Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2021

Subject Code:3170624 Date:17/12/2021

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)**	Write advantages and disadvantages of prestressed concrete	**03**
	(b)	Differentiate between Pre-tensioning and Post-tensioning	**04**
	(c)	A rectangular concrete beam of cross-section 30cm deep and 20cm wide is prestressed by means of 15 wires of 5mm diameter located 5.5 cm from the bottom of the beam and 3 wires of diameter of 5mm, 3.5cm from the top. Assuming the prestress in the steel as 840 N/mm^2, calculate the stressed at the extreme fibers of the mid span sections when the beam is supporting its own weight over a span of 6 m. If a uniformly distributed live load of 6 kN/m is imposed, evaluate the maximum stress in concrete. The density of concrete is 24 kN/m^3	**07**
Q.2	**(a)**	Explain the differences of prestressed concrete (PSC) over reinforced concrete (RCC).	**03**
	(b)	Explain the concept of thrust line in PSC sections.	**04**
	(c)	A rectangular concrete bam 250 mm wide and 300 mm deep is prestressed by a force of 500 kN at a constant eccentricity of 60 mm. The beam supports a concentrated load of 68kN at the centre span of 4 m. Calculate the resultant stresses at center span and quarter span for the beam. Neglect the self-weight of the beam.	**07**
		OR	
	(c)	A prestressed concrete beam with a rectangular section 150mm wide, 300mm deep supports a uniformly distributed load of 4 kN/m, which includes the self-weight of the beam. The effective span of the beam is 5 m. The beam is concentrically prestressed by cable carrying a force of 180 kN. Locate the position of the pressure line in the beam.	**07**
Q.3	**(a)**	Discuss IS 1343 recommendations for design of prestressed members subjected to bending and torsion.	**03**
	(b)	Enlist different types of flexural failure and explain any one in detail.	**04**
	(c)	A beam of symmetrical I-section spanning 8 m has flange width of 150 mm and flange thickness of 80 mm respectively. The overall depth of the beam is 450 mm. Thickness of web is 80 mm. The beam is prestressed by a parabolic cable with an eccentricity of 150 mm at the centre of the span and zero at the supports. The Live Load on the beam is 2.5kN/m. (1) Determine the effective force in the cable for balancing the Dead Load	**07**

and Live Load on the beams
(2) Calculate the shift of the pressure line from the tendon centre line.

OR

Q.3 **(a)** Explain difference between Time dependent and Immediate losses in Prestressed concrete sections. **03**

(b) List the various types of tensioning device used in prestressed concrete. **04**

(c) A pre-stresses beam, 180mm wide and 400mm deep, is prestressed with tendons of 3 wires of 8mm diameter initially stressed to 1200 N/ m^2 located at 80mm from the soffit of the beam. Span of the beam is 8m; find the percentage loss of stress in tendons if **07**
i) the beam is pre-tensioning
ii) the beam is post-tensioning
If the concrete undergoes a further shortening due to creep and shrinkage while there is a relaxation of 6% of stress in steel
Modular ratio: 6
E_s = 210 kN / mm^2
Anchorage slip = 0.8mm
Friction coefficient of wave effect = 0.002 / m
Creep coefficient, ϕ = 1.6
Total residual shrinkage strain = 300 x 10^{-6} for pre-tensioning and 200 x 10^{-6} for post-tensioning

Q.4 **(a)** Enlis the assumptions of Strain compatibility method **03**

(b) Discuss IS 1343 recommendations for design of prestressed members subjected to shear **04**

(c) A rectangular beam of span 8m and cross section 100mm wide x 250mm deep is prestressed by a straight cable with an effective prestressing force of 250 kN located at an eccentricity of 40mm. The beam carries a live load of 1.2 kN/m all over it's span. **07**
Calculate
i)Top and bottom fiber stresses at center of span. Density of concrete = 24 kN/m3.
ii)Find Magnitude of Prestressing force with an eccentricity of 40mm which can balance the stresses due to dead and live loads at the bottom fibre of the central section of the beam.

OR

Q.4 **(a)** Explain with sketch IS 1343 (2012) recommendations for computing the Moment of resistance of rectangular section. **03**

(b) Enlist the formula for calculation of Moment of resistance of Flanged sections as per IS 1343 (2012) recommendations **04**

(c) An Unsymmetrical I section has an overall depth of 2000mm. The top flange width and depth are equal to 1200mm and 300mm respectively, and the bottom flange width and depth are equal to 750mm and 200mm respectively. The thickness of the web is 300mm. The tendons having a cross sectional area of 7000mm^2 are located at 200mm from soffit of the beam. If the ultimate compressive strength of concrete and tensile strength of steel are 42 and 1750 N/mm^2 respectively, and the tendons are effectively bonded to concrete, Estimate the Flexural strength of the section using IS 1343 recommendations. **07**

Q.5 **(a)** Enlist the formula for calculating losses due to Elastic deformation and Friction in prestressed concrete sections **03**

	(b)	Define transmission length, and what is expression of it as per IS 1343 (2012) recommendations.	**04**
	(c)	A bonded prestressed concrete beam is of rectangular section of width 400mm and overall depth 1200mm. The tendons consisting of 3300 mm^2 of standard strands with characteristic strength of 1700 N/mm^2. The strands are located at 870 mm from the top face of the beam. The characteristic cube strength of concrete is 60 N/mm^2. Estimate the ultimate moment capacity of section using IS 1343 (2012) recommendations.	**07**

