SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK

VI SEMESTER

PCE104 – PRESTRESSED CONCRETE STRUCTURES

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UNIT I - PRINCIPLES OF PRESTRESSING

Basic concepts of Prestressing- Types and systems of prestressing- Need for High Strength materials, Analysis methods, losses of prestress– Short and Long term deflections– Cable layouts.

PART – A

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Define prestressed concrete.	BT - 1	*Remember*
2.	What is meant by prestressing force?	BT - 1	*Remember*
3.	List the types of prestressing based on the method of application.	BT - 1	*Remember*
4.	What are the various methods/systems of Pre stressing?	BT - 1	*Remember*
5.	Distinguish between pre-tensioning & post-tensioning	BT - 2	*Understand*
6.	List the types of post tensioning losses.	BT - 1	*Remember*
7.	State the advantages of prestressed concrete over RCC.	BT - 1	*Remember*
8.	Define loss of prestress.	BT - 1	*Remember*
9.	What are the losses encountered in pre tensioned and post tensioned members?	BT - 1	*Remember*
10.	What is meant by high strength concrete in prestressing?	BT - 1	*Remember*
11.	What is the role of high tensile steel in prestressed concrete?	BT - 1	*Remember*
12.	Define cable profile in prestressed members.	BT - 1	*Remember*
13.	Differentiate wires and tendos.	BT - 1	*Remember*
14.	What is meant by long-term deflection?	BT - 1	*Remember*
15.	Write down the classification of pre stressed concrete member.	BT - 1	*Remember*
16.	Explain why high strength materials are required in prestressed concrete.	BT - 2	*Understand*
17.	Distinguish between pre-tensioning and post-tensioning.	BT - 2	*Understand*
18.	Explain the need for prestressing in concrete structures.	BT - 2	*Understand*
19.	Why are losses of prestress more significant in long-span members?	BT - 2	*Understand*
20.	Differentiate between prestressed concrete and reinforced cement concrete (RCC).	BT - 2	*Understand*
21.	Write down the factors influencing deflections.	BT - 2	*Understand*
22.	Differentiate between short-term and long-term deflections in prestressed concrete members.	BT - 2	*Understand*
23.	Differentiate bonded and un bonded tendon.	BT - 2	*Understand*
24.	How does prestressing improve the durability of concrete structures?	BT - 1	*Remember*
25.	Why are higher grades of steel used in prestressed concrete?	BT - 1	*Remember*

PART – B

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Elaborate the advantages and disadvantages of Prestressing.	BT - 3	*Apply*
2.	Explain the types of prestressing in detail.	BT - 3	*Apply*
3.	Briefly explain various systems and methods of pre stressing with neat sketch	BT - 4	*Analyse*

4.	Sketch and discuss about cable layouts in detail.	*BT - 3*	*Apply*
5.	A rectangular concrete beam of cross-section 30 cm deep and 20 cm wide is prestressed by means of 15 wires of 5 mm diameter located 6.5 cm from the bottom of the beam and 3 wires of diameter of 5 mm, 2.5 cm from the top. Assuming the prestress in the steel as 840 N/mm^2, calculate the stresses at the extreme fibers of the mid-span section when the beam is supporting its own weight over a span of 6 m. If a uniformly distributed live load of 6kN/m is imposed, evaluate the maximum working stress in concrete. The density of concrete is 24kN/m^3 .	*BT - 4*	*Analyse*
6.	A rectangular concrete beam 100 mm wide by 250 mm deep spanning over 8 m is prestressed by a straight cable carrying an effective prestressing force of 250 kN located at an eccentricity of 40 mm. The beam supports a live load of 1.2 kN/m. a) Calculate the resultant stress distribution for the centre of span cross section of the beam assuming the density of concrete as 24 kN/m^3 b) Find the magnitude of prestressing force with an eccentricity of 40 mm which can balance the stresses due to dead and live loads at the soffit of the centre span section.	*BT - 4*	*Analyse*
7.	A rectangular concrete beam, 250 mm wide and 600 mm deep, is prestressed by means of 4 No's of 14 mm diameter high tensile bars located 200 mm from the soffit of the beam. If the effective stress in the wires is 700 N/mm^2, what is the maximum bending moment that can be applied to the section without causing tension at the soffit of the beam?	*BT - 4*	*Analyse*
8.	An unsymmetrical I-section beam is used to support an imposed load of 2 kN/m over a span of 8m. The sectional details are top flanges, 300 mm wide and 60 mm thick; bottom flange, 100 mm wide and 60 mm thick; thickness of web = 80 mm; overall depth of the beam is 400 mm. At the centre of the span, the effective prestressing force of 100 kN is located at 50 mm from the soffit of the beam. Estimate the pre stress at the centre of span section of the beam for the following load condition: a. Prestress + self-weight b. Prestress + self-weight + live load	*BT - 4*	*Analyse*
9.	A concrete beam having a rectangular section 100mm wide and 300mm deep is prestressed by a parabolic cable carrying an initial force of 240kN. The cable has an eccentricity of 50mm at the centre of span at the supports. If the span of the beam is 10m wide and the live load is 2kN/m. a) Estimate the short time deflection at the centre of span. Assuming Ec= 38kN/mm^2 and creep co-efficient Φ = 2.0. Loss of pre stress = 20% of initial stress after 6 months. b) Estimate the long time deflection at the centre of span at this stage, assuming the dead and live loads are simultaneously applied after the release of pre stress.	*BT - 3*	*Apply*
10.	A prestressed concrete beam of section 120 mm wide by 300 mm deep is used over an effective span of 6 m to support a uniformly distributed load 4kN/m, which includes the self-weight of the beam. The beam is prestressed by a straight cable carrying a force of 180kN and located at an eccentricity of 50 mm. Determine the location of the thrust line (or) pressure line in the beam and plot its position at quarter and central span	*BT - 4*	*Analyse*

