



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 III

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	PEC	25SE301T	Program Elective - III (Refer PE Basket)	4	-	-	4	40	60	50	100
2	PEC	25SE302T	Program Elective - IV (Refer PE Basket)	4	-	-	4	40	60	50	100
3	PROJ	25SE303P	Project Phase - I	-	-	16	8	100	100	100	200
Total				8	-	16	16	180	220	-	400

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STRUCTURAL ENGINEERING

Semester	Hours per Week			Credits	Maximum Marks		
	L	T	P		Continual Assessment	End Sem Examination	Total
First Semester	20	-	8	24	250	350	600
Second Semester	20	-	8	24	250	350	600
Third Semester	8	-	16	16	130	170	300
Fourth Semester	-	-	32	16	100	100	200
Total	48	-	64	80	730	970	1700

Basket for Program Elective

Semester	Course Category	Course Code	Name of Course	Credits
I	PEC	25SE105T(i)	Theory of Elasticity & Elastic Stability	4
		25SE105T(ii)	Advanced Steel Structures	
		25SE105T(iii)	Design of Environmental Structures	
II	PEC	25SE205T(i)	Design of High Rise Structures	4
		25SE205T(ii)	Bridge Engineering	
		25SE205T(iii)	Advanced Earthquake Design	
III	PEC	25SE301T(i)	Advanced Foundation Design	4
		25SE301T(ii)	Structural Health Monitoring	
		25SE301T(iii)	Retrofitting and Rehabilitation of Structures	
III	PEC	25SE302T(i)	Sustainable Construction and Demolition Engineering	4
		25SE302T(ii)	Theory of Plates and Shells	
		25SE302T(iii)	Smart Structures and Application	

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THIRD SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25SE301T(i)	PE – III Advance Foundation Design	4	-	-	4	40	60	100
Course Objectives		Course Outcomes						
1. To introduce various aspects of foundation engineering along with bringing out the advanced theories and practical knowledge of the subject 2. To develop an ability and skill to apply the codal provisions for the design of various types of foundation 3. To develop an ability and skill to design various aspects of foundation engineering including soil exploration, details of shallow and deep foundations		At the end of the course, students will be able to: 1. Understand various Bearing Capacity Theories. 2. Select and design shallow foundation satisfying bearing capacity and settlement requirements 3. Design pile foundation satisfying bearing capacity and settlement requirements 4. Understand the engineering behavior of well Foundations and their design aspects 5. Understand the engineering behavior of expansive soils and selection of suitable foundation type for such soils						

Unit I	[9 Hrs]
Bearing Capacity Theories- Bearing capacity theories (Terzaghi's, Meyerhoff's, Hansen's, Vesic's, Balla's)- foundations subjected to centric vertical loads, inclined loads, eccentric loads, foundations on layered soils, anisotropic soils, foundations on slopes, over voids, interference of footings.	
Unit II	[9 Hrs]
Shallow Foundations-Settlement analysis- components of settlement, elastic settlement, flexible and rigid footings, contact pressure distribution, prediction of elastic parameters from SPT, CPT and other field tests, consolidation settlement, differential settlement. Design of individual footings, strip footing, combined footing, rigid and flexible mat, buoyancy raft, basement raft, underpinning.	
Unit III	[9 Hrs]
Pile Foundations- Estimation of load carrying capacity of single and pile group under various loading conditions. Pile load testing (static, dynamic methods and data interpretation), settlement of pile foundation, code provisions, design of single pile and pile groups, and pile caps. Load transfer mechanism, Pile capacity in various soil types, negative skin friction, group action, settlements, laterally loaded vertical piles, pile foundations on rocks.	
Unit IV	[9 Hrs]
Well Foundations- Types, components, construction methods, design methods (Terzaghi, IS and IRC approaches), check for stability, base pressure, side pressure and deflection.	
Unit V	[9 Hrs]
SPECIAL TOPICS- Foundations on difficult sub-soils (collapsible and expansive soils) - Foundations for tall structures.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Foundation Analysis and Design	Bowles. J.E.	Edition, 5th Edn, 1997	Tata McGraw-Hill International
2	Shallow Foundations: Bearing capacity and settlement	Das B.M.	-	CRC Press, 1999
3	Pile Foundations in Engineering Practice	Prakash, S. and Sharma, H.D.	-	John Wiley & Sons Inc., 1990.