OR

Q.5	**(a)**	Enlist various loads acting on bridges.	**03**
	(b)	What are the advantages of Composite construction with prestressed and in situ concrete for structural members.	**04**
	(c)	The cross-section of a symmetrical I-section prestressed beam is 300mm by 750mm (overall), with flange and web 100mm thick. The beam is post-tensioned by cables containing 48 wires of 5mm diameter high-tensile steel wires at an eccentricity of 250mm. The 28- days strength of concrete in compression is 40N/mm^2. Assuming that the grouting of the tendons is 100 percent effective, determine the ultimate moment of resistance of the section using IS 1343 (2012) recommendations.	**07**

****

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – SUMMER 2022

Subject Code:3170624 Date:14/06/2022

Subject Name:Design of Prestressed Concrete structures

Time:02:30 PM TO 05:00 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)**	Explain the basic concept of Prestressed Concrete.	**03**
	(b)	State the advantages and disadvantages of Prestressed concrete.	**04**
	(c)	A rectangular concrete beam, 300mm deep and 200mm wide, is prestressed by means of 15 wires of 5mm diameter located 65mm from the bottom of the beam and 3 wires of 5mm diameter, 25mm from the top. Assuming the initial prestress in the steel as 850 N/mm^2, calculate the percentage loss of stress immediately after transfer, allowing for the loss of stress due to elastic deformation of concrete only. Take E_s = 210 kN/m^2 and E_c = 31.5 kN/m^2.	**07**
Q.2	**(a)**	List the various types of loss of prestress in pre-tensioned and post-tensioned members.	**03**
	(b)	Distinguish between Pre-tensioned and Post-tensioned Concrete members.	**04**
	(c)	A post-tensioned prestressed beam of rectangular section 250mm wide is to be designed for an imposed load of 12 kN/m, uniformly distributed on a simply supported span of 12m. The stress in the concrete must not exceed 17 N/mm^2 in compression or 1.4 N/mm^2 in tension at any stage and the loss of prestress may be assumed to be 15%. Calculate (a) the minimum possible depth of the beam; (b) for the section provided, the minimum prestressing force and the corresponding eccentricity.	**07**
		OR	
	(c)	A simply supported prestressed concrete beam with a rectangular section150mm wide, 300mm deep supports a uniformlydistributed load of 4 kN/m, which includes the self-weight of the beam. Theeffective span of the beam is 5 m. The beam is concentrically prestressedby cable carrying a force of 180 kN. Locate the position of the pressure linein the beam.	**07**
Q.3	**(a)**	List the various types of tensioning devices used in prestressed concrete.	**03**
	(b)	State the assumptions made in the design of prestressed concrete members for the limit state of collapse in flexure.	**04**
	(c)	An unsymmetrical I-section beam is used to support a LL of 3 kN/m over a simply supported span of 10m. The sectional details are: Top flange 300mm wide and 60mm thick; bottom flange 150mm wide and 60mm thick; web thickness 80mm; overall depth of beam 500mm. At the center of the span, the effective prestressing force of 150 kN is	**07**

located at 50mm from the soffit of the beam. Estimate the stresses at the mid-span of the beam for the following combinations: (a) Prestress + self-weight; (b) Prestress + self-weight + LL.

OR

Q.3	**(a)**	Explain the difference between Immediate and Time-dependent losses inPrestressed concrete sections.	**03**
	(b)	State the maximum permissible compressive stress in flexure at the transfer stage and service stage.	**04**
	(c)	A 6m long simply supported rectangular beam of cross-section 300mm deep and 200mm wide is prestressed by means of 15 wires of 5mm diameter located 65mm from the bottom of the beam and 3 wires of 5mm diameter, 25mm from the top. Assuming the prestress in the steel as 900 N/mm^2, calculate the stresses at the extreme fibres of the mid-span section when the beam is subjected to uniformly distributed LL of 5 kN/m in addition to its own self-weight. Take density of concrete as 24 kN/m^3.	**07**
Q.4	**(a)**	Explain the concept of load balancing.	**03**
	(b)	Explain the different modes of flexural failure observed in prestressed concrete beams?	**04**
	(c)	A bonded prestressed concrete beam is of rectangular section of width400mm and overall depth 1200mm. The tendons consisting of 3300 $mm^2$of standard strands with characteristic strength of 1700 N/mm2. The strandsare located at 870 mm from the top face of the beam. The characteristiccube strength of concrete is 60 N/mm^2. Estimate the ultimate moment capacity of section using IS 1343 (2012) recommendations.	**07**

OR

Q.4	**(a)**	Explain drying shrinkage strain and autogenous shrinkage strain.	**03**
	(b)	State the assumptions of Strain compatibility method.	**04**
	(c)	The floor slab for an auditorium of span 10m is to be designed as a one-way prestressed concrete slab with parallel post-tensioned cables in each of which the force at transfer is 500 kN. The slab is required to support a uniformly distributed LL of 25 kN/m^2 with compressive and tensile stress in concrete at any stage not exceeding 15 N/mm^2 and zero respectively. Design the suitable thickness for the slab and estimate the maximum horizontal spacing of the cables and their position at the mid-span section. Assume the prestress loss ratio as 0.80.	**07**
Q.5	**(a)**	Explain transmission length in pre-tensioned members.	**03**
	(b)	State the four fundamental conditions for stresses at transfer and service stage.	**04**
	(c)	Explain stress distribution in the end block in the prestressed concrete beam.	**07**

OR

Q.5	**(a)**	What is creep in prestressed concrete? What are the factors that affect creep of concrete?	**03**
	(b)	Discuss IS 1343 recommendations for design of prestressed memberssubjected to shear.	**04**
	(c)	Compute the bursting force and Design suitable anchorage zone reinforcementaccording IS 1343. The end block of size 200mm wide and 300mm deep ispost tensioned with two Freyssinet anchorage each of 100 mm diameter withtheir centers located at 75 mm from the top and bottom of the beam. The forcetransmitted by each anchorage being 2000 kN.	**07**

****