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PRESIDENCY UNIVERSITY BENGALURU

 **SET-A**

SCHOOL OF ENGINEERING

**END TERM EXAMINATION – MAY/JUNE 2024**

**Semester :** Semester VI - 2021

**Course Code :** CIV3047\_v02

**Date :** June 19, 2024

**Time :** 1:00 PM - :400 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 Question 10\*2 = 20 Marks

* 1. List any two differences between a conventional RCC member and PSC member.
	2. Outline the various methods of pre stressing.

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

* 1. Define the following terms related to PSC members (i) Load balancing (ii) Cracking moment

(CO1) [Knowledge]

* 1. List the assumptions made in the analysis of stresses in pre stressed concrete members.

(CO1) [Knowledge]

* 1. What do you mean by axial pre-stressing and eccentric pre-stressing of PSC members?

(CO1) [Knowledge]

* 1. Define creep and shrinkages in concrete.
	2. List the applications of pre stressed concrete.

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

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

(CO2) [Knowledge]

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

(CO2) [Knowledge]

* 1. A post tensioned concrete beam 100 mm wide and 300 mm deep, spanning over 10 m is stressed by three cables. 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 50 mm eccentricity at center. The third cable is straight with a uniform eccentricity of 50 mm below the centroidal axis. Sketch the PSC beam and show the cable profiles.
	2. List the various losses of prestress in Pre-tensioned PSC members.

(CO2) [Knowledge]

(CO2) [Knowledge]

* 1. Write the expression to calculate the loss of prestress due to shrinkage of concrete.

(CO2) [Knowledge]

* 1. List the assumptions made in strain compatibility method of analysis of PSC members in flexure.

(CO3) [Knowledge]

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

(CO3) [Knowledge]

# PART B

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

* 1. Prestressing is a process in which internal stresses are introduced in a planned manner, so that the stresses resulting from the superimposed loads are counteracted to a desired degree. Explain the mechanism of pre tensioning of a PSC element.

(CO1) [Comprehension]

* 1. A rectangular concrete beam, 300mm wide and 600mm deep, is prestressed by means of four 14mm dia high-tensile bars located 200mm from the soffit of the beam. If the effective stress in the wires is 700 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. A rectangular concrete beam of cross section 120 mm wide and 300 mm deep is prestressed by a straight cable carrying an effective force of 180 kN at an eccentricity of 50 mm. The beam supports a total load of 4 kN/m over a span of 6m. If the modulus of rupture of concrete is 5 N/mm², evaluate the load factor against cracking assuming the density of concrete as 24 kN/m³.

(CO1) [Comprehension]

* 1. A prestressed concrete beam with a rectangular section 120 mm wide and 300 mm deep supports a uniformly distributed load of 3 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 250 kN. Locate the position of pressure line in the beam.

(CO1) [Comprehension]

* 1. Discuss the effect of external loading on the tensile stresses in tendons. Mention the expressions to calculate the slope at the ends of a beam for the following conditions (i) beam subjected to only pre stressing force (ii) beam subjected to pre stressing and external UDL.

(CO1) [Comprehension]

* 1. A concrete beam having a width of 100 mm and depth of 300 mm is post tensioned by a parabolic cable with an eccentricity of 50 mm at the center of span and concentric at the supports. Prestressing force in the cable is 280 kN. Assuming an ultimate creep coefficient of 3, estimate the loss of stress in the cable due to creep of concrete. Take modular ratio as 6.

(CO2) [Comprehension]

* 1. A concrete beam is post-tensioned by a cable carrying an initial stress of 1000N/mm². The slip at the jacking end was observed to be 5mm. The modulus of elasticity of steel is 210 kN/mm². Estimate the percentage loss of stress due to anchorage slip if the length of the beam is (i) 20m and (ii) 30m

(CO2) [Comprehension]

* 1. Mention the expressions to calculate the deflections in prestressed beams due to the following cable profiles (i) Straight with constant eccentricity (ii) Parabolic with zero eccentricity at ends.

(CO2) [Comprehension]

* 1. A prestressed concrete beam of rectangular section 120mm wide x 300mm deep, spans over 6m. The beam is prestressed by a straight cable carrying effective force of 200kN at an eccentricity of 50mm. The modulus of elasticity of concrete is 38kN/mm² and density of concrete is 24kN/m³. Compute the deflection at the center span under prestress and self-weight.
	2. Describe briefly losses of prestress due to friction in PSC members.

(CO2) [Comprehension]

(CO2) [Comprehension]

* 1. Discuss the assumptions made in the strain compatibility method of flexural analysis of PSC beams.

(CO3) [Comprehension]

* 1. Explain with the help of a neat sketch, failure of under reinforced and over reinforced sections of PSC beams.

(CO3) [Comprehension]

# PART C

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

* 1. A prestressed concrete beam of section 120 mm wide by 300 mm deep is used over an effective span of 6 m to support a uniformly distributed load of 4 kN/m, which includes the self-weight of beam. The beam is prestressed by a straight cable carrying a force of 180 kN and located at an eccentricity of 50 mm. Determine the location of the thrust line and plot its position at quarter and central span sections.

(CO1) [Application]

* 1. A concrete beam, 120 mm wide and 300mm deep, is prestressed by a straight cable carrying an effective force of 180 kN at an eccentricity of 50 mm. The beam spanning over 6 m supports a total uniformly distributed load of 4 kN/m, which includes the self-weight of the beam. The initial stress in the tendons is 1000 N/mm². Determine the percentage increase of stress in the tendons due to the loading on the beam. Es = 210 kN/mm², Ec = 35 kN/mm².

(CO1) [Application]

* 1. A prestressed concrete pile, 250x250 mm, contains 60 pre-tensioned wires, each of 2mm diameter, uniformly distributed over the section. The wires are initially tensioned on the prestressing bed with a total force of 400 kN. Calculate the final stress in concrete and the percentage loss of stress in steel after all losses, given the following data:

Es = 210 kN/mm² and Ec = 32 kN/mm² Creep coefficient =1.5

Shrinkage strain = 0.0002

Relaxation of steel stress = 5% of initial stress

(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 concrete beam of 10m span, 150 mm wide and 300 mm deep, is prestressed by three cables. The area of each cable is 200 mm² and the initial stress in the cable is 1200 N/mm². Cable 1 is parabolic with an eccentricity of 50 mm above the centroid at the supports and 50 mm below the center of span. Cable 2 is also parabolic with zero eccentricity at supports and 50 mm below the center of span. Cable 3 is straight with uniform eccentricity of 50mm below the centroid. If the cables are tensioned from one end only, estimate the percentage loss of stress in each cable due to friction. Assume μ = 0.35 and k = 0.0015 per m.

(CO2) [Application]

* 1. A pre-tensioned prestressed concrete beam having a rectangular section with a width of 150 mm and overall depth of 350 mm is prestressed by tendons of effective area 461 mm² at an effective depth of 300 mm. Assuming a characteristic strength of concrete and steel as 35 and 1500 N/mm², estimate the ultimate flexural strength of the section using the provisions of IS1343 code.

(CO3) [Application]