BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: MTech **SEMESTER : II**
BRANCH: Civil **SESSION : SP/2023**

SUBJECT: CE547 PRESTRESSED CONCRETE

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
6. IS 1343:1980 is allowed in the examination hall.

			CO	BL
Q.1(a)	A prestressed concrete beam of rectangular cross section 300 mm by 600 mm is 12 m long supports a live load 12 kN/m in addition to its own self weight. The beam is prestressed by a cable having high-tensile wires of 2000 mm^2 area stressed to 800 N/mm^2. The cable is straight and located at a distance of 175 mm from the soffit of the beam. Determine the shift in the pressure line at one quarter span and centre of span, when the beam supports the service load.	[5]	CO1	K1
Q.1(b)	A pretensioned beam 250 mm wide and 300 mm deep is prestressed by 12 wires each of 7 mm diameter initially stressed to 1200 N/mm^2 with their centroids located 100 mm from the soffit. Estimate the final percentage loss of stress due to elastic deformation, creep, shrinkage and relaxation using IS: 1343-80 code and the following data: Relaxation of steel stress = 90 N/mm^2 Es= 210 kN/mm^2, Ec = 35 kN/mm^2 Creep coefficient (φ) = 1.6 Residual shrinkage strain = 3 x $10^{(-4)}$	[5]	CO1	K1
Q.2(a)	A concrete box section girder has an overall depth and width of 800 and 600 mm respectively. The concrete walls are 100 mm thick on both the horizontal and vertical parts of the box. Determine the maximum permissible torque if the section is uniformly prestressed by a force of 200 kN. Assume the maximum permissible diagonal tensile stress as 0.7 N/mm^2	[5]	CO2	K2
Q.2(b)	The cross-section of a prestressed concrete beam is an unsymmetri-cal T-section with an overall depth of 1300 mm. Thickness of web= 150 mm. Dis-tances of top and bottom fibres from the centroid are 545 mm and 755 mm respectively. At a particular section, the beam is subjected to an ultimate moment M = 2130 kN m and a shear force V = 231 kN. Effective depth d = 1100 mm, Cube strength of concrete= 35 N/mm^2. Effective prestress at the extreme tensile face of the beam $f$ep = 19.3 N/mm^2, Second moment of area I = 665 x 10^8 mm^4, Area of steel in the section A_P = 2310 mm^2, Tensile strength of tendons fp= 1500 N/mm^2, Effective stress in tendons after all losses $f$pe = 890 N/mm^2. Estimate the flexure-shear resistance of the section using Indian code regulations.	[5]	CO2	K3
Q.3(a)	A continuous prestressed concrete beam ABC (AB = BC = 10 m) has a uniform rectangular cross section with a width of 100 mm and depth of 300 mm. The cable carrying an effective prestressing force of 300 kN is parallel to the axis of the beam and located at 100 mm from the soffit Determine the secondary and resultant moment at the central support B.	[5]	CO3	K3
Q.3(b)	In continuation of Q5(a) (a) If the beam supports an imposed load of 1.5 kN/m, calculate the resultant stresses at top and bottom of the beam at B. Assume density of concrete as 24 kN/m^3 (b) Locate the resultant line of thrust through beam AB.	[5]	CO3	K3

PTO

Q.4(a)	A precast pre-tensioned beam of rectangular section has a breadth of 120 mm and a depth of 200 mm. The beam with an effective span of 5 m, is prestressed by tendons with their centroids 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 cast concrete assuming the pre tensioned beam as: (a) unpropped, Assume the same modulus of elasticity for concrete in precast beam and in situ cast slab.	[5]	CO4	K4
Q.4(b)	For Question 4(a), draw the stress distribution in unpropped and propped composite construction	[5]	CO4	K4
Q.5(a)	Design a non – cylinder prestressed concrete pipe of 600 mm internal diameter to withstand a working hydrostatic pressure of 1.05 N/mm^2, using a 2.5 mm high tensile wire stressed to 1000 N/mm^2 at transfer. Permissible maximum and minimum stresses in concrete at transfer and service loads are14 and 0.7 N/mm^2. The loss ratio is 0.8.	[5]	CO5	K2
Q.5(b)	Calculate also the test pressure required to produce a tensile stress of 0.7 N/mm^2 in concrete when applied immediately after tensioning and also the winding stress in steel if Es =210 kN/mm^2 and Ec = 35 kN/mm^2.	[5]	CO5	K2

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$100\left(\frac{A_p}{bd}\right)$	Concrete grade		
	M-30	M-35	M-40 and above
0.25	0.37	0.37	0.38
0.50	0.50	0.50	0.51
0.75	0.59	0.59	0.60
1.00	0.66	0.67	0.68
1.25	0.71	0.73	0.74
1.50	0.76	0.78	0.79
1.75	0.80	0.82	0.83
2.00	0.84	0.86	0.88
2.25	0.88	0.90	0.92
2.50	0.91	0.93	0.95
2.75	0.94	0.96	0.98
3.00	0.96	0.99	1.01