Solapur University, Solapur

Revised Structure and Syllabus
(W.E.F. 2012-13)

For

M.E. (Civil-STRUCTURES)

Choice Based Credit System (CBCS) - CGPA

For M.E. Civil (Struct) - First Year: With effect from- 2015-16
For M.E. Civil(Struct) - Second Year: With effect from- 2016-17

SOLAPUR UNIVERSITY, SOLAPUR
FACULTY OF ENGINEERING & TECHNOLOGY
Curriculum for M.E. Civil-Structures
Choice Based Credit System (CBCS) (WEF 2015-16)

Semester I: Theory Courses

Course Code	*Name of the Course*	*Engagement Hours*			*Credits*	*SA*	*FA*		*Total*
		L	*T*	*P*		*ESE*	*ISE*	*ICA*	
1	Theory of Elasticity & Plasticity	3	-	-	3	70	30	-	100
2	Mechanics of structures	3	-	-	3	70	30	-	100
3	Advanced Design of Concrete Structures	3	-	-	3	70	30	-	100
4	Dynamics of Structures	3	-	-	3	70	30	-	100
5	Elective-I	3	-	-	3	70	30	-	100
	Total	15	-	-	15	350	150	-	500

Semester I: Laboratory / Tutorial Courses

Course Code	*Name of the Course*	*Engagement Hours*			*Credits*	*SA*	*FA*		*Total*
		L	*T*	*P*		*ESE*	*ISE*	*ICA*	
1	Theory of Elasticity & Plasticity	-	1	-	1	-	-	25	25
2	Mechanics of structures	-	1	-	1	-	-	25	25
3	Advanced Design of Concrete Structures	-	1	-	1	-	-	25	25
4	Dynamics of Structures	-	1	-	1	-	-	25	25
5	Elective-I	-	1	-	1	-	-	25	25
6	Seminar-I	-	1	-	2	-	-	50	50
	Total	-	6	-	7	-	-	175	175
	Grand Total	**15**	**6**	**-**	**22**	**350**	**150**	**175**	**675**

L Lecture
T Tutorial
P Lab Session

FA Formative Assessment
SA Summative Assessment
ESE End Semester Examination
ISE In Semester Evaluation
ICA Internal Continuous Evaluation

List of Courses under Elective-I:

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

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Semester II: Theory Courses

Course Code	*Name of the Course*	*Engagement Hours*			*Credits*	*SA*	*FA*		*Total*
		L	*T*	*P*		*ESE*	*ISE*	*ICA*	
7	Theory of Plates & Shells	3	-	-	3	70	30	-	100
8	Finite Element Method	3	-	-	3	70	30	-	100
9	Earthquake Engineering	3	-	-	3	70	30	-	100
10	Advanced Design of Steel Structures	3	-	-	3	70	30	-	100
11	Elective-II	3	-	-	3	70	30	-	100
	Total	15	-	-	15	350	150	-	500

Semester II: Laboratory / Tutorial Courses

Course Code	*Name of the Course*	*Engagement Hours*			*Credits*	*SA*	*FA*		*Total*
		L	*T*	*P*		*ESE*	*ISE*	*ICA*	
7	Theory of Plates & Shells	-	1	-	1	-	-	25	25
8	Finite Element Method	-	1	-	1	-	-	25	25
9	Earthquake Engineering	-	1	-	1	-	-	25	25
10	Advanced Design of Steel Structures	-	1	-	1	-	-	25	25
11	Elective-II	-	1	-	1	-	-	25	25
12	Seminar-II	-	1	-	2	-	-	50	50
	Total	-	6	-	7	-	-	175	175
	Grand Total	**15**	**6**	**-**	**22**	**350**	**150**	**175**	**675**

L Lecture
T Tutorial
P Lab Session

FA Formative Assessment
SA Summative Assessment
ESE End Semester Examination
ISE In Semester Evaluation
ICA Internal Continuous Evaluation

List of courses under Elective-II:

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

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Semester III: Laboratory / Tutorial Courses

Course Code	*Name of the Course*	*Engagement Hours*			*Credits*	*SA*	*FA*		*Total*
		L	*T*	*P*		*ESE*	*ISE*	*ICA*	
13	Lab. Practice	-	-	1*	1	-	-	25	25
14	**Dissertation Phase-I** Synopsis Submission Seminar	-	-	3*	3	-	75	-	75
15	**Dissertation Phase-II** Term work	-	-	-	3	-	100	-	100
16	**Dissertation Phase-II** Progress Seminar presentation	-	-	--	6	200	-	-	200
	Total	**--**		**4***	**13**	**200**	**175**	**25**	**400**

L	Lecture	FA	Formative Assessment
T	Tutorial	SA	Summative Assessment
P	Lab Session	ESE	End Semester Examination
		ISE	In Semester Evaluation
		ICA	Internal Continuous Evaluation

Note: * Indicates contact hours per student.

- For all activities related to dissertation Phase I (synopsis submission seminar and progress seminar) student must interact regularly every week with the advisor.
- Synopsis submission seminar shall cover detailed synopsis of the proposed work. Student shall submit Synopsis of the Dissertation Work only after delivering this seminar.
- Progress seminar shall be delivered capturing details of the work done by student for dissertation.
- Student shall deliver all seminars using modern presentation tools. A hard copy of the report shall be submitted to the Department before delivering the seminar. A PDF copy of the report must be submitted to the advisor along with other details if any.
- Lab Practice shall include any of the below activities as recommended by Advisor and student shall submit a report after completion of the activity to Advisor along with other details if any. Software / hardware assignments, learning new software, literature survey, filed work, industrial training etc. related to dissertation work.
- Details of modes of assessment of seminar and dissertation shall be as specified in 7(III) of PG Engineering Ordinance of Solapur University, Solapur.

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Semester IV: Laboratory / Tutorial Courses

Course Code	*Name of the Course*	*Engagement Hours*			*Credits*	*SA*	*FA*		*Total*
		L	*T*	*P*		*ESE*	*ISE*	*ICA*	
17	**Dissertation Phase III**: Progress Seminar presentation and Report	-	-	5*	4.0	-	100	-	100
18	**Dissertation Phase-IV** Term work	-	-	-	6.0	-	200	-	200
19	Final submission of the dissertation and Viva voice	-	-	-	6.0	200	-	-	200
	Total	**-**	**-**	**5***	**16.0**	**200**	**300**	**-**	**500**

L	Lecture	FA	Formative Assessment
T	Tutorial	SA	Summative Assessment
P	Lab Session	ESE	End Semester Examination
		ISE	In Semester Evaluation
		ICA	Internal Continuous Evaluation

Note: * Indicates contact hours per student

- For all activities related to dissertation Phase III, student must interact regularly every week with the advisor.
- Progress seminar shall be delivered capturing details of the work done by student for dissertation.
- Student shall deliver all seminars using modern presentation tools. A hard copy of the report shall be submitted to the Department before delivering the seminar. A PDF copy of the report must be submitted to the faculty advisor along with other details if any.
- Details of modes of assessment of seminar and dissertation shall be as specified in 7(III) of PG Engineering Ordinance of Solapur University, Solapur.

Solapur University, Solapur
M.E. (CIVIL- STRUCTURES)-I
Choice Based Credit System (CBCS)

1. Theory of Elasticity & Plasticity

Teaching Scheme:

Lectures: 3 hours per week

Tutorial: 1 hour per week

Credits: 4

Examination Assessment Scheme:

Theory:

ESE: 70 marks, ISE: 30 marks

Theory ESE duration: 4 Hours

ICA: 25 marks

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Section- I

1. Preamble – Skeletal structures and continua, uniqueness theorem, St. Venant's principle. (2)

2. Stress and strain at a point, static indeterminancy of problem of 3-D elasticity, D.E. of equilibrium in rectangular co-ordinates, Generalized Hooke's law, Strain compatibility equations, stress compatibility equations, practical implications of Laplacian forms, principal stresses and strains, numerical problems, Airy's stress function and its applications. (8)

3. Cylindrical co-ordinate system- axisymmetrical problems and its D.E. (4)

4. Stress concentration around hole in an infinitely large plate, thick cylinders and spheres, rotating disks. (6)

Section- II

5. Torsion – Shafts of non circular prismatic sections, warping function approach, stress approach, membrane analogy. (5)
6. Plasticity: Basic equations, similarities and 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)

7. Elastic perfectly plasstic materials-thick cylinders, thick spheres, plastic hinge formation in beams of rectangular, T, circular cross sections, shape factors, reserved strength of beam,

elasto-plastic deflections of beams of rectangular cross sections, residual stresses, introduction to strain hardening problems. (7)

8. 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 Singh
6. Theory of Plasticity by Sadhu Singh
7. Theory of Plasticity by Prager.
8. Theory of Plasticity by Chakraborty

Solapur University, Solapur
M.E. (CIVIL- STRUCTURES) – I
Choice Based Credit System (CBCS)

2. Mechanics of Structures

Teaching Scheme:

Lectures: 3 hours per week

Tutorial: 1 hour per week

Credits: 4

Examination Assessment Scheme:

Theory:

ESE: 70 marks, ISE: 30 marks

Theory ESE duration: 4 Hours

ICA: 25 marks

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Section- I

1. **Influence Line Diagrams for Indeterminate Structures:** Continuous beams, portal frames and two hinged arches. Muller-Breslau's Principle and Moment Distribution Method. (7)
2. **Beams curved in plane:** Determinate and indeterminate beams curved in plan. (5)
3. **Beams on elastic foundations:** Analysis of infinite, Semi- infinite and finite beams. (8)

Section- II

4. **Beam columns:** Concept of geometric and material non linearity, 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:** 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 and 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.

Recommended Books:

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

Solapur University, Solapur
M.E. (CIVIL- STRUCTURES)- I
Choice Based Credit System (CBCS)

3. Advanced Design of Concrete Structures

Teaching Scheme:

Lectures: 3 hours per week

Tutorial: 1 hour per week

Credits: 4

Examination Assessment Scheme:

Theory:

ESE: 70 marks, ISE: 30 marks

Theory ESE duration: 4 Hours

ICA: 25 marks

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

4. Mechanics of Pre-stressed concrete, stress concept, strength concept and load balancing concept, high strength material, systems of prestressing, losses of prestress. (7)
5. Design of prestress concrete beams, box, T and I Sections, Shear, Deflection, Design of end block, IS code method. (7)
6. Analysis and Design of continuous beams, partial prestressing, circular prestressing pipes. (6)

TERM WORK:

Problems/tutorials based on above topics.

RECOMMENDED BOOKS:

1. Reinforced concrete, Limit state Design by Ashok K. Jain, New Chand and Bros. Roorkee.

2. Advanced Reinforced Concrete Design by P.C. Varghese- Prentice Hall of India.

3. Advanced Reinforced Concrete Design by N. Krishnaraju- CBS Publishers & Distributors.

4. Reinforced Concrete Structures Vol.1 & Vol.2 by Jain and Jaikrishna.

5. Prestressed concrete by S. Ramamurtham, Dhanpat rai and sons.

6. Prestressed concrete by N. Krishnaraju.

7. Prestressed concrete by T. Y. Lin.

8. Reinforced Concrete Structures Vol.1 & Vol.2 by B. C. Punmia, A. K. Jain, Arun K. Jain.

9. Advanced Reinforced Concrete Design by Bhavikatti S.S.

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M.E. (CIVIL- STRUCTURES)- I
Choice Based Credit System (CBCS)

4. Dynamics of Structures

Teaching Scheme:

Lectures: 3 hours per week

Tutorial: 1 hour per week

Credits: 4

Examination Assessment Scheme:

Theory:

ESE: 70 marks, ISE: 30 marks

Theory ESE duration: 4 Hours

ICA: 25 marks

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Section- I

1. Single-Degree-of-Freedom System, Analysis 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 system subjected to general dynamic loading, Duhamel's Integral, Application to simple loading cases, Numerical evaluation of response integral, Piecewise exact method, Newmark Beta Method. (7)

Section-II

4. MDOF System, Selection of DOFs, Formulation of Equation 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. (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.

RECOMMENDED BOOKS:

1. Dynamics of structures - R.W. Clough and J. Penxiene, 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 Publications
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.

Solapur University, Solapur

M.E. (CIVIL- STRUCTURES) – I

Choice Based Credit System (CBCS)

5. Elective-I

1. Design of Foundations

Teaching Scheme:

Lectures: 3 hours per week

Tutorial: 1 hour per week

Credits: 4

Examination Assessment Scheme:

Theory:

ESE: 70 marks, ISE: 30 marks

Theory ESE duration: 4 Hours

ICA: 25 marks

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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. (8)

2. Design of wall footing, strap footing, combined footing, (Rectangular & Trapezoidal) (6)

3. Raft foundation, different types, Design considerations and various methods of analysis of raft. (5)

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. (8)

5. Analysis and design of drilled piers and well foundation. (6)

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. (6)

Term Work:

A set of tutorials on the topics mentioned in syllabus.

RECOMMENDED 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" Elithelm Earnest and Sohn.1974.
5. Goodman, L. J.and Karol, R. H.,", Theory and Practice of Foundation Engineering",McMillion,1968.
6. "Soil Dynamics," Shamsher Prakashan, McGraw Hill Book Co.
7. D. D. Barkar, "Dynamics of Bases & Foundation."

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M.E. (CIVIL- STRUCTURES) – I
Choice Based Credit System (CBCS)

5. Elective- I

2. Advances in Concrete Composites

Teaching Scheme:

Lectures: 3 hours per week

Tutorial: 1 hour per week

Credits: 4

Examination Assessment Scheme:

Theory:

ESE: 70 marks, ISE: 30 marks

Theory ESE duration: 4 Hours

ICA: 25 marks

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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, tensile, 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. (8)

Section- II

3. Silica Fume Concrete

Introduction, physical and chemical properties of silica Fume, 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, 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 Concrete by Rafat Siddique, Galgotia pub. Pvt. Ltd.
3. Fiber Reinforced Cement Composites by P.N.Balaguru, S.P.Shah, Mc-Graw Gill
4. Fiber Cement and Fiber Concrete by John Wiley and sons.
5. Fracture Mechanics and Structural Concrete by Bhushan L. Karihal

   Longman Scientific and Technical John Wiley and sons.

Solapur University, Solapur

M.E. (CIVIL- STRUCTURES)-I

Choice Based Credit System (CBCS)

5. Elective I

3. Structural Optimization

Teaching Scheme:

Lectures: 3 hours per week

Tutorial: 1 hour per week

Credits: 4

Examination Assessment Scheme:

Theory:

ESE: 70 marks, ISE: 30 marks

Theory ESE duration: 4 Hours

ICA: 25 marks

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Section- I

1.Objective optimization, problem formulation, problem types, constrained and unconstrained problems, implications of risk & 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-Language multipliers, Newtons Raphson approximation, Kuhn 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-altering, one dimensional or sectioning search, transforming non linear 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)

TERM WORK

Term work problems /tutorials based on above topics.

REFERENCES

1.Foundation of Optimization by Wilde & Beighter

2.Optimization Theory & Applications by S.S. Rao

3.Optimization in Structures by Hemp.

