

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2013****Subject code: 711508N****Date: 17-06-2013****Subject Name: Prestressed Concrete****Time: 10.30 am – 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. Use of IS:456, IS:1980, IS:3370-Part-III and IS:784 is permitted.

- Q.1** A pre-tensioned simply supported beam have effective span of 10 m and subjected to imposed load of 5 kN/m. Other necessary data are as follows: Load factor for dead load=1.5, Load factor for live load=1.5, concrete cube strength $f_{cu}=45$ MPa, cube strength at transfer $f_{ci}=30$ MPa, tensile strength of concrete $f_t=1.7$ MPa, $E_c=34$ MPa, Loss ratio=0.8, Permissible stresses at transfer $f_{ct}=15$ MPa and $f_{tt}= -1$ MPa, Permissible stress at working load $f_{cw}=17$ MPa and $f_{tw}=0$ MPa, 7mm high-tensile steel wires with $f_{pu}=1600$ MPa are available. **14**

Using above data carryout (i) computation of ultimate moments and shears (ii) Fix up dimensions of I-section to resist design forces (iii) calculate minimum section modulus and (iv) compute prestressing force and eccentricity.

- Q.2** (a) In continuation of Q.1 carryout check for ultimate flexural strength and check for ultimate shear strength-section at support (uncracked in flexure) **07**
 (b) In continuation of Q.1 check for ultimate shear strength-section cracked in flexure with maximum shear. **07**

OR

- (b) In continuation of Q.1 check beam for limit state of deflection. **07**
Q.3 (a) Define and explain in brief following terms used in prestressed concrete: (i) End Block (ii) Transmission length (iii) Cap cable. **06**
 (b) A concrete beam with double overhang has the middle-span equal to 10m, left overhang 2m and right overhang 2m. The cross-section of beam is rectangular of size 300mm x 800mm. Determine the profile of the prestressing cable with effective force of 220 kN which can balance a UDL of 4.2 kN/m on beam, which exclude self weight of the beam. Sketch the cable profile marking the eccentricity of cable at support and midspan. Take unit weight of concrete 25 kN/m³. **08**

OR

- Q.3** (a) Define and explain in brief following terms used in prestressed concrete: (i) Tendon (ii) Bonded prestressed concrete (iii) Transfer. **06**
 (b) A simply supported prestressed concrete beam has span 10m and rectangular cross-section of 250mm x 600mm. Beam support 50% non-permanent imposed load of 3kN/m. The tendon follows a trapezoidal profile with an eccentricity of 100mm within the middle third of span and zero at the supports. The area of tendons $A_p=350\text{mm}^2$ have effective prestress of 1300 N/mm^2 immediately after transfer. Using following data calculate short term deflections. Take unit weight of concrete 25 kN/m³, $E_c=34\text{ GPa}$, $E_s= 200\text{ GPa}$, creep coefficient = 2, concrete shrinkage = 450×10^{-6} and relaxation of steel stress = 10%. **08**

- Q.4** (a) Enlist and explain various methods generally used for the investigation of anchorage zone stresses. Also mention codal provisions in this regards. **05**
- (b) A cylindrical prestressed concrete water tank of internal diameter 50m is required to store water over a depth of 8m. The permissible compressive stress in concrete at transfer is 14MPa and minimum compressive stress under working pressure is 1.2 MPa. The loss ratio is 0.78. Wires of 5mm diameter with an initial stress of 1100MPa are available for circumferential winding and Freyssinet cables made up of 12 wires of 8mm diameter stressed to 1300 MPa are to be used for vertical prestressing. Design tank wall assuming base connection to be fixed and tentative initial thickness of wall 230mm. Take Maximum ring tension = 912 N/mm and Maximum moment in tank wall for fixed base condition = 92160 N.mm/mm for design. **09**

OR

- Q.4** (a) A prestressed concrete pile, 300mm square, contains 75 pretensioned wires, each of 2mm diameter, uniformly distributed over the section. The wires are initially tensioned on the prestressing bed with a total force of 450kN. Calculate the final stress in the concrete and the percentage loss of stress in steel after all losses. Consider following data: $E_s=210\text{GPa}$, $E_c=32\text{ GPa}$, shortening due to creep= 30×10^{-6} mm/mm per MPa of stress, total shrinkage = 200×10^{-6} per unit length, relaxation of steel= 5% of initial stress. **06**
- (b) Design a non-cylinder prestressed concrete pipe of 900mm internal diameter to withstand a working hydrostatic pressure of 1.4MPa, using a 3mm high-tensile wires stressed to 1000MPa at transfer. Permissible maximum and minimum stresses in concrete at transfer and service loads are 14 MPa and 0.7 MPa. The loss ratio is 0.78. Calculate also the test pressure required to produce a tensile stress of 0.7 MPa in concrete when applied immediately after tensioning and also winding stress in steel if $E_s= 210\text{ GPa}$ and $E_c= 35\text{ GPa}$. **08**
- Q.5** (a) A post tensioned bridge girder with unbounded tendons is of box section of overall dimensions 1200mm wide x 2000mm deep, with wall thickness of 175mm. The high tensile steel has an area of 5000mm^2 and is located at an effective depth of 1800mm. The effective prestress in steel after all losses is 1000 MPa and effective span of the girder is 25m. If $f_{ck}=40\text{ MPa}$ and $f_p= 1600\text{ MPa}$, calculate ultimate flexural strength of the section. **07**
- (b) The support section of a prestressed concrete beam, 200mm wide and 450 mm deep, is required to support ultimate shear force of 120kN. The compressive prestress at the centroidal axis is 5MPa. The $f_{ck}=40\text{MPa}$. The cover to reinforcement is 50mm. If $f_y=415\text{MPa}$ for steel of stirrups. Design suitable reinforcement at the section as per codal provisions. **07**

OR

- Q.5** (a) (i) State the advantage of continuous members in prestressed concrete structures. **06**
(ii) Briefly explain the advantage of prestressing long span shell structures.
(iii) Explain with neat sketches the different type of cross-sections generally used for poles.
- (b) The deck slab of a road bridge of span 8m is to be designed as a one-way prestressed concrete slab, with parallel post-tensioned cables in each of which the force transfer is 450 kN. If the deck slab is required to support a uniformly distributed load of 30kN/m^2 , with the compressive and tensile stress in concrete at any stage not exceeding 14 MPa and 0 MPa respectively, calculate the maximum horizontal spacing of the cables and their positions at the mid-span section. Assume the loss ratio as 0.75. **08**
