Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2023

Subject Code:3170624 Date:01-12-2023

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 is permitted.**

			Marks
Q.1	**(a)**	What is the basic concept of Prestressed concrete?	**03**
	(b)	Briefly explain various types of tensioning devices used in prestressed concrete.	**04**
	(c)	A rectangular concrete beam, 360 mm deep and 200 mm wide, is prestressed by means of fifteen 5 mm diameter wires located 65 mm from the bottom of the beam and three 5 mm wires, located 25 mm from the top of the beam. If the wires are initially tensioned to a stress of 840 N/mm², calculate the percentage loss of stress in steel immediately after transfer, allowing for the loss of stress due to elastic deformation of concrete only. E_s = 210 kN/mm² & E_c=31.5 kN/mm²	**07**
Q.2	**(a)**	List the various types of loss of prestress in pre-tensioned and post-tensioned members.	**03**
	(b)	Distinguish between concentric and eccentric tendon.	**04**
	(c)	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 the 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 in the beam and plot its position at quarter and central span sections.	**07**
		OR	
	(c)	A rectangular concrete beam 250 mm wide by 300 mm deep is prestressed by a force of 540 kN at a constant eccentricity of 60 mm. The beam supports a concentrated load of 68 kN at the centre of a span of 3 m. Determine the location of the pressure line at the centre, quarter span and support sections of the beam. Neglect the self-weight of the beam.	**07**
Q.3	**(a)**	Explain the concept of pressure (thrust) line.	**03**
	(b)	Explain with neat sketches different types of flexure failure modes observed in prestressed concrete beam.	**04**
	(c)	A pretensioned, T-section has a flange 1200 mm wide and 150 mm thick. The width and depth of the rib are 300 and 1500 mm respectively. The high-tensile steel has an area of 4700 mm² and is located at an effective depth of 1600 mm. If the characteristic cube strength of the concrete and the tensile strength of steel are 40 and 1600 N/mm² respectively, calculate the flexural strength of the T-section.	**07**
		OR	
Q.3	**(a)**	Discuss IS 1343 recommendations for design of prestressed members subjected to bending and torsion.	**03**
	(b)	Briefly explain Strain Compatibility method.	**04**

	(c)	A post-tensioned beam with unbonded tendons is of rectangular section 400 mm wide with an effective depth of 800 mm. The cross-sectional area of the prestressing steel is 2840 mm². The effective prestress in the steel after all losses is = 900 N/mm². The effective span of the beam is 16 m. If f_{ck} 40 N/mm², estimate the ultimate moment of resistance of the section using IS:1343 code recommendations.	**07**
Q.4	**(a)**	Briefly explain failure due to web-shear cracks with neat sketch.	**03**
	(b)	What are the different ways of improving the shear resistance of structural concrete members by prestressing techniques?	**04**
	(c)	A post-tensioned bonded prestressed concrete beam of rectangular cross-section, 400 mm wide by 550 mm deep, is subjected to an ultimate bending moment of 250 kNm, ultimate torsional moment of 70 kNm and ultimate shear force of 100kN. The section has an effective prestressing force, determined from service load requirements, of magnitude 500 kN at an eccentricity of 150 mm, provided by 5 numbers of 12.5 mm stress-relieved strands of cross-sectional area 506 mm² with an ultimate tensile strength of 1820 N/mm². If the cube strength of concrete is 40 N/mm², design suitable longitudinal reinforcements in the beam using IS: 1343 code recommendations based on the skew bending approach.	**07**
		OR	
Q.4	**(a)**	Briefly explain failure due to flexure-shear cracks with neat sketch.	**03**
	(b)	Explain web shear cracks with neat sketch Discuss briefly the basic of Indian standard IS: 1343 code recommendations regarding the design of prestressed section subjected to shear.	**04**
	(c)	The support section of a prestressed concrete beam, 100 mm wide and 250 mm deep, is required to support an ultimate shear force of 60 kN. The compressive prestress at the centroidal axis is 5 N/mm². The characteristic cube strength of concrete is 40 N/mm². The cover to the tension reinforcement is 50 mm. If the characteristic tensile strength of steel in stirrups is 250 N/mm², design suitable reinforcements at the section using the IS: 1343 recommendations.	**07**
Q.5	**(a)**	Enlist various loads acting on bridges.	**03**
	(b)	Write a detail note on Bursting tensile forces according to IS 1343.	**04**
	(c)	The end block of a post-tensioned prestressed member is 550 mm wide and 550 mm deep. Four cables, each made up of 7 wires of 12 mm diameter strands and carrying a force of 1000 kN, are anchored by plate anchorages, 150 mm by 150 mm, located with their centres at 125 mm from the edges of the end block. The cable duct is of 50 mm diameter. f_{ck} is 45 N/mm². The cube strength of concrete at transfer is 25 N/mm². Permissible bearing stresses behind anchorages should conform with IS: 1343. The characteristic yield stress in mild steel anchorage reinforcement is 260 N/mm². Design suitable anchorages for the end block.	**07**
		OR	
Q.5	**(a)**	Explain various types of prestressed compression members.	**03**
	(b)	Briefly explain IS 1343 codal provision for limit state of serviceability for Maximum Compression.	**04**
	(c)	The end block of a post-tensioned prestressed concrete beam, 300 mm wide and 300 mm deep, is subjected to a concentric anchorage force of 832800 N by a Freyssinet anchorage of area 11720 mm². Design and detail the anchorage reinforcement for the end block.	**07**