Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

Course:	**Prestressed Concrete**	**Semester: VIII**
Program:	**B. Tech Civil Engineering**	**No. of Pages: 6**
Time: 03 hrs.		**Max. Marks: 100**

Instructions: 1. Answer all questions of Section A, B & C
2. Internal choice is given in Section C
3. Useful formulae and tables are given for some questions
(Assume all the necessary data if necessary)
NOTE: IS 1343 should be Allowed/Provided

SECTION A

S. No.		**Marks**	**CO**
Q 1	Objective type questions: 1. Uniformly distributed load on a concrete beam can be effectively counter balanced by selecting a. Concentric cable b. An eccentric cable c. A parabolic cable 2. Loss of stress due to friction depends upon a. Modulus of elasticity of concrete b. Coefficient of friction c. Relaxation of steel 3. Deflection of prestressed concrete beam is excessive in the a. Post cracking stage b. Pre cracking stage c. Elastic stage 4. Failure of over reinforced prestressed concrete beam is characterized by a. Large number of cracks with large deflection b. Explosive failure due to crushing of concrete in compression zone c. Sudden failure due to fracture of steel in tension 5. Horizontal or axial prestressing of concrete beams a. Reduces the shear strength of the member b. Has no effect on the shear strength c. Increase the shear strength 6. According to IS: 1343 code in Type 1 prestressed concrete structures a. Tensile stress of limited magnitude are permitted b. Limited width of cracks are permitted c. Tensile stresses are not permitted	**2X 10 = 20**	**CO 1, CO 2, CO 3, CO 4, CO 5**

	7. The minimum section modulus of a prestressed concrete section is influenced by a. The range of stress at top fiber b. The compressive stress at top fiber c. Range of stress at bottom fiber 8. For composite construction of prestressed and in situ concrete, the stress analysis for unpropped composite construction, stress due to cast in situ slab is distributed a. In whole cross section b. In precast unit section c. In cast in situ slab section 9. Circular prestressing is ideally suited for concrete pipes and tanks because a. Part of section is prestressed b. Full section is prestressed c. The section has variable stresses 10. The walls of a prestressed concrete tank with a sliding base filled with water develops a. Bending moments b. Moments and ring tension c. Only ring tension		
	SECTION B		
Q 2	A post tensioned roof girder spanning over 30 m has an unsymmetrical I section with a moment of inertia of 72490 x 10^6 mm^4 and an overall depth of 1300 mm. The effective eccentricity of the group of parabolic cables at the center of span is 580 mm towards the soffit and 170 mm towards the top of beam at the supports. The cables carry an initial prestressing force of 3200 kN. The self-weight of the girder is 10.8 kN and the live load on the girder is 9 kN//m. The modulus of elasticity of concrete is 34 kN/mm^2. If the creep coefficient is 1.6, and the total loss of prestress is 15 percent, estimate the deflection at the following stages and compare with the permissible values according to IS 1343 limits: a) Instantaneous deflection due to prestress + self-weight + live load. b) Resultant maximum long-term deflection allowing for loss of prestress and creep of concrete. $a_f = a_{i1}(1+\phi) - a_{ip}\left[\left(1-\frac{L_p}{P_i}\right)+\left(1-\frac{L_p}{2P_i}\right)\phi\right]$ $a_f = \left[a_{i1} - a_{ip}\times\frac{P_t}{P_i}\right](1+\phi)$	**7+3**	**CO 1, CO 2**
Q 3	A prestressed concrete beam (span 10 m) of rectangular section, 120 mm wide and 300 mm deep, is axially prestressed by a cable carrying an effective force of 180 kN. The beam supports a total uniformly distributed load of 5 kN/m, which includes the self -weight of the beam. Compare the magnitude of principle tension developed in the beam with and without the axial prestress. For the above beam if instead of axial prestressing a curved cable having an eccentricity of 100 mm at the center of span and reducing to zero at the supports is used, the effective force in the cable is 180 kN. Estimate the percentage reduction in the principal tension in comparison with the case of axial prestressing.	**5+5**	**CO 3**

