Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2015
'B' Grade (CGPA 2.62)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: CIVIL STRUCTURAL ENGINEERING

Name of the Course: M.Tech - Semester I, II, III & IV

(Syllabus to be implemented from w.e.f. 2023-24 & 2024-25)

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
FACULTY OF SCIENCE & TECHNOLOGY
STRUCTURE OF M.Tech. CIVIL (STRUCTURAL ENGINEERING)
Four Semester Course
Choice Based Credit System Syllabus wef 2023-24
Semester-I

Sr. No	Course Code	*Subject*	*Teaching Scheme*				*Credits*				*Evaluation Scheme*				
			L	*T*	*P*	*Total*	*Credits (L)*	*Credits (T)*	*Credits (P)*	*Total Credits*	*Scheme*	*Theory Marks*	*ICA- P Marks*	*ICA-T Marks*	*Total Marks*
1	ST101	Advanced Structural Analysis	3	1	-	4	3	1	-	4	ISE	30	--	25	125
											ESE	70	--	--	
2	ST102	Advanced Solid Mechanics	3	1	-	4	3	1	-	4	ISE	30	--	25	125
											ESE	70	--	--	
3	ST103	Dynamics & Earthquake Engineering	3	1	-	4	3	1	-	4	ISE	30	--	25	125
											ESE	70	--	--	
4	ST104	Elective- I	3	1	-	4	3	1	-	4	ISE	30	--	25	125
											ESE	70	--	--	
5	ST105	Research Methodology and IPR©	3	-	-	3	3	-	-	3	ISE	30	--	--	100
											ESE	70	--	--	
6	ST106	Structural Design Lab	-		4	4	-	-	2	2	ISE	50	50	--	100
											ESE	--	--	--	
		Total	**15**	**4**	**4**	**23**	**15**	**4**	**2**	**21**		**550**	**50**	**100**	**700**

Note : *L- Lectures, P-Practical, T-Tutorial, ISE- In Semester Evaluation, ESE- End Semester Evaluation, ICA- Internal Continuous Assessment*
© - This Course is common for M.Tech. (Civil- Structural Engineering) and M.Tech. (Mechanical-Design Engineering)

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Semester-II

Sr. No.	Course Code	*Subject*	*Teaching Scheme*				*Credits*				*Evaluation Scheme*				
			L	*T*	*P*	*Total*	*Credits (L)*	*Credits (T)*	*Credits (P)*	*Total Credits*	*Scheme*	*Theory Marks*	*ICA- P Marks*	*ICA-T Marks*	*Total Marks*
1	ST111	FEM in Structural Engineering	3	1	-	4	3	1	-	4	ISE	30	--	25	125
											ESE	70	--	--	
2	ST112	Advanced Design of Concrete Structures	3	1	-	4	3	1	-	4	ISE	30	--	25	125
											ESE	70	--	--	
3	ST113	Special Concrete & Concrete Composite	3	1	-	4	3	1	-	4	ISE	30	--	25	125
											ESE	70	--	--	
4	ST114	Elective – II	3	1	-	4	3	1	-	4	ISE	30	--	25	125
											ESE	70	--	--	
5	ST115	Elective – III	3	1	-	4	3	1	-	4	ISE	30	--	25	125
											ESE	70	--	--	
6	ST116	Advanced Concrete Lab	-	-	2	2	-	-	1	1	ISE		25	--	25
											ESE	--	--	--	
7	ST117	Mini Project	-	-	2	2	-		2	2	ISE	--	50	--	50
											ESE	--	--	--	
		Total	**15**	**5**	**4**	**24**	**15**	**5**	**3**	**23**		**500**	**75**	**125**	**700**

Note : *L- Lectures, P-Practical, T-Tutorial, ISE- In Semester Evaluation, ESE- End Semester Evaluation, ICA- Internal Continuous Assessment*

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Four Semester Course
Choice Based Credit System Syllabus wef 2023-24

- **List of elective courses for semester I and II**

Course Code	*Elective - I*	*Course Code*	*Elective – II*	*Course Code*	*Elective – III*
ST104.a	Structural Audits	ST114.a	Theory of Plates and Shell	ST115.a	Theory of Structural Stability
ST104.b	Design of Prestressed Concrete Structures	ST114.b	Design of Formwork	ST115.b	Design of RCC Bridges
ST104.c	Advanced Design of Foundation	ST114.c	Repair and Rehabilitation of Structures	ST115.c	Advanced Steel Design
ST104.d	Structural Optimization	ST114.d	Design of Industrial Structures	ST115.d	Soil Structure Interaction

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Semester-III

Sr. No.	*Course Code*	*Subject*	*Teaching Scheme*			*Credits*			*Evaluation Scheme*			
			L	*P*	*Total*	*Credits (L)*	*Credits (P)*	*Total Credits*	*Scheme*	*Theory Marks*	*ICA- P Marks*	*Total Marks*
1	ST201	Lab. Practice	-	4	4	-	2	2	ISE	--	50	50
									ESE	--	--	
2	OE001	Open Elective Course#	3	-	3	3		3	ISE	30	--	100
									ESE	70	--	
3	ST202	Dissertation Phase I : Synopsis Submission Seminar*		@4	4	-	2	2	ISE	--	50	50
									ESE	--	--	
4	ST203	Dissertation Phase II : ICA*				-	4	4	ISE	--	100	100
									ESE	--	--	
5	ST204	Dissertation Phase II Progress Seminar*				-	4	4	ISE	--	--	100
									ESE	--	100	
	Total		**3**	**8**	**11**	**3**	**12**	**15**		**100**	**300**	**400**

L- Lectures, P-Practical, T-Tutorial, ISE- In Semester Evaluation, ESE- End Semester Evaluation, ICA- Internal Continuous Assessment

