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PRESIDENCY UNIVERSITY BENGALURU

 **SET-B**

SCHOOL OF ENGINEERING

**MAKE-UP EXAMINATION JULY 2024**

**Semester :** Semester VI

**Course Code :** CIV3047\_v02

**Date :** 01 JULY 2024

**Time :** 9:30 AM 12:30 PM

#  Course Name : - Fundamentals of Pre-Stressed Concrete Design Max Marks : 100

**Program :** B. Tech. **Weightage:** 50%

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

# PART A

## Answer any 10 Questions 10\*2 = 20 Marks

* 1. Outline the expressions used to calculate the fiber stresses at the top and bottom of a PSC beam subjected to only pre stressing force when the cable is eccentrically placed.
	2. Define relaxation of stresses in steel in the case of PSC elements.
	3. Outline the strength requirements of concrete used for PSC elements.
	4. Define creep and shrinkages in concrete.
	5. List any two advantages and disadvantages of pre stressed concrete elements.
	6. Illustrate with the help of a neat sketch "thrust line" in a PSC beam.
	7. Define pre-tensioning and post-tensioning of PSC members.

(CO1) [Knowledge] (CO1) [Knowledge] (CO1) [Knowledge] (CO1) [Knowledge] (CO1) [Knowledge] (CO1) [Knowledge]

(CO1) [Knowledge]

* 1. Write the expression used to calculate the loss of prestress due to elastic deformation of concrete.

(CO2) [Knowledge]

* 1. Mention the percentage of total loss of prestress allowed in pre-tensioned and post-tensioned PSC members.

(CO2) [Knowledge]

* 1. Mention the expression used to determine the loss of prestress due to friction in PSC members.

(CO2) [Knowledge]

* 1. List the various losses of prestress in Post-tensioned PSC members.

(CO2) [Knowledge]

* 1. Mention the expression to calculate deflection of a PSC member for the below cable profile.



(CO2) [Knowledge]

* 1. Mention the expression used to calculate moment of resistance of rectangular sections as per IS1343: 2012.

(CO3) [Knowledge]

* 1. Flexural failure of prestressed concrete members can be avoided by providing minimum reinforcement. For a prestressed concrete beam 230mm wide and 300mm deep and length 6m. Calculate the required minimum steel for the said cross section as recommended by IS1343: 2012.

(CO3) [Knowledge]

# PART B

## Answer any 8 Questions 8\*5 = 40 Marks

* 1. A rectangular concrete beam 200 mm wide and 600 mm deep supports two concentrated loads of 20 kN each at the third point of a span of 8m. Suggest a suitable cable profile, if the eccentricity of the cable profile is 75 mm for the middle third portion of beam, calculate the prestressing force required to balance the bending effect of the concentrated loads (neglect self-weight of beam).

(CO1) [Comprehension]

* 1. A prestressed concrete beam with a rectangular section 120 mm wide and 300 mm deep supports a uniformly distributed load of 4 kN/m, which includes self-weight of the beam. The effective span of the beam is 6 m. The beam is concentrically prestressed by a cable carrying a force of 200 kN. Locate the position of the pressure line in the beam.

(CO1) [Comprehension]

* 1. A rectangular concrete beam, 250mm wide and 500mm deep, is prestressed by means of four 14mm dia high-tensile bars located 200mm from soffit of the beam. If the effective stress in the wires is 600 N/mm², what is the maximum bending moment that can be applied to the section without causing tension at the soffit of the beam?

(CO1) [Comprehension]

* 1. Sketch the resultant stress distribution along the cross section of a PSC beam subjected to pre stressing force (P) and UDL of intensity w kN/m when the cable is placed eccentrically (distance e from centroidal axis).

(CO1) [Comprehension]

* 1. A rectangular concrete beam 300 mm wide and 800 mm deep supports two concentrated loads of 25 kN each at the third point of a span of 9m. Suggest a suitable cable profile, if the eccentricity of the cable profile is 100 mm for the middle third portion of the beam, calculate the prestressing force required to balance the bending effect of the concentrated loads (neglect self-weight of beam).

(CO1) [Comprehension]

* 1. Explain briefly the influence of shrinkage and creep in prestressed concrete members.

