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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 - 2023

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 pre-stressing.

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**			
1 a.	What is the basic principle of prestressed concrete?	2	L1	CO1	PO1,2
b.	A concrete beam supports two concentrated loads equally spaced on the simply supported span. Suggest a suitable cable profile to counteract the effect of these live loads	2	L1	CO3	PO1,3
c.	What is anchorage slip?	2	L1	CO3	PO1,3
d.	How do you estimate the ultimate shear strength of PSC sections with web shear cracks?	2	L2	CO3	PO1,3
e.	Define anchorage zone.	2	L1	CO4	PO1,3
	II : PART - B	**90**			
	UNIT - I	**18**			
2 a.	With the neat sketches, explain pre-tensioning and post-tensioning. State the advantages and disadvantages of these methods.	9	L2	CO1	PO1,2
b.	Differentiate between; i) Concentric and eccentric tendons ii) RCC and PSC iii) Bonded and Unbonded beam	9	L3	CO1	PO1,2
c.	Outline the stress concept used for the analysis of SSB subjected to parabolic cable profile maximum at mid span and zero at support along with imposed load on it.	9	L4	CO2	PO1,2

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UNIT - II **18**

3 a.	A simply supported beam of PSC spanning over 10 m is of rectangular section 500 mm wide by 750 mm deep. The beam is prestressed by a parabolic cable having an eccentricity of 200 mm at the centre of span and zero at the end supports. The effective force in the cable is 1600 kN. If the beam supports a total UDL of 40 kN/m, which includes the self weight of the beam, i) Evaluate the extreme fiber stresses at the mid span section and draw the stress diagram ii) Calculate the force required in the cable having the same eccentricity to balance a total load of 50 kN/m on the beam	18	L3	CO2	PO1,2
b.	A concrete beam of symmetrical I-section spanning 8 m has the width and thickness of flanges equal to 200 and 60 mm respectively. The overall depth of beam is 400 mm. The thickness of web is 80 mm. The beam is prestressed by a parabolic cable with an eccentricity of 150 mm at the centre and zero at the supports with an effective force of 100 kN. The live load on the beam is 2 kN/m. Draw the stress diagram at the central section for, i) Prestress + Self weight (Density of concrete 24 kN/m^3) ii) Presstress + self weight – live load	18	L3	CO2	PO1,2

UNIT - III **18**

4 a.	What are the factors influencing the loss of stress due to creep of concrete and how do you compute the loss of stress due to it.	9	L3	CO3	PO1,3
b.	A pre-tensioned beam 250 mm wide and 30 mm deep is prestressed by 12 wires each 7mm dia initially stressed to 1200 N/mm^2 with their centroids located 100 mm from the soffit. Estimate the final percentage loss of stress due to elastic deformation, creep, shrinkage and relaxation with the following data: Relaxation of steel stress = 90 N/mm^2, E_S = 210 kN/mm^2, E_C = 35 kN/mm^2, creep co–efficient (ϕ) = 1.6, residual shrinkage strain = 3 x 10^{-4}.	9	L3	CO3	PO1,3
c.	A PSC beam of rectangular section 120 x 300 mm spans over 6 m. The beam is prestressed by a straight cable carrying an effective force of 200 kN at an eccentricity of 50 mm. The module of elasticity of concrete is 38 kN/mm^2. Compute the deflection at centre of span for the following cases:	9	L3	CO3	PO1,3

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i) Deflection under prestress + self weight

ii) Find the magnitude of the UDL which will nullify the deflection due to prestress and self weight

UNIT - IV **18**

5 a.	A pre-tensioned PSC T-section having a flange width of 1200 mm and thickness of flange 150 mm, thickness of web being 300 mm is prestressed by 4700 mm^2 of high tensile steel located at an effective depth of 1600 mm. If f_{ck} = 40 N/mm^2 and f_p = 1600 N/mm^2, estimate the ultimate moment capacity of the pre tensioned T-section.	9	L3	CO3	PO1,3
b.	A concrete beam of rectangular section 200 x 600 mm is prestressed by a parabolic cable located at an eccentricity of 100 mm at mid span and zero at support. If the beam has a span of 10 m and carries a UDL of 4 kN/m, find the effective force necessary in the cable for zero shear stress at the support section. For this condition calculate the principal stresses. The density of concrete is 24 kN/m^3.	9	L3	CO3	PO1,3
c.	A prestressed girder of rectangular section 150 x 300 mm is to be designed to support an ultimate shear force of 130 kN. The uniform prestress across the section is 5 N/mm^2. Given the characteristic cube strength of concrete as 40 N/mm^2 and Fe – 415 HYSD bars of 8 mm dia, design suitable spacing for the stirrups conforming to the IS : 1343 recommendations. Assume cover to the reinforcement as 50 mm.	9	L3	CO3	PO1,3

UNIT - V **18**

6 a.	A post-tensioned concrete beam 400 x 800 mm is prestressed by an effective prestressing force of 1100 kN at an eccentricity of 120 mm. The anchor plate is 400 mm x 400 mm. Calculate the bursting force and design reinforcement to resist this force. Sketch the details of reinforcement.	18	L4	CO4	PO1,3
b.	The end block of a post-tensioned beam is 300 x 300 mm and is prestressed concentrically by a Freyssinet cylindrical anchorage of 150 mm dia with a jacking force of 800 kN. Design suitable anchorage zone reinforcement and sketch the details.	18	L4	CO4	PO1,3

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