Note –

- 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.
- *- For all activities related to dissertation Phase I (synopsis submission seminar and progress seminar) student must interact regularly every week with the advisor.
- # - This course is common for all branches of Technology (i.e. for all M.Tech. Programs)
- 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
- @ Indicates contact hours of students for interaction with advisor.
- Details of modes of assessment of seminar and dissertation shall be as specified in 7(III) of PG Engineering Ordinance of Solapur University, Solapur

- **List of open Elective Courses-**

Sr.	***Course Code***	Open Elective Course#
1	OE001.a	Business Analytics
2	OE001.b	Operation Research
3	OE001.c	Cost Management of Engineering Projects
4	OE001.d	Non Conventional Energy
5.	OE001.e	Product Design & Development

- New Open Elective Courses may be added as and when required

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Four Semester Course
Choice Based Credit System Syllabus w.e.f. 2024-25
Semester-IV

Sr. No	Course Code	*Subject*	*Teaching Scheme*			*Credits*			*Evaluation Scheme*		
			L	*P*	*Total*	*Credits (L)*	*Credits (P)*	*Total Credits*	*Scheme*	*ICA- P Marks*	*Total Marks*
1	ST211	Dissertation Phase III :Progress Seminar #	-	4@	4	-	3	3	ISE	100	100
2	ST212	Dissertation Phase IV: Final presentation and submission of report #	-	2@	2	-	6	6	--	200	200
3	ST213	Dissertation Viva –Voce	-	-	-	-	6	6	ESE	200	200
		Total	**-**	**6**	**6**	**--**	**15**	**15**	**-**	**500**	**500**

Note –

- #- For all activities related to dissertation Phase III & IV 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 advisor along with other details if any.
- Student must submit a hard copy of Project Report to the department
- @ indicates contact hours of the student for interaction with the advisor
- Details of modes of assessment of seminar and dissertation shall be as specified in 7 (III) of PG Engineering Ordinance of Solapur University, Solapur.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M.Tech. Civil (Structural Engineering) - I

ST101 ADVANCED STRUCTURAL ANALYSIS

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (Duration: 3 Hours)
ISE: 30 marks
ICA: 25 marks

Course outcome:

At the end of the course, students will be able to

1. Draw ILD for indeterminate structures
2. Analyze the beams curved in plan
3. Analyze the structure resting on elastic foundation
4. Analyze the skeleton structures using stiffness method

Course content

Unit no.	Details	Teaching Hours
	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.	8
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	6

	and carry-over factors for beam-columns, fixed end actions due to various loads.	
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.	6

Internal Continuous Assessment (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

References:

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.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M.Tech. Civil (Structural Engineering) - I

ST102 ADVANCED SOLID MECHANICS

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (Duration: 3 Hours)
ISE: 30 marks
ICA: 25 marks

Course Outcomes: -

At the end of the course, student will be able to,

1. Identify and Solve problems of elasticity understanding the basic concepts
2. Apply numerical methods to solve continuum problems.
3. Identify and Solve problems of plasticity understanding the basic concepts.

Course content

Unit No	Details	Teaching Hours
	Section- I	
1	**Introduction to Elasticity**: Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity.	6
2	**Three-Dimensional Problems of Elasticity:** Elementary Concept of Strain, Stain at a Point, Principal Strains and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic and Deviatoric Components, Equations of Equilibrium, Stress- Strain relations, Strain Displacement and Compatibility Relations.	10

3	**Two-Dimensional Problems of Elasticity:** Plane Stress and Plane StrainProblems, Airy's stress Function, Two-Dimensional Problems in Polar Coordinates.	6
	Section- II	
4	**Torsion of Prismatic Bars:** Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes.	8
5	**Plastic Deformation :**Strain Hardening, Idealized Stress- Strain curve, Yield Criterion, Von Mises Yield Criterion	7
6	**Plastic Deformation:** Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.	7

Internal Continuous Assessment (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

References:-

1. Theory of Elasticity: Timoshenko S. and Goodier J. N., McGraw Hill, 1961.
2. Elasticity: Sadd M.H., Elsevier,2005.
3. Engineering Solid Mechanics: Ragab A.R., Bayoumi S.E., CRC Press, 1999.
4. Computational Elasticity: Ameen M., Narosa, 2005.
5. Solid Mechanics: Kazimi S. M. A., Tata McGraw Hill, 1994.
6. Advanced Mechanics of Solids: Srinath L.S., Tata McGraw Hill, 2000.
7. Introduction to Mechanics of Solids by Venkatraman & Patel
8. Theory of Plasticity by Chakraborty

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M.Tech. Civil (Structural Engineering) - I

ST103 DYNAMICS AND EARTHQUAKE ENGINEERING

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (Duration: 3 Hours)
ISE: 30 marks
ICA: 25 marks

Course Outcomes: -

At the end of the course, student will be able to,

1. Analyze dynamic response of SDOF system using fundamental theory and equation of motion
2. Analyze dynamic response of MDOF system using fundamental theory and equation of motion
3. Evaluate the seismic response of the structures
4. Analyse, design and detail the multistoried buildings subjected to seismic loads.

Course content

Unit No	Details	Teaching hours
	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	9
2	Introduction to frequency-Domain Analysis, SDOF system subjected to general dynamic loading, Numerical evaluation of SDOF –Duhamal's Integral, Application to simple loading cases constant load and rectangular load.	7
3	MDOF System, Selection of DOFs, Formulation of Equation of motion, Free vibrations, Frequencies and Mode Shapes, Determination of natural frequencies and mode shapes, Orthogonality conditions, Fundamental mode analysis, Rayleigh method, Dunkerly's Method, Response of MDOF systems to dynamic loading,Mode superposition Method	6
	Section-II	

