

NAGPUR UNIVERSITY
PROPOSED SCHEME OF EXAMINATION FOR M.TECH. (STRUCTURAL ENGINEERING) FOUR SEMESTER COURSE

FIRST SEMESTER

Sub Code	Name of Subject	Teaching Scheme (Clock Hours/week)				Assessment of Marks for Theory				Assessment of Marks for Practical				Duration of Paper in Hrs.
		L	T	P/D	Total	Paper	CA	Total	Min. for Passing	Uni. Exam	CA	Total	Min. for Passing	
IFST01	Theory of Elasticity and Stability	3	1	-	4	70	30	100	50	-	-	-	-	3
IFST02	Numerical Method for Structural Analysis	3	1	-	4	70	30	100	50	-	-	-	-	3
IFST03	Matrix Analysis of Structure	3	1	2	6	70	30	100	50	25	25	50	25	3
IFST04	Structural Instrumentation and Material Science	3	1	2	6	70	30	100	50	25	25	50	25	3
IFST05	Plastics Analysis and Design of Steel Structure	3	1	-	4	70	30	100	50	-	-	-	-	3
	Total	15	5	4	24	350	150	500*	250	50	50	100*	50	Total (T+P) =600*

SECOND SEMESTER

Sub Code	Name of Subject	Teaching Scheme (Clock Hours/week)				Assessment of Marks for Theory				Assessment of Marks for Practical				Duration of Paper in Hrs.
		L	T	P/D	Total	Paper	CA	Total	Min. for Passing	Uni. Exam	CA	Total	Min. for Passing	
IIFST01	Theory of Plates and Shells	3	1	-	4	70	30	100	50	-	-	-	-	3
IIFST02	Finite Element Method	3	1	-	4	70	30	100	50	-	-	-	-	3
IIFST03	Foundation Design	3	1	-	4	70	30	100	50	-	-	-	-	3
IIFST04	Structural Dynamics	3	1	2	6	70	30	100	50	25	25	50	25	3
IIFST05	Elective-I	3	1	2	6	70	30	100	50	25	25	50	25	3
	Total	15	5	4	24	350	150	500*	250	50	50	100*	50	Total (T+P) =600*

THIRD SEMESTER

Sub Code	Name of Subject	Teaching Scheme (Clock Hours/week)				Assessment of Marks for Theory				Assessment of Marks for Practical				Duration of Paper in Hrs.
		L	T	P/D	Total	Paper	CA	Total	Min. for Passing	Uni. Exam	CA	Total	Min. for Passing	
IIIFST01	Advanced Concrete Structures	3	1	2	6	70	30	100	50	25	25	50	25	3
IIIFST02	Elective-II	3	1	-	4	70	30	100	50	-	-	-	-	3
IIIFST03	Seminar on Dissertation	-	-	-	-	-	-	-	-	-	150	150	-	-
	Total	6	2	2	10	140	60	200*	100	25	175	200*	25	Total (T+P) =400

Elective-II – (a) High Rise (b) Design of Composite Construction (c) New Engineering Materials and Technology

FOURTH SEMESTER

Sub Code	Name of Subject	Teaching Scheme (Clock Hours/week)				Assessment of Marks for Theory				Assessment of Marks for Practical				Duration of Paper in Hrs.
		L	T	P/D	Total	Paper	CA	Total	Min. for Passing	Uni. Exam	CA	Total	Min. for Passing	
IVFST01	Dissertation /Thesis (Viva-Voce)	-	-	12	12	-	-	-	-	400	-	400	200	-

Proposed Syllabus of Examination for First Semester
M. Tech. (Structural Engineering) Full Time

I FST01 THEORY OF ELASTICITY AND ELASTIC STABILITY

SECTION A

1. Analysis of stress and strain in 2 dimensions: Introduction, Types of forces, Components of stresses and strains, Stress-strain relation, Plane stress and plane strain, Strain at a point, Differential equation of equilibrium, Boundary conditions and compatibility equations(rectangular coordinates), Airy's stress function
2. Analysis of stress and strain in 3 dimensions: Components of stress, Principal stresses, Stress invariants, Maximum shearing stress, Differential equation of equilibrium, Boundary conditions and compatibility equations.
3. Bending of cantilever of narrow rectangular section loaded at end, Bending of simply supported beam with uniform load, torsion of non-circular sections, Elliptical cross section.

