KPR Institute of Engineering and Technology

Learn Beyond

(Autonomous | Affiliated to Anna University)

POSTGRADUATE PROGRAMMES

CURRICULUM AND SYLLABI

PROGRAMME

M.E. | Structural Engineering

REGULATIONS

2026

CONTROLLED COPY

I. Vision and Mission of the Institute

Vision

To become a premier institute of academic excellence by imparting technical, intellectual and professional skills to students for meeting the diverse needs of industry, society, the nation and the world at large

Mission

- Commitment to offer value-based education and enhancement of practical skills
- Continuous assessment of teaching and learning processes through scholarly activities
- Enriching research and innovation activities in collaboration with industry and institutes of repute
- Ensuring the academic processes to uphold culture, ethics and social responsibilities

II. Vision and Mission of the Department

Vision

To be recognised in Civil Engineering through quality education, research and innovation for the sustainable developments of the society

Mission

The mission of the department is to

- Provide holistic education to students on emerging technologies in Civil Engineering
- Promote research and consultancy activities
- Instill in individuals a sense of ethical values and lifelong learning

III. Program Educational Objectives (PEOs)

The Program Educational Objectives (PEOs) of the STRUCTURAL ENGINEERING (SE) represent major accomplishments that the graduates are expected to achieve after two years of graduation.

PEO1: Graduates will excel in professional careers as structural engineers, consultants, and researchers, applying advanced knowledge of analysis, design, and modern computational tools to solve complex real-world structural engineering problems.

PEO2: Graduates will secure and advance in positions of growing responsibility in construction, consulting, and infrastructure industries, establish independent practices or lead technical teams as structural engineering professionals.

PEO3: Graduates will demonstrate professional and ethical responsibility, effective communication, and leadership in multidisciplinary teams, while engaging in lifelong learning to adapt to evolving technologies and industry practices.

IV. Program Outcomes (POs)

Graduates of the STRUCTURAL ENGINEERING will be able to

PO1: An ability to independently carry out research/investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate a high degree of proficiency and mastery in structural engineering

PO4: Analyze and design advanced structural systems, including reinforced concrete, steel, composite, and prestressed concrete structures, for strength, serviceability, and code compliance under complex loading conditions

PO5: Apply computational and analytical models to optimize the behavior and performance of structural systems for real-world engineering challenges.

PO6: Conduct independent research on structural performance, dynamics, rehabilitation, and structural health monitoring, incorporating sustainability and life-cycle considerations to develop safe and resilient infrastructure

V. PEO / PO Mapping

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Following three levels of correlation should be used:

1: Low

2: Medium

3: High

Particular	PO1	PO2	PO3
PEO 1	3	2	3
PEO 2	2	2	3
PEO 3	3	3	1

VI. Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Sem	Course Title	PO1	PO2	PO3	PO4	PO5	PO6
I	Computational Methods For Structural Analysis	✓	✓	✓	✓	✓	✓
	Advanced Reinforced Concrete Structures	✓	✓	✓	✓	✓	✓
	Theory of Elasticity and Plasticity	✓	✓	✓	✓	✓	✓
	Research Methodology and IPR	✓	✓	-	-	-	✓
	Structural Design Studio	✓	✓	✓	✓	✓	✓

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STRUCTURAL ENGINEERING

Regulation 2026

For the students admitted from 2026 onwards

CHOICE BASED CREDIT SYSTEM

CURRICULUM FOR I - IV SEMESTERS

SEMESTER I

No	Course Code	Title	Category	Type	L	T	P	J	C
1	P26MA102	Computational Methods For Structural Analysis	FC	TwL	3	-	2	-	4
2	P26ST101	Advanced Reinforced Concrete Structures	PCC	T	3	-	-	-	3
3	P26ST102	Theory of Elasticity and Plasticity	PCC	T	3	-	-	-	3
4	P26RMC01	Research Methodology and IPR	RMC	T	3	-	-	-	3
5	P26ST103	Structural Design Studio	PCC	L	-	-	4	-	2
6	-	Professional Elective - I	PEC	T	3	-	-	-	3
Total									18

T - Theory, **L** - Laboratory, **TwL** - Theory with Laboratory, **TwP** - Theory with Project

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PROFESSIONAL ELECTIVES COURSES (PEC)

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	P26STP01	Maintenance and Rehabilitation of Structures	PEC	3	0	0	3
2	P26STP02	Advanced Prestressed Concrete Design	PEC	3	0	0	3
3	P26STP03	Earthquake Resistant Design of Structures	PEC	3	0	0	3
4	P26STP04	Advanced Prefabricated Structures	PEC	3	0	0	3
5	P26STP05	Offshore Structures	PEC	3	0	0	3

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SEMESTER I

		Category: FC				
P26MA102	Computational Methods For Structural Analysis	L	T	P	J	C
		3	0	2	0	4

QP PATTERN: B

COURSE OBJECTIVES:

- To introduce matrix methods for analysis of indeterminate structures
- To develop numerical methods for solving structural engineering problems
- To provide knowledge of optimization techniques and finite element analysis for structural design

