

Subject Code: 1ET4010501	Subject Title: DESIGN OF REINFORCED CONCRETE STRUCTURES
Pre-Requisite	----

RATIONALE:

Civil Engineering structures are normally made up of either Steel Sections or of Reinforced Cement Concrete. We need to study Design of reinforced Concrete Structures as per IS 456 – 2000.

Most of the residential buildings, Commercial and Public Buildings are designed using R.C. C. due to their long durability and flexibility in size and shape of structures and its members. So, Design of RCC components like slab, beam, column and footing using Limit State Method is required to be studied. Also, precise and correct detailing of reinforcement in structure drawing is also required in order to execute smooth construction of RCC structures, and hence, study of criteria regarding reinforcement in IS 456-2000, and in SP 34 are required to be studied.

COURSE OBJECTIVE:

The course content should be taught and implemented with the aim to develop with different types of skills, so that students are able to acquire following competencies:

1. Analyse RCC building structure/element for various application.
2. Provide a design and detailed drawing of analysed structure/element using Limit State Method as per code of practice IS 456 -2000.

TEACHING AND EVALUATION SCHEME:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)			
Lecture	Tutorial	Practical	Credit	Theory		Practical	
				University Assessment	Continuous Assessment	University Assessment	Continuous assessment
3	1	4	6	60	40	40	60

DETAILS OF COURSE CONTENTS:

Unit	Topic and Subtopic	Total Hrs.	Weightage
1	LIMIT STATE METHOD 1.1 Reinforced Cement concrete , Necessity of steel in concrete , Normal location of Tension steel in beams,slabs & footing. 1.2 Limit State,Limit State of Collapse– Flexure, Shear,Compression , Torsion , Limit State of Serviceability- Deflection, Cracking. 1.3 Characteristic Strength of Concrete and Steel, Partial Safety Factor	3	5%

	for Concrete and Steel. 1.4 Characteristic Load , Partial Safety Factor for Load, Factored Load		
2	LIMIT STATE OF COLLAPSE: FLEXURE 2.1 Assumptions for Limit State of Collapse due to Flexure. 2.2 Stress and Strain Diagram of Singly Reinforced Rectangular Section (SRS) 2.3 Equation(No Derivation) related to maximum depth of N.A- Xumax, Actual Depth of N.A- Xu, Limiting Moment of Resistance- Mulim, Actual Moment of Resistance-Mu 2.4 Balance Section , Under Reinforced Section , Over Reinforced Section. 2.5 Minimum and Maximum % of steel in beam and in slab as per IS 456-200, Clear cover as per IS 456-2000., Effective Cover. 2.6 Numerical to find Moment of Resistance or to find External load carried by Singly Reinforced Rectangular Section(SRS) of beam. 2.7 Numerical to find steel area in SRS of Beam to resist limit state Bending Moment 2.8 Numerical to find Mulim and Ptlim for SRS Beam 2.9 Design problem to find size of SRS Beam and steel area for limit state Bending Moment.	7	10%
3	DOUBLY REINFORCD BEAM 3.1 Condition for Doubly Reinforced Section . 3.2 Stress and Strain Diagram of Doubly Reinforced Rectangular Section (D.R.S.) 3.3 Equation related to Actual Depth of N.A- Xu, Actual Moment of Resistance-Mu. 3.4 Numerical to analyse DRS to find Moment of Resistance of beam. 3.5 Numerical to design DRS for the assigned limit state bending moment only.	6	10%
4	FLANGED BEAM 4.1 Conditions for the beam to act as Tee Beam . 4.2 Width of Flange as per IS 456-2000. 4.3 Equation regarding Tee Beam from IS 456-2000 (Annexure G). 4.4 Numerical to find Moment of Resistance of Tee Beam. 4.5 Numerical to find main steel area in tension of Tee Beam. 4.6 Numerical to find Limiting Moment of Resistance of Tee Beam using equation of IS 456-2000.	6	10%
5	LIMIT STATE OF COLLAPSE: SHEAR 5.1 Diagonal Tension Crack in Beam due to Shear. 5.2 Equation related to Limit State of Collapse due to Shear as per IS 456-2000. 5.3 Minimum and Maximum Spacing of Stirrups, minimum shear reinforcement as per IS 456-2000. 5.4 Numerical to find spacing of stirrups in Beam for the Limit State Shear Force when tension steel in beam is provided straight.	6	10%