SECTION B

4. Differential equation for beams columns with concentrated loads, continuous lateral loads and couples for simply supported ends, Application of trigonometric series, Lateral buckling of beams.
5. Energy method for elastic buckling of columns, Approximate method, Buckling of columns on elastic foundation, Columns with intermediate compressive forces and distributed axial load, Columns with changes in cross section.
6. Effect of shearing force on critical load, Buckling of built up columns, Buckling of simply supported rectangular plates uniformly compressed in middle plane.

I FST02 NUMERICAL METHODS FOR STRUCTURAL ANALYSIS

SECTION A

1. Programming fundamentals, introduction to algorithm development, interpolation & extrapolation.
2. Integration (central difference method, the Houbolt method, Newmark's method, Wilson - θ method), Newton-Gauss Quadrature method.
3. Solution of linear algebraic equations, Gauss elimination, Cholesky, Gauss Cholesky methods Given's, Householder methods, solution errors.

SECTION B

4. Solution of non linear Equation (Newton Raphson scheme , BFGS (Broyden et al) methods, introduction to line search algorithms
5. Eigen values problems (Jacobi, QR Method, LR Method, Introduction to Determinant search method, Subspace Iteration, Householder & Given's algorithms)
6. Initial & two point boundary value problem, Euler's , Runge-Kutta, Milne's Methods, Computer oriented algorithms.

FST03 MATRIX ANALYSIS OF STRUCTURES

SECTION A

7. Stiffness method for plane truss and plane frames.
8. Stiffness method for plane grid and space frames.
9. Analysis of building systems for horizontal loads.

SECTION B

Analysis for member loading (self, temperature & Imposed), inclined supports, lack of fit, initial joint displacements.

4. Effect of shear deformation, internal member end releases.
5. Solution technique with banded & skyline technique, band minimization, frontal techniques.

PRACTICAL: -

Minimum Six practicals based on above syllabus

Syllabus

I FST04 STRUCTURAL INSTRUMENTATION AND MATERIAL SCIENCE

SECTION A

1. Study of various transducers & Principle of their working, displacement velocity acceleration.
2. Stress-strain measurement, strain gauges static and dynamics strain measurement, Calculation of stresses from measurement of strain, deflections etc.
3. Special materials for building constructions i. e. steel fibre reinforced concrete, fibre reinforced plastics.

SECTION B

4. Non-destructive testing of concrete / steel / ultrasonic techniques etc, model Analysis related to structures.
5. Admixture for concrete, theories of corrosion and its preventions.
6. Special concrete like lightweight concrete, no fines concrete, Ferro cement, fly ash concrete etc. high performance concrete.

PRACTICAL: -

Minimum Six practicals based on above syllabus

I FST05 PLASTIC ANALYSIS & DESIGN OF STEEL STRUCTURES

SECTION A

1. Plastic behavior, review curves of structural steel, plastic moments, shape factors, load factors, plastic hinge, types of collapse, collapse mechanism ,collapse load factor.
2. Upper and lower bound, uniqueness theorems, principle of virtual work, statical method, minimum and maximum theorems, step by step method.
3. Methods of release of restrains, load interaction diagrams, method of inequalities.

SECTION B

4. Plastic Moment distribution applied to continuous beams & portal frames (Max. two bays single storey)
 5. Effect of Axial force & Shear force on Plastic moment of resistance
 6. Design of beams, continuous beams and portal frames up to two storey - two bays.
 7. Minimum weight analysis, introduction to stability.
-

II FST01 THEORY OF PLATES AND SHELLS

SECTION A

1. Introduction, Moment curvature relation in pure bending, Symmetrical bending of laterally loaded circular plates, Uniformly loaded circular plates with clamped and Governing differential equations of thin rectangular plates with various boundary conditions & loading.
2. Laterally loaded rectangular plates, Differential equation of the deflection surface(Lagrange's equation), Boundary conditions, Simply supported plates under sinusoidal loading, Navier's solution.
3. Finite difference method, Differential equation to bent surface of anisotropic plate, Application to grid.