4.Mechanical foundation for design by Stark and Nicholls, Mc Graw Hill

Solapur University, Solapur
M.E. (CIVIL- STRUCTURES)- I
Choice Based Credit System (CBCS)

6. Seminar-I

Teaching scheme:
Contact Hours: 1 hour per week per student
Credits: 2

Assessment scheme:
ICA: 50 marks

Seminar-I shall consist of detailed analysis, design along with working drawings of any one structure. The student shall submit report on the subject chosen and make a presentation at the end of Semester-I.

Solapur University, Solapur

M.E. (CIVIL- STRUCTURES)- II

Choice Based Credit System (CBCS)

7. Theory of Plates & Shells

Teaching Scheme:

Lectures: 3 hours per week

Tutorial: 1 hour per week

Credits: 4

Examination Assessment Scheme:

Theory:

ESE: 70 marks, ISE: 30 marks

Theory ESE duration: 4 Hours

ICA: 25 marks

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Section-I

1. **Introduction to Plate Theory**: Thin and Thick Plates, small and large deflection theory of thin plate-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, 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 deviation 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 champed & 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 system, use of puchers 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 above topics of syllabus.

RECOMMENDED BOOKS

1. Theory of Plates & Shells by Timoshenko & W. Kreiger.
2. Design of R.C. Shell Roof 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 Flugge.

Solapur University, Solapur
M.E. (CIVIL- STRUCTURES) – II
Choice Based Credit System (CBCS)

8. Finite Element Method

Teaching Scheme:

Lectures: 3 hours per week

Tutorial: 1 hour per week

Credits: 4

Examination Assessment Scheme:

Theory:

ESE: 70 marks, ISE: 30 marks

Theory ESE duration: 4 Hours

ICA: 25 marks

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Section- I

1. **Introduction to Finite Element Method:** Principle of minimum potential energy, variation 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 section subjected to axial forces. (5)

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. (5)

   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. (5)

4. **3-D problems:** development of element stiffness matrix and nodal load vector for Tetrahedron, Hexahedral elements. (4)

Section- II

5. **Isoparametric Elements:** Shape function, Natural Co-Ordinate systems, classification- Isoparametric, subparametric, superparametric elements 1-D, 2D & 3D Isoparametric elements, Gauss-quadrature integration. (8)

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, Hamillon's principle, element mass matrices, evaluation of eigen values and eigen vectors. (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 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. Brebbin & J. J. Common.
5. Introduction to Finite Element Method by C. S. Desai & J. F. Abel.
6. Programming in Finite Element Method by Dr. C. A. Krishnamoorthy (TMH Publication).
7. Introduction to Finite Element in Engineering by T. R. Chandrapatla and Belegundu.

Solapur University, Solapur
M.E. (CIVIL- STRUCTURES) – II
Choice Based Credit System (CBCS)

9. Earthquake Engineering

Teaching Scheme:

Lectures: 3 hours per week

Tutorial: 1 hour per week

Credits: 4

Examination Assessment Scheme:

Theory:

ESE: 70 marks, ISE: 30 marks

Theory ESE duration: 4 Hours

ICA: 25 marks

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, tripartite spectrum, Construction of design response spectrum. (6)

3. Earthquake response of linear MDOF systems: Modal Analysis, Participatipn factors, Modal contributions, multistoreyed buildings with symmetric and unsymmetrical plan, Torsional response. (8)

Section- II

4. Concept of Earthquake resistant design, Objectives, Ductility, Ductility reduction factors, Over strength, 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 multistory 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 Penzien, Mc- Graw Hill Publication.
2. Dynamics of Structures:- Theory and Application to Earthquake Engineering by K. Chopra, Prentice- hall Publication.
3. Earthquake Design Practice for Buildings -- David Key, Thomas Telford Pub.
4. Earthquake Resistant Design with Rubber -James M.Kelly, Springler-Verlag Publication.
5. Earthquake Resistant Design for Engineers and Architects – D. J. Dowrick, John Wiley and Sons.
6. Passive Vibration control—Robinson, T. T. Soong.

