and design, numerical method and energy procedures, finite difference method, plates of various shapes; shell types and characteristics, classification, membrane analysis, bending analysis of shells of revolution and cylindrical shells, shell equations, solutions, analysis and design of cylindrical shells, approximate design methods for doubly curved shells.

**Books recommended:**
SEISMIC MICROZONATION (ELECTIVE-II)


**Prediction of Strong ground motion:** A theoretical study of the dependence of the Peak Ground Acceleration on source and structure parameters. High frequency earthquake strong ground motion in laterally varying media and the effect of fault zone. Physical mechanisms contributing to the seismic attenuation in the crust. Dynamic fracture mechanics. Near-field and far-field ground motions.

**Strong motion data:** Data acquisition and processing in strong motion seismology. Array analysis and synthesis mapping of strong seismic motion. Accelerogram spectral properties and prediction of peak values. Statistical model for peak ground motion from local to regional distances. Seismic intensity and its applications to engineering: a few case studies from Japan and Turkey.

**Complete strong motion synthetics:** Numerical modelling of realistic fault rupture processes: Kinematic dislocation models, 3-D modelling of spontaneous fault rupture processes. Stochastic simulation of high frequency ground motions based on seismological models of radiated spectra. Use of random vibration theory to predict peak amplitudes of transient signals. SHAKE?91. Fault surface integral and techniques for earthquake ground motion calculation with applications to source parameterization to finite faults. Path effects in strong motion seismology.


Site response and engineering application: Site response analysis using classical spectral ratio, generalized inverse technique, horizontal-to-vertical spectral ratio or receiver function, network average and Nakamura ratio. Determination of in-situ shear-wave velocity and Q-factor. Site amplification and its relation to surficial geologic condition. Constitutive relationships for soil dynamics. Soil structure interaction effects on strong ground motion. Engineering uses of strong motion data and seismic microzonation.

**BOOKS RECOMMENDED:**
1. Fundamentals of earthquake engineering by Newmark N.M. and Rosenblueth E.
2. Geotechnical Earthquake Engineering By Kramer, S.L
FINITE ELEMENT ANALYSIS

SEMESTER: 2ND  
COURSE NO. CSE-201  3  0  0  3


Shape Functions & Interpolation Polynomials. Refined One Dimensional Elements.


Finite Elements For Plate Bending Analysis. A 12-Degree-Of-Freedom Rectangular Element ( R1). Triangular Elements.

Books recommended:
Matrix & Finite Element Displacement Analysis of Structures: D.J.Dawe.
Matrix Finite Element Computer & Structural Analysis: M.Mukhopadhyay.
Concepts & Applications of Finite Element Analysis: Robert D.Cook.

EARTHQUAKE RESISTANT DESIGN (ELECTIVE-IV)

SEMESTER: 2ND  
COURSE NO.  

COURSE NO. CSE-202  
Introduction to Seismicity, Earthquake Motion and Response, Response Spectra, Philosophy of Capacity Design.
Concepts of seismic design: Earthquake resistant design of R.C.C Structures and IS:1893.
Earthquake resistant construction of R.C.C. Elements: Detailing aspects and IS:13920
Earthquake resistant design of Brick Masonry Structures and IS: 4326
Introduction to Indian Standards, related to Earthquake Engineering.
Earthquake resistant design of Bridges.

Books recommended:
1. Fundamentals of earthquake engineering Newmark N.M. and Rosenblueth E.
2. Earthquake Design practice for Buildings Key, D
3. Dynamics of Structures Anil K. Chopra
4. Dynamics of Structures Clough and Penzien
5. Seismic design of R.C.C & Masonry Structures Pauley, T. and Priestley
6. Bridge Engineering: Seismic Design W.F. Chen & Lian Duan

ADVANCED CONCRETE DESIGN

SEMESTER: 2ND  
OVERALL REVIEW:  

DESIGN OF SPECIAL RC ELEMENTS:  
Design of Slender Columns, Grid Floors, Curved Beams, Deep Beams, Plain & Reinforced Concrete Walls, Corbels & Edge (Spandrel) Beams.

SLABS:  
Design of Circular & Flat Slabs . Yield Line Analysis of Slabs.

FOLDED PLATES:  
General Features . Structural Behaviour, Analysis & Design of Folded Plates.

