SHIVAJI UNIVERSITY, KOLHAPUR

M.E. [Civil – Structures] course.

Semester I

Code No.	Subject	Teaching/week					Examination scheme				
		L	Pr.	Tu	Dr	Total	Theory paper work	Term work			
								TW	POE	OE	Total
M1	Theory of Elasticity & Plasticity	3	-	1	-	4	100	25	-	-	125
M2	Mechanics of Structures	3	-	1	-	4	100	25	-	-	125
M3	Advanced Design of Concrete Structures	3	-	1	-	4	100	25	-	-	125
M4	Dynamics of Structures	3	-	1	-	4	100	25	-	-	125
M5	Elective I	3	-	1	-	4	100	25	-	-	125
M6	Seminar I	-	-	1*	-	1*	-	50	-	-	50
		15	-	6	-	21	500	175	-	-	675

* Indicates load per candidate.

Elective I

1. Design of Foundations
2. Advances in Concrete Composites
3. Structural Optimization

Semester II

Code No.	Subject	Teaching/week					Examination scheme				
		L	Pr.	Tu	Dr	Total	Theory paper work	Term work			
								TW	POE	OE	Total
M7	Theory of Plates & Shells	3	-	1	-	4	100	25	-	-	125
M8	Finite Element Method	3	-	1	-	4	100	25	-	-	125
M9	Earthquake Engg.	3	-	1	-	4	100	25	-	-	125
M10	Advanced Design of Steel Structures.	3	-	1	-	4	100	25	-	-	125
M11	Elective-II	3	-	1	-	4	100	25	-	-	125
M12	Seminar II	-	-	1*	-	1*	-	50	-	-	50
		15	-	6	-	21	500	175	-	-	675

* Indicates load per candidate.

Elective II

1. Stability of Structures.
2. Design of R.C.C. Bridges.
3. Structural Reliability.
4. Design of Folded Plates & Shells.

Semester III

Code No.	Subject	Teaching/week					Examination scheme				
		L	Pr.	Tu	Dr	Total	Theory paper work	Term work			
								TW	POE	OE	Total
M13	Lab. Practice	-	1*	-	-	1*	-	50	-	-	50
M14	Dissertation Phase - I	-	3*	-	-	3*	-	100	-	-	100
		-	4*	-	-	4*	-	150	-	-	150

* Indicates load per candidate.

Semester IV

Code No.	Subject	Teaching/week					Examination scheme				
		L	Pr.	Tu	Dr	Total	Theory paper work	Term work			
								TW	POE	OE	Total
M15	Dissertation Phase - II	-	5*	-	-	5*	-	100	-	200	300
		-	5*	-	-	5*	-	100	-	200	300

* Indicates load per candidate.

M.E. (CIVIL - STRUCTURES) - I

1. Theory of Elasticity & Plasticity

Teaching Scheme :
Lectures : 3 Hours per week
Tutorial : 1 Hour per week

Examination scheme:
Theory paper: 100 marks
Term work : 25 marks
Paper duration: 4 Hours.

Section - I

1. Preamble-Skeletal structures & continua, uniqueness theorem, St. Venant's principle.
(2)
2. Stress & Strain at a point, static indeterminacy of problem of 3-D elasticity, D.E. of equilibrium in rectangular, cylindrical & spherical co-ordinates, Generalized Hooke's Law, Strain compatibility equations, Stress compatibility equations, practical implications of Laplacian forms, Stresses on an oblique plane, stress & strain invariants, principal stresses & strains, numerical problems, Airy's stress function & its applications.
(12)
3. Stress concentrations around hole in an infinitely large plate, thick cylinders & spheres, rotating disks.
(6)

Section - II

4. Torsion-Shafts of non circular prismatic section, warping function approach, stress approach, membrane analogy.
(5)
5. Basic equations, similarities & differences when compared with elasticity, idealized material behavior, mech. models, neck formation, hydrostatic stresses, deviatoric stresses, invariants of deviatoric stresses, various empirical stress – strain relationships, theories of plastic flow, yield criteria, strain hardening, Drucker's postulate.
(8)
6. Elastic perfectly plastic materials-thick cylinders, thick spheres, plastic hinge formation in beams of rectangular, T, circular cross sections, Shape factor, reserved strength of beam, elasto-plastic deflections of beams of rectangular cross sections, residual stresses, Introduction to strain hardening problems.
(7)
7. Collapse load calculations for circular plates with axisymmetric loadings.
(2)

TERM WORK

A set of tutorials/ problems based on above topics of syllabus.