Solapur University, Solapur
M.E. (CIVIL- STRUCTURES)- II
Choice Based Credit System (CBCS)

10. Advanced Design of Steel Structures

Teaching Scheme:

Lectures: 3 hours per week

Tutorial: 1 hour per week

Credits: 4

Examination Assessment Scheme:

Theory:

ESE: 70 marks, ISE: 30 marks

Theory ESE duration: 4 Hours

ICA: 25 marks

Section –I

1. Design of Trussed girder bridges and bearing. Deck type and through type bridges, bracing systems end bearing, mechanism and elastomeric bearings. (6)

2. Multistory steel buildings, load transfer mechanism, Internal 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. (7)

3. Cold–formed light gauges steel sections, special design considerations for compression elements, design of compression elements, stiffened compression elements, multi-stiffened elements, design of light gauge beams, behavior under repetitive loads and temperature effects. (7)

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. (6)

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 Limits States in Steel Design. (7)

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. (7)

Term Work:

A set of Tutorial/ 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 building by B. S.Taranath, McGrawHill.
4. Steel skeletal Vol. II Plastic Behaviour and design by J.F. Bekar, M.R. Horne, J.Heyman
5. Plastic methods of structural analysis by Neal B.G. Chapter and hall.
6. S.P. – 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.

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M.E. (CIVIL- STRUCTURES)
Choice Based Credit System (CBCS)

11. ELECTIVE - II
1. STABILITY OF STRUCTURES

Teaching Scheme:

Lectures: 3 hours per week

Tutorial: 1 hour per week

Credits: 4

Examination Assessment Scheme:

Theory:

ESE: 70 marks, ISE: 30 marks

Theory ESE duration: 4 Hours

ICA: 25 marks

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SECTION I

1. **Introduction:**
   Concept of stability, Static, dynamic and energy criterion of stability. Flexibility and stiffness criteria, Snap-through & post buckling behavior. (6)
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. (7)
3. **Stability of continuous Beams and Frames:**
   Moment distribution and stiffness methods for stability analysis of continuous beam & frames. (7)

SECTION II

4. **Lateral Buckling of Beam:**
   Differential equations for lateral bucking, lateral buckling of beams in pure bending, lateral buckling of beams subjected to concentrated and uniformly distributed forces. (6)
5. **In-elastic stability of Columns:**
   In-elastic buckling, double modulus theory, tangent modulus theory, Shanleys theory of in-elastic buckling, eccentrically loaded in-elastic columns. (7)

6. **Dynamic Stability of Structure:**

   Discrete systems, Lagrange-Hamilton formulation for continuous systems, Stability of continuous system, general method for conservative and non-conservative systems. (7)

Term-Work:

Problems/tutorials based on above topics.

References:

1. Stability Theory of structures – Ashwini Kumar, Tata McGraw-Hill, New Delhi.
2. Principles 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.

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M.E. (CIVIL- STRUCTURES) – II
Choice Based Credit System (CBCS)
11. ELECTIVE – II

2. Design of R. C. C. Bridges

Teaching Scheme:

Lectures: 3 hours per week

Tutorial: 1 hour per week

Credits: 4

Examination Assessment Scheme:

Theory:

ESE: 70 marks, ISE: 30 marks

Theory ESE duration: 4 Hours

ICA: 25 marks

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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 kerb, 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- piles, caissons. Construction of reinforced earth retaining wall, super structure – erection methods. Inspection, maintenance and repair of bridge. (7)
5. Design of sub-structure – abutments, piers, approach slab. (8)
6. Bearing and expansion joints – forces on bearings – Types of bearing, design of reinforced elastomeric bearings, expansion joints. (5)

Term-Work:

A set of tutorials based on above topics of syllabus.

