K. K. Wagh Institute of Engineering Education and Research, Nashik

(An Autonomous Institute from A. Y. 2022-23)

Model Answer sheet

End-Sem Examination-I | Winter 2025
Academic Year: 2025-26 | Sem: II
Class: F.Y. | Program: M.Tech.
Branch Code: CIV | Pattern: 2024
Name of Course: Design of Prestressed concrete Structures | Course Code: 2404514A

Q. No.	Details	Max. Marks
Q.1	**What are the advantages and disadvantages of Prestressed concrete.** **Advantages of Prestressed Concrete:- 4 marks** **Disadvantages of prestressed concrete:-2 marks**	**[6]**
Q.2	**Enlist different losses which occur only in pretensioned prestressed concrete members. Explain loss due to elastic shortening in detail for pretensioned memebers.** 1. Loss due to Elastic shortening 2. Loss due to Creep of concrete 3. Loss due to Shrinkage of concrete 4. Loss due to Relaxation of steel ---- 2 marks **Loss of Prestress Due to Elastic Shortening – 4 marks**	**[6]**
Q.3	**a) Design one way prestressed concrete slab of span 6.5m. by using parallel post tensioned strands of diameter 12.5mm. The slab is required to support Uniformly distributed imposed load of 18 kN/m^2 and floor finish 1.5 kN/m^2. The strength of concrete at transfer of prestress is 40 N/mm^2. Determine permissible stresses as per IS 1343.Consider grade of concrete as 50 N/mm^2 and characteristic tensile strength of strand as 1600N/mm^2. Design the spacing of the ducts and their position at mid span section. Assume loss ratio 0.85. Check the section only for flexure. (Ignore Check for stresses and check for deflection) (8marks)** 1) Determination of Permissible Stresses- 1 marks 2) Load and BM calculation - 1 marks 3) Required section modulus - 1 marks 4) Prestressing force and eccentricity with Revised prestressing force - 2 marks 5) Spacing and position of ducts- 1 marks 6) Check for flexure- 2 marks **OR** **b) A slab spanning 7.5m is to be designed as a one way prestressed concrete slab with parallel post tensioned cables. The deck slab is required to support Uniformly distributed imposed load of 20 kN/m^2. Consider grade of concrete as 50 N/mm^2 and characteristic tensile strength of strand as 1700 N/mm^2. The permissible stresses in concrete should not exceed 16N/mm^2 in compression and (-) 1.5MPa in tension is permitted at any stage. Design the spacing of the ducts and their position**	**[16]**

	at mid span section. Assume 16% losses and diameter of each strand as 12.5mm. Check the section for deflection. (Ignore Check for flexure and check for stresses) (8marks) 1) Determination of Permissible Stresses- 1 marks 2) Load and BM calculation - 1 marks 3) Required section modulus - 1 marks 4) Prestressing force and eccentricity with Revised prestressing force - 2 marks 5) Spacing and position of ducts- 1 marks 6) Check for deflection - 2 marks	
	c) Design a post tension two way slab of effective span 5.2m ×7.2m with all discontinuous edges. The slab is subjected to superimposed load 6 kN/m^2. Consider grade of concrete as 40 N/mm^2 and characteristic tensile strength of strand as 1600 N/mm^2. The permissible stresses in concrete should not exceed 16N/mm^2 in compression and no tension is permitted at any stage. Assume 16% losses and diameter of each strand as 12.5mm. Design the spacing of cable in both direction. Don't apply checks. **(8marks)** 1) Permissible stresses and Thickness of slab- 1 mark 2) Load and bending moment calculation - 2 mark 3) Check for minimum section modulus- 1 mark 4) Minimum prestressing force and eccentricity- X-direction Spacing and position of ducts- 2 marks Y-direction Spacing and position of ducts-2 marks **OR** **d) Design a post tension two way slab of effective span 6.2m ×7.2m with all discontinuous edges. The slab is subjected to superimposed load 4 kN/m^2. Take F.F. load = 2.0 kN/m^2. Consider grade of concrete as 50 N/mm^2 and characteristic tensile strength of strand as 1700 N/mm^2. The strength of concrete at transfer is 35 N/mm^2. Determine permissible stresses for type II structure as per IS 1343. Assume 14% losses and diameter of each strand as 13.5mm. Design the spacing of cable in both direction. Don't apply checks.** **(8marks)** 1) Permissible stresses and Thickness of slab- 1 mark 2) Load and bending moment calculation - 2 mark 3) Check for minimum section modulus- 1 mark 4) Minimum prestressing force and eccentricity- X-direction Spacing and position of ducts- 2 marks Y-direction Spacing and position of ducts-2 marks	
Q.4	**a) A post - tensioned prestressed beam of rectangular section 450 mm wide is to be designed for a uniformly distributed imposed load of 20kN/m, on a span of 9m. The stress in the concrete must not exceed 16**	**[16]**

