ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Effective from 2023-24)

School/ Department: School of Infrastructure and Planning
Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE),
Duration: 3 years (Six Semesters)

Abbreviation used:

AC	Audit course	LC	Lab Course	PA	Practical Assessment
PC	Professional Core	PR	Project/ Practical/ Internship	L	Lecture
PE	Professional Elective	SE	Seminar/ Expert Lecture/ Etc.	T	Tutorial
OE	Open Elective	IA*	Internal Assessment	P	Practical
MC	Mandatory/ Common Course	EA	End-Semester Assessment		

Subject Code Format:

A1	A2	B3	C4	C5	C6
School/ Dept. (Offering)		**Level**	**0:** AC	**Serial Number (01 to 99)**	
BH: Basic Sciences and Humanities		**1:** UG/ Int. Msc. (1st Year)	**1:** PC	01/ 03/…/ 19: Odd Sem. (GTE)	
CS: Computer Sciences		**2:** UG/ Int. Msc. (2nd Year)	**2:** PE	21/ 23/…/ 39: Odd Sem. (STE)	
EE: Electrical Sciences		**3:** UG/ Int. Msc. (3rd Year)	**3:** OE	41/ 43/…/ 59: Odd Sem. (WRE)	
EI: Electronic Sciences		**4:** UG/ Int. Msc. (4th Year)	**4:** MC	61/ 63/…/ 79: Odd Sem. (URP)	
IP: Infrastructure and Planning		**5:** UG/ Int. Msc. (5th Year)	**5:** LC	81/ 83/…/ 99: Odd Sem. (Prog-5)	
MS: Mechanical Sciences		**6:** PG (1st Year)	**6:** PR		
BT: Biotechnology		**7:** PG (2nd Year)	**7:** SE	02/ 04/…/ 20: Even Sem. (GTE)	
TE: Textile Engineering		**8:** Ph.D.	**8:**	22/ 24/…/ 40: Even Sem. (STE)	
			9:	42/ 44/…/ 60: Even Sem. (WRE)	
				62/ 64/…/ 80: Even Sem. (URP)	
				82/ 84/…/ 98: Even Sem. (Prog-5)	

1st Semester

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	PC 1	IP6121	Theory of Elasticity and Plasticity	3	0	0	3	40	60	-	100
2	MC 1	BH6401	Mathematical Methods in Engineering	3	0	0	3	40	60	-	100
3	MC 2	MS6403	Research Methodology and IPR	2	0	0	2	40	60	-	100
4	LC 1	IP6521	Advanced Concrete Lab.	0	0	4	2	-	-	100	100
5	AC 1	Any One from the List of AC 1 (Appendix-I)		2	0	0	0	40	60	-	100
			Total	**10**	**0**	**4**	**10**	**160**	**240**	**100**	**500**

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2nd Semester

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	PC 2	IP6123	Finite Element Analysis and its Applications	3	0	0	3	40	60	-	100
2	PE 1 (Any One)	IP6221	Structural Dynamics	3	0	0	3	40	60	-	100
		IP6223	Pre-stressed Concrete								
		IP6225	Tall Structures								
3	PE 2 (Any One)	IP6222	Advanced Steel Structures	3	0	0	3	40	60	-	100
		IP6224	Bridge Engineering								
		IP6226	Earthquake Resistance Design of Structures								
4	LC 2	IP6523	Computational Lab	0	0	4	2	-	-	100	100
5	AC 2	Any One from the List of AC 2 (Appendix-I)		2	0	0	0	40	60	-	100
			Total	**11**	**0**	**4**	**11**	**160**	**240**	**100**	**500**

3rd Semester

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	PC 3	IP6122	Design of Advanced Concrete Structures	3	0	0	3	40	60	-	100
2	PE 3 (Any One)	IP6228	Advanced Construction Materials	3	0	0	3	40	60	-	100
		IP6230	Elastic Stability and Behavior of Metal Structures								
		IP6232	Soil Structure Interaction								
3	OE 1	Any One from the List of OE 1 (Appendix-I)		3	0	0	3	40	60	-	100
4	PR 1	IP6622	Project (Specialization Related)	0	0	4	2	-	-	100	100
			Total	**9**	**0**	**4**	**11**	**120**	**180**	**100**	**400**

4th Semester

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	PC 4	IP6124	Theory of Plates and Shells	3	0	0	3	40	60	-	100
2	PE 4* (Any One)	IP7221	Mechanics of Composite Materials	3	0	0	3	40	60	-	100
		IP7223	Design of Masonry Structures								
		IP7225	Advanced Design of Foundations								
3	LC 3	IP6522	Advanced Structural lab	0	0	4	2	-	-	100	100
			Total	**6**	**0**	**0**	**08**	**80**	**120**	**100**	**300**

* Virtual/Online Course either offered by OUTR or available in MOOCs platform (No physical class)

5th Semester

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	PR 2	IP7621	Dissertation (Phase-I)	0	0	24	12	-	-	100	100
			Total	**0**	**0**	**20**	**12**	**-**	**-**	**100**	**100**

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6th Semester

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	PR 3	IP7622	Dissertation (Phase-II)	0	0	32	16	-	-	100	100
			Total	**0**	**0**	**32**	**16**	**-**	**-**	**100**	**100**

Credits and Maximum Marks

Sl. No.	Semester	Credits	Maximum Marks
1	1st	10	500
2	2nd	11	500
3	3rd	11	400
4	4th	08	300
5	5th	12	100
6	6th	16	100
	Total	**68**	**1900**

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Program Outcomes (POs)

PO 1:	Ability to apply knowledge of mathematics, basic science, general engineering skills and core engineering to the defined and applied engineering structure.
PO 2:	Able to understand, identify, formulate, analysis and solve civil engineering problems.
PO 3:	Graduate will have confident to design experiments to evaluate the performance of engineering system or component.
PO 4:	Investigate the problems, identify data form literature and data sheet and can validate with some conclusion.
PO 5:	Use the current skills, techniques of civil engineering and modern engineering tools for professional engineering practice.
PO 6:	Able to demonstrate their civil engineering knowledge and skill to assess legal environmental and cultural issues relevant to professional engineering practice.
PO 7:	Graduates could visualize professionally as well as ethically as engineering solution for environmental issues taking into account sustainable development.
PO 8:	Able to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9:	Flexibility to execute team work or individually or as leader in diverse teams in different environment.
PO 10:	Effectively communicate with engineering community, with different society at large and comprehend the issues properly.
PO 11:	Development of engineering and managerial skill required to manage the project under multidisciplinary environment.
PO 12:	Recognize the need of lifelong learning in civil engineering relevant to rapidly changing environment.

