04   TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Ashadh

| Exam.		Regular/Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of Reinforced Concrete Structures

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **_Four_** questions.
✓ The figures in the margin indicate **_Full Marks_**.
✓ Assume missing data if necessary possibly complying to IS: 456-2000.
✓ Use of IS: 456-2000, IS: 1343 and SP 16 are allowed. But, use of SP-16 is allowed only for column design.

1. a) A reinforced concrete column of a moment resisting frame has its cross section 40mm × 600mm and effective height 3.6m. The column has to carry loading combination of dead load, live load and moment due to wind load. The computed dead load and live load on column are 250 kN, and 100 kN respectively, whereas the induced horizontal load on column due to wind load is 5 kN/m. Calculate loading values for all possible loading combinations as per IS 456. [8]

   b) The moment of resistance of a rectangular reinforced concrete beam section having width b mm and overall depth D mm is $0.85bd^2$. The stresses in the extreme fiber of the concrete; and in the steel are not to exceed 7 N/mm^2 and 140 N/mm^2 respectively and the modular ratio equals to 18.33. Determine the ratio between the depth of neutral axis from the compression fiber and the effective depth of the beam. The beam is reinforced for tension side only. [12]

2. a) State all the possible safety and serviceability limit states to be considered in the design by Limit State Method. [5]

   b) Design an isolated square footing foundation of uniform thickness for a 400mm × 400mm column subjected to an axial load of 600 kN and a moment of 50 kNm at service state. Consider bearing capacity of soil as 150 kN/m^2 and concrete grade M20 and steel grade Fe415. [10]

   c) Draw idealized stress-strain curve for both steel and concrete and discuss on the design values of stresses. [5]

3. a) Write down the procedure for design of shear reinforcement. Also explain how the isolated footings are designed under punching shear? [8]

   b) Design the reinforcement required for a simple rectangular beam having effective span length of 6m. The beam is carrying 8 KN/m load from 120mm thick slab. Consider the width of beam 250mm and overall depth of beam to be 450mm. For loading calculation, consider live load on floor: 5 kN/m, floor finish: 3 kN/m, partition wall: 10 kN/m. M20 concrete and Fe415 steel are used. [12]

4. a) A concrete beam of 20m span, 200mm wide and 500mm deep is pre-stressed using a cable with cross sectional area of 250mm^2. The cable profile is parabolic with an eccentricity of 100mm above the centroid of the section at the end supports and 100mm below at the mid span. If the cable is tensioned from one end only, estimate the percentage loss of pre-stress in the cable due to the effects of friction. Consider m = 0.35 and k = 0.0015/m. Use the parabolic profile of the curve as $y = \dfrac{4e}{\ell^2} x(\ell - x)$. [12]

b) What do you understand by curtailment of tension steel in simple beams? Show by illustrating a neat sketch. [8]

5. a) Compare the factor of safety used in Working Stress Method and Partial Safety Factor used in Limit State Method for concrete and steel. [4]

b) Differentiate among the balanced, under reinforced and over reinforced section in a rectangular reinforced concrete section in limit state method with corresponding strain diagram. [8]

OR

Determine the moment of resistance of the section shown in figure below. Take $\sigma_{cbc} = 7$ N/mm^2 and $\sigma_{st} = 140$ N/mm^2. [8]
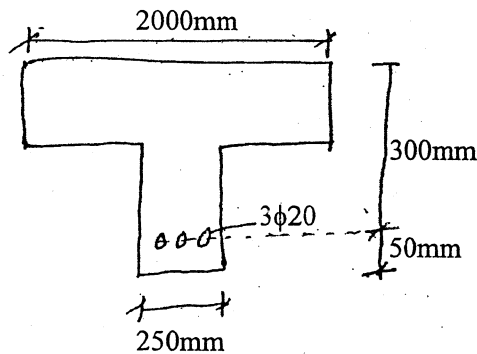
c) Design a square shaped reinforced concrete column that has to carry ultimate factored load of 800 kN inclusive of live load, at an eccentricity of 80mm in both X and Y directions. Use concrete grade M20 and steel grade Fe415. [8]

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