RECOMMENDED BOOKS

1. Theory of Elasticity by Timoshenko & Goodier.
2. Introduction to Mechanics of Solids by Venkatraman & Patel.
3. Theory of Plasticity by Johnson & Mellor.
4. Theory of Elasticity by Filonenko & Borodich.
5. Theory of Elasticity by Sadhu sing.
6. Theory of Plasticity by Sadhu sing.
7. Theory of Plasticity by Prager.
8. Theory of Plasticity by Chakraborty.

M.E. (CIVIL - STRUCTURES) - I

2. Mechanics of Structures

Teaching Scheme :
Lectures : 3 Hours per week
Tutorial : 1 Hour per week

Examination Scheme:
Theory paper: 100 marks
Term work : 25 marks
Paper duration: 4 Hours.

Section - I

1. Influence Line Diagrams for Indeterminate Structures: Continuous beams, portal frames & two hinged arches. Muller-Breslau's Principle & Moment distribution method. (7)

2. Beams Curved in Plan: Determinate & Indeterminate beams curved in plan. (5)

3. Beams on Elastic Foundations: Analysis of infinite, semi-infinite & finite beams. (8)

Section - II

4. Beam columns: Concept of geometric & material nonlinearity. Governing differential equation, Analysis of beam-columns subjected to different loadings and support conditions. Stiffness and carry–over factors for beam–columns, fixed end actions due to various loads. (5)

5. Stiffness method of structural analysis. flexibility and stiffness matrices, Analysis of continuous beams, trusses and plane frames by Structure oriented stiffness approach. (10)

6. Member Oriented Stiffness Method: Stiffness matrices of beam, truss, plane frame grid, pin & rigid jointed space frame elements on member axes. Transformation of matrices on Structure axes. Over-all joint stiffness matrix and nodal load vector, assembly rules. Calculation of member end forces, Bandwidth. (5)

Term –work: Problems / tutorials based on above topics.

References:

1. Analysis of Structures by Vazirani & Ratwani, Vol.II.
2. Advanced Theory of Structures by Vazirani & Ratwani.
3. Theory of Elastic Stability by Timoshenko & Gere.
4. Matrix Analysis of Framed Structures by Gere & Weaver.
5. Structural Analysis – A matrix approach by Pandit &Gupta.
6. Mechanics Of Structures Vol. I, II & III by Junnarkar & Shah.
7. Basic structural Analysis by C.S.Reddy.
8. Structural Analysis by Negi and Jangid.

M.E. (CIVIL - STRUCTURES) - I

3. Advanced Design of Concrete Structures

Teaching Scheme :
Lectures : 3 Hours per week
Tutorial : 1 Hour per week

Examination Scheme:
Theory paper: 100 marks
Term work : 25 marks
Paper duration: 4 Hours.

Section - I

1. Analysis and Design of Flat Slab, Grid Slab and Circular Slab. (7)

2. Analysis and Design of Combined Footing and Raft Foundation. (6)

3. Analysis and Design of overhead water tank - Rectangular and Circular with flat bottom, Design of staging for wind and seismic loads. (7)

Section - II

7. Mechanics of pre-stressed concrete, stress concept, strength concept and load balancing concept, high strength material, systems of prestressing, losses of prestress. (7)

8. Design of Prestressed Concrete, beams, box, T and I Sections, Shear, Deflection, Design of End Block, IS code method. (7)

9. Analysis and design of continuous beams, partial prestressing, circular prestressing - pipes. (6)

Term –work: Problems / tutorials based on above topics.

Referances:

9. Reinforced Concrete, Limit State Design by Ashok K. Jain, New Chand and Bros. Roorkee.
10. Advanced Reinforced concrete design by P.C. Varghese - Prentice Hall of India.
11. Advanced Reinforced concrete design by N. Krishnaraju-CBS Publishers & Distributors.
12. Reinforced concrete structures Vol I & Vol II by Jain and Jaikrishna.
13. Prestressed Concrete by S. Ramamurtham, Dhanpat Rai and sons.
14. Prestressed Concrete by N. Krishnaraju.
15. Prestressed Concrete by T. Y. Lin.
16. Reinforced concrete structures Vol I & Vol II by B.C. Punmia, A.K. Jain, Arun K. Jain.

