C **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 52U03

M.E. DEGREE EXAMINATION, APRIL 2019

Second Semester

Structural Engineering

15PSE203– PRESTRESSED CONCRETE STRUCTURES

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART - A (5 x 1= 5 Marks)

1. High-strength mixes should have a water/cement ratio of CO1- R

   (a) 0.6 to 0.8 (b) 0.3 to 0.4 (c) 0.2 to 0.3 (d) 0.1 to 0.3

2. The maximum effective reinforcement ratio of a bonded prestressed concrete beam at failure according to IS 1343 is limited to a value of CO2 -R

   (a) 0.15 (b) 0.40 (c) 0.25 (d) None of the above

3. What is the value of secondary moment in a continuous beam with concordant cable profile? CO3- R

   (a) 0.024 (b) 0 (c) 0.028 (d) 0.031

4. The prestressed water tank kept empty for a long period leads to CO4 -R

   (a) cracking (b) crushing (c) bottom failure (d) collapse of the structure

5. Composite construction using PSC and CIP concrete is adopted in CO5- R

   (a) water tanks (b) pipes (c) bridges (d) poles

PART – B (5 x 3= 15Marks)

6.	Differentiate full prestressing and partial prestressing.	CO1-U	
7.	Define Bursting tension.	CO2-R	
8.	What are cap cables and where they are used?	CO3-U	
9.	Define circular prestressing.	CO4-U	
10.	Define unpropped construction in composite PSC construction.	CO5-R	

PART – C (5 x 16= 80Marks)

11.	(a)	A prestressed concrete beam of section 150 mm wide and 300mm deep is used over an effective span of 6 m support a udl of 5 kN/m including self weight. The beam is concentrically prestressed by a straight cable carrying a force of 200 KN.Determine the location of the thrust line in the beam and plot its position.	CO1- App	(16)
		Or		
	(b)	A rectangular concrete beam of cross section 30 cm deep and 20 cm wide is prestressed by means of 15 wires of 5 mm diameter located 6.5 cm from the bottom of the beam and 3 wires of 5 mm diameter located at 2.5 cm from the top. Assuming the prestress in the steel as 840 N/mm^2, calculate the stresses at the extreme fibres of the midspan section when the beam is supporting its own weight over a span of 6 m. If anudl of 6 KN/m is imposed, evaluate the maximum working stress in concrete. Take density of concrete as 24 KN/m^3.	CO1- App	(16)
12.	(a)	A pretensioned prestressed concrete beam having a rectangular section 150 mm wide and 350 mm deep has an effective cover of 50 mm. If f_{ck} = 40 N/mm^2, f_p= 1600 N/mm^2 and the area of prestressed steel A_p = 461 mm^2. Calculate the ultimate flexural strength of section using IS 1343 provisions	CO2- App	(16)
		Or		
	(b)	The cross-section of a prestressed concrete beam is a T-section with an overall depth of 1200 mm. Thickness of web is 200 mm. Width and depth of flange are 1000 mm and 200 mm respectively. At a particular section the beam is subjected to an ultimate bending moment 2000 kNm and a shear force 250 kN. Design the shear reinforcement necessary for the zone near that section. The other details of the beam are as follows: Effective depth, d = 1100 mm; V_u = 250 kN; f_{ck}= 40 N/mm^2; Effective prestress at the extreme tensile face, f_{ep} = 19.3 N/mm^2; Moment of Inertia = 7.533 x $10^{10} mm^4$; Area of prestressing steel,	CO2- App	(16)

A_p = 2310 mm^2 ; Tensile strength of tendons, f_p = 1500 /mm^2 ; Effective prestress after losses, f_{pe}= 900 N/mm^2.

13. (a) A continuous beam ABC (AB=BC=20m) with a overall depth of 1m, is prestressed by a continuous cable carrying a force of 300kN. The cable profile is parabolic between the supports, with zero eccentricity at ends A and C. The cable has an eccentricity of 100mm towards the soffit at mid span sections and 200mm towards the top fibre at the mid support section. Evaluate the reactions developed at the supports due to prestress and show that the cable is concordant. CO3-App (16)

Or

(b) A continuous beam ABC (AB=BC=10m) is prestressed by a parabolic cable carrying an effective force of 200kN.The beam supports dead load and live load of 0.24kN/m and 2.36 kN/m respectively. Calculate the resultant moments developed in the beam and locate the pressure line. CO3-App (16)

14. (a) A cylindrical PSC water tank of internal diameter 30m is required to store water over a depth of 7.5m. The permissible compressive stress in concrete at transfer is 13 N/mm^2 and the minimum compressive stress under working pressure is 1 N/mm^2. The loss ratio is 0.75. Wires of 5mm diameter with an initial stress of 1000 N/mm^2 are available for circumferential winding and Freyssinet cables made up of 12 wires of 8mm diameter stressed to 1200 N/mm^2 are to be used for vertical prestressing. Design the tank walls assuming the base as fixed. The cube strength of concrete is 40 N/mm^2. CO4 -App (16)

Or

(b) Design a non-cylinder prestressed concrete pipe of internal diameter 500 mm to withstand a working pressure of 1 N/mm^2. High-tensile wires of 2 mm diameter stressed to 1200 N/mm^2 at transfer are available for use. Permissible maximum and minimum stresses in concrete at transfer and working loads are 13.5 N/mm^2 and 0.8 N/mm^2 (compression), respectively. Loss ratio=0.8, E_s=210 kN/mm^2, E_c = 35 kN/mm^2. Calculate,
(a) the minimum thickness of concrete foe the pipe,
(b) number of turns of wire per metre length of the pipe,
(c) the test pressure required to produce a tensile stress of CO4 -App (16)

0.7 N/mm^2 in the concrete when applied immediately after tensioning, and

(d) the winding stress in the steel.

15. (a) Explain, with necessary sketches, the steps in designing a partially prestressed concrete giving all the required equations and conditions. CO5-U (16)

Or

(b) A precast pretensioned beam of rectangular section has a breadth of 100 mm and a depth of 200 mm. The beam with an effective span of 5 m is prestressed by tendons with their centroids coinciding with the bottom kern. The initial force in the tendons is 150 kN. The loss of prestress may be assumed to be 15%. The beam is incorporated in a composite T-beam by casting a top flange of breadth 400 mm and thickness 40 mm. If the composite beam supports a Live Load of 8 kN/m^2, calculate the resultant stresses developed in the precast and in situ cast concrete assuming the pretensioned beam as Unpropped during the casting of the slab if the modulus of elasticity for concrete in precast beam and in CIP slab are different. Assume E_c (PSC) = 35 kN/mm^2 and E_c (CIP) = 28 kN/mm^2. CO5-App (16)