COURSE OUTCOMES:

CO 1:	Apply matrix methods (flexibility, stiffness) for analysis of indeterminate structures	Apply
CO 2:	Implement numerical methods (FDM, numerical integration) for solving structural problems using MATLAB	Apply
CO 3:	Formulate and solve optimization problems for structural design using KKT conditions	Apply
CO 4:	Perform finite element analysis of 1D and 2D structural elements using computational tools	Apply
CO 5:	Validate simulation results by comparing with codal provisions (IS 456 / IS 800)	Apply

CO - PO MAPPING:

Particular	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	3	3	2	3	1
CO 2	3	3	3	2	3	1
CO 3	3	3	3	2	3	1
CO 4	3	3	3	2	3	1
CO 5	3	3	3	2	3	1

SYLLABUS:

UNIT I: MATRIX METHODS 9 + 6

Stiffness method – Element stiffness matrices (truss, beam) – Assembly of global stiffness matrix – Boundary conditions – Solution for displacements and forces

UNIT II: NUMERICAL METHODS 9 + 6

Finite difference method for beams – Numerical integration - Gauss-Legendre quadrature, Newton-Cotes formulas, Simpson's rule – Application to deflection problems

UNIT III: STRUCTURAL OPTIMIZATION 9 + 6

Weight minimization, Cost minimization, Stiffness maximization – Stress, displacement, buckling, natural frequency constraints – Linear Programming Problem (LPP) – KKT conditions

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UNIT IV: FINITE ELEMENT METHOD **9 + 6**

1D and 2D elements – Shape functions – Isoparametric formulation – Application to truss and beam elements

UNIT V: SIMULATION & VALIDATION **9 + 6**

Introduction to simulation tool (MATLAB) – Modeling RC/steel structures – Result validation with IS 456 & IS 800

LIST OF EXPERIMENTS

1. Matrix Stiffness Method – 2D truss analysis Structural Application: Analysis of indeterminate trusses • Form element stiffness matrices and assemble global matrix. • Apply boundary conditions and compute displacements/forces
2. Finite Difference Method – Beam Deflection Structural Application: Simply supported & cantilever beams • Discretize beam and apply finite difference approximations. • Solve for deflections and compare with analytical solutions.
3. Structural Optimization – Truss Weight Minimization Structural Application: Minimum weight design of steel truss • Formulate objective, constraints, and apply KKT conditions. • Find optimal member areas and check constraints.
4. Finite Element Analysis – 2D Plane Stress Problem Structural Application: Stress concentration in a plate with hole • Create mesh, compute stiffness matrices, solve for displacements. • Plot stress contours and identify concentration zones.
5. Validation with IS Codes – RC Beam / Steel Column Structural Application: Design verification as per codal provisions • Simulate RC beam and validate moment capacity with IS 456. • Simulate steel column and validate axial capacity with IS 800.

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:** - Periods **Practical:** 30 Periods **Project:** - Periods **Total:** 75 Periods

TEXTBOOKS:

1. Suchart Limkatanyu, "Matrix Analysis of Frame Structures - A Modern Approach", CRC Press, 2025
2. J.N. Reddy, "Computational Methods in Engineering: Finite Difference, Finite Volume, Finite Element, and Dual Mesh Control Domain Methods", CRC Press, 2024
3. J. S. Arora, "Introduction to Optimum Design", 4th Edition, Academic Press, 2016
4. J. N. Reddy, "Introduction to the Finite Element Method", 4th Edition, McGraw-Hill, 2018

REFERENCES:

1. S.S. Bhavikatti, Mamata B Mogali, "Matrix Methods of Structural Analysis", I.K. International, 2023
2. T Chandrupatla, A Belegundu, "Introduction to Finite Elements in Engineering", 5th edition, Cambridge University Press, 2021
3. S. S. Rao, "Engineering Optimization: Theory and Practice", 5th Edition, Wiley, 2019
4. Roberto Andreani, Alberto Ramos, and Leonardo D. Secchin, "Improving the Global Convergence of Inexact Restoration Methods for Constrained Optimization Problems", SIAM Journal on Optimization 2024 34:4, 3429-3455, https://doi.org/10.1137/22M1493811

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SEMESTER I

		Category: PCC				
P26ST101	Advanced Reinforced Concrete Structures	L	T	P	J	C
		3	0	0	0	3

QP PATTERN: B

COURSE OBJECTIVES:

- To understand advanced serviceability and design concepts in reinforced concrete structures.
- To examine the behaviour of special structural elements such as deep beams, flat slabs, and pipes.
- To apply design principles for complex reinforced concrete structures under various loading conditions.