M.E. (CIVIL - STRUCTURES) - I

4. Dynamics of Structures

Teaching Scheme :
Lectures : 3 Hours per week
Tutorial : 1 Hour per week

Examination Scheme:
Theory paper: 100 marks
Term work : 25 marks
Paper duration: 4 Hours.

Section - I

1. Single-Degree-of-Freedom Systems, Analytical models, Equations of motion, Free vibration, Damping, Types of damping, Response to harmonic loading, Resonance, Support motion, Transmissibility, Vibration isolation. (7)

2. SDOF systems subjected to periodic and impulsive loading, Fourier series loading, Sine wave pulse, rectangular pulse, introduction to Frequency-Domain Analysis. (6)

3. SDOF systems subjected to general dynamic loading, Duhamel's Integral, Application to simple loading cases, Numerical evaluation of response integral, Piecewise exact method, Newmark Beta Methods. (7)

Section - II

4. MDOF Systems, Selection of DOFs, Formulation of Equations of motion, Structure matrices, Static condensation, Free vibrations, Eigen Value problem, Frequencies and Mode Shapes, Determination of natural frequencies and mode shapes by Stodola - Vianello method, Orthogonality conditions, Proportional Damping Matrix, Rayleigh damping. (8)

5. Discrete systems, Fundamental mode analysis, Rayleigh method, Rayleigh-Ritz Method, Dunkerly's Method, Response of MDOF systems to dynamic loading, Mode superposition method, Coupled and Uncoupled equations of motion, Modal contributions. (6)

6. Distributed-Parameter Systems, Partial differential equations of motion, Free and forced vibrations, Application to beams in flexure. (6)

Term –work: Problems / tutorials based on above topics.

REFERENCE BOOKS

1. Dynamics of Structures – R.W. Clough and J. Penzienc, McGraw-Hill Pub.
2. Structural Dynamics – Roy Craig, John-Wiley & Sons.
3. Dynamics of Structures- Theory & Application to Earthquake Engineering – A.K.Chopra, Prentice-Hall Pub..
4. Dynamics of Structures – Mukhopadhyay.
5. Structural Dynamics – Mario Paz.
6. Elements of Earthquake engineering by Jaikrishna, A.R. Chandrashekharan, Brijesh Chandra, Standard Publishers Distributors.

M.E. [CIVIL-STRUCTURES]

ELECTIVE - I : DESIGN OF FOUNDATION

Teaching Scheme :

Lecture Periods : 3 hours per week
Tutorial : 1 hour per week

Examination Scheme :

Paper Duration : 4 hours
Univ.Exam. : 100 marks
Sessional : 25 marks

SECTION - I

1. Theories of failure of soil, Determination of ultimate bearing capacity, Dynamic bearing capacity. Different methods of design of shallow foundations for axial and eccentric load.

2. Design of wall footing, strap footing, combined footing, (Rectangular & Trapezoidal)

3. Raft foundation, different types, Design considerations and various methods of analysis of raft.

SECTION - II

4. Determination of load carrying capacity of single pile, Rock socketing, Negative skin friction, Design of axially loaded piles, Design of pile groups and pile cap, under-reamed piles.

5. Analysis and design of drilled piers and well foundation.

6. Dynamic response of soil, criteria for satisfactory machine foundation, framed and massive foundation, Analysis and design of simple machine foundations using I.S. Code. Vibration isolation.

TERM WORK

A set of tutorials on the topics mentioned in syllabus.

REFERENCE BOOKS

1. Winterkorn H.F. and Fang H.Y., "Foundation Engineering Hand Book" - Van Nostand Reinhold Company, 1975.
2. Bowles J.E., "Foundation Analysis and Design" - McGraw Hill Book Company, 1968.
3. "Vibration Analysis and Design of Foundations for Machines and Turbines" - Major A. Collets Holding Ltd., 1962.
4. Kany M., "Design of Raft Foundations" Elihelm Earnest and Sehn. 1974.
5. Goodman, L.J. and Karol, R.H., "Theory and Practice of Foundation Engineering", McMillan, 1968.
6. "Soil Dynamics", Shamsher Prakashan, McGraw Hill Book Co.
7. D.D.Barkar, "Dynamics of Bases & Foundation"

M.E. (CIVIL) STRUCTURES PART- I

Advances in Concrete Composites

Teaching Scheme:
Lectures: 3 Hours per week
Tutorial : 1 Hour per week

Examination scheme:
Theory paper: 100 marks
Term work : 25 marks
Paper duration: 4 Hours.