	<p>5.5 Numerical to find spacing of stirrups in Beam for the Limit State Shear Force when tension steel in beam is provided with bent up bars.</p> <p>5.6 Limit State of Collapse due to Shear for Slab as per IS 456-2000</p>		
6	<p>LIMIT STATE OF SERVICEABILITY</p> <p>6.1 Span to effective depth ratio.</p> <p>6.2 Modification factor for SRRS as per IS 456-2000.</p> <p>6.3 Numerical to check Slab & Beam for Deflection.</p> <p>6.4 Maximum and Minimum spacing of Main steel and distribution steel in slab, Maximum and minimum spacing of bars in beam.</p> <p>6.5 Numerical to check spacing of steel in slab for cracking.</p> <p>6.6 Equation to find Development Length as per IS 456 -2000.</p> <p>6.7 Numerical to find Development Length.</p> <p>6.8 Anchoring reinforcing bars in Tension and in Compression.</p>	4	8 %
7	<p>DESIGN OF SLAB</p> <p>9.1 Types of Slab, Main Steel and Distribution Steel in Slab, Depth of Slab as per Deflection, Effective span as per IS 456-2000, Dead Load , Live Load on Slab, Shear and Cracking in Slab.</p> <p>9.2 Numericals to design and detail Cantilever Slab for Bending Moment , Shear , Deflection , Cracking and for development length for the assigned Floor Finish & Live Load.</p> <p>9.3 Numericals to design and detail Simply Supported One Way Slab for Bending Moment , Shear , Deflection , Cracking for the assigned Floor Finish & Live Load.</p> <p>9.4 Numericals to design and detail One Way Continuous Slab for Bending Moment , Shear , Deflection , Cracking for the assigned Floor Finish & Live Load using IS 456 -2000 B.M and S.F coefficients.</p> <p>9.5 Numericals to design and detail Two Way Simply Supported Slab with and without Torsion Steel for Bending Moment , Shear , Deflection , Cracking for the assigned Floor Finish & Live Load using IS 456 -2000 B.M coefficients (Annexure D)</p>	12	25 %
8	<p>AXIALLY LOADED SHORT COLUMN</p> <p>8.1 Column and Pedestal, Types of Columns, Slenderness Limit for Short & Long Column, Minimum Eccentricity in column, condition for axially loaded column, equation for axially loaded short column of IS 456-2000.</p> <p>8.2 Defferent Clauses of IS 456-2000 related to % compression steel , numbers of compression bars and its spacing, lateral ties – diameter and pitch</p> <p>8.3 Numerical to find axial load carrying capacity of Square , Rectangular & Circular Column.</p> <p>8.4 Numerical to design Square , Rectangular & Circular Column for the assigned limit state compression load.</p>	6	12 %

9	<p>ISOLATED FOOTING</p> <p>9.1 SBC of Soil, Types of Footing like Isolated foundation, combined footing , raft foundation , pile foundation.</p> <p>9.2 Numerical to design & to detail Isolated Pad and Slope Foundation for assigned Factored compression load of column and SBC of soil for Bending Moment, One Way Shear, Punching or Double Shear.</p>	6	10 %
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COURSE OUTCOME:

The theory should be taught and exercise should be carried out in such a manner that students are able to demonstrate following course outcomes.

1. Analysis & Design of Singly Reinforced Rectangular Section (SRRS) under Flexure.
2. Design Stirrups for Reinforced Concrete Rectangular Beam.
3. Apply Deflection & Cracking requirements of IS 456-2000.
4. Design & Detail Cantilever Slab , One Way Simply Supported Slab , One Way Continuous Slab & Two Way Simply Supported Slab.
5. Analyse & Design Doubly Reinforced Rectangular Section.
6. Analyse Tee Beam for Flexure.
7. Analyse and design RCC Column.
8. Design & Detail Isolated Footing.

LIST OF PRACTICAL/ EXERCISES:

Sr. No.	Practical/Exercise
1	Draw One Way Simply Supported Slab in Plan and in Longitudinal cross section along shorter span with reinforcement and its bent up details in A2 Size Drawing Sheet.
2	Draw One Way Continuous slab in Plan and in Longitudinal cross section having Four equal spans with reinforcement and its curtailment and its bent up details in A2 Size Drawing Sheet.
3	Draw Two Way Simply Supported Slab with Torsion Steel in Plan having longitudinal cross sections along shorter and longer span with reinforcement, bent up bars details in A2 Size Drawing Sheet.
4	Draw Longitudinal Cross Section Elevation and a Section along Length of -Singly Reinforced Beam with shear reinforcement -Doubly Reinforced Beam with shear reinforcement Above two in A2 Size Drawing Sheet
5	Draw Longitudinal Cross Section Elevation and a Section along Length of -Cantilever Beam with shear reinforcement -Flanged Beam

	Above two in A2 Size Drawing Sheet
6	Draw Plan and Cross Section Elevation of RCC Column having Isolated Slope Foundation with reinforcement details.
7	Sketch Book shall be prepared with following sketches... 1. Longitudinal and cross section elevation along Length of Singly Reinforced Simply Supported Beam 2. Longitudinal and cross section elevation along Length of Cantilever Beam 3. Longitudinal and cross section elevation along Length of Simply Supported Tee Beam 4. Plan & c/s elevation along shorter span of One Way Simply Supported Slab 5. Plan & c/s elevation along shorter span & Longer span of Two Way Simply Supported Slab without torsion steel. 6. Plan of Circular Slab with reinforcement 7. Column and Beam ductile connection 8. Column to Column Connection when size of Upper column is reduced 9. Circular Water Tank with flexible joint 10. Cantilever Retaining Wall. 11. Reinforcement details of Shear Wall 12. Reinforcement details of R C C Dome

SPECIAL INSTRUCTIONAL STRATEGIES :

1. Site Visit must be arranged for Residential & Commercial Buildings to show Reinforcement, cutting and laying of reinforcement, professional structure detail drawings.
2. Show video of concrete work carried out in slab, beam, column and footing.

LIST OF REFERENCES:

Sr.no.	Title	Author	Publication
1	Reinforced Concrete	Dr. H J shah	Charotar Publication
2	Limit State Design of Reinforce Concrete	Dr. Punamiya, A K Jain, Arun K Jain	Laxmi Publications
3	R C C design and drawing	Neelam Sharma	S K Kataria and Sons
4	Illustrated Reinforced Concrete Design	Dr. V L Shah & S R Karve	Structures Publication
5	Limit State Design of Reinforced Concrete	Vaghrese P C	PHI Learning Pvt. Ltd.
6	R C C Design & Drawing	M I Ohri	Tech India Publication Series
7	***IS-456 – 2000	-----	Bureau of Indian Standard
8	***Design Aid – SP - 16	-----	Bureau of Indian

			Standard
9	R C C Detailing– SP - 34	-----	Bureau of Indian Standard
10	Ductile Detailing-13920	-----	Bureau of Indian Standard

*** Students are permitted to appear in theory & practical examination with these IS codes.