COURSE OUTCOMES:

CO 1:	Determine deflection behaviour and crack width in reinforced concrete members.	Apply
CO 2:	Employ design concepts for deep beams and ribbed slab systems.	Apply
CO 3:	Apply analysis and design methods for flat slabs and yield line theory in slabs.	Apply
CO 4:	Utilize design principles for reinforced concrete pipes under different loading conditions.	Apply
CO 5:	Implement design procedures for bunkers, silos, and chimneys	Apply

CO - PO MAPPING:

Particular	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	3	3	2	3	1
CO 2	3	3	3	2	3	1
CO 3	3	3	3	2	3	1
CO 4	3	3	3	2	3	1
CO 5	3	3	3	2	3	1

SYLLABUS:

UNIT I: DEFLECTION AND CRACK WIDTH 9

Introduction – Short-term deflection due to applied loads – Calculation of deflection – Long-term deflection – Deflection of continuous, cantilever beams and slabs. Factors affecting crack width – Mechanism – Estimation of crack width in beams

UNIT II: DEEP BEAMS AND RIBBED SLABS 9

Minimum thickness – Checking for local failure – Design of deep beams. Specification of ribbed slab – Analysis of the slabs for moment and shear – Design of waffle slabs

UNIT III: FLAT SLABS AND YIELD LINE ANALYSIS OF SLABS 9

Types – Panel Divisions – Methods – Design of the interior panel of a flat slab. Characteristics of yield line – Methods – Analysis and design of slab by virtual work method

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UNIT IV: RCC PIPES 9

Classification of R.C.C pipes – Principle – Reinforcement in pipes – Test on pipes – Design of pipes – Design of Non-pressure R.C.C pipes for culverts

UNIT V: BUNKERS, SILOS AND CHIMNEY 9

Introduction – Difference between bunker and silo – Design of square, rectangular and circular bunkers. Parts of chimneys – Analysis of R.C chimney.

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:** - Periods **Practical:** - Periods **Project:** - Periods **Total:** 45 Periods

TEXTBOOKS:

1. P.C. Varghese, "Limit State Design of Reinforced Concrete", 3rd edition, Prentice Hall of India Pvt. New Delhi, 2016
2. B. C. Punmia, Ashok K. Jain and Arun K. Jain, "Limit State Design of Reinforced Concrete", 4th edition, Laxmi Publications, New Delhi, 2021

REFERENCES:

1. N. Subramanian, "Design of Reinforced Concrete Structures", 4th edition, Oxford University Press, New Delhi, 2019
2. Pillai S. U. and Menon D., "Reinforced Concrete Design", 4th edition, McGraw Hill Education, New Delhi, 2019
3. IS 456: 2000, "Plain and Reinforced Concrete - Code of Practice", latest reaffirmed version with amendments, Bureau of Indian Standards, New Delhi
4. IS 2210: 2018, "Criteria for Design of Reinforced Concrete Shell Structures and Folded Plates", Bureau of Indian Standards

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SEMESTER I

		Category: PCC				
P26ST102	Theory of Elasticity and Plasticity	L	T	P	J	C
		3	0	0	0	3

QP PATTERN: B

COURSE OBJECTIVES:

- To impart knowledge of stress and strain analysis in elastic solids
- To introduce analytical approaches for the torsion of non-circular and thin-walled sections
- To provide an understanding of yield criteria and the elastic–plastic behaviour of structural members

COURSE OUTCOMES:

CO 1: Examine the state of stress and strain in elastic solids using equilibrium equations, compatibility conditions and generalized Hooke's law — **Analyze**

CO 2: Distinguish plane stress and plane strain behaviour in two-dimensional elasticity problems in Cartesian and polar coordinates using stress–strain transformations and stress invariants — **Analyze**

CO 3: Apply St. Venant's and Prandtl's approaches and the membrane analogy to solve torsion problems of non-circular and thin-walled sections — **Apply**

CO 4: Deduce solutions to elasticity problems using strain energy principles, virtual work, Rayleigh–Ritz and finite difference methods — **Analyze**

CO 5: Investigate the elastic–plastic behaviour of members in bending, torsion and thick cylinders using yield criteria and plastic stress–strain relationships — **Analyze**

CO - PO MAPPING:

Particular	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	3	3	3	2	2
CO 2	3	3	3	3	2	2
CO 3	3	3	3	2	1	1
CO 4	3	3	3	3	2	2
CO 5	3	3	3	3	2	2

SYLLABUS:

UNIT I: ELASTICITY — **9**

Analysis of stress and strain – Equilibrium equations – Compatibility equations – Stress–strain relationships – Generalized Hooke's law

UNIT II: 2D STRESS STRAIN PROBLEMS — **9**

Plane stress and plane strain – Simple two-dimensional problems in Cartesian and polar coordinates – Stress–strain transformation – Stress invariants

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UNIT III: TORSION OF NON-CIRCULAR SECTION 9

Torsion of rectangular bars including hollow sections – Solution with St. Venant's approach and Prandtl's approach – Membrane analogy – Torsion of thin-walled open and closed sections

UNIT IV: ENERGY METHODS 9

Strain energy – Principle of virtual work – Energy theorems – Rayleigh-Ritz method – Finite difference method – Application to elasticity problems

UNIT V: PLASTICITY 9

Physical assumptions – Yield criteria – Plastic stress–strain relationships – Elastic-plastic problems in bending, torsion and thick cylinders

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:** - Periods **Practical:** - Periods **Project:** - Periods **Total:** 45 Periods

TEXTBOOKS:

1. Sadd M. H., "Elasticity: Theory, Applications, and Numerics", 3rd Edition, Academic Press, 2018
2. Boresi A. P., Schmidt R. J. and Sidebottom O. M., "Advanced Mechanics of Materials", 7th Edition, Wiley, 2018

REFERENCES:

1. Ansel C. Ugural and Saul K. Fenster, "Advanced Strength and Applied Elasticity", 4th Edition, Pearson, 2011
2. Sadhu Singh, "Theory of Elasticity", 4th Edition, Dhanpat Rai Sons Private Limited, New Delhi, 2013
3. Chakrabarty J., "Theory of Plasticity", 3rd Edition, Elsevier Butterworth-Heinemann, 2007
4. S. Timoshenko and J. N. Goodier, "Theory of Elasticity", 3rd Edition, McGraw Hill, 2017
5. Hibbeler R. C., "Mechanics of Materials", 10th Edition, Pearson, 2020

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SEMESTER I

		Category: RMC				
P26RMC01	Research Methodology and IPR (Common to CAD, DS, ES, PCS, PHDCE, PHDIC, PHDME, PHDSH, SE, VL)	L	T	P	J	C
		3	0	0	0	3

QP PATTERN: B

COURSE OBJECTIVES:

- To impart knowledge in problem formulation, analysis and solutions
- To impart skills required for technical paper writing / presentation without violating professional ethics
- To familiarize knowledge on patent drafting and filing patents

COURSE OUTCOMES:

CO 1: Apply the principles of research problem formulation to identify, define, and investigate engineering research problems using appropriate data collection and analysis techniques — **Apply**

CO 2: Analyze research literature, data collection methods, research ethics, and plagiarism issues to identify research gaps and select suitable methodologies — **Analyze**

CO 3: Evaluate the quality of technical reports, research papers, and research proposals by applying standard scientific writing and presentation practice — **Evaluate**

CO 4: Apply the principles and procedures of Intellectual Property Rights (IPR), including patents, patent filing, and international patenting systems, to protect technological innovation — **Apply**

CO 5: Evaluate patent rights, technology transfer mechanisms, patent databases, geographical indications, and emerging developments in Intellectual Property Rights for engineering and research applications — **Evaluate**

CO - PO MAPPING:

Particular	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	-	-	-	-	-
CO 2	3	-	-	-	-	-
CO 3	3	3	-	-	-	-
CO 4	-	3	-	-	-	2
CO 5	-	3	-	-	-	2

SYLLABUS:

UNIT I: RESEARCH PROBLEM FORMULATION — 9

Meaning of research problem – Sources of research problem – Criteria characteristics of a good research problem – Errors in selecting a research problem – Scope and objectives of research problem. Approaches of investigation of solutions for research problem – Data collection – Analysis – Interpretation – Necessary instrumentations

UNIT II: LITERATURE REVIEW AND DATA COLLECTION — 9

Effective literature studies approaches – Analysis – Plagiarism and research ethics. Method of data collection – Types of data – Primary Data – Scales of measurement – Source and collection of data observation method – Secondary data

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UNIT III: TECHNICAL WRITING / PRESENTATION 9

Effective technical writing: How to write report – Paper – Developing a research proposal – Format of research proposal – Presentation and assessment by a review committee

UNIT IV: INTRODUCTION TO INTELLECTUALPROPERTY RIGHTS 9

Nature of Intellectual Property: Patents – Designs – Trade and Copyright. Process of Patenting and Development – technological research – Innovation – Patenting – Development – International Scenario – International cooperation on Intellectual Property – Procedure for grants of patents – Patenting under PCT

UNIT V: INTELLECTUAL PROPERTYRIGHTS 9

Patent Rights: Scope of Patent Rights – Licensing and transfer of technology – Patent information and databases – Geographical Indications – New Developments in IPR – Administration of Patent System – IPR of Biological Systems – Computer Software etc.

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:** - Periods **Practical:** - Periods **Project:** - Periods **Total:** 45 Periods

REFERENCES:

1. Cooper, DR and Schindler, P S., "Business Research Methods", 9th edition, Tata McGraw Hill, 2014
2. Robert P.Merges, Peter S, Menell, Mark A.Lemley, "Intellectual Property in New Technological age", Volume I, Clause 8 Publishing,2022
3. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners", 3rd edition, Sage Publications,2010

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SEMESTER I

		Category: PCC				
P26ST103	Structural Design Studio	L	T	P	J	C
		0	0	4	0	2

QP PATTERN: B

COURSE OBJECTIVES:

- To design a structure using modern software tools like ETABS/ STAAD / STRAP
- To use standard codes, computational tools and software packages for analyzing, designing and detailing a structure.