	section. And also find the extreme fibre stress at mid-span and quarter span section.		
11.	A Prestressed concrete beam is prestressed with a tendon bent as shown. The external load of the beam consists of a concentrated load of 180 kN at mid-span. If the effective prestressing force is 1200 kN. Find the extreme stresses at midspan section, using load balancing method.	*BT - 4*	*Analyse*
12.	A pre-tensioned concrete beam of rectangular cross section 150 mm wide and 300 mm deep is pre-stressed by eight high tensile wire of 7 mm diameter located at 100 mm from the soffit of the beam. If the wires are tensioned to a stress of 1100 N/mm^2, calculate the percentage loss of stress due to elastic deformation assuming the modulus of elasticity of concrete and steel as 31.5 kN/ mm^2 and 210 kN/mm^2 and also find strain in concrete at the level of wire.	*BT - 4*	*Analyse*
13.	A prestressed concrete pile, 250 mm square, contains 60 pre-tensioned wires, each of 2 mm diameters, uniformly distributed over the section. The wires are initially tensioned on 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, gives the following data: Es = 210 kN/mm^2 Ec = 32 kN/mm^2 Shortening due to creep = 30 x 10^{-6} mm/mm per N/mm^2 Total shrinkage = 2 x 10^{-4} per unit length Relaxation of steel stress = 5 % of initial stress	*BT - 4*	*Analyse*
14.	The deck of prestressed concrete culvert is made up of a slab 500 mm thick. The slab is spanning over 10.4 m and supports a total uniformly load comprising the dead load and live loads of 33.5 kN/m. The modulus of elasticity of concrete is 38kN/mm^2. The concrete slab is prestressed by straight cables each containing 12 high-tensile wire of 7 mm diameter stressed to 1200 N/mm^2 at a constant eccentricity of 195 mm. The cables are placed at 328 mm intervals in the transverse direction. Estimate the instantaneous deflection of the slab at centre of span under prestress and the imposed loads.	*BT - 4*	*Analyse*
15.	A concrete beam with a rectangular section 300mm wide and 500mm deep is prestressed by 2 post-tensioned cables of area 600mm2each.Initially stressed to 1600N/mm^2.The cables are located at a constant eccentricity of 100mm throughout the length of the beam having a span of 10m. The modulus of elasticity of steel and concrete is 210 and 38kN/mm^2 respectively. a. Neglecting all losses, find the deflection at the centre of span when it is supporting its own weight. b. Allowing for 20% loss in prestress, find the final deflection at the centre of when it carries an imposed load of 18kN/m. Dc = 25kN/m^3.	*BT - 4*	*Analyse*
16.	A concrete beam with a cross sectional area of 32 x 10^3 mm^2 and radius of gyration of 72mm is prestressed by a parabolic cable carrying an effective prestress of 1000 N/mm^2.The span of the beam is 8m. The cable composed of 6 wires of 7mm diameter has an eccentricity of 50mm at the centre and zero at supports. Neglecting all losses, Find the central deflection of the beam as follows. a. Self-weight + Prestress b. Self-weight + Prestress + LL of 2kN/m. