Hall Ticket No | | | | | | | | | | | Question Paper Code: BSTB22

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER

M.TechIII Semester End Examinations, November- 2019

Regulations: R18

DESIGN OF PRESTRESSED CONCRETE STRUCTURES

(CIVIL ENGINEERING)

Time: 3 hours **Max. Marks: 70**

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

UNIT– I

1. a) A rectangular concrete beam 100mm wide & 250mm deep spanning over 8m is prestressed by a straight cable carrying a effective prestressing force of 250kN located at an eccentricity of 40mm. The beam supports a live load of 1.2kN/m. **[7M]**
   a) Calculate the resultant stress distribution for the centre of the span cross section of the beam assuming the density of concrete as 24kN/m2
   b) Find the magnitude of prestressing force with an eccentricity of 40mm which can balance the stresses due to dead load & live load at the soffit of the centre span section.

   b) i) Explain why high strength concrete and high strength steel are needed for PSC construction. **[7M]**
   (ii) State different types of prestressing.

2. a) A pretensioned concrete beam, 100mm wide and 300mm deep, is prestresssed by straight wires carrying an initial force of 225kN at an eccentricity of 55mm. The modulus of elasticity of steel and concrete are 210 and 35kN/mm^2 respectively. Estimate the percentage loss of stress in steel due to elastic deformation of concrete if area of steel wires is 188 mm^2. **[7M]**

   b) A PSC beam of section 120mm wide and 300mm deep is used over an effective span of 6m to support an UDL of 4kN/m including self weight. The beam is prestressed by a straight cable with a force of 180 kN and located at an eccentricity of 50 mm. Determine the location of thrust line in the beam and plot its position.). **[7M]**

UNIT– II

3. a) A pretensioned T section has a flange width of 1200mm and 150mm thick. The width and depth of the rib are 300mm and 1500mm respectively. The high tension steel has an area of 4700mm^2 and is located at an effective depth of 1600mm. If the characteristic cube strength of the concrete and the tensile strength of steel are 40 and 1600Mpa respectively; calculate the flexural strength of the section. **[7M]**

b) The cross section of a prestressed concrete beam is an unsymmetrical T-section with an overall depth of1300mm. thickness of web is 150mm. Distance of top and bottom fibres from the centroid are 545mm and 755mm respectively. At a particular section, the beam is subjected to an ultimate moment M = 2130kNm and a shear force V=237kN. Effective depth d = 1100mm, f_{ck}= 45N/mm^2, f_{ep}=19.3 N/mm^2 ,I=665x$10^8$$mm^4$, A_p= 2310mm^2, f_p=1500N/mm^2, f_{ep}=890N/mm^2. Estimate the flexural-shear resistance using IS code. **[7M]**

4. a) A PSC beam of effective span 16m is of rectangular section 400mm wide and 1200mm deep. A tendon consists of 3300mm^2 of strands of characteristic strength of 1700N/mm^2 with an effective prestress of 910N/mm^2. The strands are located 870mm from the top face of the beam. If f_{cu}=60N/mm^2. estimate the flexural strength of the section as per IS1343 provisions for the following cases: (i) Bonded tendons (ii) Unbonded tendon. **[7M]**

b) The end block of a post tensioned bridge girder is 500mm wide by 1000mm deep.Two cables, each comprising 90 high tensile wires of 7mm dia are anchored using square plates of side length 400mm with their centres located at 500mm from the topand bottom of the edges of the beam. The jacking force in each cable is 4000kN.Design a suitable anchorage reinforcement using Fe 415 grade HYSD barsConforming to IS: 1343 provision. **[7M]**

UNIT– III

5. a) A two span continuous beam ABC (AB=BC= 10 m) is of rectangular section , 200 mm wide by 500mm deep .The beam is pre-stressed by a parabolic cable, concentric at end support end having an eccentricity of 100 mm towards the soffit of the beam as centre of spans and 200mm towards the top at mid support .The effective force in the 500KN.(a) Show that the cable is concordant .(b) Locate the pressure line in the beam when it supports a live load of 5.6 KN/m in addition to its self- weight. **[7M]**

b) A pre-stressed concrete beam supports an imposed load of the 4 KN /m over an effective span of 10 m. the beam has a rectangular section with a width of 200 mm and depth of 600mm, Find the effective pre-stressing force in the cable if it is parabolic with the an eccentricity of 100mm at the centre and zero at the ends, for the following condition. If the resultant stress due to self-weight, imposed load and pre-stressing force is zero at the soffit of the beam for the mid- span section. Assume D_C =24 KN/m^3. **[7M]**

