ST. VINCENT PALLOTTI COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR

(An autonomous institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

M.Tech. Scheme of Examination & Syllabus 2025-26

STRUCTURAL ENGINEERING

SEMESTER I

Sr. No.	Course Category	Course Code	Course Title	Hours per Week			Credits	Maximum Marks			
				L	T	P		Continual Assessment	End Sem Examination	Minimum Passing Marks	Total
1	PCC	25SE101T	Matrix Analysis of Structure	4	-	-	4	40	60	50	100
2	PCC	25SE101P	Matrix Analysis of Structure Lab	-	-	4	2	25	25	25	50
3	PCC	25SE102T	Earthquake and wind effects on Structures	4	-	-	4	40	60	50	100
4	PCC	25SE103T	Foundation Design	4	-	-	4	40	60	50	100
5	PCC	25SE104T	Advanced Concrete Structures	4	-	-	4	40	60	50	100
6	PCC	25SE104P	Advanced Concrete Structures Lab	-	-	4	2	25	25	25	50
7	PEC	25SE105T	Program Elective - I (Refer PE Basket)	4	-	-	4	40	60	50	100
Total				**20**	**0**	**8**	**24**	**250**	**350**	**-**	**600**

Chairman - BoS	Dean – Academics	July 2025	1.0	Applicable for 2025-26
		Date of Release	Version	

Basket for Program Elective

Semester	Course Category	Course Code	Name of Course	Credits
I	PEC	25SE105T(i) 25SE105T(ii) 25SE105T(iii)	PE - I Theory of Elasticity & Elastic Stability PE - I Advanced Steel Structures PE - I Design of Environmental Structures	4
II	PEC	25SE205T(i) 25SE205T(ii) 25SE205T(iii)	PE - II Design of High Rise Structures PE - II Bridge Engineering PE - II Advanced Earthquake Design	4
III	PEC	25SE302T(i) 25SE302T(ii) 25SE302T(iii)	PE - IV Road Safety Engineering PE - IV New Engineering Materials and Technology PE - IV Water Recourse Management	4
III	PEC	25SE301T(i) 25SE301T(ii) 25SE301T(ii)	PE - III Advanced Foundation Design PE - III Structural Health Monitoring PE - III Global Warming and Climate Change	4

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25SE101T	Matrix Analysis of Structures	4	-	-	4	40	60	100

Course Objectives	Course Outcomes
1. Introduce the students to Stiffness Method. 2. Understand the Direct Stiffness Method. 3. Understand Matrix Stiffness Method as applied to BEAM element, TRUSS element, FRAME element and GRID Element. 4. Understand the link between Matrix Stiffness Method and Finite Element Method.	At the end of the course, students will be able to: 1. Apply Direct Stiffness Method to Rigid Jointed Structures 2. Analyse the structures using BEAM element. 3. Analyse the structure using TRUSS element. 4. Analyse the structure using FRAME element. 5. Analyse the structure using GRID element.

Unit I	**[12 Hrs]**
Direct Stiffness Method: Stiffness Coefficients, Application of Direct Stiffness Method to Rigid Jointed Structures (Maximum DOKI = 3)	
Unit II	**[12 Hrs]**
BEAM Element: BEAM element stiffness matrix, Application of BEAM element to analyse a structure, Lack of fit and settlement of supports. Maximum DOKI = 3	
Unit III	**[12 Hrs]**
TRUSS Element: TRUSS element stiffness matrix, Rotation Transformation Matrix, Application of TRUSS element to analyse a structure, Lack of fit and settlement of supports. Temperature Stresses. Maximum DOKI = 4	
Unit IV	**[12 Hrs]**
FRAME Element: FRAME element stiffness matrix, Rotation Transformation Matrix, Application of FRAME element to analyse a structure, Lack of fit and settlement of supports. Temperature Stresses. Maximum DOKI = 4	
Unit V	**[12 Hrs]**
GRID Element: GRID element stiffness matrix, Rotation Transformation Matrix, Application of GRID element to analyse a structure, Lack of fit and settlement of supports. Temperature Stresses. Maximum DOKI = 4 **Introduction to Finite Element Method:** Discretization of a structure, Analysis of a simple structure using BAR element, Uniaxial deflection, Maximum DOKI = 3	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Structural Analysis	Hibbeler R. C.	16th Edition	Pearson Publications
2	Matrix Approach to Structural Analysis	Aslam Kasimaali	9th Edition	Prentica Hall
3	Structural Analysis: Matrix Method	Pandit and Gupta	15th Edition	Tata McGraw Hill

