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**FIRST SEMESTER 2019-2020**

Course Handout Part II

01-08-2019

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

*Course No.* :  *CE F320*

*Course Title* : Design of Reinforced Concrete

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

**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, uni-axial and bi-axial bending; Design of simple Footings; Design of simple Stair Cases.

**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 stair case 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, 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 to be covered** | **Chapter in the Text Book** |
| 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 - 18 | 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 |
| 19 -22 | 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 | 23 – 26 | 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 |
| 27 - 28 | Limit state of serviceability | short term deflection calculation for beams, deflection due to shrinkage and creep | Ch 9 |
| 29 - 30 | Design of beams for Torsion | Design of beams for combined bending, shear and torsion as per IS 456 | Ch 8 |
| 2 | 31 – 36 | 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 | 37 – 40 | Design of Compression Members and isolated footing | Classification of columns based on slenderness ratio, reinforcement & loading, 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 for these columns | Ch 12 |
| 4 | 41 - 43 | 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 | 1.5 hr. | 20% | 1/10, 3:30 – 5 PM | CB |
| 2. | Project |  | 10% |  | CB |
| 3. | Assignments | Weekly | 15% |  | OB |
| 4. | Class Tests | Weekly | 15% |  | Open notes |
| 5. | Pop quizzes | 15 mins | 10% |  | CB, open notes |
| 6. | Compre. Exam | 3 hrs. | 30% | 07/12 AN | CB |

**Chamber Consultation Hour:** To be announced in the class.

**Notices:** All Notice concerning to the course will be displayed on **Notice Board** of Civil Engg. Department and CMS.

**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.

**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.

**Instructor-in-charge**

**CE F320**