4	Characteristics of Earthquakes: Earthquake terminology, Indian Earthquakes, Measurement of Earthquakes, Magnitude, Intensity, Interior of Earth, plate tectonics, Liquefaction.	8
5	Earthquake response of systems: Response spectrum theory, Strong ground motion, Concept of earthquake response spectrum Response Spectrum–elastic and inelastic response spectra, tripartite (D-V-A) response spectrum, use of response spectrum in earthquake resistant design.	8
6	Design of Reinforced concrete buildings for earthquake resistance-Load combinations, Lateral load analysis, Provisions of IS-1893 for buildings, Base Shear, Application to Multistorey buildings. Ductility and energy absorption in buildings. Confinement of concrete for ductility, design of columns and beams for ductility, ductile detailing provisions of IS-13920.	6

Internal Continuous Assessment (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

References:-

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.
7. Structural Design of Multi-storeyed Buildings, Varyani U. H., 2nd Ed., SouthAsian Publishers, New Delhi, 2002.
8. Earthquake Design Practice for Buildings -- David Key, Thomas Telford Pub.
9. Dynamics of Structures:- Theory and Application to Earthquake Engineering by K. Chopra, Prentice- hall Publication.
10. Earthquake Resistant Design for Engineers and Architects – D. J. Dowrick, John Wileyand Sons.
11. Illustrated Design of Reinforced ConcreteBuildings(GF+3storeyed), Shah V. L. &Karve S. R.,Structures Publications, Pune, 2013.
12. High Rise Building Structures, Wolfgang Schueller, Wiley., 1971.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech. Civil (Structural Engineering) - II

Choice Based Credit System (CBCS)

ST104.a STRUCTURAL AUDITS (Elective-I)

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (Duration: 3 Hours)
ISE: 30 marks
ICA: 25marks

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Course Outcomes: -

At the end of the course, students will be able to

1. Strength evaluation of existing structures.
2. Evaluate the damaged structures and implement different retrofitting techniques.
3. Maintain the concrete structures in the working and safe condition.
4. Be able to take the decision of dismantling the structure, if it is deteriorated beyond the repairing.

Unit No.	Details	Teaching hours
	Section-I	
1	Introduction to Structural Audit, Objectives, Bye-laws, Importance, Various Stages involved, Visual inspection: scope, coverage, limitations, Factors to be keenly observed.	3
2	Structural Health, factors affecting health of structures, effect of leakage, age, creep, corrosion, fatigue on life of structure. Structural health monitoring. Various measures, regular maintenance, structural safety in alteration. Quality control & assurance of materials of structure, durability of concrete, Factors affecting durability of concrete, Corrosion in structures, Testing and prevention of corrosion.	10
3	Structural Audit, Assessment of health of structure, study of structural drawings, nature of distress, visual observations, Collapse and investigation, limitations on investigator, tools for investigation, Various NDT Methods for assessing strength of distressed materials, investigation management, review of	10

	assimilated information, interviews and statements, evaluation and reporting.	
Section-II		
4	Retrofitting of Structures, parameters for assessment for restoration strategies, selection of construction chemicals during restoration, Specification for important items of work in restoration, Structural detailing for restoration and various techniques of retrofitting.	10
5	Safety during construction, formwork and staging, Modular formwork, Structural aspects for formwork in buildings & bridges. Fire safety. Demolition of Structure, study of structural system and structural drawings, outline of various demolition methods and their evaluation, partial and controlled demolition, role of safety measures, temporary support structures in demolition. Recycling of demolished materials.	12

Internal Continuous Assessment (ICA)

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

References:

1. R N. Raikar: 'Durable Structures', R & D Centre, (SDCPL), RaikarBhavan, Sector 17, Vashi, Navi Mumbai.
2. R.N. Raikar: 'Learning from Failures', R & D Centre, (SDCPL), RaikarBhavan, Sector 17, Vashi, Navi Mumbai.
3. R.N. Raikar: 'Diagnosis and treatment of structures in Distress', R & D Centre, (SDCPL), RaikarBhavan, Sector 17, Vashi, Navi Mumbai.
4. Jayakumar, J. Shah: 'A Book – A Handy Guide to Repairs, Rehabilitation and Waterproofing of RCC Building (Structures)', Third updated photo-copy set.
5. Austin. C. K : 'Formwork to Concrete', Chapman and Hall
6. Mr. Umesh Dhargalkar 'Structural Audit', Mumbai.
7. Jayakumar J. Shah: 'An Article – House Keeping of RCC Buildings', Published in April 2001 issue of the Housing Times, Vikas Premises, Fort Mumbai 400001.
8. Jayakumar J. Shah: 'An Article – Repairs & Rehabilitation of RCC Buildings (Structures) – Materials and Techniques', Published in March 2002 issue of New Building Materials and Construction World, New Delhi.
9. Jayakumar J. Shah: 'An Article – Repairs, Rehabilitation of Structurally Distressed RCC Members of Buildings', Published in July 2000 issue of Construction World, ASAP Media, Mumbai.
10. J. J. Shah: 'Point of View – Repair, Rehabilitation and Waterproofing of structures-Some View', Published in April 1998 issue of The Indian Concrete Journal, Mumbai.
11. Mani, K and Srinivasan, P.: 'An Article :Corrosion Damage and its Evaluation by Testing' in

Advanced Testing and Evaluation of Structures and Components, Allied Publishres, Chennai, 2002 pp 14.01 – 14.33.

