GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Civil (Structural Engineering)

Course / Subject Code: **ME01000051**

Course / Subject Name: Advanced Design of Reinforced Concrete Structures

w. e. f. Academic Year:	2024-25
Semester:	1st Semester
Category of the Course:	PCC

Prerequisite:	Basic course on design of reinforced concrete structures and concrete technology
Rationale:	This course is a comprehensive course on advanced design of reinforced concrete including material aspects of concrete, specifications, behaviour and design of reinforced concrete members using limit state method as per Indian Standard code of practice. The course emphasizes on the background and mechanics of the code provisions and their limitations.

Course Outcome:

After Completion of the Course, Student will able to:

No.	Course Outcomes
01	Understand the behaviour and design of reinforced concrete
02	Ensure serviceability criteria for reinforced concrete structural elements.
03	Carry out load calculation, analysis, design and detailing of different reinforced concrete elements, slender column, flat slabs and Grid floors as per relevant IS code of practice.
04	Analysis and design of special elements like corbel, deep beams, curved beams, Shear Walls, beam-column joints and different foundations as per relevant IS code of practice.

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction:** RC material characteristics, durability aspects, design philosophy, loads and load combinations, load paths, introductions to different structural systems used in modern concrete construction.	4	10
2.	**Columns:** Concept of effective length; short columns vs slender column, Effect of confinement, Derivation of axial compression and bending interaction curves, Design of slender columns; Design for biaxial bending	4	10
3.	**Advanced RC Slab Design** - Introduction to flat slabs, proportioning, analysis and design of flat slab by direct design method, and detailing. - Introduction to grid floors, Analysis and design of Grid floors by Rankine Grashoff Method, classical equivalent plate theory and IS:456 method.	6	20
4.	**Design of Reinforced Concrete Plate and Shell Structures:** Analysis and Design of Shells, Hyperbolic Paraboloid Shells, Hyperbolic Cooling Tower, Folded Plated.	12	25
5.	**Serviceability Checks:** Difference between short-term and long-term deflections; estimation of deflections, estimation of crack widths and shrinkage cracks, vibrations and fatigue	4	5
6.	**Special Topics:** - Design of Shear Walls, Design of Curved beams, Design of Staircase, Moment redistribution in continuous beams; bond and development length, curtailment of reinforcing steel. - Introduction to Strut and Tie Method; Design of Deep beams and corbels, Design of Footings: isolated and combined footings; Design of rafts, strip footing and pile cap; Beam-column joints.	15	30
	Total	45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
05	**15**	**15**	**25**	**20**	**20**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Reinforced Concrete Structures – Park and Pauley, John Wiley and Sons.
2. Reinforced Concrete Design – S N Sinha, Tata McGraw Hill.
3. Advanced Reinforced Concrete Design – Krishna Raju, CBS Publisher.
4. Reinforced Concrete Design – S. Unnikrishna Pillai and Devdas Menon, Tata Mcgraw Hill.
5. Design of Reinforced Concrete Structures – N. Subramanian, Oxford University Press.
5. Reinforced Concrete: Mechanics & Design – J. Wight and J.G. MacGregor, Prentice-Hall.
6. Design of Concrete Structures – A Nilson, D Darwin, C Dolan, McGraw-Hill Education.
7. IS Codes: IS:456, IS:875, IS:1893, IS:4326, IS:13920, SP:16, SP:34.

(b) Open source software and website:

https://ndl.iitkgp.ac.in/
https://nptel.ac.in/

Suggested Course Practical List:

Practical work shall consist of solution of at least five problems from each topic out of which at least half of problems shall be checked by use of professional / open-source software. A design project shall be given to bridge the theory and practice. The report shall consist of full analytical treatment, design procedure, references and all necessary drawings in the form of neat dimensioned sketches.

List of Laboratory/Learning Resources Required:

Professional Software: STAAD-Pro, SAP2000, ETABS, Sofistik, Midas Gen

Suggested Project List: --- Analysis and Design of a Residential / Commercial RC Building using available computer packages and verify with manual calculations.

Suggested Activities for Students: --- Detailing of reinforced concrete structures using CAD tools

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