SECTION B

4. General shell geometry, classifications, Membrane theory of cylindrical shells, equation of equilibrium, stress resultants under dead load and snow load for circular, cycloidal, catenary, and parabolic cylindrical shells.
5. Bending theory of cylindrical shells, Finster walder theory, Schorer's theory.
6. Approximate analysis of cylindrical shells by beam arch method.

II FST02 FINITE ELEMENT METHOD

SECTION A

1. Principles and discretization, Elements stiffness/ mass formulation based on direct, variational and weighted residual techniques.
2. Shape function, convergence, displacement formulation for rectangular, triangular elements in Cartesian coordinates, Application to 2D stress analysis.
3. Natural coordinates, Isoparametric elements, Numerical integration, Convergence of Isoparametric elements, Application to 1D problems.

SECTION B

4. Isoperimetric elements for two-dimensional and axisymmetric stress analysis for plane stress/ strain problems.
5. Isoperimetric formulation for thin and thick plates and shells.
6. Modelling techniques, application of FEM packages to general engineering structures.

FST03 FOUNDATION DESIGN

SECTION A

1. Design of isolated and combined footings, proportioning of footing for equal settlements.
2. Theory of sub grade reaction, beam on elastic foundation.
3. Design of rafts - I. S. code method, introduction to various methods.

SECTION B

4. Floating foundations, analysis and design of pile foundations, negative skin friction, group action in piles, design of pile cap.
5. Foundation subjected to eccentric loads, pull out resistance of foundation structures.
6. Analysis and design of simple machine foundation using I. S. code.

FST04 STRUCTURAL DYNAMICS

SECTION A

1. Fundamentals of Rigid / Deformable body dynamics, Analysis of undamped and viscously damped, single degree freedom systems.
2. Response of single degree freedom systems to harmonic loading, support motion and transmissibility, Duhamels integral.
3. Study of IS 1893-1984 and 2000 applicable to buildings and water tanks.

SECTION B

4. Free vibrations of lumped mass multi degree freedom systems, shear buildings, orthogonality criteria, Rayleigh's method
5. Dynamic analysis of systems with distributed properties, Approximate design method, Transformation factors.
6. Response spectra, Introduction to vibrations due to earthquake.

PRACTICAL: -

Minimum experiments based on above syllabus

IIFST04 Elective-I

(i) ADVANCED STEEL DESIGN

SECTION A

1. Design of connections.
2. Design of round tubular structures, Design of steel chimneys, Design of storage vessels.

SECTION B

3. Design of industrial sheds, bridges of crane / gantry Girders.
4. Design of bridges - highway and railways, Foot Bridge.

PRACTICAL: -

Minimum Four practical designs based on above syllabus.

(ii) DESIGN OF EARTHQUAKE RESISTANT STRUCTURES

Design of Earthquake Resistant Structures

SECTION A

1. Engineering geology of earthquakes, faults, Propagation of earthquake waves, quantification of earthquake, magnitude, energy, intensity of earthquake, accelerograph, accelogram, recording and analysis of earthquake records, seismicity of the world, Analysis and interpretation of earthquake data, determination of magnitude, epicenter, epicenter distances, focal depth, focal mechanism, seismic zoning
2. Causes or sources of earthquake damage, damage due to ground failure, History of past earthquakes, generation of response spectrum from available earthquake records, Evolution of seismic risk, Concept of response spectra, generation of site-specific spectrum, characteristics of earthquake ground motion
3. Guideline for achieving efficient seismic resistant design, geotechnical design consideration, determination of average shear wave velocity, average SPT etc

SECTION B

5. Strength, ductility and energy absorption, ductility of reinforced members subjected to flexure, axial loads & shear. Detailing of RCC members, beam column, Beam-column joints for ductile behaviors, IS code provisions.
6. Special aspects in Multi-storey buildings, Effect of torsion, flexible first story, P-delta effect, soil-structure, interaction on building response, drift limitation.
7. Study of IS: 1893, IS:13920 for analysis and ductile design of RCC structures and other related codes.

Reference Books:

1. IS:1893-2002
2. IS:13920-1993
3. Handbook on seismic analysis and design of structures, Farzad neaim

(iii) DESIGN OF ENVIRONMENTAL STRUCTURES

SECTION A

1. Design of Over Head Water tanks.
2. Design of under Ground Tanks.

SECTION B

3. Design of jack well/Pump house / approach bridges.
4. Design of pretreatment units i. e. clarifloculators aerators, flash Mixture, sand filters etc.