12. Popovics, S and Popovics, J.S: 'An Article: A Critique of the Ultrasonic Pulse Velocity Method for Testing Concrete' in Non-destructive Testing of Concrete Elements and Structures', ASCE, New York, 1992, pp 94-103.
13. Thandavamoorthy T.S. et al: 'Health Assessment of Concrete Structures by Ultrasonic pulse Velocity Technique an experimental Investigation in Building Materials', RRL Bhopal, February 26-27, 2004, pp. 284-89.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech. Civil (Structural Engineering) - II

Choice Based Credit System (CBCS)

ST104.b DESIGN OF PRESTRESSED CONCRETE STRUCTURES (Elective-I)

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (Duration: 3 Hours)
ISE: 30 marks
ICA: 25marks

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Course Outcomes: -

At the end of the course, students will be able to

1. Study of different prestressing techniques
2. Identify structural engineering problems reviewing available literature
3. Analyze of complex structural systems

Unit No.	Details	Teaching hours
	Section-I	
1	**Introduction to prestressed concrete**: types of prestressing, systems and devices, materials, losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer andservice loads, ultimate strength in flexure, code provisions.	6
2	**Statically determinate PSC beams**: design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions.	9
3	**Design of Anchor Blocks** Design of Anchor Blocks using Magnel's Method, Guyon's Method and IS Code Method.	5
	Section-II	

4	**Statically indeterminate structures** Analysis and design - continuous beams and frames, choice of cable profile, linear transformation and concordancy.	9
5	**Composite construction:-** precast PSC beams and cast in-situ RC slab - Analysis and design, creep and shrinkage effects. Partial prestressing - principles, analysis and design concepts, crack width calculations	9
6	**Prestressed concrete pipes** Analysis and design of prestressed concrete pipes, columns with moments.	5

Internal Continuous Assessment (ICA)

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

References:

1. Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 1955.
2. Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981.
3.Dr.V.K.Raina, Concrete Bridge Practice: Analysis, Design and Economics, Shroff Publishers & Distributors Pvt Ltd.,
4. Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Reinforced Concrete Structures, Vol. II, Laxmi Publications.
5.Jagadish&Jayaram, Design of Concrete Bridges, Tata McGraw Hill Victor, Design of Concrete Bridges, Tata McGraw Hill.
6. IS: 1343- Code of Practice for Prestressed Concrete

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M. Tech. Civil (Structural Engineering) - I

ST104.c ADVANCED DESIGN OF FOUNDATION (Elective-I)

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (Duration: 3 Hours)
ISE: 30 marks
ICA: 25 marks

Course Outcomes: -

At the end of the course, student will be able to,
1. Evaluate Bearing capacity of soil by various theories
2. Design wall footing, strap footing, combined footing
3. Design Pile foundation for the given loading and site conditions
4. Design simple Machine foundation

Course content

Unit No.	Details	Teaching hours
	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)	8
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.	7
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

Internal Continuous Assessment (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

References:-

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. Tech. Civil (Structural Engineering) - I

ST104.d STRUCTURAL OPTIMIZATION (Elective-I)

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (Duration: 3 Hours)
ISE: 30 marks
ICA: 25 marks

Course Outcomes: -

At the end of the course, student will be able to,

1. Use variational principle for optimization
2. Apply optimization techniques to structural steel and concrete members
3. Apply Linear and non linear optimization technique

Course content

Unit No.	Details	Teaching hours
	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.	7
	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.	7

Internal Continuous Assessment (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

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

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech. Civil (Structural Engineering) - I

ST105 RESEARCH METHODOLOGY AND IPR©

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits

Examination Assessment Scheme:
ESE: 70 marks (Duration: 3 Hours)
ISE: 30 marks

Course Outcomes: -

At the end of the course, student will be able to,

1. Propose and distinguish appropriate research designs and methodologies for a specific research project.
2. Develop skills in literature review, qualitative and quantitative data analysis and presentation.
3. Describe the importance of Computers, Information Technology in research and also highlight the significance of ideas, concept, and creativity in research.
4. Illustrate the importance of Intellectual Property Rights in growth of individuals & nation.
5. Exhibit knowledge about IPR protection, providing an incentive to inventors for further research work leading to creation of new and better products.

Course content

Unit No.	Details	Teaching hours
	Section-I	
1	**Introduction:** Defining Research, Scientific Enquiry, Hypothesis, Scientific Method, Types of Research, Research Process and steps in it. Research Proposals – Types, contents, sponsor agent's requirements, Ethical, Training, Cooperation and Legal aspects.	6
2	**Research Design:** Meaning, Need, Concepts related to it, categories; Literature Survey and Review, Dimensions and issues	6

	of Research Design, Research Design Process – Selection of type of research, Measurement and measurement techniques ,Selection of Sample, Selection of Data Collection Procedures, Selection of Methods of Analysis, Errors in Research.	
3	**Research Problem:** Problem Solving – Types, Process and Approaches – Logical, Soft System and Creative; Creative problem solving process, Development of Creativity, Group Problem Solving Techniques for Idea Generation – Brain storming and Delphi Method.	6
Section-II		
4	**Nature of Intellectual Property:** Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	8
5	**Patent Rights:** Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	5
6	**New Developments in IPR:** Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR	5

References:

1. Krishnaswamy, K.N., Sivakumar, Appa Iyer & Mathirajan M., (2006) - Management Research Methodology: Integration of Principles, Methods & Techniques (New Delhi, Pearson Education)
2. Montgomery, Douglas C. (2004) – Design & Analysis of Experiments, (New York, John Wiley & Sons)
3. Kothari, C.K. (2004) – Research Methodology, Methods & Techniques, (New Delhi, New Age International Ltd. Publishers).
4. Prabuddha Ganguli, IPR: Unleashing the Knowledge Economy, published by Tata McGraw Hill 2001.
5. John W Cresswell, (2009)-Research Design: Qualitative, Quantitative and Mixed Methods Approaches, (Sage Publications Pvt Ltd. 3rd Edition.)
6. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
7. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M.Tech. Civil (Structural Engineering) - I

ST106 STRUCTURAL DESIGN LAB

Lab work: - 4 hours per week, 2 Credits

Examination Scheme:
ISE: 50 marks
ICA: 50 marks

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Course Outcomes: - At the end of the course, student will be able to,

1. Design and Detail all the Structural Components of Frame Buildings.
2. Design and Detail complete Multi-Storey Frame Buildings.

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Course content	Teaching hours
Design and detailed drawing of complete G+ 3 structures by individual student using latest relevant IS codes and relevant application software.	4

Internal Continuous Assessment (ICA)

ICA shall be based upon the Term work consisting Analysis and Design calculations of the poblem. The student shall give the presentation at the end of semester based on his / her termwork. The supervisor shall assess the term work and presentation.