Section – I

1. **Fiber Reinforced Concrete**
   Introduction, properties of constituent materials, Mix proportion, mixing, casting methods, properties of freshly mixed concrete (fiber reinforced concrete), workability tests, mechanical properties, Behaviour of fiber reinforced concrete under compression, tension flexure, Research findings, application of Fiber Reinforced Concrete. **(12)**

2. **Ferro cement**
   Introduction, materials used, mechanical properties, construction techniques, design in direct tension, applications, merits as structural materials.
   (08)

Section – II

3. **Silica Fume Concrete**
   Introduction, physical and chemical properties of silica Hume, reaction mechanism of silica fume, properties of silica fume concrete in fresh state, mechanical properties and durability of silica fume concrete. **(10)**

4. **Polymer Concrete**
   Introduction, classification, properties of constituent materials, polymer impregnated concrete, polymer concrete, application. **(10)**

TERM WORK

A set of tutorials based on above topics of syllabus.

RECOMMENDED BOOKS

1. Concrete Technology & Design by R. N. Swamy,Surrey University Press.
2. Special Structural Concretes by Rafat Siddique,Galgotia pub. Pvt.ltd.
3. Fiber Reinforced Cement Composites by P. N. Balaguru, S. P. Shah, Mc-Graw Hill
4. Fiber Cement and Fiber Concrete by D.J Hannant, John Wiley and Sons.
5. Fracture Mechanics and Structural Concrete by Bhusan L. Karihal.
   Longman Scientific and Technical John Wiley and Sons.

M.E. [CIVIL-STRUCTURES]

ELECTIVE I - STRUCTURAL OPTIMIZATION

Teaching Scheme
Lectures: 3 per week
Tutorials: 1 per week

Examination Scheme
Theory: 100 marks
Term work: 25 marks
Paper: 4 hours

SECTION I

1. Objective of optimization, problem formulation, problem types, constrained and un constrained problems, implications of risk and uncertainly mathematical programming, general problems of linear and non linear programming. (7)
2. Linear Programming-Standard linear programming form, definitions and theorem, simplex method-Algorithm canonical form, improving the basis, identifying an optimal solution, locating initial basic feasible solution, examples. (7)
3. Application of linear programming -Problems on structural design trusses, plastic analysis of frame, weight minimization, transportation problem, duality, decomposition, parametric linear programming, integer linear programming examples. (6)

SECTION II

4. Non-linear optimization - classical optimization techniques-differential calculus-Lagrange multipliers, Newton Raphson approximation, Kutin tucker conditions, examples. (7)
5. Geometric programming -calculus viewpoint, polynomials, orthogonality conditions, degree of difficulty, geometric inequality, primal-dual relations, inequality constraints, examples. (7)
6. Search techniques-alternating one dimensional or sectioning search, transforming nonlinear problem into linear –cutting plane method, logarithmic transformation, graphical optimization, examples. Examples on minimum route problem, minimum cost, minimum weight, optimum design of R.C.C. sections, structural design-frame, trusses. (6)

Termwork: Problems/Tutorials based on above topics.

References:

1.Foundation of Optimization by Wilde and Beighter
2. Optimization Theory and Applications by S.S.Rao.
3. Optimization in Structures by Hemp.
4.Mathematical Foundation for design by Stark and Nicholls,McGraw Hill.

M.E. (Civil - Structures)

Semester - I

Seminar - I

Periods : 1 Hour / Week / per candidate
Term Work : 50 Marks

Seminar - I shall consist of detailed Analysis, Design along with working Drawings of any one Structure. The student should submit a detailed report on the subject chosen and make a presentation at the end of Semester-I.

M.E. (CIVIL - STRUCTURES) - II

7. Theory of Plates & Shells

Teaching Scheme :
Lectures : 3 Hours per week
Tutorial : 1 Hour per week

Examination scheme:
Theory paper: 100 marks
Term work : 25 marks
Paper duration: 4 Hours.