Q 4	List the classification criteria as per IS code for the class 1, class 2 and class 3 structures. Write the partial safety factors for loads for DL+LL+WL combination for limit state of collapse and limit state of serviceability. Write the general expression for characteristic loads. List the five failure criteria for ultimate limit state.	**3+2+1 +4**	**CO 3, CO 4**
Q 5	A post tensioned prestressed beam of rectangular section 250 mm wide is to be designed for an imposed load of 14 kN/m , uniformly distributed on a span of 12 m. The stress in the concrete must not exceed 17 N/mm^2 in compression or 1.4 N/mm^2 in tension at any time and the loss of prestress may be assumed to be 15 percent. Calculate the minimum possible depth of the beam. Formulae: $Z_t \geq \left[\frac{M_q + (1-\eta)M_g}{f_{tr}} \right]$ $Z_b \geq \left[\frac{M_q + (1-\eta)M_g}{f_{br}} \right]$	**10**	**CO 4**
SECTION-C			
Q 6	List the failure criteria with the help of load-moment interaction curve for prestressed concrete short columns. A precast pretensioned beam of rectangular cross section has a breadth of 100 mm and a depth of 200 mm. The beam with an effective span of 5 m, is prestressed by tendons with their centroid coinciding with the bottom kern. The initial force in the tendons is 150 kN. The loss of prestress may be assumed to be 15 percent. The beam is incorporated in a composite T- Beam by casting a top flange of breadth 400 mm and thickness 40 mm. If the composite beam supports a live load of 8 kN/m^2, calculate the resultant stresses developed in the precast and in situ concrete assuming the pretensioned beam as a) unpropped and b) propped during the casting of the slab. Assume same modulus of elasticity for concrete in precast beam and in situ cast slab.	**5+15**	**CO 3 & CO 4**

Q 7	A cylindrical prestressed water tank of internal diameter 30 m is required to store water over a depth of 7.5 m. The permissible compressive stress in concrete at transfer is 13 N/mm^2 and minimum compressive stress under working pressure is 1 N/mm^2. The loss ratio is 0.75. Wires of five mm diameter with an initial stress of 1000 N/mm^2 are available for circumferential winding and Freyssinet cables made up of 12 wires of 8 mm diameter stressed to 1200 N/mm^2 are to be used for vertical prestressing. Design the tank walls assuming the bas as fixed. The cube strength of concrete is 40 N/mm^2. **OR** A cylindrical prestressed water tank of internal diameter 28 m is required to store water over a depth of 7.0 m. The permissible compressive stress in concrete at transfer is 13 N/mm^2 and minimum compressive stress under working pressure is 1 N/mm^2. The loss ratio is 0.8. Wires of five mm diameter with an initial stress of 1000 N/mm^2 are available for circumferential winding and Freyssinet cables made up of 12 wires of 8 mm diameter stressed to 1200 N/mm^2 are to be used for vertical prestressing. Design the tank walls assuming the bas as fixed. The cube strength of concrete is 40 N/mm^2. **Formulae and design tables:** Direct tensile strength, $f_t = 0.267\sqrt{f_{cu}}$ N/mm^2 Flexural tensile strength, $f_{cr} = 2f_t$ Minimum wall thickness $= \left[\dfrac{N_d}{\eta f_{ct} - f_{min.w}}\right]$ $f_c = \left[\dfrac{N_d}{\eta t} + \dfrac{f_{min.w}}{\eta}\right]$ N/mm^2 $\quad w_t = \left(\dfrac{2f_s A_s}{sD}\right)$ $\quad N_t = N_d\left(\dfrac{w_t}{w_w}\right)$ $\quad N_t = tf_c$ $s = \left[\dfrac{2N_d}{w_w} \times \dfrac{f_s A_s}{f_c D t}\right]$ mm $\quad M_t = M_w\left(\dfrac{w_t}{w_w}\right)$ $\quad f_c = \left[\dfrac{f_{min.w}}{\eta} + \dfrac{M_w}{\eta Z}\right]$ When the tank is empty, the prestress required $f_c = \left[\dfrac{f_{min.w}}{\eta} + \dfrac{M_t}{Z}\right]$	**20**	**CO 5**

Table 16.2 *Moments in cylindrical walls – Fixed base free at top (IS: 3370 Part IV) Moment M_w = (Coefficient) × (wH^3) kN m/m*
Positive sign indicates tension at the outside face

