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Question Paper Code : 20516

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

Fifth Semester

Civil Engineering

CE 3501 – DESIGN OF REINFORCED CONCRETE STRUCTURAL ELEMENTS

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

(Use of IS 456 and SP 16 Design Charts are permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Determine the modular ratio of M20 grade concrete.
2. Draw the stress strain curve for concrete in compression.
3. Write the reinforcement for torsion is considered in design of a beam.
4. State the reason for providing doubly reinforced beam.
5. Define development length.
6. State the reason for reinforced concrete slab do not require shear reinforcement.
7. Identify the minimum and maximum percentage of steel allowed in R.C. Column.
8. Differentiate a column as short or long.
9. Sketch the placement of steel in rectangular footing with a non-central load.
10. Write the situations in which combined footings are preferred over isolated footings.

PART B — (5 × 13 = 65 marks)

11. (a) A rectangular beam of width 300 mm and effective depth 500 mm reinforced with 4 bars of 12 mm diameter. Find the moment of resistance and stresses in the top compression fiber of concrete and tension steel. Use concrete M20 and steel Fe415. Adopt working stress method.

Or

- (b) (i) Discuss the different limit state to be considered in reinforced concrete design. (5)
- (ii) Explain the advantages of limit state method over working stress and ultimate load methods. (8)
12. (a) Design a rectangular beam section of width 250 mm and effective depth 500 mm, subjected to an ultimate moment of 160 kNm, ultimate shear force of 30 kN and ultimate torsional moment of 10 kNm. Use concrete M20 and steel 415.

Or

- (b) Determine the reinforcement for a T beam with flange width = 1500 mm web width = 300 mm thickness of slab = 100 mm, effective depth 735 mm, to carry a moment of 380 kNm due to characteristic loads. Use M25 concrete and Fe 415 steel. Using Limit State Design.
13. (a) Design a simply supported R.C.C. slab for a roof of a hall 4 m × 10 m (inside dimensions) with 230 mm walls all around. Assume a live load of 4 kN/m² and finish 1 kN/m². Use grade 25 concrete and Fe 415 steel.

Or

- (b) Design a dog legged stairs to be provided in a residential multi storeyed building. Clear space available is 3 m × 4.8 m. Floor to floor height is 3.6 m length of landing on either side along the direction of flight is 1.2 m exposure condition is moderate.
14. (a) Design the reinforcement in a spiral column of 400mm diameter subjected to a factored load of 1500 kN The column has an supported length of 3.4 m and is braced against side sway. Use M20 concrete and Fe415 steel.

Or

- (b) Design the longitudinal reinforcement in a short column 400 mm × 600 mm subjected to an ultimate axial load of 1600 kN together with ultimate moments of 120 kNm and 90 kNm about the major and minor axis respectively. The reinforcements are distributed equally on all four sides. Adopt M20 grade concrete and Fe415 steel bars.

15. (a) A rectangular column of size 300 mm × 450 mm transmits a limit state load of 600 kN at an eccentricity of 150 mm about the major axis. Design a suitable isolated footing for the column by the limit state concept. Safe capacity of soil is 200 kN / m². Use M30 concrete and Fe 415 steel.

Or

- (b) Design a combined footing for the two columns at a multi-storey building. The columns of size 400 mm × 400 mm transmit a working load of 600 kN each and they are spaced at 5 m centres. The safe bearing capacity of soil at site is 200 kN/m². Adopt M20 grade concrete and Fe415 grade steel. Sketch the details of reinforcements in the combined footing.

PART C — (1 × 15 = 15 marks)

16. (a) Design a rectangular slab supported on its all four edges (300 mm thick) over a classroom of size 4.8 m × 6.2 m. Two adjacent edges of the slab are discontinuous and the remaining two edges are continuous. A finishing surface of cement concrete of 50 mm shall be provided over the slab. The slab shall be used as classroom. M20 grade of concrete and HYSD bars shall be used. The unit weight of finishing surface concrete is 24 kN/m³.

Or

- (b) Design the interior span of a continuous one way slab for an office floor continuous over tee beams spaced at 3 meters. Live load = 4 kN/m², Floor finish = 1 kN/m². Use concrete M20 and steel Fe415. Adopt limit state method. Sketch the steel reinforcement.