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Matrix Method of Structural Analysis	Weaver and Gere	**7th Edition**	McGraw Hill

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
25SE101P	Matrix Analysis of Structures Lab	-	-	4	2	CA	ESE	Total
						25	25	50

Course Objectives	Course Outcomes
To develop students' ability to analyze various structural systems using matrix methods through structural analysis software and validate results manually.	At the end of the course, students will be able to: 1. Analyse the continuous beam using software and validate the results with manual calculations. 2. Analyse the rigid jointed plane frame using software and validate the results with manual calculations 3. Analyse the pin jointed plane frame using software and validate the results with manual calculations 4. Analyse the grid using software and validate the results with manual calculations.

Practical No.	Title of the Practical
1	Introduction to structural analysis software. Generation of input and output file. Interpretation of the data.
2	Analysis of continuous beam subjected to point load and udl using software
3	Analysis of truss subjected to point load using software
4	Analysis of portal frame subjected to point load and udl using software
5	Analysis of a grid subjected to udl and point load using software

Text Books

S.N	Title	Authors	Edition	Publisher
1	Structural Analysis	Hibbeler R. C.	16th Edition	Pearson Publications
2	Matrix Approach to Structural Analysis	Aslam Kasimaali	9th Edition	Prentica Hall
3	Structural Analysis: Matrix Method	Pandit and Gupta	15th Edition	Tata McGraw Hill

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Matrix Method of Structural Analysis	Weaver and Gere	7th Edition	McGraw Hill

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STRUCTURAL ENGINEERING

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25SE102T	Earthquake and Wind Effects on Structures	4	-	-	4	40	60	100

Course Objectives	Course Outcomes
To equip students with fundamental knowledge and analytical skills for assessing and designing structures to resist earthquake and wind-induced forces in accordance with relevant codes and engineering principles.	At the of the course, students will be able to: 1. Explain the origin, propagation, and measurement of earthquakes, and interpret seismic records for engineering analysis. 2. Identify causes of earthquake damage and develop response and design spectra from historical earthquake data. 3. Apply IS 1893 and IS 13920 provisions to the earthquake-resistant design of RCC structures using concepts like ductility, stiffness, and capacity design. 4. Interpret wind characteristics including wind speed data, cyclone patterns, and national wind maps for structural design considerations. 5. Analyze dynamic wind-induced vibrations in structures and explore methods for vibration control and structural health monitoring.

Unit I	**[12 Hrs]**
Introduction to Earthquake: Origin of earthquake, Engineering geology of earthquakes, faults, Propagation of earthquake waves, quantification of earthquake (magnitude, & intensity of earthquake), Measurement of earthquake (accelerograph, accelogram recording and analysis of earthquake records), determination of magnitude, epicenter distances, Seismicity of the world.	
Unit II	[12 Hrs]
Sources of Earthquake: Causes or sources of earthquake damage, damage due to ground failure, History of past Earthquakes, generation of response spectrum from available earthquake records, Earthquake design spectrum and inelastic spectrum. Evolution of seismic risk.	
Unit III	[12 Hrs]
Design philosophy and study of IS code: Concepts of earthquake resistance design, Design philosophy, and four virtues of earthquake resistance design (stiffness, strength, ductility and configuration). Introduction to capacity design concept, Study of IS: 1893, Study of IS: 13920 for analysis and ductile design of RCC structures.	
Unit IV	[12 Hrs]
Wind Characteristics: Wind Characteristics: Historical Wind Speed Data, Wind Speed Map of India, Cyclones and Tornadoes.	
Unit V	**[12 Hrs]**
Dynamic Wind Effects: Dynamic Wind Effects: Wind Induced Vibrations, Analysis for dynamic wind loads, Vibration Control and Structural Health Monitoring.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Geotechnical Earthquake Engineering	Kramer, S.L	-	Prentice Hall, New Jersey
2	Introduction to earthquake engineering structures	Arya A. S.	2nd	
3	An Introduction to Wind Effects on Structures	C. Scruton	-	Oxford University Press, Oxford, UK
4	Earthquake Resistant Design of Structures	S.K.Duggal	2nd	Oxford

Indian Standard Codes of Practice

S.N	Title	Publisher
1	IS 1893 (Part 1): 2016 - Criteria for Earthquake Resistant Design of Structures - General Provisions and Buildings	Bureau of Indian Standards, New Delhi
2	IS 13935: 2019 - Repair and Seismic Strengthening of Buildings	Bureau of Indian Standards, New Delhi
3	IS 1726: 2019 - Code of Practice for Foundations	Bureau of Indian Standards, New Delhi
4	IS 4326: 1993 - Earthquake Resistant Design and Construction of Buildings – Code of Practice	Bureau of Indian Standards, New Delhi
5	IS 1893 (Part 1): 2016 - Criteria for Earthquake Resistant Design of Structures - General Provisions and Buildings	Bureau of Indian Standards, New Delhi

		Aug 2025	1.0	Applicable for 2025-26
Chairman - BoS	Dean – Academics	Date of Release	Version	

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25SE103T	Foundation Design	4	-	-	4	40	60	100

Course Objectives	Course Outcomes
1. To learn about types and purposes of different foundation systems and structures. 2. To provide students with exposure to the systematic methods for designing foundation. 3. To discuss and evaluate the feasibility of foundation solutions to different types of soil conditions considering the time effect on soil behavior. 4. To build the necessary theoretical background for design and construction of foundation system. 5. To Study the nature of the soil behavior for different foundation.	At the end of the course, students will be able to: 1. Understand various Types of foundation. 2. Understand about In Situ .test (field test of soil) 3. Understand about various analysis and design of foundation. 4. Understand reason behind .the structure and foundation failure. 5. Understand about behavior/nature of the soil.

Unit I	**[12 Hrs]**
Explorations, Geographical Investigation, Characterization of ground, site investigations, method of drilling, sampling. **In-situ tests:** SPT, CPT, plates load tests, methods for ultimate bearing capacity based on in situ tests. Introduction to Isolated Footing & Combined footing. **Bearing Capacity,** general, local and punching shear failures, correction for size, shape, depth, water table, eccentricity, ultimate and allowable Bearing capacities, Effect of ground water level.	
Unit II	**[12 Hrs]**
Raft Foundation, Introduction & Necessity, Types of Raft Foundations, Soil–Structure Interaction & Contact Pressure, Design Principles, Advanced & Special Rafts.	
Unit III	**[12 Hrs]**
Pile foundation: Introduction, Pile classification, Pile installation, cast in situ pile, End bearing pile, Driven pile, load carrying capacity of pile by state and dynamic methods, Pile load test, Pile groups, laterally loaded piles.	
Unit IV	**[12 Hrs]**
Expansive Soils: Identification, swelling pressure, Foundation on expansive soil, Stabilization of expansive soils. **Caisson and Well Foundation**: - Types of Caisson, Components of Well foundation, Stability analysis of well foundation, Tilt. And Shift.	
Unit V	**[12 Hrs]**
Machine foundations: Types, Basic definitions. Degree of Freedom of a Block foundation, General criteria for design of machine foundation, 'Free and forced Vibrations and machine foundations subjected in impact loads.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	A text book of soil mechanics and foundation engineering	V.N.S. Murthy	revised and enlarged 4th edition 1993	Saikripa Technical Consultants, Banglore
2	Basic and applied soil mechanics	Gopal Ranjan and ASR Rao	-	Wiley Easter Ltd., New delhi
3	Soil mechanics and foundation engineering	K R Arora	-	Standard Pub. And Dist. Delhi