6. a) A pre-stressed concrete beam supports an imposed load of the 4 KN /m over an effective span of 15 m. the beam has a rectangular section with a width of 200 mm and depth of 600mm, Find the effective pre-stressing force in the cable if it is parabolic with the an eccentricity of 100mm at the centre and zero at the ends, for the following condition. If the resultant stress due to self-weight, imposed load and pre-stressing force is zero at the soffit of the beam for the mid- span section. Assume D_C =24 KN/m^3. **[7M]**

b) A concrete beam with a cross- sectional area of 32×10^3 mm^2 and radius of gyration of 72 mm is pre-stressed by a parabolic cable carrying an effective stress o 1000 N/mm^2.The span of beam is 8m . The cable composed of 6 wires of 7 mm diameter has an eccentricity of 50 mm at the centre and zero at the support . Neglecting all losses , find the central deflection of the beam as follows : (a) self – weight + pre-stress.(b) self – weight + pre-stress +live load 3 KN/ m. **[7M]**

UNIT– IV

7. a) A precast pre tensioned beam of rectangular section has a breadth of 100mm and depth of 200mm. The beam with an effective span of 5m is pre stressed by the tendons with their centroids coinciding with the bottom kern. The initial force in the tendons is 150kN. The loss of prestress is 15%. The top flange width is 400mm with the thickness of 40mm.If the composite beam supports a live load of 7kN/m^2 calculate the resultant stresses **[7M]**

developed if the section is unpropped. M40 and M20 concrete are used for pre tensioned and in-situ concrete..

b) The cross-section of a composite beam consists of a 300mm x 900mm precast stem and cast-in-situ flange 900mm x 150mm. The stem is a post-tensioned unit with an initial prestressing force of 2500kN. The effective prestress available after making deduction for losses is 2200kN. The dead load moment at mid span due to the weight of the precast section is 250kNm. The dead load moment due to the weight of the flange is 125kNm. After hardening of the flange concrete, the composite section has to carry a live load which produces a bending moment of 700kNm. Examine the stress distribution in concrete at the various stages of the loading. **[7M]**

8. a) A prestressed concrete beam of rectangular section 120mm wide and 300mm deep, spans over 6m.the beam is prestressed by a straight cable carrying an effective force of 200kNat an eccentricity of 50mm. the modulus of elasticity of concrete is 38kN/m2.ompute the deflections at centre span for the following case:deflection under prestress and self-weight;Find the magnitude of udl live load which will nullify the deflection due to prestress and self weight. **[7M]**

b) A per stressed concrete beam having a cross sectional area of 3x 104 mm^2 is a simply supported over a span of 10m. Its supports a uniformly distributed imposed load of 3kN/m, Half of which is not permanent. The tendons follow a trapezoidal profile with an eccentricity of 100mm with in the middle third of the span and vary linearly from the third span points to zero at the supports. The area of the tendons A_p=350mm^2 having effective pre stressed of 1290N/mm2 immediately after transfer. Calculate the short term and long term deflection. **[7M]**

UNIT– V

9. a) Write the procedure for design of cylinder pipes ? **[7M]**

b) A prestressed cylinder pipe is to be designed using a steel cylinder of 1000 mm internal diameter and thickness 1.6 mm .A circumferential wire winding consists of a 4mm high tensile wires initially tensioned to a stress of 1000 N/mm^2.ultimate tensile strength of the wire = 1600 N/mm^2.Yield stress of the steel cylinder = 280 N/mm^2. Maximum permissible compressive stress in concrete at transfer is 14 N/mm^2 and no tensile stress are permitted under working pressure of 0.8N/mm^2.Determine the thickness of the concrete lining required , No.of times of circumferential wire winding and factor of safety against busting .Assume α_e =6. **[7M]**

10. a) Design a non-cylinder pre-stressed concrete pipe of 500 mm internal diameter to With-stand a working hydrostatic pressure of 1.05 N/ mm^2.Using a 3.0 mm high wire stressed to 800 N/mm^2 at transfer permissible max and min stresses. At transfer and service loads of 12 and 0.6 N/mm^2.The loss ratio is 0.75. Calculate also the test pressure required to produce a tensile stress of 0.7N/mm^2 in concrete when applied immediately after tensioning and also the winding stress in steel if E_S =210 $KN/mm^2$$E_c$= 35 KN/mm^2. **[7M]**

b) A pre-stressed cylinder pipe is to be designed using a steel cylinder of 1500 mm internal diameter and thickness 1.8 mm .A circumferential wire winding consists of a 6 mm high tensile wires initially tensioned to a stress of 1200 N/mm^2.ultimate tensile strength of the wire = 1825 N/mm^2.Yield stress of the steel cylinder = 280 N/mm^2. Maximum permissible compressive stress in concrete at transfer is 16 N/mm^2 and no tensile stress are permitted under working pressure of 0.9 N/mm^2.Determine the thickness of the concrete lining required , No. of times of circumferential wire winding and factor of safety against busting .Assume α_e =8. **[7M]**

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COURSE OBJECTIVES:

The course should enable the students to:

I	Find out losses in the prestressed concrete.
II	Understand the basic aspects of prestressed concrete fundamentals, including pre and post-tensioning processes..
III	Understand the material requirements as per specified norms and standards.
IV	Assess the valuation of buildings and provide practical knowledge of standard specifications of items of building construction.