PRACTICAL: -

Three to four practicals designs based on above syllabus.

Syllabus of Examination for Third Semester
M. Tech. (Structural Engineering) Full Time

III FSTO1 ADVANCE CONCRETE STRUCTURES

SECTION A

1. Analysis and Design of Slab type & T -Beam bridges, IRC Recommendations.
2. Analysis and Design of Elevated service Reservoirs, IS Recommendations for wind & earthquake, Ductile detailing.

SECTION B

3. Analysis and design of Multistoried buildings, calculation of loads, Approximate analysis, Preliminary sizing, IS:87S, IS:1893 recommendations, Ductile detailing.
4. Analysis and design of special structures i.e pipes (underground, on ground, Elevated), silos, Bunkers, chimneys, IS recommendations.

PRACTICAL: -

Minimum two Designs/Experiments based on above syllabus.

Reference Books:

1. Plain & reinforced concrete Structures Vol-II, Jain & Jaikrishna
2. IS: 1893-2002
3. Handbook on seismic analysis and design of structures, Farzad neaim
4. Seismic design of R C & masonry Buildings, paulay & Prestiley
5. Earthquake resistant Design for engineers & Architects, Dowrick D J
6. Concrete Structures in earthquake regions, Booth E.

Syllabus

IIIFSTO2 Elective-II

HIGH RISE STRUCTURES

SECTION A

1. Performance of buildings, behaviors of various type of buildings in past earthquakes, modes of failures, influence of unsymmetry, infill walls, foundations, soft story & detailing of reinforcements in buildings.
2. frames -shear walled buildings, mathematical modeling of buildings with different structural systems, Analysis of frames shear walled buildings, Analysis of coupled shear walled buildings
3. Special aspects in Multi-story buildings, Effect of torsion, flexible first story, P-delta effect, soil-structure interaction on building response, drift limitation.

SECTION B

4. Strength, ductility and energy absorption, ductility of reinforced members subjected to flexure, axial loads & shear. Detailing of RCC members, beam, column, Beam-column joints for ductile behaviors. IS code provisions.
5. Design of multi-story buildings with bracings & infills.
6. Seismic design of floor diaphragm

Reference Books:

1. IS: 1893-2002
2. Handbook on seismic analysis and design of structures, Farzad neaim
3. Seismic design of R C & masonry Buildings, paulay & Prestiley
4. Earthquake resistant Design for engineers & Architects, Dowrick D J
5. Concrete Structures in earthquake regions, Booth E.
6. Reinforced Concrete Structures, Park & Paulay

(ii) DESIGN OF COMPOSITE CONSTRUCTIONS

SECTION A

1. Introduction to composite construction, basic concepts, types of composite constructions
2. Steel concrete composite, Analysis and of composite beams
3. Composite floors, shear connectors: functions & types

SECTION B

4. Steel concrete composite columns, columns subjected to axial loads and moments.
5. Encased composite construction of beams and columns, concepts and design.
6. Study of IS: 11384, IRC-22 and their applications

PRACTICALS:

Minimum two Designs/Experiments based on above syllabus.

Reference Books:

1. Steel design manual -Construction steel research and development organization.
2. IS:11384
3. IRC-22
4. INSDAG course Material
5. Composite Structures, G M Sabnis

(iii) NEW ENGINEERING MATERIALS AND TECHNOLOGY

SECTION A

1. Steel fibers reinforced concrete, Properties, Aspect ratio, strength, durability of Fibre reinforced plastics, other types of fibers and their applications.
2. Light weight concrete, Ferro cement concrete, their types, foam concrete, workability, durability, and composition, application.
3. Fly ash blended concrete, replacement procedures, effect of admixtures, adhesives, bond strength, durability, applications

SECTION B

4. High-grade concrete, high strength performance concrete, trimix concrete.
5. Concrete admixtures, Accelerators, retarders, ND Testing of materials.
6. Introduction to steel concrete composite including infill, encased section, properties of shear connectors, use of IS:11384, IRC 220.

Reference Books:

III FST03 SEMINAR / PROJECT
Seminar based on topic for research for project

IVFST01 SEMINAR/PROJECT

Seminar research work based on some topic related to structural Engineering