Books recommended:
Advanced Reinforced Concrete Design, N.Krishna Raju (CBS Publishers & Distributors),
Advanced Reinforced Concrete Design, P.C.Varghese( Prentice Hall of India)

**SOLID MECHANICS (ELECTIVE-III)**

**SEMESTER: 2**

**COURSE NO. CSE-204**

L  T  P  C

3  0  0  3

**Analysis of Stress and Strain:**

**2D Problems:**
two dimensional problems in Cartesian and polar co-ordinates for simple problems.

**Torsion:**
Torsion of non-circular sections: methods of analysis- membrane analogy- torsion of thin rectangular and hollow thin walled sections.

**Energy methods:**

**Introduction to problem in Plasticity:**

**Books recommended:**
Theory of Elasticity By Timoshenko, S. and Goodier T.N.,
Theory of Elasticity By Chenn, W. P and Henry D. J
Theory of Elasticity By Sadhu Singh.

**FOUNDATION ENGINEERING (ELECTIVE-III)**

**SEMESTER: 2**

L  T  P  C
Overview of basic principles of geotechnical engineering, Geotechnical site investigations,

**Introduction to Foundation Engineering**
- Construction materials, Engineered structures, foundation materials.
- Load transfer device/interfacing element, superstructures, foundation structures/sub-structures, Need for load transfer device, objectives.
- Principles of foundation Engineering, challenging problems.
- Design requirements/information needed for foundation design.
- Classification of foundations (Flexible, rigid, shallow and deep foundations).

**Terminology involved in Foundation Analysis and Design**
Gross bearing capacity, ultimate bearing capacity, net-ultimate bearing capacity, safe bearing capacity, net safe bearing capacity, safe bearing pressure, allowable bearing pressure.

**Design Criteria for Foundation Design**
Locatoin and depth criteria, shear failure criteria (safe bearing capacity criteria), settlement criteria (safe bearing pressure criteria).

**Factors for Selection of Type of Foundation**
Function of the structure and the loads it must carry, sub-surface condition of the soil, cost of super-structure.

**Basic Design parameters for safe foundation design**
- service loads (DL,LL,WL,EQL,SL,etc and their combination and reduction factors)
- safe bearing capacity
- size of footing (structural design by limit state design as in case of other RC members)
- soil pressure on foundation
- conventional analysis of foundations subjected to vertical loads and moments
- thickness of footing and its requirements
- minimum reinforcement requirement (IS:456)

**Bearing Capacity of Shallow foundations**
1. Bearing capacity based on the classical earth pressure theory of Rankine
2. Semi-empirical solutions based on theory of plasticity
   (a). Prandtl’s theory  (b). Terzaghi’s theory  (c). Meyerhof’s theory
   (d). Brinch Hansen’s theory (e). Vesić’s theory  (f). Balla’s theory
   (g). Skempton’s theory  (h). Caquot & Kerisel’s theory
   (i). Frochlicl’s theory
3. Exact methods based on theory of plasticity:
4. Semigraphical methods of:
   (a). Fellinius for clay soils, and
   (b). Button, Brown, Meyerhof and Vesic for two layer stratified deposits.
5. Penetration Tests (in situ-tests):
   (a). SPT- Standard penetration test,
(b). SCPT- Static cone penetration test
(c). DCPT- Dynamic cone penetration test
(d). PMT- pressure meter test.
(e). VST- vane shear test.
(f). PLT- plate load test (Insitu- test).

Settlement of shallow foundations, Need for Raft foundations and design methods.

Pile Foundations
Types of piles, selection and installation, behaviour of single pile under vertical load: load transfer mechanism, methods of determining ultimate load bearing capacity of a single pile (c, c-ϕ & ϕ soils)- skin resistance (straight shaft, tapered piles) point bearing capacity, vertical bearing capacity of pile groups, settlement of pile groups, effect of negative skin friction on bearing capacity.

Vertical Piles Subjected to lateral loads:
Solution for laterally loaded single pile, closed form solution for pile of infinite length, P-y curves for the solution of laterally loaded piles in sand and clay, modulus of subgrade reaction, finite difference method,
Pile groups subjected to vertical and lateral loads.
Design and construction of well foundations/caissons
Foundations on expansive and collapsible soils.
Foundation soil improvements.

