BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

SECOND SEMESTER 2021 – 2022

DESIGN OF PRESTRESSED CONCRETE STRUCTURE (COMPREHENSIVE EXAMINATION)

Course No: CE F415 (Close Book) Time = 3 hours Total Marks: 100

Attempt all questions. Assume suitable data if necessary.

Q1. Answer the following questions 3 x 5 =15

a) What is transmission length?
b) What is differential shrinkage?
c) What is cap cable?
d) What is concordant cable profile?
e) What is Hoyer effect?

Q2. Derive the expression for ultimate shear resistance of prestressed concrete due to web shear cracking. 5

Q3. A rectangular concrete beam having cross sectional dimensions- 200 mm width and 600 mm depth and having span equal to 10 metres is pretensioned by a force of 1000 kN at a constant eccentricity of 200 mm. If the beam is carrying a transversely acting concentrated load of 100 kN at mid-span, determine the location of the pressure line when the self-weight of the beam is neglected. 10

Q4. A rectangular concrete beam having dimensions 300 mm width and 900 mm depth is post-tensioned by effective pre-stressing force 1800 kN at a constant eccentricity of +300 mm. If the beam carries a uniformly distributed load of 20 kN/m including its self-weight over its entire span of 8 m, determine the ultimate web shear resistance of the beam at support using IS:1343-2012. Assume, weight density of concrete to be 24 kN/m^3. Assume characteristic strength of the concrete to be 40 N/mm^2. 15

Q5. A rectangular simply supported beam having cross sectional dimensions 250 mm width and 500 mm depth is post tensioned by an effective force of 500 kN. The force is applied through a concentrically placed distribution plate at the end. The distribution plate is 100 mm deep and extending over the full width of the cross section. Assuming that the tensile stress is critical at a distance half the depth of the beam, calculate the bursting tensile force on a horizontal plane passing through the centreline of the distribution plate using- (a) Magnel's Method and (b) IS:1343-2012. 15

Q6. A post-tensioned beam having an equal flanged 'I' cross section needs to carry a live load having intensity 4 kN/m over its simply supported span of 30 metres. Both the top and bottom flanges are 500 mm wide and 150 mm deep. The web is 200 mm thick, and the overall depth of the beam is 1100 mm. The following data are given - permissible tensile stresses are zero at transfer and at working, permissible compressive stresses at working = 16.5 N/mm^2, permissible compressive stresses at transfer =15 N/ mm^2, Loss ratio = 0.80. Assuming an effective cover of 150 mm to the post-tensioning cables, answer the following - (a) Check for minimum sectional modulus requirement, (b) Check for stresses at extreme fibres, (c) Calculate

the minimum prestressing force and corresponding maximum possible eccentricity and (d) Is the structure a Class-I category structure? Comment on it. 25

Q7. A continuous prestressed concrete beam having an overall depth of 1500 mm and width 400 mm is carrying uniformly distributed loads of intensity 15 kN/m and 9 kN/m inclusive of its self-weight over its two equal spans of 20 m each respectively. (a) Draw the resultant bending moment diagram of the entire structure and indicate the secondary moment due to the redundant reaction from the applied (imposed + dead) load. (b) Suggest the nature of a possible concordant profile for the applied loading so that the secondary reaction becomes zero. 15