(CO2) [Comprehension]

* 1. A pretensioned concrete beam of rectangular cross section 150mm wide and 300 mm deep, is prestressed by 8 high tensile wires of 7mm diameter located at 100 mm from the soffit (bottom) of the beam. If the wires are tensioned to a stress of 1200 N/mm², calculate the percentage loss of stress due to elastic deformation assuming the modulus of elasticity of concrete and steel as 31.5 kN/mm² and 210 kN/mm².

(CO2) [Comprehension]

* 1. Discuss the application of Mohr's theorem in the determination of deflection of PSC members.

(CO2) [Comprehension]

* 1. Outline the factors influencing deflection of PSC beams.

(CO2) [Comprehension]

* 1. Write the expression to estimate the long term deflections of PSC beams and name the terms.

(CO2) [Comprehension]

* 1. Explain briefly various types of flexural failure of prestressed concrete member.

(CO3) [Comprehension]

* 1. Describe the various modes of failure of PSC beams other than flexure.

(CO3) [Comprehension]

# PART C

## Answer any 4 Questions 4\*10=40 Marks

* 1. A prestressed concrete beam, 120 mm wide and 300 mm deep, is prestressed by a cable which has an eccentricity of 100 mm at the center-of-span section. The span of the beam is 6 m. If the beam supports two concentrated loads of 10 kN each at one-third span points, determine the magnitude of the prestressing force in the cable for load balancing for the following cases:

Considering live loads but neglecting self-weight of the beam, and considering both self-weight of the beam and live loads. Dc = 24 kN/m³

(CO1) [Application]

* 1. A rectangular concrete beam of cross section 300 mm deep and 200 mm wide is prestressed by means of 15 wires of 5 mm diameter located 65 mm from the bottom of the beam and 3 wires of diameter 5 mm, 25 mm from the top. Assuming the prestress in steel as 840 N/mm², calculate the stresses at the extreme fibers of the mid-span section when the beam is supporting its own weight over a span of 6 m. If a uniformly distributed LL of 6 kN/m is imposed, evaluate the maximum working stress in concrete. The density of concrete is 24 kN/m³.

(CO1) [Application]

* 1. A post tensioned concrete beam, 150mm wide and 300mm deep, is prestressed by three cables, each with a cross-sectional area of 50mm² and with an initial stress of 1200N/mm². All the three cables are straight and located 100mm from the soffit of the beam. If the modular ratio is 6, calculate the loss of stress due to elastic deformation of concrete for the following cases:
		1. Simultaneous tensioning and anchoring of all three cables
		2. Successive tensioning of the three cables

(CO2) [Application]

* 1. The deck of prestressed concrete culvert is made up of a slab of 500 mm thick. The slab is spanning over 10.4 m and supports a total UDL of 33.5 kN/m, including Dead Load and Live Load. The modulus of elasticity of concrete is 38 kN/mm². The concrete slab is prestressed by a straight cable each containing 12 high tensile wires of 7mm diameter stressed to 1200 N/mm² at a constant eccentricity of 195 mm. The cables are spaced at 328 mm intervals in the transverse direction. Estimate the instantaneous deflection of the slab at center of span under prestress and the imposed loads.

(CO2) [Application]

* 1. A post tensioned concrete beam 100 mm wide and 300 mm deep, spanning over 10 m is stressed by successive tensioning and anchoring of three cables 1, 2 and 3 respectively. The cross sectional area of each cable is 200 mm² and the initial stress in the cable is 1200 N/mm², modular ratio is 6. The first cable is parabolic with an eccentricity of 50mm below the centroidal axis at the center of span and 50 mm above the centroidal axis at the support sections. The second cable is parabolic with zero eccentricity at the supports and 50mm eccentricity at center. The third cable is straight with a uniform eccentricity of 50 mm below the centroidal axis. Estimate the percentage loss of stress in each of the cables due to elastic deformation of concrete, if they are successively tensioned and anchored.

(CO2) [Application]

* 1. A pre-tensioned T-beam has a flange width of 300 mm and thickness of 200 mm. The rib is 150 mm wide and 350 mm deep. The beam is prestressed by tendons of cross-sectional area of 200 mm² at an effective depth of 500 mm. If fck = 50 N/mm² and fpu = 1600 N/mm², estimate the flexural strength of section per IS1343 specifications.

(CO3) [Application]