GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering - SEMESTER - VII EXAMINATION - WINTER 2025

Subject Code: 3170624   **Date: 13-11-2025**

Subject Name: Design of Prestressed Concrete structures

Time: 10:30 AM TO 01:00 PM   **Total Marks: 70**

Instructions
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.
5. Use of IS: 1343 (2012) is permitted.

			Marks
Q.1	**(a)**	Justify why high-strength concrete and high-tensile steel are essential in prestressed concrete.	**03**
	(b)	Compare Pre-tensioning and post-tensioning techniques of prestressed concrete.	**04**
	(c)	Describe, with neat sketches, how the Load Balancing Concept can be used to effectively control deflection in prestressed concrete beams.	**07**
Q.2	**(a)**	Define the term Pressure Line or Thrust Line in a prestressed concrete beam. How is it related to the Load Balancing Concept?	**03**
	(b)	A prestressed concrete beam 300 mm x 500 mm is post tensioned by a parabolic cable with an eccentricity of 50 mm at the center and concentric at the supports, prestressing force is 500 kN. Estimate loss of prestress in cable due to creep of concrete. Take modular ratio 6 and creep coefficient as 3.0.	**04**
	(c)	Define the loss of prestress in prestressed concrete. Differentiate in detail between Immediate Losses and Time-Dependent Losses.	**07**

OR

	(c)	A rectangular beam of size 300×600 mm is prestressed by 8 wires of 9 mm diameter with their centroid at 50 mm below the centroidal axis of the beam. Initial prestress = 2000 N/mm^2, f_{ck}= 50 N/mm^2, Es=210 kN/mm^2, relaxation loss = 5%, creep coefficient= 1.6, Total shrinkage strain = 3×10^{-4}, Age of loading = 28 days, Relative humidity 60%, Calculate: (i) Loss of prestress due to elastic shortening of concrete (ii) Loss due to creep of concrete (iii) Loss due to shrinkage of concrete (iv) Loss due to relaxation of stress in steel	**07**
Q.3	**(a)**	Explain the terms: end block, anchorage zone.	**03**
	(b)	What are the different types of flexural failure modes of prestressed concrete beams? Explain with sketches.	**04**

(c) Explain the method of computing the flexural strength of rectangular and T-beam sections as per IS: 1343–2012. **07**

OR

(a) Explain the Strain Compatibility Method for determining the ultimate flexural strength of a prestressed concrete section. **03**

(b) Explain the concept of composite construction using prestressed and in-situ concrete. **04**

(c) Explain the phenomenon of bursting force that develops in the end block. If the end block of a post-tensioned concrete beam, with an overall square cross-section of side 400 mm, is subjected to a prestressing force of 500 kN through a square anchorage plate of side 120 mm. Calculate the bursting force as per IS 1343:2012. **07**

Q.4 (a) List the factors influencing the short term and long-term deflections of prestressed concrete members. **03**

(b) A pre-tensioned T-section has a flange 1200 mm wide and 200 mm thick. The rib is 250 mm wide and 450 mm deep. The effective depth of cross section is 600 mm. The high tensile steel has an area of 800 mm^2. If the characteristic cube strength of concrete and tensile strength of steel is 50 and 1860 N/mm^2 respectively, calculate the flexural strength of the T-section. **04**

(c) A rectangular concrete beam having section 150 × 450 mm is prestressed by a parabolic cable carrying initial prestressing force of 400 kN. The cable has an eccentricity of 100 mm at the center of span and is concentric at the supports. If span of the beam is 10 m and live load 4 kN/m, estimate short term deflection. **07**

Assuming E=35 kN/mm^2 and creep coefficient is 2.0, loss of prestress = 15% of initial prestress after 6 months, estimate long term deflection at the center of the span, assuming that dead load and live loads are simultaneously acting after the release of prestress.

OR

(a) Explain the modes of failure in prestressed concrete beams subjected to combined bending, shear and torsion. **03**

(b) Explain the procedure for calculating shear capacity of cracked and uncracked sections in prestressed concrete beams as per IS 1343:2012. **04**

(c) The support section of a prestressed concrete beam, 200 mm wide by 400 mm deep is required to support an ultimate shear force of 180 kN. The compressive prestress at the centroid axis is 6 N/mm^2. The characteristic cube strength of concrete is 50 N/mm^2, the cover to reinforcement is 40 mm. If the characteristic tensile strength of stirrups is 500 N/mm^2, design suitable shear reinforcement in the section as per the IS: 1343-2012. **07**

Q.5 (a) A prestressed concrete beam has a rectangular cross-section of 500 x 800 mm and a span of 12 meters. It carries a uniformly distributed load of 25 kN/m, which includes its own self-weight. The beam is axially prestressed by a cable providing an effective force of 2000 kN, applied along the longitudinal centroidal axis. Determine the extreme fiber stresses in the concrete at the mid-span section. **03**

(b) Explain elastic design of prestressed tension members. **04**

(c) A prestressed concrete beam span 12 m of rectangular section 200 mm wide and 450 mm deep is axially prestressed by a cable carrying an effective force of 350 kN. The beam supports total udl of 7 kN/m including self-weight. Compare the magnitude of principal tensile stress in the beam with and without axial prestress. **07**

OR

(a) List various types of prestressed tension and compression members. **03**

(b) Write the stress equations for a short prestressed concrete column at transfer and service load conditions. Define all the terms used. **04**

(c) Explain the procedure as per the IS 1343:2012 for designing a rectangular RC beam subjected to combined bending, shear, and torsion. **07**

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