Hall Ticket No | | | | | | | | | | |

Question Paper Code: BST002

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

M.Tech I Semester End Examinations (Regular) - February, 2017

Regulation: IARE–R16

ADVANCED REINFORCED CONCRETE DESIGN

(Structural Engineering)

Time: 3 Hours **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Define Diagonal tension. How can we prevent diagonal tension in reinforced concrete beams? What are the conditions in which we design a doubly reinforced beam? **[8M]**

   (b) A rectangular simply supported beam 300 mm x 500 mm, spanning over 5 m is subjected to a maximum moment of 150 kN-m at the mid-span. The beam is reinforced with four bars of 25 mm diameter, on the tension side at an effective depth of 450 mm. The bars are spaced at 50 mm center to center. Check the beam for serviceability limit state of cracking if M20 concrete and Fe 415 steel are used **[6M]**

2. (a) Explain the terms short term and long term deflection in a beam. Explain the method of calculating long term deflection? **[7M]**

   (b) Design a rectangular beam 230 mm x 600 mm over an effective span of 5m. The superimposed load on the beam is 50 kN/m. Effective cover to reinforcement is taken as 50 mm. Use M20 concrete and Fe 415 steel. **[7M]**

UNIT – II

3. (a) Explain yield line formulation in Two-way slabs? List the guidelines for Yield Line Patterns. **[6M]**

   (b) Draw the bending moment diagram for a beam, fixed at ends and carrying total uniformly distributed load w_u, after 20% redistribution. Determine the magnitude by the point of contraflexure is shifted. **[8M]**

4. (a) Explain the bases underlying the various limitations imposed by the Code with regard to moment redistribution. **[6M]**

   (b) Apply yield line theory to estimate the collapse load of an isotropically reinforced circular slab of radius R, simply supported on the periphery, and subject to **[8M]**

   i. a uniformly distributed load of intensity w_u per unit area and

   ii. a concentrated load P_u at the centre.

UNIT – III

5. (a) Explain the geometry, behavior and design considerations for a waffle slab? **[6M]**

   (b) How is the positive and negative bending moments distributed in the column and middle strips in the interior span in the Direct Design method of Flat Slabs? How is the effect of pattern load considered in Direct Design method as per IS 456 code? **[8M]**

6. (a) List a few factors that affect the punching shear strength of flat slabs. How is a flat slab designed for punching shear? State the equations for nominal shear stress and design shear stress. **[6M]**

   (b) Design the interior panel of a large single-storey warehouse flat slab roof with a panel size of 6 m x 6 m supported by columns of size 500 mm x 500 mm. The height of the columns is 5m. Take live load as 3.0 kN/m^2 and the weight of finishes including waterproof treatment as 2.5 kN/m^2. Use M25 concrete and Fe 415 steel. Assume mild environment. **[8M]**

UNIT – IV

7. (a) Describe the detailing to be adopted in simply supported deep beams according to IS 456: 2000. How are bearing stresses checked in deep beams? **[4M]**

   (b) Design a corbel to support a factored vertical load of 300 kN, applied at a distance of 350mm from the column face. The column is 300 mm x 500 mm in plan. Assume M30 concrete, Fe 415 steel, and moderate environment. **[10M]**

8. (a) Why is anchoring of main bar important in corbels? What are the methods suggested in IS 456 for anchoring the main bars of corbels? **[4M]**

   (b) Design a simply supported, 300 mm thick RC vertical deep beam of height 4.0 m, which is supported over 500 mm wide piers having a clear spacing of 5m. The beam carries a service superimposed load of 200 kN/m. Assume M20 grade concrete and steel of grade Fe 415 **[10M]**

UNIT – V

9. (a) What are the variables that affect the strength and behavior of slender columns? Differentiate the behavior of a slender column from that of a short column. **[4M]**

   (b) Design a rectangular combined footing to support two columns of size 300 mm x 300 mm (with six 16mm bars) and 400 mm x 400 mm (with six 20mm bars), carrying 800 kN and 1200 kN (service + dead loads), respectively. These columns are located 3.6 m apart and the column carrying 800 kN is flush with the property line. Assume SBC of 200 kN/m^2. Assume M25 concrete in columns and M20 concrete in the footing and Fe 415 steel in the columns as well as footing. **[10M]**

10. (a) Explain the behavior of combined two-column footing. **[4M]**

    (b) Design the reinforcement of a short column of size 300 mm x 500 mm and unsupported length of 3m subjected to a factored axial load P_u of 1400 kN and factored moment M_{ux} about major axis of 130 kNm and M_{uy} about minor axis of 60 kNm. Adopt M30 concrete and Fe 500 grade steel and assume moderate environment. **[10M]**