SEMESTER –II

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech. Civil (Structural Engineering) - II

Choice Based Credit System (CBCS)

ST 111 FEM IN STRUCTURAL ENGINEERING

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (Duration: 3 Hours)
ISE: 30 marks
ICA: 25marks

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Course Outcomes: -

At the end of the course, student will be able to,

1) Analyse 1-D problems related to structural analysis like Bars, Trusses, Beams and Frames using finite element approach.
2) Find solution to problems using direct approach methods like Rayleigh – Ritz or Galerkin's Method.
3) Solve 2-D problems using knowledge of theory of elasticity.
4) Students will be able to implement the knowledge of numerical methods in FEM to find the solution to the various problems in statics and dynamics

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Unit No.	Details	Teaching hours
	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	
	Section-II	
4	**Isoparametric Elements:** Shape function, Natural Co-Ordinate systems, classification- Isoparametric, subparametric, superparametric elements 1-D, 2D & 3D Isoparametric elements, Gauss-quadrature integration.	8
5	**Finite Element Applications to Structural Dynamics:** Formulation, Hamillon's principle, element mass matrices, evaluation of eigen values and eigen vectors.	6
6	**Advanced Topics in FEM:** **3-D problems:** development of element stiffness matrix and nodal load vector for Tetrahedron, Hexahedral elements. **Axisymmetric Elements:** Development of element stiffness matrix and nodal load vector.	6

Internal Continuous Assessment (ICA)

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

References:

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

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M.Tech. Civil (Structural Engineering)-II

ST 112: ADVANCED DESIGN OF CONCRETE STRUCTURES

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (Duration: 3Hours)
ISE: 30 marks
ICA: 25 marks

Course Outcomes: -

At the end of the course, student will be able to,

1. Analyze and Design various special types of slabs
2. Analyze and Design Combined Footing and Raft foundation
3. Analyze and Design Overhead water tanks.
4. Design of Deep beam, Corbel, Chimneys , **S**ilos and Bunkers

Course content

Unit no.	Details	Contact Hours
	Section-I	
1	Analysis and Design of Flat slab, Grid Slab and Circular slab.	8
2	Analysis and Design of Combined Footing and Raft foundation	6
3	Design of miscellaneous structures: Design of Deep Beam and Corbel, Design of Shear Walls.	8
	Section-II	
4	Analysis and Design of Overhead water tank- Rectangular and Circular with flat bottom, Design of staging for wind and seismic	8

	loads.	
5	Design of RCC Chimneys- Design factors, stresses due to self-weight and wind load, Temperature stresses	6
6	Design of silos and bunkers – classification, Square bunkers and circular bunkers, Silos- Lateral pressure, Airy's theory, Shallow Bins, Deep Bins	8

Internal Continuous Assessment (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

References:-

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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. Reinforced Concrete Structures Vol.1 & Vol.2 by B. C. Punmia, A. K. Jain, Arun K. Jain.
6. Advanced Reinforced Concrete Design by Bhavikatti S.S.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech. Civil (Structural Engineering) - II

Choice Based Credit System (CBCS)

ST113: SPECIAL CONCRETE & CONCRETE COMPOSITES

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (duration: 4 Hours)
ISE: 30 marks
ICA: 25marks

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Course Outcomes: -

At the end of the course, students will be able to

1. Achieve Knowledge of design and development of problem solving skills.
2. Summarize the Light Weight concrete, Fiber reinforced concrete and High and Performance concrete
3. Design and cast ferrocement products
4. Produce Silica fume Concrete
5. Design and cast Polymer concrete

Unit No.	Details	Teaching hours
	Section-I	
1.	**Components of modern concrete and developments in the process and constituent materials:** Role of constituents, Development in cements and cement replacement materials, pozzolona, fly ash, silica fume, rice husk ash, recycled aggregates, chemical admixtures. Mix proportioning of Concrete: Principles and methods.	7
2.	**Light Weight concrete:** Introduction, classification, properties, strength and durability, mix proportioning and problems. High density concrete: Radiation shielding ability of concrete, materials for high density concrete, mix proportioning, properties in fresh and hardened state, placement methods.	6
3	**Ferro cement:** Introduction, materials used, mechanical properties, construction techniques, design in direct tension, applications,merits as structural materials.	7
4.	**High Performance concrete:** constituents, mix proportioning, properties in fresh and hardened states, applications and limitations. Ready Mixed Concrete-QCI-RMCPC scheme requirements, Self Compacting Concrete, Reactive powder concrete, and bacterial concrete.	6

	SECTION -II	
5.	**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.	6
6.	**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.	6
7.	**Polymer concrete** Introduction, classification, properties of constituent materials, polymer impregnated concrete, polymer concrete, application.	7

Internal Continuous Assessment (ICA)

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

References:

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.
6. Neville A.M, "Properties of Concrete" Pearson Education Asia, 2000
7. P. Kumar Mehta, Paul J.N. Monterio, CONCRETE:Microstructure, Properties and Materials", Tata McGraw Hill
8. A.R.Santhakumar, (2007) "Concrete Technology"-Oxford University Press, New Delhi, 2007
9. Gambhir "Concrete Technology" TMH.
10. Short A and Kinniburgh.W, "Light Weight Concrete"- Asia Publishing House, 1963
11. Aitcin P.C. "High Performance Concrete"-E and FN, Spon London 1998
12. Rixom.R. and Mailvaganam.N., "Chemical admixtures in concrete"- E and FN, Spon London 1999
13. Rudnai.G., "Light Weight concrete"- Akademiaikiado, Budapest, 1963
14. http://qcin.org/CAS/RMCPC/

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech. Civil (Structural Engineering) - II

Choice Based Credit System (CBCS)

ST114.a THEORY OF PLATES AND SHELLS (ELECTIVE II)

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (duration: 3 Hours)
ISE: 30 marks
ICA: 25marks

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Course Outcomes: -

At the end of the course, students will be able to

1. Use analytical methods for the solution of thin plates.
2. Apply the numerical techniques and tools for the complex problems in thin plates.
3. Use analytical methods for the solution of shells.
4. Apply the numerical techniques and tools for the complex problems in shells.