References:

1. Essentials of Bridge Engineering by Johnson Victor, Tata McGraw-Hill.
2. Concrete Bridge – Analysis & Design by Dr.V.K.Raina- Tata McGraw-Hill.
3. Design of Bridges by N. Krishna Raju- Tata McGraw-Hill
4. Reinforced Concrete Structure – by Dr. B.C.Punmia, Arun Kumar Jain – Laxmi Publication.
5. Concrete bridge design – R.L.Rowe.
6. Design of bridge structure – by Jayram M.A.

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M.E. (CIVIL- STRUCTURES) –II
Choice Based Credit System (CBCS)

11. ELECTIVE – II
3. Structural Reliability

Teaching Scheme:

Lectures: 3 hours per week

Tutorial: 1 hour per week

Credits: 4

Examination Assessment Scheme:

Theory:

ESE: 70 marks, ISE: 30 marks

Theory ESE duration: 4 Hours

ICA: 25 marks

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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. (7)

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. (7)

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. (6)

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. (7)

5. Reliability based design load and resistance factors of design, safety checking formats and code calibrations, IS Code provisions, introduction to stochastic process. (7)

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

TERM WORK:

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

REFERENCE BOOKS:

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

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M.E. (CIVIL- STRUCTURES) –II
Choice Based Credit System (CBCS)

11. ELECTIVE – II

4. Design of Folded Plates & Shells

Teaching Scheme:

Lectures: 3 hours per week

Tutorial: 1 hour per week

Credits: 4

Examination Assessment Scheme:

Theory:

ESE: 70 marks, ISE: 30 marks

Theory ESE duration: 4 Hours

ICA: 25 marks

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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. (7)
2. Analysis and Design of cylindrical shells by membrane theory. (6)
3. Analysis and Design of cylindrical shells by beam Theory. (6)

Section- II

4. Shells of Double curvature-Analysis and Design by membrane theory of shells of revolution. (6)
5. Anticlastic and synclastic shells of Double curvature. Analysis and Design by membrane Theory. (7)
6. Design of Folded Plates – iteration method and Simpsons method. (7)

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. Ramaswami 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.

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M.E. (CIVIL- STRUCTURES)
Choice Based Credit System (CBCS)

Semester – II
12. Seminar – II

Teaching scheme:
Contact Hours: 1 hour per week per student
Credits: 2

Assessment scheme:
ICA: 50 marks

The Seminar – II shall be based on topic of dissertation as approved by faculty. The student shall submit a detailed report on the subject chosen and make a presentation at the end of semester II. Students shall prepare a power point presentation and deliver it. The student shall be able to answer questions asked on the topic.

Seminar shall be evaluated by three departmental PG recognized faculty members. The grading shall be done on the basis of the depth of the work done, understanding of the problem, technical quality of the report prepared and presentation given by the student.

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Choice Based Credit System (CBCS)
Semester – III
13. Lab. Practice

Teaching scheme:
Contact Hours: 1 hour per week per student
Credits: 1

Assessment scheme:
ICA: 25 marks

Lab practice shall be related to the dissertation as decided by the faculty advisor for developing/ acquiring necessary skills required for completion of M. E. Project at M. E. Part II. The lab practice shall be amongst one of the following, as decided by faculty advisor:

(i) Proficiency in use of application software for solving problems.

(ii) Requisite field work if any.

(iii) Lab work

(iv) Industrial exposure/ Training as deemed fit.

The student shall submit a report to the faculty advisor regarding completion of Lab Practice. As an internal continuous assessment (ICA) the faculty advisor shall monitor the progress and certify completion of student's work. Accordingly after assessment, ICA marks shall be submitted to the University through institute.