	N/mm^{2}in compression or 1.4N/mm^2 in tension at any time and the loss of prestress may be assumed to be 16%. diameter of each strand as 12.5mm. Design the section and decide arrangement of ducts. Also determine limiting zone. Don't apply checks. (8marks) 1) Determination of permissible stresses- 2) Preliminary dimensions and section properties- 2 marks 3) SF and BM calculations- 1 mark 4) Minimum section modulus- 1 marks 5) Prestressing force and eccentricity- 2 marks 6) Limiting zone and arrangement of ducts- 2 marks **OR** **b) A pre - tensioned I- section has both flanges are 400 mm wide and 150 mm deep. The rib is 150 mm wide and 400 mm deep. The effective depth of the cross section is 500 mm. If fck = 50 N/mm2, fpu = 1600N/mm^2, and the area of prestressing steel Aps =491 mm^2, Calculate the ultimate flexural strength of the section using IS1343 code provisions.** **(8 marks)** 1) $\frac{A_{ps}\, f_{pu}}{bdf_{ck}}$ - 3 marks 2) Fpb – 1 mark 3) Xu – 1 mark 4) Mur- 3 marks	
	c) A prestressed concrete beam 300 mm wide & 400mm deep is provided with two symmetrical cables each with a prestressing force of 650 kN. Design the end block with reinforcement required to resist bursting forces. (8 marks) 1) Dimensions of base plate- 1 marks 2) Bursting force- 2 marks 3) Bearing stress- 2 marks 4) Thickness of base plate-1 marks 5) End block reinforcement – 2 **OR** **d) A prestressed concrete beam of rectangular section 400 mm wide by 400 mm deep is to be designed to support an ultimate shear force of 300 kN. All the ducts are straight.** **The uniform prestress across the section is 6.5 N/mm^2. The characteristic cube strength of the concrete is 50N/mm^2 and steel is Fe415 with bar diameter 8 mm. Design suitable spacing for the stirrups conforming to IS1343 recommendations for uncracked section. Assume effective cover as 40 mm. (8 marks)** 1) Determination of Vu- 4 marks 2) Comparison of Vu-2 marks 3) Determination of spacing- 2 marks	

Q.5	**a) Design a post tensioned flat slab for the following data-** **Centre to centre distance between columns=6.2 m along both the directions** **Column size=500mm Circular; Flat Slab with drop** **Live load=6.5 kN/m^2** **Floor finish=1kN/m^2** **Materials= M40, Fpu= 1600 N/mm^2.** **Permissible stresses in the concrete= 15 N/mm^{2}in compression and 1.5 N/mm^2 in tension. Determine all bending moments and number of strands in middle strip and edge strip. Ignore check for flexure, shear and stresses. (8marks)** 1) Dimensions of flat slab-middle strip, edge strip, drop and capital-2 marks 2) Load and stiffness calculations-1 marks 3) BMs for end panels – midspan and support-2 marks 4) BMs for interiors panel – midspan and support -2 marks 5) Prestressing force and number of ducts in each panel -1 marks **OR** **b) Design a post tensioned flat slab for the following data-** **Centre to centre distance between columns=8.0 m along both the directions** **Column size-750mm square; Flat Slab with drop** **Live load=5.5 kN/m^2** **Floor finish=2.0 kN/m^2** **Materials= M50, Fpu= 1600 N/mm^2; fci = 40 N/mm^2** **Determine all bending moments and number of strands in middle strip and edge strip. Ignore check for flexure, shear and stresses. (8marks)** 1) Dimensions of flat slab-middle strip, edge strip, drop and capital-2 marks 2) Load and stiffness calculations-1 marks 3) BMs for end panels – midspan and support-2 marks 4) BMs for interiors panel – midspan and support -2 marks 5) Prestressing force and number of ducts in each panel -1 marks.	**[16]**
	c) Perform punching shear check for a post tensioned flat slab with column capital and drop for the following data- **Centre to centre distance between columns=6.5 m along both the directions** **Column size-500mm Circular** **Live load=8 kN/m^2** **Floor finish=2.0 kN/m^2** **Materials= M40, Fpu= 1600 N/mm^2.** **Ignore BM calculations, check for flexure, stresses. (8marks)** Dimensions of flat slab-middle strip, edge strip, drop and capital-2 marks I) First location - at d/2 from the periphery of column capital	

	1) Area resisting shear – 0.5 marks 2) Shear resisted by concrete section 1 marks 3) Ultimate design shear at critical section 1 marks 4) Check – safe/unsafe 0.5 marks II) Second location - at d/2 from the periphery of column drop 1) Area resisting shear – 0.5 marks 2) Shear resisted by concrete section 1 marks 3) Ultimate design shear at critical section 1 marks 4) Check – safe/unsafe 0.5 marks **OR** **d) Perform punching shear check for a post tensioned flat slab with column capital and drop for the following data-** **Centre to centre distance between columns=7.8 m along both the directions** **in both directions** **Column size-650mm Sqaure** **Live load=6 kN/m^2** **Floor finish=2.0 kN/m^2** **Materials= M50, Fpu= 1600 N/mm^2.** **Ignore BM calculations, check for flexure, stresses. (8marks)** Dimensions of flat slab-middle strip, edge strip, drop and capital-2 marks I) First location - at d/2 from the periphery of column capital 1) Area resisting shear – 0.5 marks 2) Shear resisted by concrete section 1 marks 3) Ultimate design shear at critical section 1 marks 4) Check – safe/unsafe 0.5 marks II) Second location - at d/2 from the periphery of column drop 1) Area resisting shear – 0.5 marks 2) Shear resisted by concrete section 1 marks 3) Ultimate design shear at critical section 1 marks 4) Check – safe/unsafe 0.5 marks	