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Foundation Engineering	R.B. Peck, W. E. Hanson and T. H. Thournburn, John Wiley	-	-
2	Foundation analysis Design	J.E. Bowles	-	McGraw Hill Book co. New York

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25SE104T	Advanced Concrete Structures	4	-	-	4	40	60	100

Course Objectives	Course Outcomes
To equip students with advanced knowledge and design skills in prestressed, reinforced, and special concrete structures as per IS codes for practical engineering applications.	At the end of the course: 1. Understand and analyze prestressed concrete members with codal provisions. 2. Design interior panels of flat slabs with moment distribution, shear check, and reinforcement detailing. 3. Analyze and design elevated, underground, and ground-supported water tanks as per IS codes. 4. Evaluate flexural cracking and calculate crack width in RCC members using empirical and codal methods. 5. Apply design theories to analyze and design silos and bunkers for material storage.

Unit I **[10 Hrs]**

Introduction to Prestressed Concrete Structures:
Introduction to prestressed concrete, types of prestressing, systems and devices, materials, losses in prestress, IS1343-2012 codal provisions.
Analysis of PSC flexural members, stresses at transfer and service loads.

Unit II **[10 Hrs]**

Design of interior panel of Flat slab:
Limitations, Components,Total Design moment,Distribution of moments,Shear in Flat Slab,Check for shear as per IS456:2000 Detailing of reinforcement

Unit III **[18 Hrs]**

Design of water tank:
Introduction, Analysis and Design of Elevated water tank, Underground water tank and water tank resting on ground.

Unit IV **[12 Hrs]**

Calculation of crack width:
Calculation of Crack width in Reinforced Concrete Members: Introduction, Factors affecting crack width in beams, Mechanisms of flexural cracking, Calculation of crack width, Simple empirical method, Estimation of crack width in beams by IS 456

Unit V **[10 Hrs]**

Silos, and Bunkers:
Introduction, Rankine's Theory, Janssen's Theory, Airys Theory, analysis and design of silos and bunkers

Text Books

S.N	Title	Authors	Edition	Publisher
1	Limit State Design of Reinforced Concrete	P. C. Varghese	-	PHI Learning
2	Design of Reinforced Concrete Structures	N. Subramanian	-	Oxford University Press
4	Reinforced Concrete: Limit State Design	A. K. Jain	-	Nem Chand & Bros
5	Prestressed Concrete	N. Krishana Raju	-	MCGraw Hill Education

Reference Books

S.N	Title	Authors	Edition	Publisher
1	IS: 456 – 2000 (Plain and Reinforced Concrete – Code of Practice)	BIS	-	Bureau of Indian Standards
2	IS: 875 (Part I to V) – Code for Design Loads	BIS	-	Bureau of Indian Standards
3	IS: 3370 – Code for Liquid Retaining Structures	BIS	-	Bureau of Indian Standards
4	IS: 1893 – Criteria for Earthquake Resistant Design	BIS	-	Bureau of Indian Standards
5	SP 34 (1987): Handbook on Concrete Reinforcement and	SP - 34	-	Bureau of Indian Standards
6	Handbook on Reinforced Concrete Design	SP - 16	-	Bureau of Indian Standards

		Aug 2025	1.0	Applicable for 2025-26
Chairman - BoS	Dean – Academics	Date of Release	Version	

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25SE104P	Advanced Concrete Structures Lab	-	-	4	2	25	25	50

Course Objectives	Course Outcomes
To enable students to analyse, design, and detail advanced concrete structures using relevant IS codes and practical applications.	At the end of the course students will be able to 1. To develop the ability to analyse and design advanced concrete structural elements using relevant IS codes. 2. To enhance skills in preparing accurate reinforcement detailing for flat slabs, water tanks, silos, and bunkers. 3. To provide hands-on exposure through software, Excel-based design, and practical site insights for real-world structural applications.