M.E. (CIVIL-STRUCTURES)

Semester – III

Choice Based Credit System (CBCS)

14. Dissertation Phase- I

Synopsis Submission Seminar

Teaching scheme:
Contact Hours: 3 hour per week per student
Credits: 3

Assessment scheme:
ISE: 75 marks

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The student is expected to carry out intensive literature survey for a period of about two months in the field of interest and to select a topic for his/her dissertation in consultation with the faculty advisor assigned. The student shall then submit a report and deliver a seminar on the problem chosen by him/her to the panel of three departmental PG recognized faculty members. It shall be expected that a student justifies the gravity and also the relevance of the problem through his/her seminar. This shall be for the approval of synopsis.

The assessment of Synopsis Submission Seminar shall be done by aforesaid panel of three departmental PG recognized faculty members.

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M.E. (CIVIL- STRUCTURES)
Choice Based Credit System (CBCS)
Semester – III

15. Dissertation Phase II

Term Work

Credits: 3 **Assessment scheme:**
ISE: 100 marks

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Student shall submit a report to the faculty advisor, on the basis of work carried out in accordance with instructions given by faculty advisor, throughout the semester. Dissertation Phase II evaluation consists of term-work evaluation (ISE) based on the efforts put in by the student to carry out his/her work & the results obtained thereof.

The faculty advisor shall complete the assessment of the report and accordingly allocate the marks to the student out of maximum 100 marks.

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M.E. (CIVIL- STRUCTURES)
Choice Based Credit System (CBCS)
Semester – III

16. Dissertation Phase II

Progress Seminar Presentation

Credits: 6 **Assessment scheme: ESE:** 200 marks

Progress seminar shall be delivered capturing details of the work done by the student for dissertation. Student shall deliver seminar using modern presentation tools. A hard copy of report shall be submitted to the faculty advisor before delivering the seminar. A PDF copy of the report must be submitted to the faculty advisor along with other details if any.

End Semester Evaluation (ESE) shall consist of presentation of progress seminar on the report submitted by the student, followed by demonstration before a panel three departmental PG recognized faculty members.

M.E. (CIVIL- STRUCTURES)

Semester – IV

Choice Based Credit System (CBCS)

17. Dissertation Phase III

Term Work

Progress seminar Presentation and Report

Teaching scheme:
Contact Hours: 5 hour per week per student
Credits: 4

Assessment scheme:
ISE: 100marks

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For all activities related to Phase III, student must interact regularly every week with the faculty advisor. The student who has cleared his/her Phase II evaluation, shall submit a report and present the status of work carried out on the dissertation after 8-10 weeks of Phase II ESE to three departmental PG recognized faculty members.

Progress seminar shall be delivered capturing details of the work done by student for dissertation. Student shall deliver seminar using modern presentation tools. A hard copy of report shall be submitted to the faculty advisor before delivering the seminar. A PDF copy of the report must be submitted to the faculty advisor along with other details if any.

The evaluation will be done by the aforesaid panel of three departmental PG recognized faculty members based on the requirements of completion of dissertation work for the dissertation Phase- III.

M.E. (CIVIL- STRUCTURES)

Semester – IV

Choice Based Credit System (CBCS)

18. Dissertation Phase-IV

Term Work

Credits: 6 **Assessment scheme:**

ISE: 200 marks

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After completing the dissertation work to the satisfaction of faculty advisor, the student shall submit the dissertation report to the University in the prescribed format. The final approved dissertation shall be submitted in black bound hard copy along with soft copy on CD/DVD.

The evaluation of dissertation is to be carried out by the faculty advisor as ISE for 200 marks. This evaluation shall be on the basis of the requirements of completion of dissertation work. The faculty advisor shall submit mark list of term work marks, along with the submission of dissertation to university as mentioned in assessment scheme.

M.E. (CIVIL- STRUCTURES)

Semester – IV

Choice Based Credit System (CBCS)

19. Dissertation Phase IV

Final Submission of the dissertation and Viva-Voce

Credits: 6 **Assessment scheme:**

ESE: 200 marks

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Open defense of the student on his/her dissertation shall be arranged by the university. This defense shall be in front of the panel of examiners as appointed by university authority. The evaluation will be done by panel of examiners as appointed by university authority.