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Foundation Design	Teng, W.C.	-	Prentice-Hall of India (Pvt) Ltd., 1965
2	Design of Foundation Systems - Principles and Practices	Kurian, N.P.	2nd Edn. 1994	Narosa Publishing House

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25SE301T(ii)	PE – III Structural Health Monitoring	4	-	-	4	40	60	100

Course Objectives	Course Outcomes
1. To understand the structural health monitoring for structures. 2. To understand the conditional assessment & techniques for strengthening and retrofitting of structures.	The students will be able to 1. Understand the fundamentals of structural dynamic 2. Analyze the need and challenges of Structural Health Monitoring 3. Describe various methods of damage detection 4. Apply the Structural Health Monitoring technique for building. 5. Apply the Structural Health Monitoring techniques for bridge.

Unit I	[8 Hrs]
Non-Destructive Evaluations : - Concrete strength assessment –Rebound hammer test – Ultrasonic pulse velocity tests, penetration resistance, pullout tests, core sampling and testing, chemical tests – carbonation, chloride, content and corrosion problem.	
Unit II	[8 Hrs]
Introduction to Structural Health Monitoring: Factors affecting the health of structures, SHM scheme, various steps in SHM, damage diagnostic methods, challenges in SHM, Experimental modal analysis, operational modal analysis and combined methods	
Unit III	[7 Hrs]
Methods of Damage Detection: Vibration Control & SHM Damage Diagnostic methods based on vibration response, Method based on modal frequency/shape/damping, Curvature and flexibility method, Modal strain energy method, Sensitivity method, Baseline-free method.	
Unit IV	[7 Hrs]
Health Monitoring Systems of Building Structures: Numerical modeling– Use of sensors – Data acquisition techniques – Data Processing – Diagnostic techniques – Wireless sensor network – Rehabilitation techniques.	
Unit V	[8 Hrs]
Health Monitoring of Bridges: Measurement of Parameters, Sensors/Transducers technologies, Measurement & Health monitoring Techniques: Vibration signal analysis, Strain gage based Instrumentation, Destructive & Non-destructive testing, Load Test, etc	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Structural Health Monitoring: A Machine Learning Perspective	Charles R Farrar, and Keith Worden,	first edition, 2012-2013.	John Wiley & Sons ,
2	Structural health monitoring using smart sensors, Newmark Structural Engineering at Urbana	Nagayama, T. and Spencer Jr, B.F.	first edition, 2007	Laboratory. University of Illinois

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Fibre optic methods for structural health monitoring	Glisic, B. and Inaudi, D.	first edition, 2008	John Wiley & Sons
2	Passive and active sensing technologies for structural health monitoring	Do, R.	first edition, 2014	University of California, San Diego.

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THIRD SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
25SE301T(iii)	PE - III Retrofitting and Rehabilitation of Structures	4	-	-	4	40	60	100
Course Objectives		Course Outcomes						
1. To understand causes of distress and deterioration in structures. 2. To learn condition assessment using NDT and destructive testing methods. 3. To evaluate structural properties and damage in structures. 4. To study repair materials and rehabilitation techniques. 5. To select suitable retrofitting and strengthening methods for structures.		At the end of the course, students will be able to: 1. Estimate causes for distress and deterioration of structures. 2. Explain NDT techniques for condition assessment of structures for identifying damages in structures. 3. Evaluate structural properties. 4. Select repair material and identify a suitable repair option. 5. Select retrofitting strategy suitable for distress and formulate guide lines for repair management of deteriorated structures.						

Unit I	[9 Hrs]
INTRODUCTION: An overview of present repair practices, distress identification and repair management, Causes of distress in concrete structures-Holistic Models for deterioration of concrete, Permeability of concrete, aggressive chemical agents, durability aspects, Condition Survey Definition, objectives, different stages-Preliminary inspection, planning stage, visual inspection, field laboratory testing stage, consideration for repair strategy	
Unit II	[9 Hrs]
NON DESTRUCTIVE AND DESTRUCTIVE TESTING METHODS: Non-Destructive evaluation tests - Concrete strength assessment - Rebound hammer test - Ultrasonic pulse velocity tests, penetration resistance, pull out tests, core sampling and testing, Chemical tests - Carbonation tests and chloride content, Corrosion potential assessment, half cell potentiometer test, resistivity measurement, Identification and estimation of damage.	
Unit III	[9 Hrs]
EVALUATION OF STRUCTURAL PROPERTIES: Fire damage assessment, structural integrity and soundness assessment, interpretation and evaluation of results, Evaluation of reserve strength of existing structures, analysis necessary to identify critical sections, active and passive repairs, modeling of repaired composite structures	
Unit IV	[9 Hrs]
REPAIR MATERIALS AND CASE STUDIES: Selection of repair materials for concrete-Essential parameters for repair materials-Strength and durability aspects, cost and suitability aspects, Materials for repair. Discussion of case studies- RCC buildings, water tanks, industrial structures-Identifying a suitable repair option for certain damage in a structure.	
Unit V	[9 Hrs]
REPAIR/ REHABILITATION METHODS AND STRATEGIES: Rehabilitation and retrofitting methods-repair options, performance requirements of repair systems, factors for selection of repair methods, Repair stages, Methods of repair including foundation rehabilitation methods, chemical and electrochemical method. Repair/Rehabilitation strategies - Stress reduction technique, repair and strengthening of columns and beams, Compressive strength of concrete, cracks/joints, masonry, foundation, base isolation.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Maintenance, Repair & Rehabilitation and Minor Works of Buildings	Varghese P.C.	1st Edition	PHI Learning Private Ltd., New Delhi, 2014
2	Concrete Technology	Santhakumar A.R.	2nd Edition	Oxford University Press, New Delhi, 2007
3	Handbook on Repair and Rehabilitation of RCC Buildings	CPWD (Central Public Works Department)	—	Govt. of India Press, New Delhi

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Concrete Technology – Theory and Practice	Shetty, M.S.	—	S. Chand and Company, New Delhi, 1992
2	Rehabilitation of Concrete Structures	Vidivelli, B.	—	Standard Publishers Distributors, New Delhi, 2008
3	Maintenance and Repairs of Buildings	P.K. Guha	—	New Central Book Agency (P) Ltd., Kolkata

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
25SE302T(i)	PE - IV Sustainable Construction and Demolition Engineering	4	-	-	4	CA	ESE	Total
						40	60	100
Course Objectives		Course Outcomes						
1. To understand construction methods, planning, and demolition practices used in civil engineering projects. 2. To study construction equipment, scheduling techniques, and structural behavior during demolition. 3. To learn safety regulations, risk assessment, and protection measures in construction and demolition activities. 4. To understand waste management, recycling, and environmental aspects of construction and demolition works. 5. To develop knowledge of advanced construction technologies and sustainable construction practices.		At the end of the course, students will be able to: 1. Explain construction methods, demolition techniques, and planning procedures. 2. Select suitable equipment and scheduling techniques for construction projects. 3. Analyze structural stability and safety requirements during demolition operations. 4. Apply waste management, recycling, and environmental protection practices in construction projects. 5. Evaluate modern construction technologies and sustainable practices for efficient project execution.						

Unit I	[9 Hrs]
Introduction to Construction & Demolition: Overview of construction industry, Types of construction projects (buildings, bridges, industrial) Demolition: definition, scope, and importance, Life cycle of structures (construction → use → demolition) Sustainability in construction and demolition.	
Unit II	[9 Hrs]
Construction Planning, Methods and Equipment: Site investigation and preparation, conventional construction, precast construction, Pre-Engineered Buildings (PEB), formwork and scaffolding, construction equipment such as cranes, excavators and concrete mixers, basics of scheduling using CPM and PERT.	
Unit III	[9 Hrs]
Demolition Techniques and Structural Aspects: Manual demolition, mechanical demolition, implosion technique, deconstruction methods, factors affecting selection of demolition methods, behavior of structures during demolition, load redistribution, progressive collapse, temporary supports and shoring, stability during dismantling, protection of adjacent structures.	
Unit IV	[9 Hrs]
Safety in Construction and Demolition: Safety regulations and standards, hazards in construction and demolition such as falling debris, dust, noise and structural collapse, PPE, fire and electrical safety, safety planning and risk assessment.	
Unit V	[9 Hrs]
Waste Management, Environmental and Legal Aspects: Types of construction and demolition waste, waste minimization techniques, recycling of concrete, steel and wood, environmental impact assessment, sustainable demolition practices, environmental regulations, pollution control, legal permissions, documentation and compliance, green building concepts.	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Construction Planning, Equipment and Methods	R.L. Peurifoy & Clifford J. Schexnayder	8th Edition	McGraw Hill Education
2.	Demolition: Practices, Technology and Management	V.A. Profillidis	1st Edition	CRC Press
3.	Construction Safety Management and Engineering	Darryl C. Hill & Brian H. Kleiner	1st Edition	Pearson Education

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Project Planning and Control with PERT and CPM	Dr. B.C. Punmia & K.K. Khandelwal	Revised Edition	Laxmi Publications
2.	Building Failures: Diagnosis and Avoidance	B.A. Richardson	2nd Edition	CRC Press
3.	Handbook of Construction Management	Abdul Razzak Rumane	1st Edition	CRC Press
4.	Sustainable Construction	Charles J. Kibert	4th Edition	Wiley Publications

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25SE302T(ii)	PE - IV Theory of Plates and Shells	4	-	-	4	40	60	100

Course Objectives	Course Outcomes
<ol style="list-style-type: none"> To introduce the fundamental concepts of plates and shell structures, including geometry, co-ordinate systems, stress-strain relations, and equilibrium conditions. To develop the ability to analyze thin rectangular and circular plates subjected to different loading and boundary conditions using classical plate theory. To understand the structural behaviour and analysis of cylindrical shells using membrane theory and equilibrium equations. To familiarize students with different shell forms, their classification, and various analytical methods used in shell analysis. To provide knowledge of doubly curved and axi-symmetrical shells, including their geometry, analysis, and design applications in engineering structures. 	<p>The students will be able to</p> <ol style="list-style-type: none"> Explain the basic concepts of shell structures, shell coordinates, strain-displacement relations, and governing equilibrium equations. Analyze thin rectangular plates under different loading and support conditions using Navier's and Levy's methods. Evaluate the behaviour and stress distribution in circular plates subjected to symmetrical and concentrated loads. Classify different types of shells and analyze cylindrical shells using membrane equations and Flugge's equations. Analyze and design doubly curved and axi-symmetrical shell structures such as elliptic paraboloids, hyperbolic paraboloids, conoids, spherical shells, and cooling towers.

Unit I	[9 Hrs]
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..	
Unit II	[9 Hrs]
Small Deflection Theory of Thin Rectangular Plates: Assumptions – Derivation of governing differential equation for thin plates – Boundary conditions – simply supported plate under sinusoidal load – Navier solution – Application to different cases – Levy's solution for various boundary conditions subjected to different loadings like uniform and hydrostatic pressure.	
Unit III	[9 Hrs]
Circular Plates: Differential Equation for symmetrical bending of Laterally loaded circular Plates – Uniformly loaded circular plates – circular plate concentrically loaded – circular plate loaded at center	
Unit IV	[9 Hrs]
Shells – functional behaviour – examples – structural behaviour of shells classification of shells – Definitions – various methods of analysis of shells – merits and demerits of each method – 2D. Membrane equation. Equations of equilibrium: Derivation of stress resultants – cylindrical shells – Flugge's equations.	
Unit V	[9 Hrs]
Introduction to the shells of Double curvatures: Geometry, analysis and design of elliptic paraboloid, conoid and hyperbolic parabolic shapes, inverted umbrella type. Axi- Symmetrical shells: General equation - Analysis and axi-symmetrical by membrane theory. Application to spherical shell and hyperboloid of revolution cooling towers.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Theory of Plates and Shells	Stephen P. Timoshenko, S. Woinowsky-Krieger	2nd Edition	Tata McGraw Hill
2	Analysis and Design of Concrete Shell Roofs	G. S. Ramaswamy	—	CBS Publishers & Distributors
3	Design of Concrete Shell Roofs	David P. Billington	—	Tata McGraw Hill, New York

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Shell Analysis	N. K. Bairagi	—	Khanna Publishers, New Delhi
2	Design of Shells and Folded Plates	P. C. Varghese	—	PHI Learning Pvt. Ltd.
3	Design of Concrete Shell Roofs	Chatterjee	—	Oxford & IBH Publishing Co.

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						CA	ESE	Total
25SE302T(iii)	PE - IV Smart Structures and Application	4	-	-	4	40	60	100
Course Objectives		Course Outcomes						
1. To understand the concept and applications of smart materials and smart structures. 2. To study the characteristics and functioning of sensors and actuators. 3. To learn the principles and techniques of base isolation in structures. 4. To understand vibration control methods and energy dissipation techniques. 5. To develop knowledge of dampers and modern structural control systems for earthquake-resistant structures.		At the end of the course, students will be able to: 1. Explain the behavior and applications of smart materials and smart structures. 2. Identify different types of sensors and actuators used in structural systems. 3. Apply principles of base isolation for seismic protection of structures. 4. Analyze vibration control and energy dissipation techniques in structures. 5. Select suitable dampers and structural control devices for improving structural performance.						

Unit I	[9 Hrs]
Smart Materials: Introduction to smart structures, application, smart systems –Components of smart systems, different types smart materials – characteristics and behavior of smart materials – modeling of smart materials.	
Unit II	[9 Hrs]
Actuators and Sensors: Introduction of sensors and actuators., features and - characteristics of sensors-types of sensors and actuators-electronic, thermal and hydraulic type actuators, characteristics of sensors and actuators.	
Unit III	[9 Hrs]
Base Isolation: Theory of Base Isolation, Principle of base isolation, Methods, Techniques	
Unit IV	[9 Hrs]
Vibration Controlled Techniques: Energy dissipation devices; introduction, Methods, principals.	
Unit V	[9 Hrs]
Energy Deissipation devices: Dampers, purpose, Types of energy dissipation devices; Metallic yield dampers, friction dampers, viscoelastic dampers, tuned mass dampers.	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Smart Structures: Analysis and Design	Srinivasan, A.V. and Michael McFarland, D.	1st Edition	Cambridge University Press, 2000
2.	Smart Structures and Materials 2003	Yoseph Bar-Cohen	1st Edition	The International Society for Optical Engineering, 2003

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Smart Structures and Materials	Brian Culshaw	1st Edition	Artech House, Boston, 1996
2.	Smart Materials and Structures	M.V. Gandhi and B.S. Thompson	1st Edition	Chapman and Hall, 1992
3.	Basics of Structural Dynamics and Aseismic Design	Damodarasamy and Kavitha	—	PHI Publishers, New Delhi

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