Section - I

1. **Introduction to Plate Theory :** Thin and Thick Plates, small and large deflection theory of thin plates - assumptions, moment - curvature relations, stress resultants, Governing Differential Equation for bending of plates, various boundary conditions. (2)

2. **Rectangular plates - Navier's solution :** Simply supported rectangular plates subjected to uniformly distributed and varying loads on entire area, parabolic loads, sinusoidal loads, partly loaded plates, concentrated loads and couples, distributed couples, symmetric & anti-symmetric loading. (5)

3. **Rectangular plates - Levy's solution :** Plates subject to uniformly distributed and varying loads and sinusoidal parabolic loads between simply supported edges. Conditions for other two edges- simply supported, fixed, free, elastically restrained. (5)

4. **Finite difference method :** Solution of plate problems derivation of delta/ pattern/stencil for biharmonic form for a rectangular mesh, two stage solutions, solution for various loadings and boundary conditions, use of symmetry & anti-symmetry, extrapolation formula, introduction to improved Finite Difference Technique. (4)

5. **Energy methods :** Use of potential energy principle, solution of rectangular plates with various boundary conditions and loadings. (3)

6. **Circular Plates :** Bending of circular plates with clamped & simply supported edges, plate with a central hole, uniformly distributed and varying loads, conical loads, distributed couples, ring loads, semicircular plates, axisymmetric loaded plates. (3)

Section - II

7. **Introduction :** Classification of shells on geometry, thin shell theory, equation of shell surfaces, stress resultants, stress - displacement relations, compatibility and equilibrium equations. (3)

8. **Membrane analysis :**

a) Equation of equilibrium for synclastic shells, solution for shells subject to self weight, live load. (3)

b) Equation of equilibrium in rectangular co-ordinate system. Hypar, use of Pucher's function, simple problems on hyperbolic paraboloids. Elliptic paraboloidal shells, conoids. (3)

c) Cylindrical shells – equation of equilibrium, open shells with parabolic, circular, elliptical directrix-simple problems. (2)

d) Shells with closed directrix–circular, elliptical-simple problems. Problems on pipes carrying fluid/liquid under pressure, just filled & partly filled. (2)

9. **Bending theory of cylindrical shells :** Symmetrically loaded circular cylindrical shell –Derivation of Governing Differential Equation, resembling that for beam on elastic foundation, beam theory. Finsterwalder's theory- Derivation of governing differential equation of 8^{th} order. D.K.J. theory-Donnell's equation, Characteristic equation. Schorer's theory-Derivation of differential equation. (7)

TERM WORK

A set of tutorials/ problems based on above topics of syllabus.

RECOMMENDED BOOKS

1. Theory of Plates & Shells by Timoshenko & W.Kreiger.
2. Design of R.C. Shell Roofs by G.S.Ramaswamy.
3. Analysis of Thin Concrete shells by K Chandrashekhara.
4. Analysis of Plates & Shells by Gould.
5. Theory of Plates by Szilard.
6. Theory of Plates by Bennett.
7. Stresses in Shells by Fluggee.

M.E. (CIVIL - STRUCTURES) - II

8. Finite Element Method

Teaching Scheme :
Lectures : 3 Hours per week
Tutorial : 1 Hour per week

Examination scheme:
Theory paper: 100 marks
Term work : 25 marks
Paper duration: 4 Hours.

Section - I

1. **Introduction to Finite Element Method :** Principle of minimum potential energy, variational principle, Galerkin approach, Rayleigh- Ritz method. Point collocation method, least square method, finite element procedure. (5)
2. **1-D problems :** Discretization, nodes, element incidence, displacement model, shape function, selection of order of polynomials, application to bars with constant and variable cross sections subjected to axial forces. (4)
3. **2-D problems :** Development of element stiffness matrix and nodal load vector for truss, beam and plane frame elements. Transformation of matrices, relevant structural engineering applications. (4)
   2-D elements of triangular and quadrilateral shapes for plane stress and plane strain problems. Pascal's triangle, convergence requirements and compatibility conditions, shape functions, boundary conditions, element aspect ratio, applications to a continuum. (4)
4. **3-D problems :** Development of element stiffness matrix and nodal load vector for Tetrahedron, Hexahedral elements. (3)

Section - II

5. **Isoparametric Elements :** Shape function, Natural coordinate systems, classification - isoparametric, subparametric, superparametric elements, 1-D & 2-D isoparametric elements, Gauss – quadrature integration. (6)
6. **Axisymmetric Elements :** Development of element stiffness matrix and nodal load vector. (4)
7. **Plate and Shell Elements :** Formation of stiffness matrix for plate bending elements of triangular and quadrilateral shapes, cylindrical thin shell elements. (6)
8. **Finite Element Applications to structural dynamics :** Formulation, Hamilton's principle, element mass matrices, evaluation of eigenvalues and eigenvectors. (4)

TERM WORK

A set of tutorials/ problems based on above topics of syllabus out of which at least two applications must be with use of commercially available computer software.

