INSTITUTE OF AERONAUTICAL ENGINEERING

(AUTONOMOUS)

Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

ASSIGNMENT QUESTIONS

Course Title	**PRESTRESSED CONCRETE STRUCTURES**			
Course Code	A80150			
Regulation	R15 (JNTUH)			
Course Structure	**Lecturers**	**Tutorials**	**Practical's**	**Credit's**
	4	**-**	**-**	**4**
Course Coordinator	**Dr. VENU M, Professor**, Department of Civil Engineering			
Team of Instructors	**Dr. VENU M, Professor**, Department of Civil Engineering **Mr. GUDE RAMA KRISHNA, Assistant Professor,** Department of Civil Engineering			

COURSE OBJECTIVES:
The course should enable the student to:

I. Understand the importance of prestressed concrete and the evolution of prestressing to overcome the short coming of reinforced concrete.
II. Acquire knowledge about the methods of prestressing and prestressing devices for pre-tensioning and post-tensioning.
III. Assess the losses of prestressing PSC members due various causes like friction, elastic shortage of concrete, shrinkage, creep, etc.
IV. Analyze sections of PSC beams with straight, concentric, eccentric, bent and parabolic tendons and design PSC beams of rectangular and I sections for flexure.
V. Design shear reinforcements, structural elements for shear, torsion and anchorage as per the provisions of BIS.
VI. Interpret the transmission mechanism of prestressing force by bond and compute deflection ofbeams under loads.

S. No.	Question	Blooms Taxonomy Level	Course Outcome
1	Why high strength steel is essential for PSC construction?	Remember	1
2	What is the principle of post tensioning?	Remember	1
3	What do you mean by unbonded tendon?		1
4	A PSC beam of 120 mm wide and 300 mm deep is used over a span of6m to support a udl of 4kN/m including its self weight. The beam is prestressed by a straight cable carrying a forceof180kN&locatedat an eccentricity of50mm. Determine the location of the thrust line in beam & plot its position at quarter & central span sections.	Understand	1
5	(i) Explain why high strength concrete and high strength steel areNeeded for PSC construction. (ii) State different types of prestressing	Remember	2
6	A PSC beam of 120mm wide and 300mm deep is used over a span of6m to support a udl of 4kN/m including its self weight. The beam is prestressed by a straight cable carrying a force of 180 Kn and located at location of the thrust line in beam & plot its position at quarter & central span sections.	Remember	`2
7	A PSC beam of 230 mm wide and 450mm deep is used over Prestressed by a cable carrying a force of 650 kN & located at an	Remember	2

	eccentricity of 75 mm. The beam supports three concentrated loads of 25 kN at each quarter span points. Determine the location of the pressure line in beam at centre, quarter &support sections. Neglect the moment due to self- weight of the beam.		
8	A rectangular concrete beam 100mm wide &250mm deep spanning over 8m is prestressed by a straight cable carrying an effective pre-stressing force of 250kN located at an eccentricity of 40mm. The beam supports a live load of1.2 kN/m. (i) Calculate the resultant stress distribution for the centre of the span cross section of the beam assuming the density of concrete as24kN/m^2 (ii) Find the magnitude of prestressing force with an eccentricity of 40 mm which can balance the stresses due to dead load & live load at the soffit of the centre span section.	Understand	2
9	A simply supported PSC beam of cross section 100 mm wide and 250 mm deep is loaded with a uniformly distributed load of magnitude 1.2 kN/m on a span of 8 m. Obtain the stress distribution at mid span by stress and strength concept, if the prestressing force is 250 kN applied eccentrically all along with its centre of gravity at 40 mm. Assuming the density of concrete as 24 kN/m^3.	Understand	2
10	A prestressed concrete beam of rectangular section 375mm wide and750mm deep has a span of 12.5m. The effective prestressing force is1520kN at an eccentricity of 150mm. The dead load of the beam is7 kN/m and the beam has to carry a live load of 12.5kN/m. Determine the extreme stresses in concrete i) At the end section. ii) At the mid-section without the action of the live load iii) At the mid-section with the action of the live load.	Remember	1
	UNIT-II **LOSSES OF PRESTRESS**		
1	Derive expressions for losses of prestress due to friction and creep of Concrete.	Remember	2
2	What is the Wobble Coefficient?	Remember	3
3	What do you mean by loss of stress due to relaxation of stress in steel?		3
4	List out the post-tensioning losses.	Remember	3
5	Prestressed pretensioned beam of 200mm wide and 300mm deep is Used over a span of 10m is prestressed with a wires of area 300mm^2 at an eccentricity of 60mm carrying a prestress of 1200N/mm^2, Find the percentage of loss of stress, Ec= 35 kN/mm^2 Shrinkage of concrete= 300 x 10^{-6}, creep coefficient=1.6.	Understand	4
6	A concrete beam of 10m span, 100mm wide and 300mm deep is Prestressed by 3 cables. The area of each cable is 200mm^2 and the initial stress in the cable is1200N/mm^2. Cable 1 is parabolic with an Eccentricity of 50mm above the centroid at the supports and 50mmBelow at the centre of span. Cable 2 is also parabolic with zero eccentricity at supports and 50mm below the centroid at the centre of span. Cable 3 is straight with uniform eccentricity of 50mm below the centroid. If the cables are tensioned from one end only. Estimate the percentage loss of stress in each cable due to friction. Assume μ = 0.35 and k= 0.0015 perm.	Remember	4
7	A pretensioned beam 300mm x 450mm is pre-tensioned by 12 wires Each of 7mm diameter, initially stressed to1200MPa with their centroid is located100 mm from the soffit. Estimate the final percentage loss of stress due to elastic deformation, creep, shrinkage and relaxation. Assume relaxation of steel stress=90MPa.	Understand	4

