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**FIRST SEMESTER 2023-2024**

Course Handout Part II

Date: 11-08-2023

In addition to part-I (General Handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

*Course No.* :  *CE F320*

*Course Title* : Design of Reinforced Concrete

*Instructor-in-Charge* : Prof. Arkamitra Kar

Instructor :

**Scope & Objective of the Course**

Design Philosophies: Concepts of Working Stress in comparison with Limit State Method; Limit State Design for flexure of singly and doubly reinforced rectangular and flanged section beams; one-way and two-way slabs; Design for bond, anchorage and development length; Design of beams for shear; Limit state of serviceability for beams and slabs; Limit State Design for collapse of columns subjected to axial, uniaxial and biaxial bending; Design of simple footings; Design of simple staircases.

**Expected Course Outcome (CO):**

After attending this course, the student will develop an ability to:

* Design and detail an RC Beam of any straight shape according to IS 456: 2000
* Design and detail an RC Slab according to IS 456: 2000
* Design and detail an RC Column and isolated RC Footing using IS 456: 2000
* Design and detail an RC staircase using IS 456: 2000

Student Learning Outcomes (SLOs) assessed in this course – **(a), (b), (j),** and **(k).**

**Text Book (TB)**

J. N. Bandhopadhyay, “Design of Concrete Structures”, 2008, 1st Edition, Prentice-Hall of India, New Delhi

**Reference Books (RB)**

1. IS 456:2000 “Code of practice for Plain and Reinforced concrete”, Bureau of Indian

Standards, New Delhi.

1. Special Publication (SP)-16, Design aids for reinforced concrete to IS 456:1978, Bureau of Indian Standards, New Delhi.
2. P. C. Verghese, “Limit State Design of Concrete”, 2nd edition, PHI Pvt. Ltd., New Delhi, 2011.
3. S.U.Pillai and Devdas Menon, “Reinforced Concrete Design”, 3rd Edition, TMH, New Delhi, 2009.
4. Jain, A.K., Reinforced Concrete: Limit State Design”, 6th Edition, Nemchand & Bros, Roorkee, 2002.

**Course Plan**

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| **CO** | **Lecture No.** | **Learning Objective** | **Topics Covered** | **Reference to TB** |
| 1 | 1-2 | Objectives & Methods  of Analysis & Design | Introduction, objectives, Methods of Design, Loads & Forces acting on structures | Ch 1 |
| 3-4 | Properties of Concrete | Stress-strain curve for concrete, Size effect, behavior of concrete in tension, Durability of concrete, properties of Steel, Stress-strain curve for steel | Ch 2 |
| 5-6 | Philosophies of Limit State Method | A review on various design Philosophies, Types of Limit States, partial safety factors for materials and loads | Ch 3 |
| 7-11 | Limit State of Collapse-Flexure and singly reinforced rectangular beam | Assumptions in Limit State Design, Analysis of singly reinforced rectangular, Design of Singly Reinforced Concrete Beam, Analysis of singly reinforced rectangular beams using SP-16 tables and Charts. | Ch 4 |
| 12 - 14 | Analysis & Design of Doubly Reinforced rectangular section Beams | Assumptions and basic principles, analysis and design of doubly reinforced concrete beams with rectangular section | Ch 5 |
| 15 - 16 | Analysis & Design of Simply supported Flanged Sections | Effective Width, Analysis of Flanged sections for various cases, Design of simply supported Flanged beam Sections, Design of continuous beam Flanged sections | Ch 6 |
| 17 - 18 | Design for Bond, anchorage and development length | Design bond strength, development length, check for development length in tension, anchoring of reinforcing bars, bearing stress at bonds, reinforcement splicing, Design for bond, Development length, Curtailment of reinforcement, Lap splice | Ch 8 |
| 1 | 19 - 22 | Design of Beams for Shear | Modes of failure due to shear, shear strength of concrete, critical section for shear, enhanced shear strength near support, minimum shear reinforcement, Design of shear strength, check for shear at point of tension reinforcement curtailment | Ch 7 |
| 23 - 26 | Limit state of serviceability | short term deflection calculation for beams, deflection due to shrinkage and creep, combined bending, shear, and torsion | Ch 8, 9 |
| 2 | 27 - 34 | Design of one way and two-way Slabs | Design shear strength of concrete in slabs, design consideration for slabs, design and reinforcement detailing of one way simply supported and continuous slabs, design and reinforcement detailing of two-way slabs | Ch 10 |
| 3 | 35 - 39 | Design of Compression Members and isolated footing | Classification of columns, Design of rectangular and circular columns subjected to Axial load, (Axial load + uni-axial bending) and (Axial load + Bi-axial bending); Design of isolated RC footings | Ch 12 |
| 4 | 40 - 42 | Design of Stair Cases | Types of stair cases, components of staircase, structural system of stair cases, effective span, Design of stair cases spanning transversely and longitudinally | Ch 11 |

**Evaluation Scheme**

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| **Ec. No.** | **Evaluation component** | **Duration** | **Weightage** | **Date, time** | **Nature of component** |
| 1. | Midsem | 90 mins. | 35% | 10/10 - 2.00 - 3.30PM | CB |
| 2. | Class Tests | 15 mins. | 25% | TBA in class, 5×5% | OB |
| 3. | Compre. Exam | 180 mins. | 40% | 11/12 FN | CB |

**Chamber Consultation Hour:** F 4-5 PM, or by prior appointment based on urgency through BITS email only (WhatsApp or any other social media texts shall not be considered).

**Notices:** All notices concerning the course will be conveyed through CMS. CB components allow the students to use any and all relevant IS Codes and original class notes signed by the IC.

**Make up policy:** Makeup will be given only to the genuine cases with prior permission.

**Evaluation:** Curved gradation policy will be adopted; however, the student is expected to score *at least 30%* of the total marks to achieve a completed grade, as 25% of the course is OB.

**Academic Honesty and Integrity Policy**: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

*Arkamitra Kar* (sd.)

**Instructor-in-charge, CE F320**