$\frac{H^2}{Dt}$	Coefficients at point									
	0.1H	0.2H	0.3H	0.4H	0.5H	0.6H	0.7H	0.8H	0.9H	1.0H
0.4	+.0005	+.0014	+.0021	+.0007	–.0042	–.0150	–.0302	–.0529	–.0816	–.1205
0.8	+.0011	+.0037	+.0063	+.0080	+.0070	+.0023	–.0068	–.0224	–.0465	–.0795
1.2	+.0012	+.0042	+.0077	+.0103	+.0112	+.0090	+.0022	–.0108	–.0311	–.0602
1.6	+.0011	+.0041	+.0075	+.0107	+.0121	+.0111	+.0058	–.0051	–.0232	–.0505
2.0	+.0010	+.0035	+.0068	+.0099	+.0120	+.0115	+.0075	–.0021	–.0185	–.0436
3.0	+.0006	+.0024	+.0047	+.0071	+.0090	+.0097	+.0077	+.0012	–.0119	–.0333
4.0	+.0003	+.0015	+.0028	+.0047	+.0066	+.0077	+.0069	+.0023	–.0080	–.0268
5.0	+.0002	+.0008	+.0016	+.0029	+.0046	+.0059	+.0059	+.0028	–.0058	–.0222
6.0	+.0001	+.0003	+.0008	+.0019	+.0032	+.0046	+.0051	+.0029	–.0041	–.0187
8.0	.0000	+.0001	+.0002	+.0008	+.0016	+.0028	+.0038	+.0029	–.0022	–.0146
10.0	.0000	.0000	+.0001	+.0004	+.0007	+.0019	+.0029	+.0028	–.0012	–.0122
12.0	.0000	–.0001	+.0001	+.0002	+.0003	+.0013	+.0023	+.0026	–.0005	–.0104
14.0	.0000	.0000	.0000	.0000	.0001	+.0008	+.0019	+.0023	+.0001	–.0090
16.0	.0000	.0000	–.0001	–.0002	–.0001	+.0004	+.0013	+.0019	+.0001	–.0079

	Coefficients at point				
	.80H	.85H	.90H	.95H	1.00H
20.0	+.0015	+.0014	+.0005	–.0018	–.0063
24.0	+.0012	+.0012	+.0007	–.0013	–.0053
32.0	+.0007	+.0003	+.0007	–.0008	–.0040
40.0	+.0002	+.0005	+.0005	–.0005	–.0032
48.0	.0000	+.0001	+.0005	–.0003	–.0026
56.0	.0000	.0000	+.0004	–.0001	–.0023

Table 16.3 *Ring tension cylindrical walls – Fixed base free at top (IS: 3370-Part IV) Ring tension N_d = (Coefficient × wHR kN/m)*

$\frac{H^2}{Dt}$	Coefficients at point									
	0.1H	*0.2H*	*0.3H*	*0.4H*	*0.5H*	*0.6H*	*0.7H*	*0.8H*	*0.9H*	*1.0H*
0.4	+0.149	+0.134	+0.120	+0.101	+0.082	+0.066	+0.049	+0.029	+0.014	+0.004
0.8	+0.263	+0.239	+0.215	+0.190	+0.160	+0.130'	+0.096	+0.063	+0.034	+0.010
1.2	+0.283	+0.271	+0.254	+0.234	+0.209	+0.180	+0.142	+0.099	+0.054	+0.016
1.6	+0.265	+0.268	+0.268	+0.266	+0.250	+0.226	+0.185	+0.134	+0.075	+0.023
2.0	+0.234	+0.251	+0.273	+0.285	+0.285	+0.274	+0.232	+0.172	+0.104	+0.031
3.0	+0.134	+0.203	+0.267	+0.322	+0.357	+0.362	+0.330	+0.262	+0.157	+0.052
4.0	+0.067	+0.164	+0.256	+0.339	+0.403	+0.429	+0.409	+0.334	+0.210	+0.073
5.0	+0.025	+0.137	+0.245	+0.346	+0.428	+0.477	+0.469	+0.398	+0.259	+0.092
6.0	+0.018	+0.119	+0.234	+0.344	+0.441	+0.504	+0.514	+0.447	+0.301	+0.112
8.0	–0.011	+0.104	+0.218	+0.335	+0.443	+0.534	+0.575	+0.530	+0.381	+0.151
10.0	–0.011	+0.098	+0.208	+0.323	+0.437	+0.542	+0.608	+0.589	+0.440	+0.179
12.0	–0.005	+0.097	+0.202	+0.312	+0.429	+0.543	+0.628	+0.633	+0.494	+0.211
14.0	–0.002	+0.098	+0.200	+0.306	+0.420	+0.539	+0.639	+0.666	+0.541	+0.241
16.0	–0.000	+0.099	+0.199	+0.304	+0.412	+0.531	+0.641	+0.687	+0.582	+0.265

	Coefficients at point				
	.75H	*.80H*	*.85H*	*.90H*	*.95H*
20.0	+0.716	+0.654	+0.520	+0.325	+0.115
24.0	+0.746	+0.702	+0.577	+0.372	+0.137
32.0	+0.782	+0.768	+0.663	+0.459	+0.182
40.0	+0.800	+0.805	+0.731	+0.530	+0.217
48.0	+0.791	+0.828	+0.785	+0.593	+0.254
56.0	+0.763	+0.838	+0.824	+0.536	+0.285