	E_c=35GPa, creep co-efficient=1.6 and residual shrinkage strain = 3 x10-4.		
8	A rectangular concrete beam360 mm deep and 200 mm wide is Prestressed by means of fifteen 5mm diameter wires located 65mm from the bottom of the beam and three 5mm wires, located 25mm from the top of the beam. If the wires are initially tensioned to a stress of 840N/mm^2, calculate the percentage loss of stress due to elastic deformation of concrete only. E_s= 210 kN/mm^2 and Ec= 31.5 kN/mm^2.	Remember	4
9	A straight pretensioned prestressed concrete member 12m long with aCross section of 400 mm wide and 500mm deep is concentrically post tensioned by four tendons of 250 mm^2 each. The tendons are stressed one after another to the stress of 1000N/mm^2.The eccentricity of prestressing force is 100mm at the centre of the span. Compute the loss of prestress due to elastic shortening of concrete. How can the loss be counteracted?	Understand	3
10	A prestressed concrete pile,250 mm square, contains 60 pretensioned wires, each of 2mm diameter, uniformly distributed over the section. The wires are initially tensioned in the prestressing bed with a total force of 300 kN. Calculate the final stress in concrete and the percentage loss of stress is steel after all losses, given the following data :Es=210 kN/mm^2;E_c= 32 kN/mm^2	Understand	3
	UNIT-III **FLEXURE AND SHEAR**		3
1	State the difference in load carrying mechanism in flexure under working load condition between RCC and PSC.	Remember	4
2	Sketch the strain and stress force diagram of PSC flexural member Section at ultimate condition.	Understand	4
3	What are the assumptions made in strain compatibility method?	Remember	4
4	Sketch the different flexural failure modes of prestressed beams.		4
5	A pretensioned T section has a flange width of 1200mm and 150mmthick.The width and depth of the bar 300 mm and 1500 mm respectively. The high tension steel has an area of 4700 $mm^2$and is located at an effective depth of 1600 mm. If the characteristic cube strength of the concrete and the tensile strength of steel are 40 and 1600 Mpa respectively; calculate the flexural strength of the section.	Understand	5
6	A post tensioned bridge girder with unbounded tendons is of size 1200mm wide by 1800mm deep is of box section with wall thickness of150mm. The high tensile steel has an area of 4000$mm^2$and is located at an effective depth of 1600 mm. The effective prestress in steel after loss is 1000N/mm^2& effective span is 24m.If f_{ck}=40N/mm^2, f_y =1600 N/mm^2 Estimate the flexural strength.	Remember	6
7	A PSC beam of effective span 16m is of rectangular section 400mmwide and 1200 mm deep. A tendon consists of 3300$mm^2$of strands of characteristic strength 1700 N/mm^2 with an effective prestress of 910N/mm^2. The strands are located 870mm from the top inter face of the beam. $I_{ff_{cu}}$=60N/mm^2,estimate the flexural strength of the section as per BIS provisions for the following cases: (i) Bonded tendons (ii) Un bonded tendons	Understand	6
8	Explain about the types of shear cracking occurs in prestressed concrete section. Write the recommendations for Design for shear based on I.S. 1343 Code.	Remember	6
9	(i) Discuss the load deflection behavior of under prestressed, partially prestressed and over prestressed members in detail.	Remember	7