COURSE OUTCOMES:

CO 1:	Develop structural models using appropriate software tools for analysis	**Apply**
CO 2:	Calculate loads and load combinations as per relevant standards using appropriate computational tools	**Apply**
CO 3:	Design structural elements and connections as per codal provisions	**Apply**
CO 4:	Analyze the structural safety performance for design optimization	**Analyze**
CO 5:	Prepare detailed structural drawings and reports in accordance with codal provisions	**Apply**

CO - PO MAPPING:

Particular	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	3	3	2	3	3
CO 2	3	3	3	2	3	3
CO 3	3	3	3	2	3	3
CO 4	3	3	3	3	3	3
CO 5	3	3	3	2	3	3

SYLLABUS:

LIST OF EXPERIMENTS

1. Prepare a design basis report for a project.
2. Develop a model of a structure for analysis.
3. Calculate and apply the loads on the structure as per relevant standards
4. Analyse and Design the structural elements and connections as per relevant standards
5. Check for safety and optimization
6. Prepare a detail structural drawing and report

CONTACT PERIODS:

Lecture: - Periods **Tutorial:** - Periods **Practical:** 60 Periods **Project:** - Periods **Total:** 60 Periods

REFERENCES:

1. 1. Gambhir.M.L., "Design of Reinforced Concrete Structures", 4th edition, Prentice Hall of India, New Delhi, 2016
2. Subramanian.N, "Design of Steel Structures", 2nd edition, Oxford University Press, 2016.
3. E – Resources: Open source structural analysis and design software / student versions.

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PROFESSIONAL ELECTIVE COURSES

P26STP01	Maintenance and Rehabilitation of Structures (Common to PHDCE, SE)	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

QP PATTERN: B

COURSE OBJECTIVES:

- To understand the causes and mechanisms of deterioration in concrete structures.
- To examine inspection and evaluation techniques for distressed structures.
- To apply suitable repair and rehabilitation methods for structural improvement.

COURSE OUTCOMES:

CO 1:	Determine the causes and types of deterioration in concrete structures for suitable repair selection	**Apply**
CO 2:	identify the methods for inspecting and evaluating damaged structures.	**Apply**
CO 3:	Select appropriate materials to repair concrete structures.	**Apply**
CO 4:	Employ repair and strengthening techniques for rehabilitating distressed structures.	**Apply**
CO 5:	Implement maintenance strategies to improve the durability and service life of structures.	**Apply**

CO - PO MAPPING:

Particular	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	3	3	2	1	1
CO 2	3	3	3	2	1	1
CO 3	3	3	3	2	1	1
CO 4	3	3	3	2	1	1
CO 5	3	3	3	2	1	1

SYLLABUS:

UNIT I: CAUSES AND TYPES OF DETERIORATION 9

Causes of deterioration in concrete structures – Physical causes such as temperature variation, shrinkage and creep – Chemical causes including sulphate attack and carbonation – Corrosion of reinforcement and its stages – Types of cracks and their classification – Spalling, scaling and surface defects – Influence of environmental exposure on deterioration of concrete.

UNIT II: INSPECTION AND EVALUATION OF STRUCTURES 9

Preliminary investigation and data collection – Visual inspection techniques and identification of defects – Detailed investigation methods – Non-destructive testing methods for concrete – Core sampling and testing – Assessment of structural condition – Evaluation of extent and severity of damage in structural members.

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UNIT III: REPAIR MATERIALS 9

Types of repair materials – Cement-based repair materials and their properties – Polymer-modified mortars – Epoxy resins and their characteristics – Grouting materials and applications – Criteria for selection of suitable repair materials – Compatibility of repair materials with existing concrete.

UNIT IV: REPAIR TECHNIQUES 9

Importance of surface preparation – Methods of crack repair such as sealing, routing and injection – Grouting techniques and applications – Shotcrete and guniting methods – Repair of spalled and damaged concrete – Bonding techniques between old and new concrete – Precautions during repair works.

UNIT V: REHABILITATION AND MAINTENANCE 9

Concept of structural rehabilitation – Strengthening techniques for reinforced concrete members – Jacketing of beams and columns – Plate bonding methods – Rehabilitation procedures for damaged structures – Preventive maintenance techniques – Measures for improving durability and extending service life of structures.

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:** - Periods **Practical:** - Periods **Project:** - Periods **Total:** 45 Periods

TEXTBOOKS:

1. B. Vidivelli, "Rehabilitation of Concrete Structures", Reprint edition, Tata McGraw-Hill Education, New Delhi, 2018
2. P. C. Varghese, "Maintenance, Repair and Rehabilitation and Minor Works of Buildings", 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2016

REFERENCES:

1. P. K. Guha, "Maintenance and Repairs of Buildings", latest edition, New Central Book Agency, Kolkata, 2018
2. G. Nandini Devi, "Maintenance, Repair, Rehabilitation and Retrofitting of Structures", 1st edition, Techsar Pvt. Ltd., 2021
3. ACI Committee 546, "Concrete Repair Guide", latest revision, American Concrete Institute
4. IS 15988: 2013, "Seismic Evaluation and Strengthening of Existing Reinforced Concrete Buildings", Bureau of Indian Standards

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PROFESSIONAL ELECTIVE COURSES

		Category: PEC				
P26STP02	Advanced Prestressed Concrete Design	L	T	P	J	C
		3	0	0	0	3

QP PATTERN: B

PRE-REQUISITES:

- P26ST101 - Advanced Reinforced Concrete Structures

COURSE OBJECTIVES:

- To develop an understanding of the philosophy of design of prestressed concrete
- To be able to design indeterminate prestressed concrete structure
- To design the various prestressed concrete structures

COURSE OUTCOMES:

CO 1:	Identify the various methods of prestressing and estimate the loss	**Apply**
CO 2:	Design the beams for flexure, shear, bond and torsion	**Analyze**
CO 3:	Analyze and design the continuous beams and composite beams	**Analyze**
CO 4:	Design the water tank, piles and masts	**Analyze**
CO 5:	Analyze and design the prestressed concrete bridge	**Analyze**

CO - PO MAPPING:

Particular	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	3	3	2	3	1
CO 2	3	3	3	3	3	2
CO 3	3	3	3	3	3	2
CO 4	3	3	3	3	3	2
CO 5	3	3	3	3	3	2

SYLLABUS:

UNIT I: INTRODUCTION 9

Concepts of Prestressing – Materials and methods of prestressing – Design philosophy – Analysis methods, Time-dependent deformation of concrete and losses of prestress – High Strength Concrete and High Tensile Steel for prestressing – Sustainability in prestressed concrete.

UNIT II: DESIGN FOR FLEXURE, SHEAR AND TORSION 9

Behaviour of flexural members, Determination of ultimate flexural strength using IS 1343:2012 and international codal provisions – Design for Flexure, Shear, torsion and bond of pre-stressed concrete elements – Transfer of prestress – Deflection and crack control – Serviceability and durability

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UNIT III: DESIGN OF CONTINUOUS AND COMPOSITE BEAMS 9

Statically indeterminate structures – Analysis and design of continuous beams and frames – Choice of cable profile – Methods of achieving continuity – Concept of linear transformations, concordant cable profile and gap cables – Composite sections of prestressed concrete beam and cast in situ RC slab – Design of composite sections – Partial prestressing – Limit State design of partially prestressed concrete beams

UNIT IV: DESIGN OF TENSION AND COMPRESSION MEMBERS

Prestressed concrete compression and tension members – Application in the design of prestressed pipes and prestressed concrete cylindrical water tanks – Design of compression members with and without flexure – Design of Piles and flagmasts – Two way pre-stressed concrete floor systems – Connections for pre-stressed concrete elements

UNIT V: DESIGN OF PRESTRESSED CONCRETE BRIDGES 9

Review of IRC and IRS loadings – Effect of concentrated loads on deck slabs, load distribution methods for concrete bridges – Analysis and Design of superstructures – Design of prestressed concrete bridges incorporating long-term effects like creep, shrinkage, relaxation, and temperature effects – Dynamic response of bridge decks – BIM and digital tools in bridge design.

CONTACT PERIODS:

Lecture: 36 Periods **Tutorial:** - Periods **Practical:** - Periods **Project:** - Periods **Total:** 36 Periods

TEXTBOOKS:

1. Krishna Raju, N., "Prestressed Concrete", Tata McGraw Hill Publishing Co., New Delhi, 6th Edition, 2025
2. Pillai, S.U. and Menon, D., "Reinforced Concrete Design", Tata McGraw Hill Publishing Co., New Delhi, 3rd Edition, 2017

REFERENCES:

1. Lin, T.Y. and Burns, H., "Design of Prestressed Concrete Structures", John Wiley and Sons Inc., 3rd Edition, 2010
2. Nilson, A.H., "Design of Prestressed Concrete", John Wiley and Sons Inc., New York, 2nd Edition, 2004
3. Rajagopalan, N., "Prestressed Concrete", Narosa Publications, New Delhi, 2nd Edition, 2014
4. Nawy, E.G., "Prestressed Concrete: A Fundamental Approach", Prentice Hall, 5th Edition, 2022

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PROFESSIONAL ELECTIVE COURSES

		Category: PEC				
P26STP03	Earthquake Resistant Design of Structures	L	T	P	J	C
		3	0	0	0	3

QP PATTERN: B

COURSE OBJECTIVES:

- To solve the equation of motion for single and multi-degree of freedom system
- To understand the basics of Earthquake Engineering
- To design the structures subjected to seismic forces

COURSE OUTCOMES:

CO 1:	Solve the equation of motion for single degree of freedom system	**Apply**
CO 2:	Compute the equation of motion of Multi degree of freedom with free vibration	**Apply**
CO 3:	Analyze the response of structures subjected to earthquake ground motions using response spectra and time-history analysis	**Analyze**
CO 4:	Employ earthquake and vibration concepts to determine structural response under dynamic loading	**Apply**
CO 5:	Design earthquake-resistant masonry and reinforced concrete structures by applying ductile detailing	**Apply**

CO - PO MAPPING:

Particular	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	3	3	2	3	1
CO 2	3	3	3	2	3	1
CO 3	3	3	3	3	3	2
CO 4	3	3	3	2	3	1
CO 5	3	3	3	2	3	1

SYLLABUS:

UNIT I: DYNAMIC RESPONSE OF SINGLE DEGREE OF FREEDOM SYSTEM 9

Mathematical models of single degree of freedom systems – Free and forced vibration of SDOF systems – Response of SDOF to special forms of excitation – Effect of damping – Evaluation of damping – Transmissibility – Duhamel integral – Fourier transform of non-harmonic forces

UNIT II: FREE VIBRATION OF MULTI-DEGREE OF FREEDOM SYSTEMS 9

Mathematical models of two degree of freedom systems and multi-degree of freedom systems –Free vibrations – Damped and undamped systems – Normal modes of vibration – Orthogonality of normal modes – Applications

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UNIT III: FORCED VIBRATION OF MULTI - DEGREE OF FREEDOM SYSTEMS 9

Forced vibrations of multi-degree of freedom systems – Damped and Undamped – Rayleigh-Ritz method – Mode superposition technique – Vibration control – Tuned mass damper – Introduction to distributed mass system – Response spectrum analysis – Time-history analysis of structural systems

UNIT IV: EARTHQUAKE GROUND MOTION AND ITS EFFECTS ON STRUCTURES 9

Plate tectonics, Engineering Seismology – Seismic waves and characteristics, Earthquake Monitoring and Seismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation of Earthquake Parameters, Microzonation. Effect of Earthquake on Different Types of Structures – Lessons Learnt from Past Earthquakes – Seismic Zoning of India – Evaluation of Earthquake Forces as per codal provisions – Response Spectra, Design Spectra

UNIT V: EARTHQUAKE RESISTANT DESIGN OF MASONRY AND RC STRUCTURES 9

Structural Systems, Types of Buildings – Causes of damage, Planning Considerations, effect of material of construction on the performance of structures, Lateral load analysis of structures – Earthquake Resistant Design of structural and non-structural elements – Earthquake Resistant Design of Masonry Buildings and R.C.C. Buildings, Ductile detailing.

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:** - Periods **Practical:** - Periods **Project:** - Periods **Total:** 45 Periods

TEXTBOOKS:

1. Chopra A.K., "Dynamics of Structures", 5th edition, N J Pearson Education Inc., 2020.
2. Duggal S.K., "Earthquake Resistant Design of Structures", 2nd edition, Prentice Hall of India, New Delhi, 2013.

REFERENCES:

1. Paz, M , "Structural dynamics Theory and computation", Kluwer Academic Publishers, 2006
2. Craig, R. R., Jr. Kurdila, A. J, "Fundamentals of structural dynamics", John Wiley & Sons, 2011
3. Mukhopadhyay, M., "Structural Dynamics", 1st edition, Ane Books, India, 2006
4. Brebbia C. A., "Earthquake Resistant Engineering Structures VIII", WIT Press, 2015

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PROFESSIONAL ELECTIVE COURSES

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		Category: PEC				
P26STP04	Advanced Prefabricated Structures	L	T	P	J	C
		3	0	0	0	3

QP PATTERN: B

COURSE OBJECTIVES:

- To understand the design principles of prefabricated structures
- To analyze the RC prefabricated floors, stairs and roofs
- To design Industrial building and shell roofs

COURSE OUTCOMES:

CO 1:	Identify the principles and processes involved in planning, production and erection	**Apply**
CO 2:	Examine the behaviour and detailing of joints and connections in prefabricated structural members	**Apply**
CO 3:	Develop suitable designs for prefabricated floors, stairs and roofs considering strength and deflection requirements.	**Apply**
CO 4:	Interpret the behaviour and design requirements of prefabricated wall systems under various loading conditions.	**Apply**
CO 5:	Assess the structural components, erection and jointing systems of prefabricated industrial buildings and shell roofs	**Analyze**

CO - PO MAPPING:

Particular	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	3	3	2	-	2
CO 2	3	3	3	2	3	3
CO 3	3	3	3	2	3	3
CO 4	3	3	3	2	3	2
CO 5	3	3	3	3	3	3

SYLLABUS:

UNIT I: DESIGN PRINCIPLES **9**

Specific requirements for planning and layout of prefabrication plant – IS Code specifications – Detailed study on IS 15916:2020 – Modular coordination – Standardization – Disuniting of Prefabricates – Production – Transportation – Erection – Stages of loading and code provisions – Safety factors – Material properties – Deflection control – Lateral load resistance – Location and types of shear walls

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UNIT II: JOINTS AND CONNECTIONS IN STRUCTURAL MEMBER 9

Prefabricated structures – One way and two-way prefabricated slabs – Connections – Beam to column and column to column – Types of joints – Based on action of forces – Compression joints – Shear joints – Tension joints – Based on function – Construction, contraction and expansion – Design of expansion joints – Dimensions and detailing – Types of sealants – Types of structural connections.

UNIT III: FLOORS, STAIRS AND ROOFS

Types of floor slabs – Hollow core slab system – Analysis – Design example of cored and panel types – Two-way systems – Staircase: slab design – Types of roof slabs and insulation requirements – Description of joints – Behaviour and reinforcement requirements – Deflection control for short term and long-term loads – Ultimate strength calculations in shear and flexure

UNIT IV: WALLS 9

Types of wall panels – Long wall and cross-wall large panel buildings – Blocks and large panels – Curtain – Partition and load bearing walls – Load transfer from floor to wall panels – Framed buildings with partial and curtain walls – Vertical loads – Eccentricity and stability of wall panels – Design curves – Types of wall joints – Curve behaviour and design – Leak prevention – Joint sealants – Sandwich wall panels – Approximate design of shear walls

UNIT V: INDUSTRIAL BUILDINGS AND SHELL ROOFS 9

Components of single storey – Industrial sheds with large gantry systems – R.C. Roof Trusses – Roof Panels – Corbels and Columns – Wind bracing design – Cylindrical – Folded plate and Hyper prefabricated shells – Erection and jointing – Joint design – Handbook-based design

CONTACT PERIODS:

Lecture: 36 Periods **Tutorial:** - Periods **Practical:** - Periods **Project:** - Periods **Total:** 36 Periods

TEXTBOOKS:

1. Kims S. Elliot, "Precast Concrete Structures", 3rd edition, CRC Press, Taylor & Francis, 2017.
2. Hubert Bachmann, Alfred Steinle, "Precast Concrete Structures", 2nd edition, Ernst & Sohn, Wiley Publication, 2015.

REFERENCES:

1. Ryan E. Smith, "Prefab Architecture: A Guide to Modular Design and Construction", 2nd edition, John Wiley and Sons Inc., London, 2010.
2. Handbook of Precast Concrete Buildings, ICI Publications, 2016.
3. Laszlo Mokk, "Prefabricated Concrete for Industrial and Public Structures", 3rd edition, Academia Kiado, Budapest, 2007.

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PROFESSIONAL ELECTIVE COURSES

		Category: PEC				
P26STP05	Offshore Structures	L	T	P	J	C
		3	0	0	0	3

QP PATTERN: B

COURSE OBJECTIVES:

- To learn the types and functions of offshore structure
- To analyze and design the offshore structures under environmental and operational loads
- To design offshore structures as per Indian codal provisions

COURSE OUTCOMES:

CO 1:	Identify the types and functions of offshore structures	**Apply**
CO 2:	Evaluate loads on offshore structures including wave, wind, current, ice and accidental loads using Morrison's Equation	**Analyze**
CO 3:	Apply various wave theories to estimate wave kinematics and pressure distribution on offshore members	**Apply**
CO 4:	Analyze the offshore structures subjected to static and dynamic loads	**Analyze**
CO 5:	Design Offshore structures like Platform, Helipads, Jackets and Towers	**Apply**

CO - PO MAPPING:

Particular	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	3	3	2	2	1
CO 2	3	3	3	3	3	2
CO 3	3	3	3	2	3	1
CO 4	3	3	3	3	3	2
CO 5	3	3	3	2	3	1

SYLLABUS:

UNIT I: INTRODUCTION 9

Types of Offshore Structures – Types of Offshore Platforms – Functions of Offshore Structures – Components of a Typical Offshore Structure – Overview of Indian Offshore Oil and Gas Infrastructure (ONGC, Reliance) – Regulatory Bodies: DGMS, API, DNV-GL

UNIT II: LOADS ON OFFSHORE STRUCTURES 9

Wave forces on Structures – Environmental Loadings – Use of Morrison Equation – Diffraction Theory

UNIT III: WAVE THEORIES 9

Wave Generation and Propagation – Small and Finite amplitude wave theories – Wave Energy and Pressure distribution – Application to offshore structural loading.

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UNIT IV: ANALYSIS OF OFFSHORE STRUCTURES 9

Foundation Modelling – Pile-Soil Interaction – Static method of analysis – Dynamics of Offshore structures – Software: SACS, SESAM, ANSYS.

UNIT V: DESIGN OF OFFSHORE STRUCTURES 9

Design of Platforms – Derricks – Helipads – Design Principles and examples of Jacket tower – Mooring Cables – Pipelines – Corrosion Protection: Cathodic Protection, Coatings – Inspection, Maintenance and Decommissioning of Offshore Structures

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial:** - Periods **Practical:** - Periods **Project:** - Periods **Total:** 45 Periods

TEXTBOOKS:

1. Reddy, D.V. and Swamidas, A.S.J., "Essentials of Offshore Structures – Framed and Gravity Platforms", CRC Press, 2nd Edition, 2022.
2. El-Reedy, M.A., "Offshore Structures: Design, Construction and Maintenance", Gulf Professional Publishing, 2nd Edition, 2020.

REFERENCES:

1. Clauss, G., Lehmann, E., Ostergaard, C, "Offshore Structures Vol. I: Conceptual Design and Hydromechanics", Springer-Verlag, 2012.
2. Sarpkaya, T., "Wave Forces on Offshore Structures", Cambridge University Press, 2010.
3. API RP 2A-WSD, "Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms – Working Stress Design", 22nd Edition, API, 2014.
4. DNV-GL OS-C101, "Design of Offshore Steel Structures", Det Norske Veritas, 2021.
5. IS 4651 (Parts 1–5), "Code of Practice for Planning and Design of Ports and Harbours", BIS, New Delhi.

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