Unit No.	Details	Teaching hours
	Section-I	
1	**Introduction:** Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using principle of Virtual Work, Boundary Conditions.	5
2	**Static Analysis of Plates:** Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under various Loadings, Levy's solution for Rectangular Plate with other Boundary Conditions.	10
3	**Circular Plates:** Analysis under Axi-symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates	10

Section-II		
4	**Static Analysis of Shells:** Membrane Theory of Shells - Cylindrical, Conical and Spherical Shells.	6
5	**Shells of Revolution:** with Bending Resistance - Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels	6
6	**Thermal Stresses in Plate/ Shell**	5

Internal Continuous Assessment (ICA)

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

References:

1. Theory of Plates and Shells, Timoshenko S. and KriegerW., McGraw Hill.
2. Stresses in Plates and Shells, Ugural Ansel C., McGraw Hill.
3. Thin Elastic Shells, Kraus H., John Wiley and Sons.
4. Theory of Plates, Chandrashekhara K., Universities Press.
5. Design and Construction of Concrete Shells, Ramaswamy G.S.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech. Civil (Structural Engineering) - I

ST114.b DESIGN OF FORMWORK (ELECTIVE II)

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (Duration: 3 Hours)
ISE: 30 marks
ICA: 25 marks

Course Outcomes: -

At the end of the course, student will be able to,
1. Select proper formwork, accessories and material
2. Design the form work for Beams, Slabs, columns, Walls and Foundations.
3. Design the form work for Special Structures
4. Design the flying formwork

Course content

Unit No.	Details	Teaching hours
	Section-I	
1	**Introduction to formwork** Types of formwork, Requirement of formwork , Selection of formwork, Trenchless technology	6
2	**Formwork materials** Timber, Plywood, Steel, Aluminum, Plastic, and Accessories. Types of supports, Horizontal and Vertical Formwork Supports,	8
3	**Formwork Design** Concepts, Formwork Systems and Design for Foundations, Walls, Columns Slab and Beams	8
	Section-II	

4	**Formwork Design for Special Structures**: Shells, Domes, Folded Plates, Overhead Water Tanks, Tower, Bridges.	9
5	**Flying Formwork**: Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues – Pre- and Post-Award.	6
6	Causes and Case studies in Formwork Failure, Formwork Issues in Multi- Story Building Construction.	6

Internal Continuous Assessment (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

References:-

1. Formwork for Concrete Structures, Peurify, McGraw Hill Publication India
2. Formwork for Concrete Structures, Kumar Neeraj Jha, Tata McGraw Hill Education.
3. IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech. Civil (Structural Engineering) - I

ST114.c REPAIR AND REHABILITATION OF STRUCTURES (ELECTIVE II)

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (Duration: 3 Hours)
ISE: 30 marks
ICA: 25 marks

Course Outcomes: -

At the end of the course, student will be able to,

1. Achieve Knowledge of design and development of problem solving skills.
2. Understand the cause of deterioration of concrete structures.
3. Design and develop analytical skills.
4. Summarize the principles of repair and rehabilitation of structures
5. Understands the concept of Serviceability and Durability.

Course content

Unit No.	Details	Teaching hours
	Section-I	
1	**General:** Introduction, Cause of deterioration of concrete structures, Diagnostic methods & analysis, preliminary investigations, experimental investigations using NDT, load testing, corrosion mapping, core drilling and other instrumental methods, Quality assurance for concrete construction, as built concrete properties strength, permeability, thermal properties and cracking.	6
2	**Influence on Serviceability and Durability:** Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, and cathodic protection.	8

4	**Maintenance and Repair Strategies:** Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance, Preventive measures on various aspects. Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration, testing techniques	9
	SECTION II	
5	**Materials for Repair:** Special concretes and mortars, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fiber reinforced concrete. Techniques for Repair: Rust eliminators and polymers coating for rebar during repair foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shot Crete Epoxy injection, Mortar repair for cracks, shoring and underpinning.	6
6	**Examples of Repair to Structures:** Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure, engineered demolition techniques for dilapidated structures - case studies	6

Internal Continuous Assessment (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

References:-

1. Sidney, M. Johnson "Deterioration, Maintenance and Repair of Structures".
2. Denison Campbell, Allen & Harold Roper, "Concrete Structures – Materials, Maintenance and Repair"- Longman Scientific and Technical
3. R.T.Allen and S.C. Edwards, "Repair of Concrete Structures"-Blakie and Sons
4. Raiker R.N., "Learning for failure from Deficiencies in Design, Construction and Service"- R&D Center (SDCPL).

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M. Tech. Civil (Structural Engineering) - II

Choice Based Credit System (CBCS)

ST114.d DESIGN OF INDUSTRIAL STRUCTURES (ELECTIVE- II)

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (Duration: 3 Hours)
ISE: 30 marks
ICA: 25marks

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Course Outcomes: -

At the end of the course, students will be able to

1. Design Steel Gantry Girders.
2. Design Steel Portal, Gable Frames.
3. Design Steel Bunkers and Silos.
4. Design Chimneys and Water Tanks

Unit No.	Details	Teaching hours
	Section-I	
1	**Steel Gantry Girders** – Introduction, loads acting on gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction detail, design procedure.	8
2	**Portal Frames** – Design of portal frame with hinge base, design of portal frame with fixed base - Gable Structures – Lightweight Structures	8
3	**Steel Bunkers and Silos** – Design of square bunker – Jansen's andAiry's theories – IS Code provisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams Design of cylindrical silo – Side plates – Ring girder – stiffeners.	6
	Section-II	
4	**Chimneys** – Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration,	6

	design of base plate, design of foundation bolts, design of foundation.	
5	**Water Tanks** – Design of rectangular riveted steel water tank – Tee covers – Plates – Stays – Longitudinal and transverse beams –Design of staging – Base plates – Foundation and anchor bolts –	8
6	**Design of pressed steel water tank** – Design of stays – Joints – Design of hemispherical bottom water tank – side plates – Bottom plates – joints – Ring girder – Design of staging and foundation	6

Internal Continuous Assessment (ICA)

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

References:

1. Design of Steel Structure, Punmia B. C., Jain Ashok Kr., Jain Arun Kr., 2nd Ed., Lakshmi Publishers, 1998.
2. Design of Steel Structures, Ram Chandra, 12th Ed., Standard Publishers, 2009.
3. Design of Steel Structures, Subramaniyam.

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M. Tech. Civil (Structural Engineering) - II

Choice Based Credit System (CBCS)

ST115.a THEORY OF STRUCTURAL STABILITY (ELECTIVE- III)

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (Duration: 3 Hours)
ISE: 30 marks
ICA:25marks

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Course Outcomes: -

At the end of the course, students will be able to

1. Determine stability of columns and frames
2. Determine stability of beams and plates
3. Use stability criteria and concepts for analyzing discrete and continuous systems

Unit No.	Details	Teaching hours
	Section-I	
1	**Introduction:** Concept of stability, Static, dynamic and energy criterion of stability. Flexibility and stiffness criteria, Snap-through & post buckling behavior.	5
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.	4
3	**Stability of continuous Beams and Frames:** Moment distribution and stiffness methods for stability analysis of continuous beam & frames	6
	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.	6
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.	5

Internal Continuous Assessment (ICA)

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

References:

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.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Tech. (Civil-Structural Engineering)-II
Choice Based Credit System (CBCS)

ST115.b DESIGN OF R. C. C. BRIDGES (ELECTIVE – III)

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (Duration: 4 Hours)
ISE: 30 marks
ICA: 25marks

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Course outcome:

At the end of the course, students will be able to

1. Select the suitable type of bridges according to the site condition.
2. Categorize IRC loads, distribution of these loads among longitudinal beams of a bridge.
3. Design Solid deck slab and T beam bridge superstructure
4. Analyze and verify the adequacy of piers and abutments.
5. Identify and design the suitable type of bearing for the given condition

Unit no.	**Details**	**Contact Hours**
	Section-I	
1	**Introduction to Bridg Engineering:-** 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.	5
2	**Loading on 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 Bridge Deck:-** Analysis and Design of R. C. deck slab, beam and slab (For IRC class AA and IRC class A loading), T beam, Pigeaud's theory,	12

	Courbon's theory, Introduction to Hendry-Jaeger And Morice-Little Method, Analysis and Design of box culvert.	
	Section-II	
4	**Design of sub structure:-** Piers and Abutments- type, shape and their suitability, Design of sub-structure – abutments, piers, approach slab	8
5	**Bearings and Expansion Joint:-** Bearing and expansion joints – forces on bearings – Types of bearing, design of reinforced elastomeric bearings, expansion joints	8
6	**Construction techniques:-** Construction of sub structure- piles, caissons. Construction of reinforced earth retaining wall, super structure – erection methods.	5

Internal Continuous Assessment (ICA)

Problems/ tutorials based on above topics.

References:

1. "Essentials of Bridge Engineering"- D Johnson Victor, Oxford & IBH Publishing Co New Delhi
2. "Design of Bridges"- N Krishna Raju, Oxford & IBH Publishing Co New Delhi
3. "Principles and Practice of Bridge Engineering"- S P Bindra Dhanpat Rai & Sons New Delhi
4. IRC 6 – 1966 "Standard Specifications And Code Of Practice For Road Bridges"- Section II Loads and Stresses, The Indian Road Congress New Delhi
5. IRC 21 – 1966 "Standard Specifications And Code Of Practice For Road Bridges"-Section III Cement Concrete (Plain and reinforced) The Indian Road Congress New Delhi
6. IS 456 – 2000 "Indian Standard Plain and Reinforced Concrete Code of Practice"- (Fourth Revision) BIS New Delhi
7. IS 1343 – "Indian Standard Prestressed Concrete Code of Practice"- BIS New Delhi
8. Raina V.K., "Concrete Bridge Practice"- Tata McGraw Hill
9. Bakht B & Jaeggar, "Bridge Analysis Simplified"- McGraw Hill
10. Ponnuswamy. S, "Bridge Engineering"- Tata McGraw Hill.
11. Derrick Beckett, "An Introduction to Structural Design of ConcreteBridges"- Surrey University Press

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Tech. (Civil-Structural Engineering)-II
Choice Based Credit System (CBCS)

ST115.c ADVANCED STEEL DESIGN (ELECTIVE – III)

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (Duration: 3 Hours)
ISE: 30 marks
ICA: 25marks

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Course outcome:

At the end of the course, students will be able to
1. Design steel structures/ components by different design processes.
2. Use the design provisions for hot-rolled and cold-formed steel structures.
3. Design Steel Beams with Web Openings.
4. Perform plastic analysis and design of portal frames and Beams.

Unit no.	Details	Contact Hours
	Section-I	
1	**Laterally Unrestrained Beams:** Lateral Buckling of Beams, Factors affecting lateral stability, IS 800 code provisions, Design Approach. Lateral buckling strength of cantilever beams, continuous beams, beams with continuous and discrete lateral restraints, Mono- symmetric and non- uniform beams – Design Examples. Concepts of Shear Center, Warping, Uniform and Non-Uniform torsion.	8
2	**Tubular Structures:** Design of tubular Trusses and scaffoldings using circular hollow, rectangular hollow sections as per code, detailing of joints.	8
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. IS 801& 811 code provisions-	6

	numerical examples.	
	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. Plastic analysis and design of portal frames, collapse mechanisms, plastic moment distribution method, Introduction to Limits States in Steel Design.	8
5	**Steel Beams with Web Openings:** Shape of the web openings, practical guide lines, and Force distribution and failure patterns, Analysis of beams with perforated thin and thick webs, Design of laterally restrained castellated beams for given sectional properties, Vierendeel girders (design for given analysis results)	8
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.	6

Internal Continuous Assessment (ICA)

Problems/ tutorials based on above topics.

References:

1. Dynamics of Structures – Theory & Application to Earthquake Engineering, A.K. Chopra , Prentice Hall Publications
2. Design of steel structures - Vol. II, Ramchandra, Standard book, house Delhi.
3. Design of steel structures, A.S. Arya. J.L. Ajamani, Nemchand and brothers.
4. Limit state design of steel structures, S K Duggal, Tata McGraw Hill Education
5. IS: 800 - 1984, Code of Practice for General Construction in Steel, BIS, New Delhi.
6. IS: 801 - 1975, Code of Practice for use of cold formed light gauge steel structural members in general building construction, BIS, New Delhi.
7. IS: 802 (Part I and II)-1978, Code of practice for use of structural steel in overhead transmission line towers, BIS, New Delhi.
8. IS:806-1988, Code of practice for use of steel tubes in general building construction, BIS, New Delhi.
9. IS: 811-1987, Specification for cold formed light gauge structural steel sections, BIS, New Delhi.
10. IS: 875 (Part 1, 2 and 3) – 1987, Code of practice for design loads for buildings and structures, BIS, New Delhi.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Tech. (Civil-Structural Engineering)
Choice Based Credit System (CBCS)

ST115.d SOIL STRUCTURE INTERACTION (ELECTIVE- III)

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (Duration: 3 Hours)
ISE: 30 marks
ICA: 25marks

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Course outcome:

At the end of the course, students will be able to

1. Evaluate soil structure interaction for different types of structure under various conditions of loading.
2. Prepare a comprehensive numerical tool for interaction problem based on theory of subgrade reaction such as beam, footing raft etc.
3. Analyze the soil-structure interaction of framed structures
4. Evaluate action of group of piles considering soil structure interaction

Unit no.	Details	Contact Hours
	Section-I	
1	**Soil-Foundation Interaction**:- Introduction to soil - Foundation interaction problems, Soil behaviour, Foundation behaviour, Interface, behaviour, Scope of soil-foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behaviour, Time dependent behaviour.	**7**
2	**Beam On Elastic Foundation - Soil Models** :- Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.	**7**
3	**Soil-foundation-structure interaction models:-** Idealization of soil by linear and non-linear modified Winkler model, Elastic continuum model (isotropic and anisotropic), Two parameter elastic models- Heteny model, Pasternak model, Reissner model.	8

Section-II		
4	**Soil Structure Interaction in Framed Structures:-** structures with isolated foundation, spring analog approach, determinations of spring parameters, structures with continuous beams and rafts as foundation, finite element modelling, sub-structure technique of analysis, concept of relative stiffness, Interactive behavior of some framed structure(5)	5
5	**Soil pile interaction:** Laterally loaded single piles-Concept of coefficient of horizontal subgrade reaction, finite difference and finite element solution, soil-structure interaction of framed structures with pile foundation, Interaction of other structures with soil foundation system, Tanks with annular ring foundations, chimneys, silos, cooling towers, underground subways and tunnels.	10
6	Introduction to dynamic soil structure interaction as well as non-linear soil/concrete behavior.	5

Internal Continuous Assessment (ICA)

Assignment based on above topics

Reference Books

1. John, P. Wolf, 'Dynamic Soil-Structure-Interaction'.
2. John, P. Wolf,' Soil-Structure-Interaction in Time Domain'.
3. Hemsley, J.A, Elastic Analysis of Raft Foundations, Thomas Telford, 1998.
3. McCarthy, D.F. Essentials of Soil Mechanics and Foundations, basic geotechnics (6th Edition), Prentice Hall, 2002.
4. Selvadurai, A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier, 1979.
5. Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, John Wiley, 1980.
6. Scott, R.F. Foundation Analysis, Prentice Hall, 1981.
7.Structure Soil Interaction - State of Art Report, Institution of structural Engineers, 1978. ACI 336, Suggested Analysis and Design Procedures for Combined Footings and Mats, American Concrete Institute, Dehit, 1988.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M.Tech. Civil (Structural Engineering) - II

Choice Based Credit System (CBCS)

ST116 ADVANCED CONCRETE LAB

Lab Scheme:
2 hours per week – 1 Credits

Examination Assessment Scheme:
ICA: 25 marks

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Course Outcomes: - At the end of the course, student will be able to,

1. Design high grade concrete and study the parameters affecting its performance.
2. Conduct Non Destructive Tests on existing concrete structures.
3. Apply engineering principles to understand behavior of structural elements

Details of Lab work	Teaching hours
1. Study of parameters of high strength concrete, Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture. 2 Non-Destructive testing of existing concrete members. 3. Behavior of Beams under flexure, Shear.	2

Reference Books:

1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012.
2. Concrete Technology, Shetty M. S., S. Chand and Co., 2006.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M.Tech. Civil (Structural Engineering) - II

Choice Based Credit System (CBCS)

ST117 MINI PROJECT

Lab Scheme:
2 hours per week, 2 Credits

Examination Assessment Scheme:
ICA: 50 marks

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Course Outcomes:

At the end of the course, the students will be able to:

1. Identify structural engineering problems reviewing available literature.
2. Study different techniques used to analyze complex structural systems.
3. Work on the solutions given and present solution by using his/her technique applying engineering principles.

Syllabus Contents:

Mini Project shall consist of detailed analysis, design along with working drawings of any one structure.

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

The student shall submit report on the subject chosen and make a presentation at the end of Semester-I. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.

Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the Advisor.