Techno India NJR Institute of Technology

Course File

Design of Concrete Structures

(5CE4-03)

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For Techno India NJR Institute of Technology
पंकज पोरवाल
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(Principal)

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. (Civil Engineering)

5CE4-03: DESIGN OF CONCRETE STRUCTURES

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Fundamental concepts of design of RC members, assumptions. Types and function of reinforcement. Introduction to various related IS codes, Characteristic load and characteristic strength. **Working Stress Method:** Working stress design philosophy. Analysis and Design of singly reinforced rectangular beam section for flexure.	5
3	**Limit State Design:** Limit state design philosophy. Assumptions, Analysis and design of singly reinforced, doubly reinforced rectangular beams and flanged beams for flexure using codal provisions for simply supported, cantilever, fixed and continuous beams.	10
4	**Limit state of serviceability for deflection**: control of deflection as per codal provisions of empirical coefficients. **Limit state of collapse in shear**: Types of shear reinforcement and its detailing, analysis and design of shear reinforcement for prismatic sections. **Limit state of collapse in bond**: concept of bond stress, anchorage length and development length. Detailing and curtailment of reinforcement as per codal provisions.	6
5	**Slabs:** Analysis and design of one way and two-way slabs using LSM, Detailing of reinforcement. Check for shear and deflection.	6
6	**Columns:** Short and long columns, their structural behaviour. Analysis and design of axially loaded short columns, using LSM. Analysis of eccentrically loaded short columns. Introduction to PuMu interaction curves and their use for eccentrically loaded columns. **Footings:** Analysis and design of Isolated column footing for axial load. Introduction to combined footing for two columns (without central beam) for axial loads using LSM.	5 4
7	**Torsion:** Analysis and Design of beams for torsion as per codal method.	3
	TOTAL	40

Course Overview:

Student will learn basics of "Design of concrete structures" from these 40 hours course. the student will able to understand the properties of concrete and steel and the behaviour of reinforced concrete as a structural material and also, Students will be able to design of reinforced concrete structural members such as beams, slabs, footings, and columns.

DSS plays a significant role in ensuring that all Company's projects are aligned with strategic vision and objectives, and meet operational, cost, budget, and time-related targets. Student should learn and develop problem solving abilities using DSS in order to get a good job in top civil engineering company India or abroad.

Course Outcomes:

CO. NO.	Cognitive Level	Course Outcome
1	Application	Students will be able to identify the design mix and compute the characteristic strength of concrete.
2	Comprehension	Students will be able to classify the basic philosophy of Working Stress and Limit State Design of RCC structures.
3	Synthesis	Students will be able to design different structural components like beams, columns, slabs etc
4	Synthesis	Students will be able to prepare detailed reinforcement diagram of each component using techniques involved in the course.
5	Application	Students will be able to compute shear, deflection and development length.

Prerequisites:

- Students will be able to identify the design mix and compute the characteristic strength of concrete.
- Students will be able understand the basic philosophy of Working Stress and Limit State Design of RCC structures.
- Students will be able to design different structural components like beams, columns, slabs and footing etc.
- Students will be able to compute shear, deflection and development length.
- Students will be able to draw detailed reinforcement diagram of each component using techniques involved in the course.

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Course Outcome Mapping with Program Outcome:

Course Outcome	Program Outcomes (PO's)											
CO. NO.	Domain Specific (PSO)					Domain Independent (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	2	1	1	1	2	3
CO2	3	2	2	3	2	1	2	1	1	1	1	1
CO3	2	2	2	1	2	2	2	2	1	1	2	1
CO4	2	2	2	2	1	1	0	0	0	1	0	0
CO5	2	2	2	1	2	2	2	2	1	1	2	1
1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)												

Course Coverage Module Wise:

Lecture No	Unit	Topic
1	1	**INTRODUCTION:** Objective, scope and outcome of the course
2	2	**FUNDAMENTAL CONCEPTS OF DESIGN OF RC MEMBERS**,
3	2	Types and function of reinforcement. Introduction to various related IS codes,
4	2	Characteristic load and characteristic strength
5	2	Working Stress Method: Working stress design philosophy
6	2	Design of singly reinforced rectangular beam section for flexure
7	3	**LIMIT STATE DESIGN: LIMIT STATE** Students will able to identify design philosophy and Assumptions
8	3	Students will able to design of singly reinforced
9	3	Students will able to design of singly reinforced
10	3	Students will able to design of singly reinforced
11	3	Students will able to Doubly reinforced rectangular beams and flanged beams for flexure using codal provisions for simply supported
12	3	Students will able to design of doubly reinforced rectangular beams and flanged beams for flexure using codal provisions for simply supported.
13	3	Students will able to design of doubly reinforced rectangular beams and flanged beams for flexure using codal provisions for simply supported
14	3	Students will able to design of cantilever, fixed and continuous beams