COURSE OUTCOMES (COs):

CO 1	Understand different types of prestressing, losses, analysis of PSC flexural members and Codal provisions.
CO 2	Understand ultimate and serviceability limit states for flexure, design for shear, transmission force for pretensioning and post tensioning and anchorage zone stresses.
CO 3	Understand the determinacy of plane , space truss, analysis and design for plane , space truss, analysis and design of continuous beams and frames and cable profile linear transformation
CO 4	Understand composite construction with precast PSC beams , cast insitu R.C slab, analysis, design of composite beams, calculation of creep, shrinkage and crack width.
CO 5	Analysis and design of prestressed concrete pipes,columns with moments.

COURSE LEARNING OUTCOMES (CLOs):

BSTB22.01	Understand the concept of pre-stressing and the behaviour of concrete structures.
BSTB22.02	Recognize the general principles, methods of pre-stressing, and pre-stressing devices for pre- tensioning and post-tensioning.
BSTB22.03	Determine losses of pre-stress in pre-stressed concrete structures.
BSTB22.04	Apply the provisions of IS-1343(1980) code to the design of pre-stressed concrete structures for flexure and shear.
BSTB22.05	Understand the ultimate & serviceability limit states for flexure.
BSTB22.06	Design the shear reinforcements for pre-stressed concrete beams.
BSTB22.07	Understand the transmission force for pretensioning and posttensioning.
BSTB22.08	Understand Anchorage zone stresses for post tension members.
BSTB22.09	Understand the determinacy of plane and space trusses.
BSTB22.10	Understand the structural analysis for plane truss and space truss.
BSTB22.11	Understand the analysis and design of continuous beams and frames.
BSTB22.12	Understand the cable profile and linear transformation.
BSTB22.13	Understand the method of composite construction with precast PSC beams and cast insitu RC slab.
BSTB22.14	Analysis and design of composite beams.
BSTB22.15	Calculate the effects creep and shrinkage and parital prestressing.
BSTB22.16	Able to calculate crack width.
BSTB22.17	Analysis of prestressed concrete pipes with moments.

BSTB22.18	Analysis of prestressed columns with moments.
BSTB22.19	Design of prestressed concrete pipes with moments.
BSTB22.20	Design of prestressed columns with moments.

MAPPING OF SEMESTER END EXAMINATION - COURSE OUTCOMES

SEE Question No		Course Learning Outcomes		Course Outcomes	Blooms Taxonomy Level
1	a	BSTB22.04	Apply the provisions of IS-1343(1980) code to the design of pre-stressed concrete structures for flexure and shear.	CO 1	Understand
	b	BSTB22.01	Understand the concept of pre-stressing and the behaviour of concrete structures.	CO 1	Understand
2	a	BSTB22.03	Determine losses of pre-stress in pre-stressed concrete structures.	CO 1	Understand
	b	BSTB22.04	Apply the provisions of IS-1343(1980) code to the design of pre-stressed concrete structures for flexure and shear.	CO 1	Understand
3	a	BSTB22.05	Understand the ultimate & serviceability limit states for flexure	CO 2	Understand
	b	BSTB22.07	Understand the transmission force for pretensioning and posttensioning.	CO 2	Remember
4	a	BSTB22.05	Understand the ultimate & serviceability limit states for flexure	CO 2	Understand
	b	BSTB22.06	Design the shear reinforcements for pre-stressed concrete beams..	CO 2	Understand
5	a	BSTB22.10	Understand the structural analysis for plane truss and space truss.	CO 3	Understand
	b	BSTB22.11	Understand the analysis and design of continuous beams and frames.	CO 3	Understand
6	a	BSTB22.09	Understand the determinacy of plane and space trusses.	CO 3	Understand
	b	BSTB22.12	Understand the cable profile and linear transformation	CO 3	Understand
7	a	BSTB22.14	Analysis and design of composite beams..	CO 4	Understand
	b	BSTB22.14	Analysis and design of composite beams..	CO 4	Understand
8	a	BSTB22.13	Understand the method of composite construction with precast PSC beams and cast insitu RC slab.	CO 4	Understand
	b	BSTB22.15	Calculate the effects creep and shrinkage and parital prestressing	CO 4	Understand
9	a	BSTB22.17	Analysis of prestressed concrete pipes with moments.	CO 5	Understand
	b	BSTB22.19	Design of prestressed concrete pipes with moments.	CO 5	Understand
10	a	BSTB22.19	Design of prestressed concrete pipes with moments.	CO 5	Understand
	b	BSTB22.19	Design of prestressed concrete pipes with moments.	CO 5	Understand

Signature of Course Coordinator **HOD, CE**