RECOMMENDED BOOKS

1. The finite Element Method (Fourth Edition) Vol I & II by O.C. Zienkiewicz & R. L. Taylor.
2. An Introduction to the Finite Element Method by J.N.Reddy.
3. Concepts & Applications of Finite Element Analysis by R.D.Cook
4. Fundamentals of Finite Element Techniques by C.A.Brebbia & J.J.Connor.
5. Introduction to Finite Element Method by C.S. Desai & J.F. Abel.
6. Programming in Finite Element Method by Dr. C.S. Krishnamoorthy.(TMH publication)
7. Introduction to Finite Element in Engineering by T.R.Chandrupatla and Belegundu.

M.E. (CIVIL - STRUCTURES) - II

9. Earthquake Engineering

Teaching Scheme :
Lectures : 3 Hours per week
Tutorial : 1 Hour per week

Examination scheme:
Theory paper: 100 marks
Term work : 25 marks
Paper duration: 4 Hours.

Section - I

1. Characteristics of Earthquakes: Earthquake terminology, Indian earthquakes, Measurement of earthquakes, Magnitude, Intensity, Frequency-magnitude relationship, liquefaction. (5)

2. Earthquake response of linear SDOF systems, Response spectrum theory, Strong ground motion, Accelerometers, Peak parameters, Concept of earthquake response spectrum, Trepartite spectrum, Construction of design response spectrum. (6)

3. Earthquake response of linear MDOF systems, Modal analysis, Participation factors, Modal contributions, Multistoreyed buildings with symmetric and unsymmetric plan, Torsional response. (8)

Section - II

4. Concept of Earthquake resistant design, Objectives, Ductility, Ductility reduction factors, Overstrength, Response reduction factor, Design response spectrum, Lateral stiffness, Conceptual design, Building configuration. (6)

5. Lateral load analysis, Provisions of IS: 1893 for buildings, Base shear, Application to Multistorey buildings, Load combinations. (5)

6. Detailing of RCC and Masonry buildings, Provisions of IS: 13920, IS: 4326. (5)

7. Concepts of Structural Control, Passive control, Base Isolation, Tuned Mass Dampers, Vibration absorbers. (4)

Term –Work:
The term work shall consist of : 1) Set of tutorials based on above syllabus and
2) Analysis and design of a multistorey RCC building for earthquake forces using IS Code provisions (Not less than 3 storeys) with drawings showing typical detailing.

Reference Books

1. Dynamics of Structures – R.W.Clough and Joseph Penziene, Mc-Graw Hill Pub.
2. Dynamics of Structures: Theory & Application to Earthquake Engineering – A.K.Chopra, Prentice-Hall Pub.
3. Earthquake Design Practice for Buildings – David Key, Thomas Telford Pub.
4. Earthquake Resistant Design with Rubber – James M. Kelly, Springler-Verlag Pub.
5. Earthquake Resistant Design for Engineers & Architects – D.J. Dowrick, John Wiley & Sons.
6. Passive vibration control - Robinson, T.T.Soong.

M.E. (CIVIL - STRUCTURES) - II

10. Advanced Design of Steel Structures

Teaching Scheme :
Lectures : 3 Hours per week
Tutorial : 1 Hour per week

Examination scheme:
Theory paper: 100 marks
Term work : 25 marks
Paper duration: 4 Hours.

Section - I

1. Design of Trussed girder bridges and bearings. Deck type and through type bridges, bracing systems, end bearings, mechanical and elastomeric bearings.

2. Multistory steel buildings, load transfer mechanism, lateral load resisting systems, Design of moment resistant frames, concentrically braced frames, interacting moment resisting frames with shear walls for seismic/ wind effects structural systems, framed tube structures, braced tube structures, tube in tube structures.

3. Cold-formed light gauge steel sections, special design considerations for compression elements, design of compression elements, stiffened compression elements, multistiffened elements, design of light gauge beams, behavior under repetitive loads and temperature effects.

Section - II

4. Plastic analysis, plastic bending of beams, plastic hinge, upper and lower bond theorems, uniqueness theorem, yield criteria, analysis and design of fixed and continuous beams.

5. Plastic analysis and design of portal frames, collapse mechanisms, analysis and design of gables, multistorey-multibay frames, rectangular and tapered haunch knee, check for stability of frames, plastic moment distribution method, minimum weight design, variable repetitive loads, Introduction to Limit States in Steel Design.

6. Concrete-Steel composite sections, elastic behavior of composite beams, shear connectors, behavior at ultimate load, Design of composite beams, Design of encased steel columns.