List of Practical

1. Design of Flat Slab Interior Panel with reinforcement detailing – Using IS 456:2000 provisions.
2. Design of Circular Water Tank – Underground/Overhead tank with reinforcement detailing, design with IS 3370.
3. Design of Circular Water Tank Resting on ground with reinforcement detailing, design with IS 3370.
4. Design of Silo – Analysis and reinforcement detailing for a circular silo.
5. Design of Bunker – Application of Rankine's/Janssen's theory with detailing.
6. Excel Programming of any two design.
7. Practical Insights into Advanced Concrete Structures: A Site Visit.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Limit State Design of Reinforced Concrete	P. C. Varghese	-	PHI Learning
2	Design of Reinforced Concrete Structures	N. Subramanian	-	Oxford University Press
3	Advanced Reinforced Concrete Design	P. C. Varghese	-	PHI Learning
4	Reinforced Concrete: Limit State Design	A. K. Jain	-	Nem Chand & Bros

Reference Books

S.N	Title	Authors	Edition	Publisher
1	IS: 456 – 2000 (Plain and Reinforced Concrete – Code of Practice)	BIS	-	Bureau of Indian Standards
2	IS: 875 (Part I to V) – Code for Design Loads	BIS	-	Bureau of Indian Standards
3	IS: 3370 – Code for Liquid Retaining Structures	BIS	-	Bureau of Indian Standards
4	IS: 1893 – Criteria for Earthquake Resistant Design	BIS	-	Bureau of Indian Standards
5	SP 34 (1987): Handbook on Concrete Reinforcement and	SP - 34	-	Bureau of Indian Standards
6	Handbook on Reinforced Concrete Design	SP - 16	-	Bureau of Indian Standards

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25SE105T(i)	Theory of Elasticity & Elastic Stability	4	-	-	4	40	60	100

Course Objectives	Course Outcomes
To develop a comprehensive understanding of stress-strain behavior in elastic solids and stability analysis of structural elements under various loading conditions.	At the end of the course: 1. Analyze stress and strain components in two-dimensional problems and apply Airy's stress function for equilibrium and compatibility. 2. Determine principal stresses, stress invariants, and solve three- dimensional equilibrium and compatibility conditions 3. Compute bending and torsional stresses in cantilevers, beams, and elliptical cross sections using elasticity principles. 4. Derive and solve differential equations for beam deflection and buckling, including lateral-torsional buckling and plate buckling problems. 5. Apply energy methods and approximate techniques to analyze elastic buckling of columns with varying conditions and constraints..

Unit I	**[12 Hrs]**
Analysis of Stress and strain in 2 dimensions: Introduction, Types of forces, Components of Stresses and strains, Stress-strain relation, Plane stress and plane strain strain at a point, Differential equation of equilibrium, Boundary conditions and compatibility equations (rectangular coordinates), Airy's stress function.	
Unit II	[12 Hrs]
Analysis of stress and strain in 3 dimensions: Components of stress, principal stresses, stress invariants, Maximum shearing stress, Differential equation of equilibrium, Boundary conditions and compatibility equations.	
Unit III	[12 Hrs]
Bending of cantilever of narrow rectangular section loaded at end, Bending of simply supported beam with uniform load, torsion of non-circular sections, Elliptical cross section.	
Unit IV	[12 Hrs]
Differential equation for beam, columns with concentrated loads, continuous lateral loads and couples for simply supported ends, Application of trigonometric series, Lateral bucking of beams. Buckling of simply supported rectangular plates uniformly compresses in middle plane.	
Unit V	[12 Hrs]
Energy method for elastic buckling of columns, Approximate method, Buckling of columns on elastic foundation, Columns with intermediate compressive forces and distributed axial load, Columns with changes in cross section..	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Theory of Elasticity	S.P. Timoshenko and J.N. Goodier	3rd Edition,1963	Mc-Graw Hill Book Company, New Delhi
2	Theory of Elasticity	S.P. Timoshenko and J.M. Gere	2nd Edition,1963	Mc-Graw Hill Book Company, New Delhi