Program Specific Outcomes (PSOs)

PSO1	Graduates of this program should excel in conceptualizing and solving problems of various domains in civil engineering.
POS2	Graduates should be able to perform best individually and in a team by acquiring leadership skills and managing projects in multidisciplinary environments.
POS3	Graduates should be able to show ethical professionalism, good communication skills, and adapt modern tools of civil engineering by engaging themselves in lifelong learning.

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1st Semester

PC 1	IP6121	Theory of Elasticity and Plasticity	3	0	0	3

Course Objectives:

1. To make the students understand the concepts of elasticity and equip them with the knowledge to independently handle the problems of elasticity.
2. To enhance the competency level and develop the self-confidence through quality assignments in theory of Elasticity.
3. To inculcate the habit of researching and practicing in the field of elasticity.
4. To understand the concepts of plasticity, yield criteria, plastic flow etc.,

Module- I

Linear elasticity; stress, strain, constitutive relations, strain displacement relations, Equilibrium and compatibility equations, stress and displacement functions, Two dimensional problems in cartesian and polar coordinates. Description of an elasticity problem as a boundary value problem, bending of beams- cantilever and simply supported beam, stress distribution for axisymmetric problems, pure bending of curved bars, effect of circular holes on stress distributions in plates. Aries stress function.

Module- II

Stress and strain in three dimensions: Principal stresses, maximum shearing stress, principal axes of strain. Stretching of prismatical bar by its own axis. Elementary problems of elasticity in three dimensions.

Torsion of non-circular prismatic bars. Saint Venant's theory.Various analogies. Torsion of hollow and thin section. Application of energy methods.

Module- III

Introduction to the theory of plasticity., the yield criteria of metals, stress space representation of yield criteria. stress-strain relations plastic potential, flow rules and maximum work hypothesis.

Two-dimensional plastic flow problems. Incompressible two-dimensional flow, stresses in plastic materials in condition of plane strain, equation of equilibrium the simplest slip-line fields.

Text/Reference Books:

1. S P Timoshenko and J N Goodier, Theory of Elasticity, Mc Graw Hill
2. Computational Elasticity – M Ameen, Narosa Publishing House.
3. Advanced Mechanics of Solids – L S Srinath, Tata McGraw-Hill
4. Hoffman and Sachs, Theory of plasticity
5. W. Johnson and P B Meller, Plasticity of Mechanical Engineers
6. C.R. Calladine, 'Plasticity for Engineers', Ellis Herwood, Chichester, U.K., 1985
7. M. Kachanov, 'Theory of Plasticity', MIR Publication.

Course Outcomes:

CO1: Students will be able to understand the concepts of stresses and strains for 2-D and 3-D elasticity problems.
CO2: Students will learn the boundary value problems and stress distribution for axisymmetric problem.
CO3: Analyse the problems of 2-D elasticity in Cartesian/Polar Coordinates.
CO4: Evaluate with the use of airy's stress function in 2-D problems of elasticity in Cartesian/Polar Coordinates.
CO5: Utilize the knowledge of various theories of torsion of prismatic bars of various cross sections and can solve the problems of torsion.
CO6: Analyse the concepts of plasticity, yield criteria, plastic flow etc.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	M	M	H	M	L	M	H	M	L	H	M	L
CO2	H	M	H	M	H	M	M	L	M	M	H	L	H	M	L
CO3	H	H	H	M	M	H	M	L	M	M	H	L	H	L	M
CO4	H	H	H	M	H	M	M	L	L	H	M	L	H	M	L
CO5	H	H	H	M	H	M	H	L	L	M	M	L	H	H	L
CO6	H	H	H	M	H	M	H	L	L	M	M	L	H	H	M

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MC 1	BH6401	Mathematical Methods in Engineering	3	0	0	3

Refer Appendix-I for detailed Syllabus.

MC 2	MS6403	Research Methodology and IPR	2	0	0	2

Refer Appendix-I for detailed Syllabus.

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LC 1	IP6521	Advanced Concrete Lab.	0	0	4	2

Course Objectives:

1. To perform different workability and strength test of concrete.
2. To perform the Mix design as per IS 10262:2009.

List of Experiments

1. Mix design of concrete by using codal provisions.
2. Evaluation of mechanical properties of concrete.
3. Condition assessment of the concrete by using NDT techniques (Rebound hammer & Ultrasonic pulse velocity).
4. Durability of Concrete (Surface resistance, chloride attack, permeability determination).
5. Failure of RC beams in bending and shear (two point and one-point loading).

Course Outcomes:

CO1: Understand the Mix design as per IS 10262:2019.
CO2: Evaluate the workability, strength and durability of concrete.
CO3: Carry out the procedure of RC beams in bending and shear (two point and one-point loading).
CO4: Assess the concrete properties by NDT techniques

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	H	H	M	H	M	H	M	H	L	M	H	H	M	M
CO2	M	H	H	M	H	M	H	M	H	L	M	H	H	M	M
CO3	M	H	H	M	H	M	H	M	H	L	M	H	H	M	M
CO4	M	H	H	M	H	M	H	M	H	L	M	H	H	M	M

AC 1	Any One from the List of AC 1 (Appendix-I)	2	0	0	0

Refer Appendix-I for detailed Syllabus.

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2nd Semester

PC 2	IP6123	Finite Element Analysis and its Applications	3	0	0	3

Course Objectives:

1. To provide an overview and basic fundamentals of Finite Element Analysis.
2. To introduce basic aspects of finite element theory, including domain discretization, interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems.
3. To explain the underlying concepts behind variational methods and weighted residual methods in FEM.
4. Formulate simple structural problems in to finite elements.

Module-I

Introduction: The Continuum, Equations of Equilibrium, Boundary Conditions, Straind is placement relations, Stress strain Relations, Plane stress and plane Strain problems, Basics of finite element method (FEM), different steps involved in FEM, Different approaches of FEM, Direct stiffness method, Energy approach, Weighted residual Method.

Module-II

One and Two Dimensional Problems: Detail formulation including shape functions. stress strain relations, strain displacement relations and derivation of stiffness matrices using energy approach, Assembling of element matrices, boundary conditions, Numerical solution of one dimensional problems using spring, bar, truss, beam elements and frames. Derivation of shape function using Lagrange's interpolation, Pascal's triangle, Convergence criteria. Finite Element modeling of two dimensional problems using Constant strain Triangle (CST) elements, Stress strain relations for isotropic and orthotropic materials, Four noded rectangular elements, axisymmetric solids subjected to axisymmetric loading.

Module-III

Isoperimetric Elements: Natural coordinates, isoperimetric elements, four node, eight node elements. Numerical integration, order of integration.

Plate Bending: Bending of plates, triangular elements, rectangular elements, and quadrilateral elements.