Books Recommended:

SOIL STRUCTURE INTERACTION (ELECTIVE-II)

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Soil foundation Interaction:
Introduction to soil foundation interaction problems, soil behaviour, foundation behaviour, interface behaviour, scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, two parameter elastic model, Elastic Plastic behaviour, Time dependent behaviour.

Beam on Elastic foundation-soil models:
Infinite beam, two parameters, Isotropic elastic half space, analysis of beams of finite length, classification of finite beams in relation to their stiffness.

Plate on Elastic medium:

Elastic analysis of piles:
Elastic analysis of single pile, theoretical solutions for settlement and load distributions, analysis of pile group, interaction analysis, load distribution in groups with rigid cap.

Laterally loaded pile:
Load deflection prediction for laterally loaded piles, sub-grade reaction and elastic analysis, interaction analysis, pile raft system, solution through influence charts.

Books recommended:
- Elastic analysis of soil foundation interaction By Selva durai, A.P.S.
- Pile Foundation Analysis and Design By Poulos, H.G. & Davis E.H.
- Foundation Analysis By Scott, R.F.
- Geotechnical Earthquake Engineering By Kramer, S.L

CONSTRUCTION TECHNIQUES AND MANAGEMENT
(ELECTIVE-IV)

SEMESTER: 2ND
COURSE NO. CSE-207
L  T  P  C
3  0  0  3

Construction planning-Construction facilities, Schedules, Layout of Plant utilities, Construction methods: Excavation and handling of Earth and Rock; Production and handling of Aggregartes and Concrete, cooling of concrete in dams, Drainage treatment of aquifers/sub-terrainean reservoirs; Tunneling, Tunneling in soft rocks-Grouting, chimney formation, etc; Construction control and management-CPM/PERT, Human Factors, Organisation.

References:
ROCK MECHANICS AND TUNNELLING (ELECTIVE-IV)

SEMESTER: 2ND  L  T  P  C
COURSE NO. CSE-208  3  0  0  3

Rock Mechanics
Classification and index properties of rocks, Rock strength and failure criteria, initial stresses in rocks, influence of joints and their orientation in distribution of stresses-deformability of rocks.
Measurement of insitu, laboratory and insitu measurements of shearing, tensile and compressive strength, deformability of rocks.
Simple engineering applications in rock mechanics, underground openings, rock slopes, foundations, mining subsidence – case studies,
Rock bolt systems- installation techniques, testing of rock bolts, choice of rock bolts.

Tunnelling
Tunnel Engineering: Necessity, planning of tunnels, site investigation for tunnels, types of tunnels, tunnel alignment and grade, size and shape of a tunnel, method of constructions, methods of tunneling in hard rocks - full face method - heading and bench method - drift method - different methods of tunneling in soft soils including compressed air and shield tunneling - shafts in tunnels - ventilation of tunnel and various methods - lining of tunnels - drainage and lighting of tunnels, problems in tunnel constructions, boom tunnelling machines, full face tunnel boring machines; support of tunnels; adverse ground conditions; ground treatment and hazards in tunnelling.

Books Recommended


**DESIGN OF TALL BUILDINGS (ELECTIVE-IV)**

SEASON: 2ND  
COURSE NO. CSE-202  


**Books recommended:**

1. High Rise Building Structures Schueller, W
2. Structural Analysis & Design of tall Buildings B.S. Taranath
3. Handbook of Concrete Structures M. Fintal.
4. Tall Building Structures: Analysis & Design B. Stafford Smith & A. Coule

**DESIGN OF INDUSTRIAL STRUCTURES**

SEASON: 3RD  
COURSE NO. CSE-301  

1. Planning of Industrial Structures.
2. Design of Single & Multi-bay Industrial Structures in Concrete & Steel.
5. Towers.

**Books recommended:**

2. Design of Steel Structures, By Ram Chandra.

3. Design of Steel Structures, By Duggal.

**BRIDGE ANALYSIS AND DESIGN**

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**Books recommended:**

- Concrete Bridge Design By Rowe, R.E
- Design of Bridges By Victor Johnson
- Concrete Bridge Practice Analysis, Design and Economics By Raina V.K.