TERM WORK

A set of tutorials/ problems based on above topics of syllabus.

RECOMMENDED BOOKS

1. Design of steel structures - Vol. II by Ramchandran, standard book house delhi.
2. Design of steel structures - A.S. Arya. J.L. Ajamani, Nemchand and brothers.
3. Structural analysis and design of tall buildings by B.S.Taranath. McGrawHill.
4. Steel skeletal Vol. II Plastic behavior and design by J.F.Bekar, M.R. Horne, J. Heyman. ELBS.
5. Plastic methods of structural analysis by Neal B.G. Chapter and Hall.
6. SP - 6 (BIS)
7. Teaching Resource for Structural Steel Design - Vol. III by IIT Madras, Anna University Chennai, SERC, Madras and Institute for Steel Development and Growth (INSDAG), Kolkatta.

M.E. [CIVIL-STRUCTURES]

ELECTIVE -II
STABILITY OF STRUCTURES

Teaching Scheme
Lectures: 3 per week
Tutorials: 1per week

Examination Scheme
Theory: 100 marks(duration-4hrs.)
Term work:25 marks

SECTION I

1. Introduction:
   Concept of stability. Static, dynamic and energy criterion of stability. Flexibility and stiffness criteria. Snap – through & post buckling behavior.
2. Stability of columns:
   Critical load for standard boundary conditions. Elastically restrained perfect Columns, effect of transverse shear in buckling, columns with geometric imperfections, eccentrically loaded columns. Orthogonality of buckling modes.
   Large deformation theory for columns.
3. Stability of continuous Beams and Frames:
   Moment distribution and stiffness methods for stability analysis of continuous beam & frames.

SECTION-II

4. Lateral Buckling of Beam:
   Differential equations for lateral buckling , lateral buckling of beams in pure bending , lateral buckling of beams subjected to concentrated and uniformly distributed forces.
5. In-elastic stability of columns:
   In-elastic buckling , double modulus theory , tangent modulus theory , Shanleys theory of in-elastic buckling ,eccentrically loaded inelastic columns.
6. Dynamic Stability of Structures:
   Discrete systems, Lagrange- Hamilton formulation for continuous systems,
   Stability of continuous systems, general method for conservative and non- conservative systems.

Term-work: Problems/ tutorials based on above topics.

References:

1. Stability Theory of structures: - Ashwini Kumar, Tata McGraw-Hill, New Delhi.
2. Priciples of structural stability Theory- Alexander Chajes, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.
3. Theory of Elastic Stability-Timoshenko and Gere, McGraw-Hill International.
4. Design for Structural Stability – Kirby and Nether Cot, Granada Publishing, London.

M.E. (CIVIL) STRUCTURES PART- II

Design of R.C.C. Bridges

Teaching Scheme:
Lectures: 3 Hours per week
Tutorial : 1 Hour per week

Examination scheme:
Theory paper: 100 marks
Term work : 25marks
Paper duration: 4 Hours.

Section I

1. General Basic bridge forms – beam, arch, suspension, various types of bridges, selection of type of bridge and economic span length, super structure – philosophy, geometric alignment, drainage, road kurb, wall foundation, pile foundation, open well foundation. **(6)**

2. Design loads for bridges – dead load, vertical live load, IRC loading, wind load, longitudinal forces, centrifugal forces, buoyancy, water current forces, thermal forces, deformation and horizontal forces. **(5)**

3. Design of R. C. deck slab, beam and slab, T beam, Pigeaud's theory, Courbon's theory, balanced cantilever bridge, box culvert. **(9)**

Section II

4. Construction techniques – construction of sub structure footing, piles, cassions, construction of reinforced earth retaining wall and reinforced earth abutments, super structure – erection method bridge deck construction, by cantilever method, Inspection maintenance and repair of bridges. **(7)**

5. Design of sub – structure – abutments, Piers, approach slab. **(8)**

6. Bearing and expansion joints – forces on bearings – Types of bearings, design of unreinforced elastometric bearings, expansion joints. **(5)**

Term-work

A set of tutorials based on above topics of syllabus

Reference: --

1.Concrete Bridge Practice by Dr. V.K. Raina – Tata Mc-Graw Hill
2.Reinforced Concrete Structures – Vol II by Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain – Laxmi publications.
3.Essential of bridge Eng. By Victor
4.Concrete bridge design – R. E. Rowe
5. Design of bridge structure by Jagadesh T. R. & Jayram M. A.

