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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Eighth Semester, B.E. - Civil Engineering

Semester End Examination; July / Aug. - 2022

Design of Pre-Stressed Concrete Structures

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Apply the knowledge of principles of prestressing.

CO2: Analyze the stresses in PSC members under flexure.

CO3: Evaluate various losses, defection members, flexural strength, shear strength and principal tensile stresses in PSC members.

CO4: Design PSC beams for shear and end block design as per codal provisions.

Note: *I) **PART - A** is compulsory. **Two** marks for each question.*

*II) **PART - B**: Answer any **Two** sub questions (from a, b, c) for a Maximum of **18 marks** from each unit.*

III) IS:1343-2012 is permitted. Assume any missing data.

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
I a.	Define pre-tensioning.	2	L1	CO1	PO1,2
b.	Write any two assumptions made in analysis of PSC beams.	2	L1	CO2	PO1,2
c.	What is short term deflection?	2	L1	CO3	PO1,3
d.	Define End block.	2	L1	CO4	PO1,3
e.	What is time dependent loss?	2	L1	CO3	PO1,3
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	Distinguish between pre-tensioning and post-tensioning.	9	L2	CO1	PO1,2
b.	Explain the necessity of using high strength concrete and high strength steel in pre-stressed concrete structures.	9	L2	CO1	PO1,2
c.	Explain with neat sketches load balancing concept.	9	L2	CO1	PO1,2
	UNIT - II	**18**			
2 a.	An unsymmetrical I-section beam is used to support a live load of 5 kN/m over a span of 12 m. The sectional details are, top flange 400 mm wide and 80 mm thick, bottom flange 250 mm wide and 80 mm thick, thickness of the web is 80 mm and overall depth of beam = 500 mm. At the center of the span the effective pre-stressing force is 140 kN is located at 60mm from the soffit of the beam. Estimate the stress at the center of the span section of the beam for the following conditions. Consider density of concrete = 25 kN/m^3 i) At transfer condition ii) At working condition	18	L3	CO2	PO1,2

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b. A cantilever beam of span 4 m is 250 mm × 400 mm in section. It is pre-stressed with an initial pre-stressing force of 400 kN located at 80 mm from the tension edge. The beam carries a load of 3 km/m together with point load of 12 kN at 1.5 m from free end in addition to its own weight. 18 L3 CO2 PO1,2

i) Transfer of pre-stress ii) Working load condition

Assume loss of pre-stress as 20%. Also draw stress distribution diagrams across the section.

UNIT - III **18**

3 a. Explain the types of pre-stress losses. How do you compute loss of pre-stress due to elastic shortening of concrete? 9 L2 CO3 PO1,3

b. A post tensioned rectangular beam 300 × 500 mm is pre-stressed with initial pre-stresses of 700 N/mm^2. The Beam consists of 4 straight cables of each of area 200 mm^2. The cables are situated at 125 mm below the neutral axis. The cables are pulled one by one. Determine;

i) Percentage loss of Pre-stress due to concrete 9 L3 CO3 PO1,3

ii) Percentage loss of pre-stress due to concrete + anchorage slip.

Given: Shrinkage strain = 2×10^{-4}, modular ratio = 5, span = 10 m, stress relaxation in steel = 2%, $E_S = 2.1\times10^5$ N/mm^2, slip of anchorage = Δ = 2.5 mm.

c. A pre-stressed concrete beam of rectangular section 120 mm wide and 300 mm deep pre-stressed by a straight cable carrying an effective force of 150 kN at an eccentricity of 60 mm. Beam supports an imposed load of 5 kN/m over a span of 8 m. Compute the deflection for short-term and long term deflection and check whether they comply with IS code recommendations. 9 L3 CO3 PO1,3

Take; E_c = 36 kN/mm^2, creep co-efficient = 2, loss ratio = 0.9 density of concrete = 24 kN/m^3.

UNIT - IV **18**

4 a. A PSC beam 250 mm wide and 600 mm deep is pre-stressed by tendons having an area of 560 mm^2 located at 150 mm form soffit of the beam. Given f_{ck} = 40 N/mm^2 and f_P = 1600 N/mm^2. Estimate the flexural strength of the beam for the following cases as per IS code recommendations. 9 L3 CO3 PO1,3

i) If the beam is pre-tensioned

ii) If the beam is post-tensioned with effective bond

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b.	Explain the different types of flexural failures in a PSC member.	9	L2 CO3 PO1,3
c.	A pre-tensioned T section has a flange width of 120 mm and 150 mm thick. The width and depth of the rib are 300 mm and 1500 mm respectively. The high tension steel has an area of 4700 mm^2 and is located at an effective depth of 1600 mm. If the characteristic cube strength of the concrete and the tensile strength of the steel are 40 and 1600 MPa respectively. Calculate the flexural strength of the section.	9	L3 CO3 PO1,3
	UNIT - V	**18**	
5 a.	A circular anchorage 100 mm diameter carrying 12 wires of 7 mm diameter is concentrically located in the ends of I-section of web thickness 225 mm with overall depth of 500 mm. Determine the bursting force and maximum tensile stress in the end block. Design the end block using IS-1343-2012. Assume f_P = 1600 N/mm^2 and sketch the reinforcement details.	18	L3 CO4 PO1,3
b.	The end block of a PSC beam of rectangular section is 150 mm wide and 400 mm deep. An effective pre-stressing force of 400 kN is transmitted to concrete by a distribution plate of 150 mm wide and 120 mm deep concentrically located at the ends. Calculate the maximum bursting force and design the reinforcement for end block using Fe415 grade steel. Also calculate maximum tensile stress and sketch the reinforcement details	18	L3 CO4 PO1,3

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