Ref. No.: Ex/Arch/CE/T/323/2024

Bachelor of Architecture, Third Year Second Semester Examination, 2024

DESIGN OF STRUCTURES – II

Full Marks – 100 **Time: 3 Hrs.**

- **Answer Question-1 and Any FOUR Questions from the rest.**
- **The use of the following IS Codes is allowed in the examination hall:**
  IS-456:2000, SP-16, IS:800:2007, IS:808-1989, IS:4923-2017, IS:1161-2014, SP-6-Part-1

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1. Answer Any Five Questions: **5 X 4 = 20**

(A) Explain the differences between a One-way Slab and a Two-way Slab, based on their load transfer mechanism and also on their structural behaviour.
What are the main considerations that generally govern the thickness of a two-way slab?

(B) Under what circumstances do you need to opt for a doubly reinforced concrete beam section? What are the disadvantages of using a doubly reinforced beam section?

(C) What are the generic forces that act on a typical Rectangular RC column cross-section? Draw a schematic diagram. How do you select the relative dimensions of a rectangular RC Column based on the force values?

(D) Why clear covers to the reinforcements are provided in RC structures? What are the IS:456-2000 code suggested values of clear covers for Slab, Beam, and Column?

(E) What are the design criteria to be checked for designing an RC Rectangular Isolated Footing? How do you determine the required base area of an RC footing?

(F) Based on which criteria the classification of the steel sections is done as per the IS:800-2007 code?
What are the section classes as per the IS:800-2007 code?
For structural use, which section class is most desired and why?

(G) Two identical steel beams with the same cross-section, span, loading, and support conditions, except for one criterion – one beam is laterally restrained and the other is laterally unrestrained. In which case the major axis bending moment capacity will be higher? Clarify your answer.

2. Design a two-way RC Slab for a rectangular panel of 6 m. X 4 m. with all the edges simply-supported (and the corners are prevented from lifting) to support a Live Load of 5 kN/m^2. Use M-20 grade concrete and Fe-415 grade reinforcement steel. Draw the plan and cross-section

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of the slab showing the reinforcement details. Assume any other data as required and mention them specifically.

3. Determine the Ultimate Moment of Resistance of a Doubly Reinforced Beam Section of 350 mm wide X 600 mm depth, reinforced with Tension Steel Area (A_{st}) 3054 mm^2 and Compression Steel Area (A_{SC}) 982 mm^2. The Grade of Concrete is M20 and the Grade of Reinforcement Steel is Fe415. Assume the clear cover is 50 mm at both faces.

4. Determine the reinforcements to be provided in a short column subjected to an axial load and biaxial moments. The Column cross-section is 300 mm X 600 mm., subject to the following external forces – (a) a factored axial load of 1200 kN; (b) a factored moment acting parallel to the larger dimension of the column of 100 kN.m. and (c) a factored moment acting parallel to the shorter dimension of the column of 60 kN.m. Use M-20 grade of concrete and Fe-415 grade of reinforcement steel. The moments due to minimum eccentricities as per code are less than the applied moments. The reinforcements are distributed equally on the four sides of the column. Draw the column cross-section at the base of the column showing the reinforcement details. Assume any other data as required and mention them specifically.

5. A Square RCC Column, having a cross-section of dimension 400 mm X 400 mm, is subjected to an Axial Compressive Load of 120 kN, with Bi-Axial Moments of 80 kN.m. and 40 kN.m. orthogonal to each other. Provide an RCC square footing of dimension 2.0 m x 2.0 m for that column.

(a) Calculate the Bearing Pressure developed at the four corners of the footing.
(b) Please check whether any tension zone has developed under the footing. (Loses contact with the soil)
(c) Considering the Allowable Bearing Capacity of the underneath soil as 80 kN/m^2, comment on the factor of safety of the footing from the bearing capacity point of view.

6. Write down the step-by-step procedure for finding the Major Axis Bending Moment Capacity of a doubly-symmetric Steel I-section Laterally Unrestrained Beam using the clauses of the IS:800-2007 Code. Please mention all the relevant clauses of the code at each step.

7. A Steel Plate Girder having a span of 6 meters, is subjected to an imposed load of 12 kN/m, apart from its self-weight. The Girder is simply supported at both ends. The compression flange of the girder is <u>laterally restrained throughout the span</u>.
The Plate Girder is fabricated with the following dimensions:
Total Depth of the Girder = 500 mm
Top and Bottom Flange Dimension = 300 mm x 20 mm
The thickness of the Web = 10 mm
(a) Calculate the Major Axis Bending moment capacity of the Girder and
(b) Check whether the provided section can carry the applied loading.