M.E. (CIVIL - STRUCTURES) - II

Elective II-Structural Reliability

Teaching Scheme :
Lectures : 3 Hours per week
Tutorial : 1 Hour per week

Examination scheme:
Theory paper: 100 marks
Term work : 25 marks
Paper duration: 4 Hours.

Section - I

1. Fundamentals of Probability theory, Concepts of structural safety, design method, basic statistics and probability data reductions, Histograms, sample correlation, Random variables, discrete and continuous variables, common probability distributions.

2. Resistance distributions and parameters, statistical analysis of materials- steel, concrete bricks and mortar, characterization of variables, allowable stresses, probabilistic analysis for live load, gravity load and wind load.

3. Structural reliability, computation of basic structural reliability, reliability analysis of simple elements, level II reliability methods, Basic variables and failure surface FOS method reliability of systems, multiple failure modes, redundant and non redundant systems, series, parallel and combined systems, Fault tree, Event tree analysis.

Section - II

4. Monte Carlo methods of analysis study of structural safety, generation of random numbers, continuous discrete and jointly distributed variables, application to reliability analysis of concrete structures.

5. Reliability based design load and resistance factors of design, safety checking formats, and code calibrations, IS code provisions, introduction to stochastic process.

6. Decision analysis, Simple risk decision problems, decision models, decision tree, decision criteria, decision based on existing information, prior analysis.

TERM WORK

A set of tutorial problems based on above topics of syllabus.

REFFERENCE BOOKS

1. R.E.Melchers, Structural Reliability, analysis and predictions, Ellis-Horwood Ltd. Chichester UK.
2. Edward Haugen, Probilistic approaches to design, John Wiley and sons.
3. R. Ranganathan, Reliability analysis and design of structures, Tata McGraw Hill.

M.E. (CIVIL) STRUCTURES PART- II

Design of Folded Plates & Shells

Teaching Scheme:
Lectures: 3 Hours per week
Tutorial : 1 Hour per week

Examination scheme:
Theory paper: 100 marks
Term work : 25 marks
Paper duration: 4 Hours.

Section – I

1. shells and folded plates
   Introduction, Behavior, different forms, factors governing selection of shell type and Dimensions of folded plates ,Advantages and Disadvantages of shell roofs.

2. Analysis and Design of cylindrical shells by membrane theory.

3. Analysis and Design of cylindrical shells by Beam Theory.

Section – II

4. Shells of Double curvature – Analysis and Design by membrane theory of shells of revolution.

5. Anticlastic and synclastic shells of Double curvature. Analysis and Design by membrane Theory.

6. Design of Folded Plates – iteration method and Simpsons method.

Term Work

A set of problems/ design based on above topics with special emphasis on programming and application of Finite Element Method to shells.

Reference Books

1. Design and Construction of Concrete Shell Roofs- G.S. Ramaswamy CBS Publishers
2. Analysis of Thin Concrete Shells- K Chandrashekhara.. TMcGH
3. Theory and Design of Concrete Shells- B. K . Chatterjee. Oxford & IBH.
4. IS 2204- 1962.
5. IS 2210- 1962.

M.E. (Civil - Structures)

Semester - II

Seminar - II

Periods : 1 Hours/ Week / per candidate

Term Work : 50 Marks

The Seminar-II shall be based on topic of dissertation as approved by staff member incharge. The student should submit a detailed report on the subject chosen and make a presentation at the end of Semester-II.

M.E. (Civil - Structures)

Semester - III

Lab. Practice

Periods : 1 Hour / Week / per candidate

Term Work : 50 Marks

Lab practice shall include any of the following as decided by the guide.
Software assignments, Field work, Lab. Work, Industrial Training. The student should submit a report along with oral presentation based on the above work at the end of Semester-III.

M.E. (Civil - Structures)

Semester - III

Dissertation Phase I

Periods : 3 Hours / Week / per candidate

Term Work : 100 Marks

The candidate shall submit a report and make a presentation in front of panel of experts as decided by guide at the end of Semester-III

M.E. (Civil - Structures)

Semester - IV

Dissertation Phase II

Periods : 5 Hours / Week / per candidate

Term Work : 100 Marks –Sessional Marks

200 Marks --Oral

The continuous assessment of the work carried out by the student shall be done and the Sessional marks shall be based on the performance of the student. The dissertation shall consist of literature survey on the topic chosen in the relevant field, theoretical and or experimental work based on the literature, discussion and conclusion.