Text/Reference Books:

1. C. S. Krishnamoorthy, Finite Element analysis-Theory and Programming, Tata Mc Hill.
2. R. D. Cook., Concepts and Applications of Finite Element Analysis , Wiley.
3. O. C Zienkiewicz .and R. L. Taylor, Finite Element Method, Mc Graw Hill
4. C.S. Desai and J.F. Abel, Introduction to the Finite Element Method: CBS Publishers

Course Outcomes:

CO1: Identify the information requirements and sources for analysis, design and evaluation of object.
CO2: Derive element stiffness matrices of 1-D and 2-D body element.
CO3: Apply mechanics of materials topics to provide preliminary results used for testing the reasonableness of finite element results.
CO4: Analyse and build FEA models (i.e displacements and stresses) of 1-D and 2-D body for various engineering problems.
CO5: Analyse and build FEA models (i.e displacements and stresses) of iso-parametric element.
CO6: Analyse and build FEA models (i.e displacements and stresses) of plate.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	L	L	M	M	L	M	L	L	L	H	H	L	M
CO2	H	M	L	L	M	M	L	M	L	L	L	H	H	L	M
CO3	H	H	H	M	M	M	L	L	L	L	L	H	H	L	M
CO4	H	H	H	H	H	H	M	M	L	L	L	H	H	L	M
CO5	H	H	H	H	H	H	M	M	L	L	L	H	H	L	M
CO6	H	H	H	H	H	H	M	M	L	L	L	H	H	L	M

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PE 1	IP6221	Structural Dynamics	3	0	0	3

Course Objectives:

1. To analyse single degree of freedom systems without damping and with damping
2. To analyse the multi degree freedom system and continuous systems using iterative techniques.
3. To Evaluate dynamic response using numerical methods.
4. To Draw mode shapes and deterministic analysis of Earthquake.

Module-I

Hamilton's principle,Single degree of freedom system: Equation of motion, Damped and undamped free vibration, Response to harmonic, periodic, impulse load and general dynamic load, Duhamel's integral;

Module-II

Multi-degrees of freedom system: Equation of motion, Free vibration analysis, Dynamic response and modal analysis.

Free and Forced vibration of distributed mass system: Longitudinal, flexural and torsional vibration of rods, transeverse vibration of beams. Raleigh's principle.

Module-III

Analysis of structural response to Earthquakes: Seismological background, Deterministic analysis of earthquake. Introduction to Random Vibration.

Text/Reference Books:

1. W.T.Thomson, "Theory of Vibration with Applications"
2. R.W. Clough &J.Penzien, "Dynamics of Structures", McGraw Hill
3. Dynamics of Structures: Theory and Applications to Earthquake Engineering, A K Chopra , Prentice Hall of India
4. Structural Dynamics by S SRao
5. Structural Dynamics - Theory and Computation, M. Paz, Van Nostrand, 1985.
6.Structural Dynamics, M Mukhopadhyay: Anne Books Pvt Ltd, New Delhi

Course Outcomes:

CO1: Understand single degree of freedom systems without damping and with damping.
CO2: Implement the concept of response to harmonic, periodic and impulse loading.
CO3: Apply the concept of multi degree freedom system and continuous systems using iterative techniques.
CO4: Analyze free and forced vibration of distributed mass system
CO5: Evaluate dynamic response using numerical methods.
CO6: Draw mode shapes and analysis structures for seismic loading.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	M	H	L	M	L	L	L	M	M	H	M	M
CO2	H	H	H	M	H	M	M	L	L	M	H	M	H	M	M
CO3	H	H	H	M	H	L	M	L	L	M	H	M	H	L	M
CO4	H	H	H	M	H	M	M	L	L	L	M	M	H	M	M
CO5	H	H	H	M	H	M	L	L	L	M	M	M	H	H	M
CO6	H	H	H	M	H	M	L	L	L	M	M	M	H	H	M

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PE 1	IP6223	Pre-stressed Concrete	3	0	0	3

Course Objectives:

1 To understand the concepts of prestressing
2 To understand the behaviour of prestressed members in compression and flexure.
3 To understand the design of prestressed concrete members
4 To understand the transfer of prestress and Anchorage stresses

Module I

Prestressing system, materials and codes: Basic concept, Losses of prestress, analysis of prestress and bending stresses. Need for high strength steel and concrete. Advantages and applications. Pre-tensioning and post tensioning systems.

Module – II

Design of beams: Analysis and design of section for bending and shear, pressure line, concept of load balancing, cracking moment, bending of cables, limit state analysis and design, anchorage zone stresses, design of end block, Application to bridges.

Module –III

Selection of prestress concrete members, short term and long-term deflections of uncracked members.

Module –IV

Flexural strength of prestressed concrete sections Continuous beams, Design concept concordance of cables, Secondary design consideration. Design pretensioned and post tensioned beam

Text/Reference Books:

1. Prestressed Concrete, Raju,N.K., Tata McGraw Hill
2. Prestressed Concrete, T. Y. Lin
3. Prestressed Concrete, Ramamruthan

Course Outcome:

CO1: Understand the terminology, concept and principles related to prestressing systems and post tensioning systems.
CO2: Evaluate different losses in the prestress and analyze the sections for resultant stresses.
CO3: Analyze and design of pretensioned as well as post-tensioned concrete beams using limit state method for bending and shear.
CO4: Understand the design concept concordancy of cables, anchorage zone stresses, design of end block and its application to bridges.
CO5: To understand the concordance of cable in prestressed members.
CO6: To evaluate short term and long term deflection of prestressed members.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	POS1	POS2	POS3
CO1	H	H	H	H	H	M	H	L	L	M	L	M	H	M	L
CO2	H	H	M	M	H	M	H	L	M	M	H	L	H	M	M
CO3	H	M	H	H	M	H	H	M	L	M	H	L	H	M	L
CO4	H	H	H	M	H	M	M	L	M	M	M	L	H	M	L
CO5	H	M	M	H	H	M	M	L	L	L	M	L	H	M	M
CO6	H	M	H	M	M	M	H	L	M	M	L	H	H	L	M

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PE 1	IP6225	Tall Structures	3	0	0	3

Course Objectives:

1.To understand the Design philosophy and essential amenities.
2. To understand the Types of loads and Materials for the tall buildings.
3. To understand the load distribution in steel and concrete and different resisting systems
4. To study the concepts of analysis for displacements and member forces for load transfer systems and dynamic analysis
5. To understand the research needs in tall building materials, systems and designs

Module-I

Structural systems and concepts. Matrix and approximate methods, analysis of tall building frames, lateral load analysis, multi bay frames, gravity loads, settlement of foundation.

Foundation-superstructure interaction. Earthquake effects and design for ductility. Analysis of shear walls - plane shear walls, infilled frames, coupled frames, frames with shear walls.

Module-II

Principle of three-dimensional analysis of tall buildings; Perforated cores, pure torsion in thin tubes, bending and warping of perforated cores.

Module-III

Analysis of floor system in tall buildings, Vierendal girders, diagrid floors, elastic stability of frames and shear walls. Analysis of thermal stresses.

Text/Reference Books:

1. Tall buildings - B. S. Taranath:
2. Handbook of Concrete Structures - Mark Fintel
3. Tall buildings - Coull and Smith
4. Design of Multi-storeyed structures - U. H. Variani
5. Tall Chimneys: Design & Construction - S. N. Manohar
6. Transmission Line Structures - Santhakumar& Murthy
7. IS:6533 (Part 2) –Code of Practice for Design and Construction of Steel Chimney
8. IS:4998 (Part 1)- Criteria for Design of Reinforced Concrete Chimneys

Course Outcome:

CO1: To understand the Design philosophy and essential amenities.
CO2: To understand the Types of loads and Materials for tall buildings.
CO3: To analyze the load distribution in steel and concrete and different resisting systems.
CO4: To study the concepts of analysis for displacements and member forces for load transfer systems and dynamic analysis.
CO5: To understand the research needs in tall building materials, systems and designs.
CO6: To evaluate thermal stresses in tall structures.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	H	H	H	H	H	M	H	L	L	M	L	M	H	M	L
CO2	H	H	M	M	H	M	H	L	M	M	H	L	H	M	M
CO3	H	M	H	H	M	H	H	M	L	M	H	L	H	M	L
CO4	H	H	H	M	H	M	M	L	M	M	M	L	H	M	L
CO5	H	M	M	H	H	M	M	L	L	L	M	L	H	M	M
CO6	H	M	H	M	M	M	H	L	M	M	L	H	H	L	M

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

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Syllabus (Effective from 2023-24)

School/ Department: School of Infrastructure and Planning
Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE),
Duration: 3 years (Six Semesters)

PE 2	IP6222	Advanced Steel Structures	3	0	0	3

Course Objectives:

1. To learn the preliminary design of industrial requirements.
2. To learn the procedures of cantilever, portal frame methods of analyses.
3. To understand about types gantry girders and its design methodologies.
4. To understand theorems of plastic analysis and principles of optimization in structural design.

Module-I

Properties of steel: mechanical properties, hysteresis, ductility; Hot-Rolled Sections: compactness and non-compactness, slenderness, residual stresses.

Inelastic bending – curvature, plastic moments, design criteria - stability, strength, drift; Stability criteria: stability of beams - local buckling of compression flange &web ,lateral-torsional buckling.

Module-II

Stability of columns - slenderness ratio of columns, local buckling of flanges and web, bracing of column about weak axis, load and resistance factor design; Strength Criteria: beams – flexure, shear, torsion, columns - moment magnification factor, effective length, P-M interaction, biaxial bending, joint panel zones; Drift criteria: P-Δ effect.

Module-III

Deformation-based design; Connections: types – welded, bolted, location – beam column, column-foundation, splices. Design of industrial trusses and frames.

Text/Reference Books:

1. N Subramanian, 'Design of steel structures', Oxford University Press
2. M Bill Wong, 'Plastic analysis and design of steel structures',
3. M Bruneau, CM Uang and SER Sabelli, 'Ductile design of steel structures'

Course Outcomes:

CO1: Design self-supporting stacks and chimneys for industrial buildings.
CO2: Analyse multi-storey frames using approximate methods
CO3: Design gantry girder to resist all types of loads.
CO4: Design of columns ,P-M interaction &P-Δ effect.
CO5: Analyse portal frames by using plastic design methodologies.
CO6: Apply principles of optimization in structural design.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	H	M	L	M	M	L	L	H	M	H	M	M
CO2	H	H	H	M	H	L	M	M	L	L	M	H	H	M	M
CO3	H	H	M	M	L	L	M	M	L	L	M	M	M	H	M
CO4	H	M	H	L	L	L	L	L	L	M	L	H	H	M	H
CO5	H	H	M	M	L	M	M	L	L	L	H	M	H	H	M
CO6	H	M	H	L	L	L	L	L	L	M	L	H	H	M	H

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School/ Department: School of Infrastructure and Planning
Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE),
Duration: 3 years (Six Semesters)

PE 2	IP6224	Bridge Engineering	3	0	0	3

Objectives:

1. To acquaint with the different loads and support conditions pertaining to design of Bridges
2. To understand the IRC loads and design considerations of bridges
3. To understand the design of different types of bridges
4. To understand the design of bridge foundations, piers and abutments.

Module-I

Introduction and selection of type of bridges, longitudinal arrangement and economical span, bridge components, Design preliminaries: Layout, types of loads including wind and seismic loads, standard specifications for road bridges, substructures, superstructures, IRC provisions on loads and stresses, specification for single/double multi lane railway and road bridges, Abutments, piers and their foundations.

Module-II

Design of reinforced concrete slab culvert, box culvert bridge by Limit State Method following latest IS/IRC codes.
Deck slab bridge, Tee beam and slab bridge, design of prestressed concrete bridge by Limit State Method.

Module-III

Design of balanced cantilever bridge, design of continuous bridge, Introduction to long span bridges and segmental bridges by Limit State Method.

Text/Reference Books:

1. N.K.Raju, " Design of bridges", Oxford & IBH Publishing Co. pvt. ltd.
2. D.J.Victor," Essentials of bridge engineering", Oxford &IBH Publishing Co. pvt. ltd.
3. IndianRoad Congress Codes No.5,6,18,21,24, Jamnagar House, Shah Jahan Road,NewDelhi.

Course Outcome:

CO1: Identify different loads and support conditions pertaining to design of bridges.
CO2: Design foundations for bridges.
CO3: Design the piers and abutments for bridges.
CO4: Design of reinforced concrete slab culvert & box culvert.
CO5: Design T-Beam bridges and prestressed concrete bridges.
CO6: Design of balanced cantilever bridge, design of continuous bridge.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	H	L	M	M	L	L	L	L	M	H	H	H
CO2	H	H	H	H	M	M	M	L	L	L	M	M	H	M	H
CO3	H	H	M	M	L	M	M	L	L	L	M	M	H	H	M
CO4	H	H	M	M	L	M	M	L	L	L	M	M	M	M	H
CO5	H	H	M	M	L	M	M	L	L	L	H	M	H	H	M
CO6	H	H	M	M	L	M	M	L	L	L	M	M	H	M	H

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School/ Department: School of Infrastructure and Planning
Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE),
Duration: 3 years (Six Semesters)

PE 2	IP6226	Earthquake Resistance Design of Structures	3	0	0	3

Course Objectives:

1. To make the students understand the fundamental concepts in the analysis of the structures subjected to seismic forces.
2. To understand the vibration of structures during earthquakes.
3. To understand the students to do a competent design & detailing of seismic resistant structures.
4. To understand the student fundamentals of Seismic Planning.

Module-I

Seismology, Characteristics of earthquakes; Earthquake intensity and magnitude; Recording instruments and base line correction; seismic risk and hazard, Predominant period and amplification through soil; Soil dynamics and seismic inputs to structures, Characterization of ground motion.

Module-II

Earthquake response of structures; Seismic coefficient method, time history analysis, direct integration module analysis, Response spectrum, analysis, Spectral analysis; seismic coefficient method lateral load calculation, base shear.

Module-III

Idealization of structural systems for low, medium and high rise buildings; Nonlinear and push over analysis.
Earthquake resistant design; Code provisions of analysis and design of buildings (IS 1893 & 13920); Reinforcement detailing for members and joints.

Course Outcomes:

By the end of this course, students will be able to:

CO1: Analyse the forces acting on structures due to earthquakes.
CO2: Understand estimation of design moments and shears for framed structure as per IS:1893 and its detailing
CO3: Apply the concepts in the design of structures.
CO4: Implement the Selection process of materials and construction form of super structure.
CO5: Assess various irregularities in buildings
CO6: Apply the provisions of IS:13920 for building structures

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	H	M	M	M	L	L	L	L	H	L	M	H
CO2	H	H	H	H	M	M	L	L	L	L	L	H	H	M	L
CO3	H	H	H	H	H	H	M	L	L	M	M	H	H	M	M
CO4	H	H	H	H	H	L	M	L	L	L	L	H	H	M	H
CO5	M	H	M	H	H	M	H	H	M	M	L	H	H	M	H
CO6	H	H	H	H	H	H	M	M	M	H	M	H	H	M	H

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School/ Department: School of Infrastructure and Planning
Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE),
Duration: 3 years (Six Semesters)

LC 2	IP6523	Computational Lab	0	0	4	2

Course Objectives:

1. To Analysis and design Multi-storey building frames & Elevated Water Tank using STAAD-Pro and Etabs
2. ETABS; Analysis and design of bridge decks and other structures & steel trusses using STAAD-Pro,ETABS.

List of Experiments

1. Computational programming using STAAD-Pro,
2. ETABS to design RC structure elements like beam, column, slab etc.
3. Analysis and design of Multi-storey building frames & Elevated Water Tank using STAAD-Pro,
4. ETABS; Analysis and design of bridge decks and other structures & steel trusses using STAAD-Pro,ETABS.

Course Outcomes:

CO1: Solve structural engineering problems using numerical methods
CO2: Able to design the RCC Structural Element like Beams & Portal Frames.
CO3: Able to design a multi storey building and water tank problem
CO4: Analyse the usage of different data/file structures in building & Bridge components computational.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	H	H	M	L	M	L	M	L	L	M	M	L	H	L	M
CO2	H	H	M	M	L	L	L	L	H	M	H	L	H	H	M
CO3	H	M	M	M	L	H	M	L	M	M	H	L	H	M	L
CO4	H	H	H	H	H	M	M	L	H	M	M	L	H	M	M

AC 2	Any One from the List of AC 2 (Appendix-I)	2	0	0	0

Refer Appendix-I for detailed Syllabus.

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Syllabus (Effective from 2023-24)

School/ Department: School of Infrastructure and Planning
Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE),
Duration: 3 years (Six Semesters)

3rd Semester

PC 3	IP6122	Design of Advanced Concrete Structures	3	0	0	3

Course Objectives:

1. To design reinforced concrete water tanks and domes.
2. To analyze and design of building frames for wind load and earthquake load.
3. To design reinforced concrete frames for ductility as per IS:13920;2016.
4. To understand the design of deep beams and concrete shear walls.

Module-I

Behavior of reinforced concrete beams and slabs, long term & short term deflection, Estimation of crack width.

Module-II

Analysis and design of building frames subjected to wind load and Earthquake forces, Design of chimney.

Module-III

Ductility of reinforced structures; material ductility-steel and concrete, section ductility, member ductility, structural ductility, ductile detailing of reinforced concrete frames for seismic forces.
Design of deep beams & corbel, Design of concrete shear walls.

Text/Reference Books:

1.R Park and T Paulay," Reinforced Concrete Structures", John Wiley & Sons
2 .SPillai, D Menon, “Reinforced Concrete Design”
3.P.C. Varghese, "Advanced Reinforced Concrete Design", PHI, 2nd Edition, 2002
4 .A.K. Jain, "Reinforced Concrete: Limit State Design", Nemchand and Bros, 1999
5 .Ramakrishna&Arthur,"Ultimate strength design for structural concrete".

Course Outcomes:

CO1: To evaluate the deflection and crack width of reinforced concrete beams and slabs.
CO2: Able to analyze and design building frames for wind load and earthquake load.
CO3: Implementation of IS:13920:2016 for ductile design and detailing of RC frames.
CO4: Understand and design of deep beams and concrete shear walls.
CO5: Able to adapt the design procedure for reinforced concrete water tanks and domes.
CO6: To understand the design of chimney and concrete shear walls.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	POS1	POS2	POS3
CO1	H	H	H	H	H	M	H	L	L	M	L	M	H	M	L
CO2	H	H	M	M	H	M	H	L	M	M	H	L	H	M	M
CO3	H	M	H	H	M	H	H	M	L	M	H	L	H	M	L
CO4	H	H	H	M	H	M	M	L	M	M	M	L	H	M	L
CO5	H	M	M	H	H	M	M	L	L	L	M	L	H	M	M
CO6	H	M	H	M	M	M	H	L	M	M	L	H	H	L	M

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School/ Department: School of Infrastructure and Planning
Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE),
Duration: 3 years (Six Semesters)

PE 3	IP6228	Advanced Construction Materials	3	0	0	3

Course Objectives:

1. To understand properties of highstrength concrete; High density and lightweight concretes and perform the mix design.
2. To understand the application of industrial waste materials in concrete.
3. To understand mechanical and physical properties of fibre reinforced concrete and application of polymers in civil engineering.
4. To study the structural aspects of fibre reinforced plastic in sandwich panels and other composites

Module-I

Fresh concrete and its rheology. Mechanical, deformational behavior and microstructure of hardened concrete. Creep and shrinkage. Testing of concrete.Mix design and properties of concrete; High strength concrete; High density and lightweight concretes; admixtures.

Module-II

Industrial waste materials in concrete, their influence on physical and mechanical properties and durability of concrete, Concreting under extreme weather conditions, High performance concrete, Vacuum concrete, Self-compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes. Changes in concrete with time, Corrosion of concrete in various environments. Corrosion of reinforcing steel. Ferro-cement, material and properties.

Module-III

Foams and light-weight materials, fibrereinforced concrete. Types of fibres, workability, mechanical and physical properties of fibre reinforced concrete. Polymers in Civil Engineering, Polymers, fibres and composites.

Fibre reinforced plastic in sandwich panels, modeling. Architectural use and aesthetics of composites.Adhesives and sealants.Structural elastomeric bearings and resilientseating.Moisture barriers, Polymer foams and polymers in Building, Polymer concretecomposites.

Text/Reference Books:

1. Neville A.M., 'Properties of concrete', 3rd ed., 1985, ELBS Lea F.M.,
2. 'Chemistry of cement and concrete', 3rd ed., 1970, Edward Arnold Proceedings of recent seminars etc. and journals.
3. P. K. Mehta, “Concrete: Microstructure, Properties and Materials”

Course Outcomes:

CO1: Able to understand properties of fresh concrete and its rheology:Mechanical, deformational behavior, microstructure and creep and shrinkage of High strength concrete
CO2: Able to understand the implementation of industrial waste materials in concrete.
CO3: Able to analyze the mechanical and physical properties of fibre reinforced concrete and application of polymers in civil engineering.
CO4: Able to evaluate the structural aspects of fibre reinforced plastic in sandwich panels and other composites.
CO5: Able to analyze the structural aspects of Polymer concretecomposites and its use in buildings.
CO6: Able to adapt the mix design and properties of concrete; High density and lightweight concretes.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	M	M	M	M	M	L	M	H	M	L	H	M	L
CO2	H	H	M	H	H	M	M	L	H	M	H	L	H	M	M
CO3	H	M	M	M	M	H	M	L	M	M	H	L	H	M	L
CO4	H	H	H	H	H	M	M	L	H	H	M	L	H	M	L
CO5	H	M	M	M	H	M	H	L	L	M	M	L	H	M	L
CO6	H	M	H	M	H	M	H	L	L	M	M	L	H	L	H

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Syllabus (Effective from 2023-24)

School/ Department: School of Infrastructure and Planning
Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE), Duration: 3 years (Six Semesters)

PE 3	IP6230	Elastic Stability and Behavior of Metal Structures	3	0	0	3

Course Objectives:

1. To acquaint with basic principles relating to stability of structures
2. To help the students to learn about mathematical treatment of stability Problems.
3. To train students in dealing with buckling, and torsion developed for different structures under different support and loading conditions.
4. To acquaint students with the Elastic and in-elastic Buckling behaviour of structures.

Module-I

Introduction Fundamental principles and models for elastic stability. Stability/ elastic buckling of column

Module-II

Classification of dynamical systems, linear and non-linear Eigen value problems. The energy criterion and energy based methods of stability analysis. Stability of plates, frames, beams and arches.

Module-III

Lateral buckling of beams, combined bending and axial, combined bending and torsion. Buckling of thin elements. Torsional buckling of thin walled structures and open sections Column-strength curves. Buckling and post-buckling strength of plates.

Module-IV

Introduction of dynamic stability of simply supported column.

Text/Reference Books:

1. S P Timoshenko and J M Gere, 1963, Theory of elastic stability, McGraw Hill, London.
2. A Chajes, 1974, Principles of elastic stability, Prentice Hall, NJ.
3. G J Simitses, 1976, An introduction to the elastic stability of structures, Prentice Hall, NJ.
4. Z P Bazant and L Cedolin, 1990, Stability of structures, Oxford University Press, Oxford.
5. N G R Iyengar, 1986, Structural stability of columns and plates, Affiliated East-West Press, New Delhi.
6. D O Brush and B O Almoroth, 1975, Buckling of bars, plates and shells, McGraw Hill, NY.
7. T V Galambos, 1998, Guide to stability design criteria for metal structures, Wiley, NY
8. Stability Analysis and Design of Structures, New Delhi by Gambhir M.L

Course Outcomes:

CO1: Distinguish different types of beam columns and developing differential equations under different loading conditions.
CO2: Demonstrate skills in treating both elastic and in-elastic buckling of structures.
CO3: Develop skills relating to torsion and lateral buckling of structures.
CO4: Identify the difference of Elastic and in-elastic Buckling Behaviour of Structures
CO5: Analyze the dynamic stability of simply supported column
CO6: Understand the behavior of Metal Structures.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	H	H	M	M	M	L	L	L	H	H	H	M
CO2	H	H	M	M	M	M	M	M	L	L	L	H	H	H	M
CO3	H	H	L	M	L	M	M	M	L	L	L	H	H	H	M
CO4	H	H	H	M	M	M	M	M	L	L	L	H	H	H	M
CO5	H	H	M	M	M	L	M	M	L	L	L	H	H	H	M
CO6	M	H	M	L	M	M	L	M	L	L	L	H	H	H	M

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School/ Department: School of Infrastructure and Planning
Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE), Duration: 3 years (Six Semesters)

PE 3	IP6232	Soil Structure Interaction	3	0	0	3

Course Objectives:

1. To apply advanced Techniques of Analysis such as FEM and Finite Difference Method in design of foundation.
2. To prepare Comprehensive Design Oriented Computer Programs for Specific Problems.
3. To analyse different types of frame Structures founded on stratified natural deposits with linear and non-linear stress-strain characteristics
4. To analyse single and group action of piles.

Module –I

Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction. Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method.

Module –II

Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different Types of Structure under various Conditions of Loading and Subsoil Characteristics. Preparation of Comprehensive Design Oriented Computer Programs for Specific Problems, Interaction Problems based on Theory of Sub Grade Reaction Such as Beams, Footings, Rafts Etc.

Module –III

Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress-Strain Characteristics

Determination of Pile Capacities and Negative Skin Friction, Action of Group of Piles Considering Stress-Strain Characteristics of Real Soils, Anchor Piles and Determination of Pullout Resistance.

Text/Reference Books:

1. Analytical and Computer Methods in Foundation, Bowels J.E., McGraw Hill Book Co., New York, 1974.
2. Numerical Methods in Geotechnical Engineering, Desai C.S. and Christian J.T., McGraw Hill Book Co., New York.
3. Soil Structure Interaction - The real behaviour of structures, Institution of Structural Engineers.
4. Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg. Vol-17, Elsevier Scientific Publishing Company.
5. Elastic Analysis of Soil-Foundation Interaction, Selvadurai A.P.S., Elsevier Scientific Publishing Company.
6. Analysis & Design of substructures, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd.
7. Design of Foundation System- Principles & Practices, Kurian N. P., Narosa Publishing

Course Outcomes: Students who successfully complete this course will be able to:

CO1: Understand the Nature and Complexities of Soil Structure Interaction
CO2: Apply advanced Techniques of Analysis such as FEM and Finite Difference Method in design of foundation.
CO3: Evaluation of soil structure interaction for different types of structure under various conditions of loading.
CO4: Prepare Comprehensive Design Oriented Computer Programs for Specific Problems.
CO5: Analyse different types of frame Structures founded on stratified natural deposits with linear and non-linear stress-strain characteristics
CO6: Analyse single and group action of piles.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	H	H	M	M	M	L	L	L	H	H	H	M
CO2	H	H	M	M	M	M	M	M	L	L	L	H	H	H	M
CO3	H	H	L	M	L	M	M	M	L	L	L	H	H	H	M
CO4	H	H	H	M	M	M	M	M	L	L	L	H	H	H	M
CO5	H	H	M	M	M	L	M	M	L	L	L	H	H	H	M
CO6	M	H	M	L	M	M	L	M	L	L	L	H	H	H	M

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Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE),
Duration: 3 years (Six Semesters)

OE 1	Any One from the List of OE 1 (Appendix-I)	3	0	0	3

Refer Appendix-I for detailed Syllabus.

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PR 1	IP6622	Project (Specialization Related)	0	0	4	2

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School/ Department: School of Infrastructure and Planning
Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE),
Duration: 3 years (Six Semesters)

4th Semester

PC 4	IP6124	Theory of Plates and Shells	3	0	0	3

Course Objectives:

1.To understand the basic equations, bending effects of plates.
2. To impart knowledge on the analysis of different types of plates underdifferent boundary conditions and loading.
3. To analyse spherical, conical & cylindrical shells.
4. To understand membrane theory of cylindrical shells, cylindrical tanks of uniformthickness.

Module-I

Plates: Pure bending of plates, Slope and curvature of slightly bent plates, relationship between moment and curvature, strain energy in bending of plates, energy Differential equations for symmetrical bending of circular plates under lateral loads. Uniformly loaded, concentrically loaded and loaded at the center of simply supported and fixed circular plates. Differential equation of the deflection surface and boundary conditions of laterally loaded rectangular plates by classical theory, Solutions of simply supported rectangular plates due to sinusoidal loads, uniformly distributed loads and concentrated load by Navier's Solution, Levy approach

Module-II

Shells: Membrane theory and Bending theory of symmetrical loaded shells of revolution, Spherical shells, conical shells, Membrane theory of cylindrical shells and shells of Double curvature such as Hyperbolic paraboloids and elliptic paraboloids, conoids

Module-III

Circular cylindrical shells loaded symmetrically with respect to its axis, particular cases of
symmetrical deformation of circular cylindrical shells, cylindrical tanks of uniform wall thickness

Text/Reference Books:

1. SP Timoshenko and SW Krieger, 'Theory of Plates and Shells'
2. OP Billington, Thin shell structures
3. E Ventsel and T Krauthammer, 'Thin Plates and Shells: Theory, Analysis & Applications', CRC, 1st edition, 2001
4. M.H Jawad, 'Theory and design of plate and shell structures', Kluwer Academic Publications
5. P.L. Gould, 'Analysis of shells and plates', Pearson Higher Education

Course Outcomes:

CO1: Understand the basic concepts of bending effects of plates.
CO2: Analyse rectangular & circular plates for different boundary conditions and under loading conditions.
CO3: Analyse simply supported rectangular plates by Navier's Solution and Levy approach
CO4: Understand membrane theory and bending theory of cylindrical shells
CO5: Analyse spherical, conical and cylindrical shells.
CO6: Analyse the circular cylindrical shells loaded symmetrically with respect to its axis.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	H	H	M	M	M	L	L	L	H	H	H	M
CO2	H	H	M	M	M	M	M	M	L	L	L	H	H	H	M
CO3	H	H	M	M	M	M	M	M	L	L	L	H	H	H	M
CO4	H	H	H	M	M	M	M	M	L	L	L	H	H	H	M
CO5	H	H	M	M	M	M	M	M	L	L	L	H	H	H	M
CO6	H	H	M	M	M	M	M	M	L	L	L	H	H	H	M

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School/ Department: School of Infrastructure and Planning
Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE),
Duration: 3 years (Six Semesters)

PE 4	IP7221	Mechanics of Composite Materials	3	0	0	3

Course Objectives:

1. Explain the behavior of constituents in the composite materials
2. Enlighten the students in different types of reinforcement
3. Develop the student's skills in understanding the different manufacturing methods available for composite material.
4. Illuminate the knowledge and analysis skills in applying basic laws in mechanics to the composite materials.

Module-I

Introduction: definition and characteristics, fibres, matrices, fibre reinforced composites, advantages and limitations, basic concepts and characteristics: isotropy, orthotropic, classification, methods of manufacturing composites, lamina and laminate, micromechanics and macro mechanics, constituent materials and properties, rules of mixture, defects in composites

Module-II

Elastic behaviour of unidirectional lamina: specially orthotropic and transversely isotropic material, relation between mathematical and engineering constants, stress strain relations for thin lamina, transformation of stress and strain, transformation of elastic parameters, transformation of stress-strain relations in terms of engineering constants.

Module-III

Elastic behaviour of multidirectional laminates, symmetric and balanced laminates,cross ply and angle ply laminates, design considerations, computational procedure for finding engineering elastic properties, stress and failure analysis of multidirectional laminates, theories of failure

Bending of laminated composite plates, thin laminated plate theory, deflection of all edges, simply supported rectangular symmetric cross-ply laminate, two opposite edges simply supported.

Text/Reference Books:

1. R. M. Jones," Mechanics of composite materials"
2. Mukhopadhyay, "Mechanics of composite materials and structures"
3. I.M. Daniel & O. Ishai, "Engineering Mechanics of Composite Materials", OxfordPress
4. S.W.Tsai&H.T.Hahn, "Introduction to Composite Materials: Techonomic Pub.Co.INC, USA.
5. P.K.Sinha,"A short term course on Composite Materials and Structures"-1996

Course Outcomes:

CO1: Understand the mechanical properties of anisotropic materials and how they vary from conventional construction materials.
CO2: Use the constitutive equations of composite materials to comprehend both macro and micro mechanical behaviour.
CO3: Determine the relationship between stresses and strains and engineering constants in composite materials.
CO4: Perform calculations and estimate the stiffness and strength of composite plates.
CO5: Design a composite laminate with given requirements.
CO6: Adapt various methods for more advanced tools of composites analysis and design including failure theories and their implementation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	M	H	M	L	L	L	L	L	L	H	L	L	M
CO2	H	H	H	H	M	M	L	L	L	L	L	H	H	M	L
CO3	H	H	H	H	H	M	M	L	L	L	L	H	H	M	M
CO4	H	H	M	H	M	L	L	L	L	L	L	H	H	M	L
CO5	H	H	M	H	H	M	M	L	L	L	L	H	H	M	M
CO6	H	H	H	M	H	H	M	M	M	L	L	H	H	M	H

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Effective from 2023-24)

School/ Department: School of Infrastructure and Planning
Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE),
Duration: 3 years (Six Semesters)

PE 4	IP7223	Design of Masonry Structures	3	0	0	3

Course Objectives:

1. To have better understanding of the properties and characteristics of masonary materials.
2. To be familiar with design criteria for reinforced masonary walls.
3. To determine flexural strength of reinforced masonary members subjected to in plane and out of plane loading.
4. To perform elastic and inelastic analysis of masonary structures with respect to seismic requirements.

Module –I

Introduction: Historical Perspective, Masonry Materials, Masonry Design Approaches, Overview of Load Conditions, Compression Behaviour of Masonry, Masonry Wall Configurations, Distribution of Lateral Forces.

Module –II

Flexural Strength of Reinforced Masonry Members: In plane and Out-of-plane Loading. Interactions: Structural Wall, Columns and Pilasters, Retaining Wall, Pier and Foundation.

Shear Strength and Ductility of Reinforced Masonry Members. Prestressed Masonry - Stability of Walls, Coupling of Masonry Walls, Openings, Columns, Beams.

Module –III

Elastic and Inelastic Analysis, Modeling Techniques, Static Push Over Analysis and use of, Capacity Design Spectra.

Text/Reference Books:

1. Design of Reinforced Masonry Structures, Narendra Taly, ICC, 2nd Edn,
2. Masonry Structures: Behavior and Design, Hamid Ahmad A. and Drysdale Robert G., 1994.
3. Mechanics of Masonry Structures, Editor: Maurizio Angelillo, 2014.
4. Earthquake-resistant Design of Masonry Buildings,Tomaevi Miha, Imperial College Press, 1999.

Course Outcomes:

CO1: Understand the properties and characteristics of masonary materials.
CO2: Design reinforced masonary walls.
CO3: Analyze reinforced masonary members subjected to in plane and out of plane loading.
CO4: Analyze the Shear Strength and Ductility of Reinforced Masonry Members
CO5: Design of Prestressed Masonry.
CO6: Perform elastic and inelastic analysis of masonary structures with respect to seismic requirements.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	H	H	M	M	M	L	L	L	H	H	H	M
CO2	H	H	M	M	M	M	M	M	L	L	L	H	H	H	M
CO3	H	H	L	M	L	M	M	M	M	L	L	H	H	H	M
CO4	H	H	H	M	M	M	M	M	L	M	L	H	H	H	M
CO5	H	H	M	M	M	L	M	M	M	L	L	H	H	H	M
CO6	M	H	M	L	M	M	L	M	L	L	L	H	H	H	M

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Syllabus (Effective from 2023-24)

School/ Department: School of Infrastructure and Planning
Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE),
Duration: 3 years (Six Semesters)

PE 4	IP7225	Advanced Design of Foundations	3	0	0	3

Course Objectives:

1. To estimate bearing capacity of soil & proportioning of foundations using field test data.
2. To analyse& design of pile footings.
3. To gain knowledge about well foundation and familiarization of IS & IRC codal provisions.
4. To understand sheeting and bracing Systems in Shallow and Deep Open Cuts in Different Soil Types.

Module –I

Shallow Foundations, Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations using Field Test Data, Pressure - Settlement Characteristics from Constitutive Laws.

Module –II

Pile Foundations, Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behavior of Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles.

Well Foundation, IS and IRC Code Provisions, Elastic Theory and Ultimate Resistance Methods. Tunnels and Arching in Soils, Pressure Computations around Tunnels.

Module –III

Open Cuts, Sheeting and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types. Coffer Dams, Various Types, Analysis and Design, Foundations under uplifting loads, Soil-structure interaction

Text/Reference Books:

1. Design of foundation system, N.P. Kurian, Narosa Publishing House
2. Foundation Analysis and Design, J. E. Bowles, Tata McGraw Hill New York
3. Analysis and Design of Substructures, Sawmi Saran, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.

Course Outcomes:

CO1: Understand and estimate bearing capacity of soil ; proportioning of foundations using field test data.
CO2: Applythe concept of estimating load transfer of piles.
CO3: Analyze pile foundations.
CO4: Computations of Elastic Theory and Ultimate Resistance of Tunnels and Arching in Soils
CO5: Understand Sheeting and Bracing Systems in Shallow and Deep Open Cuts in different Soil Types.
CO6: Design of foundations under uplifting loads & Soil-structure interaction

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	M	M	H	M	L	L	H	M	L	H	M	L
CO2	H	H	H	M	H	M	M	L	L	M	H	L	H	M	L
CO3	H	H	H	M	M	H	M	L	L	M	M	L	H	M	M
CO4	H	H	H	M	H	M	M	L	L	M	H	L	H	M	L
CO5	H	H	H	M	H	M	H	L	L	H	M	L	H	H	L
CO6	H	H	H	M	H	M	H	L	L	M	H	L	H	H	M

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Syllabus (Effective from 2023-24)

School/ Department: School of Infrastructure and Planning
Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE),
Duration: 3 years (Six Semesters)

LC 3	IP6522	Advanced Structural lab	0	0	4	2

Course Objectives:

1. To perform different destructive and non-destructive strength and durability test of concrete.
2. To perform the Mix design using admixtures as per IS 10262:2009.
3. To determine tensile strength of different steel rebars and rolled steel sections.

List of Experiments

1. Mix design of concrete of different grades & using admixtures
2. Tensile and Flexural strength of concrete of different grades
3. Tensile strength of different types of steel rebars, rolled steel sections
4. Testing of simply supported RCC beams for flexural failure
5. Testing of simply supported RCC beams for shear failure
6. Testing of RCC column
7. Non-destructive testing of concrete including rebound hammer and ultrasonic pulse method
8. Permeability of concrete.

Course Outcomes:

CO1: Understand the Mix design as per IS 10262:2019 and evaluate the strength and durability of concrete.
CO2: Determine tensile strength of different steel rebars and rolled steel sections.
CO3: Carry out the procedure of RC beams in bending and shear (two point and one-point loading) and RCC column.
CO4: Assess the concrete properties by NDT techniques

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	H	H	M	H	M	H	M	H	L	M	H	H	M	M
CO2	M	H	H	M	H	M	H	M	H	L	M	H	H	M	M
CO3	M	H	H	M	H	M	H	M	H	L	M	H	H	M	M
CO4	M	H	H	M	H	M	H	M	H	L	M	H	H	M	M

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Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE),
Duration: 3 years (Six Semesters)

5th Semester

PR 2	IP7621	Dissertation (Phase-I)	0	0	24	12

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Syllabus (Effective from 2023-24)

School/ Department: School of Infrastructure and Planning
Course: M. Tech. (SSP, Part Time), Programme: Structural Engineering (STE),
Duration: 3 years (Six Semesters)

6th Semester

PR 3	IP7622	Dissertation (Phase-II)	0	0	32	16