	(ii) Explain concept of limit state, partial safety factor.		
10	A prestressed girder of rectangular section 150 mm wide by 300 mmbeam is to be designed to support an ultimate shear force of 130 kN. The uniform prestress across the section is 5 N/mm^2. Given the characteristic cube strength of concrete as 40 N/mm^{2}and Fe-415HYSD bars of 8mm diameter, design suitable spacing for the stirrups conforming to the Indian standard code IS:1343 recommendations. Assume cover to the reinforcement as 50 mm.	Understand	7
UNIT-1V **TRANSFEROF PRESTRESS IN PRETENSIONED MEMBERS**			
1	The end block of a post tensioned concrete beam 300 mm X 300 mm is Subjected to a concentric anchorage force of 800 kN by a freyssinet anchorage system of area1100 mm^2. Discuss and detail the anchorage reinforcement for the end block.	Understand	8
2	A PSC beam 250mm wide and 650 mm deep is subjected to an effective prestressing force of 1360 kN along the centroidal axis. The cable is placed symmetrically over the mild steel anchor plate of area 150 mm x 350 mm. design the end block. Take f_{ck} = 30N/mm^2. Assume initial prestressing force is1.2 times the effective prestressing force.	Understand	8
3	Draw a sketch showing the stress distribution in end block by double Anchor plate.	Remember	9
4	What is the zone of transmission in end block of PSC structures?	Understand	9
5	What is end block?	Understand	10
6	The end block of a PSC beam with rectangular cross section is100mm wide and 200 mm deep. The prestressing force of 100 kN is transmitted to the concrete by a distribution plate of 100mm x 50 mm, concentrically loaded at the ends. Calculate the position and the magnitude of tensile stress on the horizontal section through the centre and edge of the anchor plate. Compute the bursting tension on the horizontal planes.	Remember	9
7	Explain the terms end Block, Anchorage zone and Bursting tension with reference to post tensioned prestressed members. What are the various generally used for the investigation of anchorage zone stresses.	Remember	9
8	A pretensioned beam is prestressed using 5mm – diameter wires with an initial stress of 80 percent of the ultimate tensile strength of steel (f_{pu}=1600 N/mm^2). The cub strength of concrete at transfer is 30N/mm^2. (a) Calculate the transmission length. (b) Compute the bond stressat¼and½ the transmission length from the end, and (c) Calculate the overall average bond stress.	Understand	10
9	A prestressed beam of rectangular section, 200 mm wide by 500 mm deep is pretensioned by five high-tensile wiresof 7mm diameter located at an eccentricity of 150 mm. the maximum shear force at quarter span section is 200 kN. if the modular ratio as 6,compute the bond stress developed assuming (a) the section is uncracked (b) the section is cracked	Remember	9
10	A pretensioned beam, 200 mm wide by 500 mm deep, is prestressed by seven wires 15 mm diameter strands at an effective eccentricity of200 mm. the cube strength of concrete at transfer is 35 N/mm^2. Estimate the transmission length for the strands using ISC recommendations.	Understand	9
UNIT-V			

COMPOSITEBEAMS AND DEFLECTIONS			
1	What is propped construction?	Remember	9
2	How will you achieve composite action in composite construction?	Remember	9
3	Name the loadings to be considered for computing short term deflections.	Remember	10
4	A PSC beam of 120 mm wide and 300 mm deep is used over a span of 6 m is prestressed by a straight cable carrying a force of 200 Kn & located at an eccentricity of 50 mm. E_c=38 kN/mm^2. Find the deflection at centre span a) Under prestress + self weight. b) Find the magnitude of live load udl which will nullify the deflection due to prestress & self weight.	Remember	10
5	A PSC beam with rectangular section, 150 mm wide 300 mm deep is Prestressed by three cables each carrying effective prestress of 200 kN. The span of the beam is12 m. The first cable is parabolic with an eccentricity of 50 mm below the centroidal axis at the centre of the span and 50 mm above the centroidal axis at the supports. The second cable is parabolic with an eccentricity of 50 mm at the centre of the span and zero eccentricity at the supports. The third cable is straight with an eccentricity of 50mm below the centroidal axis. If the beam supports an udlof 6 kN/m and E_c= 38 kN/mm^2. Estimate the instantaneous deflection for the following stages i) Prestress+ self weight of the beam ii) Prestress+ self weight of the beam+ live load	Remember	10
6	Explain the design procedure of Prestressed composite section.	Remember	9
7	A precast pretensioned beam of rectangular sectionhas a breadth of 100 mm and depth of 200 mm. The beam with an effective span of 5 m is prestressed by the tendons with the centroids coinciding with the bottom kern. The initial force in the tendons is 150 kN. The loss of prestress is15%. The top flange width is 400 mm with the thickness of 40 mm. If the composite beam supports alive load of 8kN/m^2. Calculate the resultant stresses developed if the sections is propped and unpropped.	Understand	10
8	A composite T beam is made up of pretensioned rib of 100 mm wide and 200 mm deep and a cast insitu slab of 400 mm wide and 40 mm thick. Having the modulus of elasticity as 28 kN/m^2, if the differential shrinkage is 100x10^{-6}.determine the shrinkage stresses developed in precast and cast insitu units.	Remember	10
9	A PSC beam of crosssection 150 mm x 300 mm is simply supported over a span of 8 m and is prestressed by means of symmetric parabolic cables @ adistance of 76 mm from the soffit @ mid span and 125 mm @ top @ support section. If the force in the cable i.e350 KN. Calculate deflection @ mid span the beam is supporting its own weight The point load which must be applied at mid span to restore the beam to the level of its support.	Understand	9
10	A composite T-girder of span 5 m is made up of a pre-tensioned rib, 100 mm wide by 200 mm depth, with an insitu cast slab, 400 mm wide and 40 mm thick. The rib is prestressed by a straight cable having an eccentricity of 33.33 mm and carrying initial force of, 150 kN. The loss of prestress is15%. Check the composite T-beam for the limit state of deflection if its supports an imposed load of 3.2 kN/m for (i) unpropped (ii) propped. Assume modulus of Elasticity of 35 kN / mm^2 for both precast & insitu cast elements.	Remember	10

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