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Computational Elasticity—Theory of Elasticity, Finite and Boundary Element Methods	M. Ameen	1st Edition,2007	Narosa publication

		Aug 2025	1.0	Applicable for 2025-26
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FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25SE105T(ii)	Advanced Steel Structures	4	-	-	4	40	60	100

Course Objectives	Course Outcomes
1. To understand basic principles of reliability-based design on steel structures. 2. To understand the behavior of various members of structures. 3. To understand the design philosophy of various structural member.	1. To recognize the design philosophy of steel structures and understand the concept of limit state design and design connections. 2. To study the behavior of members, and industrial buildings. 3. Apply the principles, procedures and current codal requirements to the analysis and design of truss and bridges, etc. 4. Design of gantry girders as a structural member. 5. Understand and design of advanced steel structures like chimney.

Unit I	**[12 Hrs]**
Introduction: Introduction to Structural Steel, failure of connections, design of various connections.	
Unit II	**[12 Hrs]**
Analysis and Design of Industrial Building (Design of purlins for roofs, design of built up purlins)	
Unit III	**[12 Hrs]**
Introduction to truss. Design of truss bridges.	
Unit IV	**[12 Hrs]**
Introduction to girder. Design of gantry girder and plate girder	
Unit V	**[12 Hrs]**
Introduction to chimney, types of chimney. Design of steel chimneys	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Design of Steel Structures	Arya A.S and Ajmani J.L.	-	Nemchand & bross
2	Design of Steel Structures	Duggal S.K.	-	-

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Design of Steel Structures	Gaylord,E.H. & Gaylord,C.N	-	McGraw Hill Pub., (1998).
2	Steel Structures- Design and Behavior	Salmon and Johnson	-	Harper and Collins Publishers.

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25SE105T(iii)	Design of Environmental Structures	4	-	-	4	40	60	100

Course Objectives	Course Outcomes
1. Understand the Fundamental Concepts of Environmental Engineering. 2. Explore the Design and Functionality of Environmental Infrastructure. 3. Analyze the Role of Structural Engineering in Environmental Systems.	At the end of the course: 1. To apply the principle of limit state design. 2. To do structural design of concrete and steel pipes. 3. To do the structural design of a complete water and wastewater treatment plant. 4. To do air pollution control devices design. 5. To design underground water storage structures.

Unit I	[12 Hrs]
Analysis of Stress and strain in 2 dimensions: Introduction, Types of forces, Components of Stresses and strains, Stress-strain relation, Plane stress and plane strain strain at a point, Differential equation of equilibrium, Boundary conditions and compatibility equations (rectangular coordinates), Airy's stress function.	
Unit II	[12 Hrs]
Analysis of stress and strain in 3 dimensions: Components of stress, principal stresses, stress invariants, Maximum shearing stress, Differential equation of equilibrium, Boundary conditions and compatibility equations.	
Unit III	[12 Hrs]
Bending of cantilever of narrow rectangular section loaded at end, Bending of simply supported beam with uniform load, torsion of non-circular sections, Elliptical cross section.	
Unit IV	[12 Hrs]
Differential equation for beam, columns with concentrated loads, continuous lateral loads and couples for simply supported ends, Application of trigonometric series, Lateral bucking of beams. Buckling of simply supported rectangular plates uniformly compresses in middle plane.	
Unit V	[12 Hrs]
Energy method for elastic buckling of columns, Approximate method, Buckling of columns on elastic foundation, Columns with intermediate compressive forces and distributed axial load, Columns with changes in cross section..	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Prestressed Concrete	Krishna Raju	6th Edition	Tata McGraw Hill Publishing Co.
2	Concrete liquid retaining structures	Green, J.K. and Perkins, P.H.	-	Applied Science Publishers
3	Storage structures	Rajagopalan K.	-	Tata McGraw Hill