15	3	Students will able to design of cantilever, fixed and continuous beams
16	3	Students will able to design of cantilever, fixed and continuous beams
17	4	**LIMIT STATE OF SERVICEABILITY FOR DEFLECTION**: Students will able to compute control of deflection as per codal provisions of empirical coefficients
18	4	Students will able to understand Limit state of serviceability for deflection: and compute control of deflection as per codal provisions of empirical coefficients
19	4	Students will able to understand Limit state of collapse in shear and write the types of shear reinforcement and its detailing
20	4	Students will able to design of shear reinforcement for prismatic sections
21	4	Students will able to understand Limit state of collapse in bond, concept of bond stress, anchorage and development length
22	4	Students will able to draw Detailing and identify curtailment of reinforcement as per codal provisions
23	5	**SLABS: ANALYSIS AND DESIGN OF ONE WAY USING LSM**
24	5	Students will able to design of one way using LSM
25	5	Students will able to design two-way slabs using LSM
26	5	Students will able to two-way slabs using LSM
27	5	Students will able to draw detailing of reinforcement
28	5	Students will able to compute for shear and deflection
29	6	**COLUMNS:** Students will able to understand short and long columns, their structural behaviour
30	6	Students will able to design of axially loaded short columns using LSM
31	6	Students will able to understand design of axially loaded short columns using LSM
32	6	Students will able to analyze of eccentrically loaded short columns
33	6	Students will able to understand concept of Pu-Mu interaction curves and their use for eccentrically loaded columns
34	6	Students will able to design of Isolated column footing for axial load
35	6	Students will able to design of Isolated column footing for axial load
36	6	Students will able to identify combined footing for two columns (without central beam) for axial loads using LSM

37	6	Students will able to identify combined footing for two columns (without central beam) for axial loads using LSM
38	7	**TORSION:** Students will able to understand the torsional behaviour of beams in frame structures.
39	7	Students will able to Design of beams for torsion as per codal method
40	7	Students will able to Design of beams for torsion as per codal method

TEXT/REFERENCE BOOKS

1. Reinforced Concrete: Limit state design by A.K. Jain, Nemchand and Brothers.
2. Limit state design by Dayaratnam, Oxford and IBH Publishing House
3. Limit State Design of Reinforced Concrete by Verghese P.C., PHI Delhi
4. Reinforced Cement Concrete Design by Neelam Sharma, S.K. Kataria & Sons

Course Level Problems (Test Items):

CO.NO.	Problem description
1	A. Write the differences in between under Reinforced and over reinforced section as per Limit State Method. B. Explain the Design methods of RCC with Relatives merits and de-merits. C. Design doubly reinforced rectangular beam 300 mm x 600 mm over an effective span of 5m. The superimposed load on the beam in 50 kN/m. Effective cover is 50 mm. TakeFe415 and M25.
2	A. Discuss the reason that doubly reinforced beams are preferred than singly reinforced beams? B. Design shear reinforcement at support of beam section 300 mm wide reinforced with four bars of 25mm dia. At an effective depth of 570mm. the beam has to resist a factored shear force of 400 kN at support section. Assume M25 and Fe415 Grade of concrete and reinforcement respectively. C. Determine the moment of resistance of the an Isolated simply supported T-beam has a flange width (b) = 2400mm, Flange thickness (D_f) =120 mm, Effective span (L) =3.6 m. The effective depth of beam (d) = 580 mm and its width (b_w) =300 mm. It is reinforced with 8 bars of 20 mm diameter. Use M20 & Fe 415.
3	A. Draw the stress block parameters for a typical T-Beam section having $X_u<D_f$, $X_u>D_f$ and $X_{umax}>X_u>D_f$, also give the formula to determine ultimate moment of resistance for each condition.

	B. An office Floor having 4m x 10m clear dimension is having 230 mm thick walls all round. The room is proposed to be covered by RC slab using M20 and Fe 415. Take live load 4 kN/m, finish floor load 1.5 kN/m. Design the slab with all necessarily checks and details.
4	A. Explain the following a) Restrained Slab b) Unrestrained Slab c) Two Legged Vertical Stirrups b) Discuss the purpose and provision of providing distribution reinforcement in one-way slab as per IS 456:2000. c) Discuss the purpose and provision of providing torsion reinforcement in Two-way slab as per IS 456:2000.
5	A. Describe the followings (Any two): a) Differentiate between short column and long column, describe their structural behaviour. b) Describe the salient feature of PU-MU interaction curve and its uses. B. Discuss the combined footing for two columns (without central beam) for axial loads using LSM.

Assessment Methodology:

1. Assignments one from each unit.
2. Online Quiz at Google classroom.
3. Midterm subjective paper based on topics as mentioned in the modules (Twice during the semester).
4. Final paper at the end of the semester subjective.

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TEACHING AND LEARNING RESOURCES UNIT-WISE

1. FUNDAMENTAL CONCEPTS OF DESIGN PHILOSOPHY OF RC MEMBERS

VideoTutorials:

http://www.nptelvideos.com/video.php?id=1648&c=11

http://www.nptelvideos.com/video.php?id=1644&c=11

http://www.nptelvideos.com/video.php?id=1645&c=11

http://www.nptelvideos.com/video.php?id=1640&c=11

Theory concepts:

https://drive.google.com/drive/u/0/folders/1xOW8yP5YXYPbFcWisWAclrf02pfcfgBC

https://drive.google.com/drive/u/0/folders/1qrfuXk48BAs1htlQQ3TsnJ5BNDUsfc3d

Sample Quiz:

https://www.onlineinterviewquestions.com/rcc-structures-design-mcq/

https://drive.google.com/drive/u/0/folders/12mtJqoOmzcPMiLx0b-LF5uP7yibAvDoQ

2. LIMIT STATE DESIGN: LIMIT STATE DESIGN AND SERVICEABILITY

VideoTutorials:

http://www.nptelvideos.com/video.php?id=1641&c=11

http://www.nptelvideos.com/video.php?id=1635&c=11

http://www.nptelvideos.com/video.php?id=1643&c=11

http://www.nptelvideos.com/video.php?id=1642&c=11

http://www.nptelvideos.com/video.php?id=1634&c=11

http://www.nptelvideos.com/video.php?id=1639&c=11

Theory concepts:

https://drive.google.com/drive/u/0/folders/1xOW8yP5YXYPbFcWisWAclrf02pfcfgBC

https://drive.google.com/drive/u/0/folders/1qrfuXk48BAs1htlQQ3TsnJ5BNDUsfc3d

Sample Quiz:

https://edurev.in/course/quiz/attempt/-1_Test-RCC--Concrete-Structures--1-/4146f869-86bb-433f-8751-4f3d06ea7c84

https://teswesm.com/online-test/design-of-concrete-structures-mcqs-set-2/205/20-20

3. SLABS: ANALYSIS AND DESIGN OF ONE WAY USING LSM

VideoTutorials:

http://www.nptelvideos.com/video.php?id=1646&c=11

Theory concepts:

https://drive.google.com/drive/u/0/folders/1xOW8yP5YXYPbFcWisWAclrf02pfcfgBC

https://drive.google.com/drive/u/0/folders/1qrfuXk48BAs1htlQQ3TsnJ5BNDUsfc3d

Sample Quiz:

https://www.onlineinterviewquestions.com/rcc-structures-design-mcq/

4. DESIGN OF COLUMNS AND FOOTING AND TORSION:

VideoTutorials:

http://www.nptelvideos.com/video.php?id=1637&c=11

http://www.nptelvideos.com/video.php?id=1636&c=11

http://www.nptelvideos.com/video.php?id=1622&c=11

Theory concepts:

https://drive.google.com/drive/u/0/folders/1xOW8yP5YXYPbFcWisWAclrf02pfcfgBC

https://drive.google.com/drive/u/0/folders/1qrfuXk48BAs1htlQQ3TsnJ5BNDUsfc3d

Sample Quiz:

https://www.examveda.com/civil-engineering/practice-mcq-question-on-rcc-structures-design/

https://expertmcqs.com/rcc-structures-design-mcq-test-online-quiz/

PREVIOUS YEAR QUESTION PAPERS

5E1343

Roll No. _____ Total No. of Pages : 2

5E1343

B.Tech. V - Semester (Main) Examination, Nov. - 2019

PCC/PEC Civil Engineering

5CE4-03 Design of Concrete Structures

Time : 3 Hours **Maximum Marks : 120**

Min. Passing Marks : 42

Instructions to Candidates:

*Attempt **all ten** questions from **Part A**, selecting **five** questions out of **Seven** from **Part B** and **Four** questions out of **Five** from **Part C**. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly). Units of quantities used/calculated must be stated clearly.*

Use of following supporting material is permitted during examination.(mentioned in form no.205)

1. IS 456:2000

PART - A

(Answer should be given up to **25** words only)

All questions are **compulsory** **(10×2=20)**

1. Write any two difference between limit state and working state methods.
2. What do you understand by torsion of the beam?
3. What do you understand by singly reinforced beam?
4. Write the concept of bond stress.
5. What is anchorage length and development length?
6. Explain difference between design load and working load.
7. Write any two difference between short column and long column.
8. Define one way and two way slab.
9. Define factor of safety.
10. Write any two difference between combined and isolated footing.

PART - B

(Analytical/Problem solving questions)

Attempt any **five** questions **(5×8=40)**

1. A rectangular singly R.C beam with cross - section 320 mm×550 mm is simply supported over the clear span of 4.50 m with support of 250 mm each. Calculate ultimate moment of resistance of the beam using limit state method. Use M20 Fe 415 steel grade.

2. Determine the moment of resistance of a R.C.C beam 350 mm× 350 mm (effective) and is reinforced with 3 bars of 20 mm diameter. The permissible stresses in concrete and steel are 7N/mm² and 230 N/mm². Take m = 13.33.
3. A R.C.C beam 300 mm × 600 mm in section is reinforced with 5-25 mm diameter bars. It is subjected to a design shear force of 200 kN. Comment on its shear design use M20 concrete and Fe 415 steel.
4. A short column 400 mm × 400 mm is reinforced with 4-25 mm diameter bars. Find the ultimate load carrying capacity of the column. Use M20 concrete and Fe 415 steel. Assume e<0.05 D.
5. A reinforced concrete beam is 300 mm × 700 mm is subjected to a bending moment of 150 kN-m. Determine the area of reinforcement if M20 concrete and Fe 415 steel is used. Take effective cover as 40 mm. (Follow limit state method).
6. An R.C.C beam 250 mm × 500 mm has a clear span of 5.5 m. The beam has 2 - 20 mm diameter bars going into the support. Factored shear force is 140 kN. Check for development length if Fe 415 and M20 grade of concrete is used.
7. Find the factored moment of resistance of an R.C.C beam 300 mm × 450 mm. The beam is reinforced with 4-25 mm diameter bars in the tension zone. 2-20 mm diameter bars are placed at a distance of 50 mm from top in the compression zone. Use M 20 concrete and Fe 415 steel.

PART - C

(Descriptive/Analytical/Problem Solving/Design Question)

Attempt any **Four** questions **(4×15=60)**

1. Design a square footing of uniform thickness for an axially loaded column of 450mm×450 mm size. The safe bearing capacity of soil is 190 kN/m². Load on column is 850 kN. Use M20 concrete and Fe 415 steel.
2. A rectangular concrete Beam 300 mm wide and 500 mm deep is subjected to the following at a section (i) Factored bending moment of 80 kN-m (ii) Factored shear force of 70 kN and (iii) Factored torsional moment of 40 kN-m Design the section for torsion. Use M 20 grade of concrete and Fe 415 grade of steel.
3. Design a simply supported roof slab for a room 7.5m×3.5 m clear in size. The slab is carrying an imposed load of 5kN/m2. Use M20 and Fe415 steel. Take unit weight of R.C.C 25 kN/m³.
4. Design a circular column of diameter 400 mm subjected to a load of 1200 kN. The column is having spiral ties. The column is 3 m long and is effectively held in position at both ends but not restrained against rotation. Use M25 concrete and Fe 415 steel.
5. A rectangular reinforced concrete beam is simply supported on two masonry walls 230 mm thick and 6 m a part (centre - to - centre). The beam is carrying an imposed load of 15 kN/m. Design the beam with all necessary checks by limit state methods. Use M 25 concrete and Fe 415 steel.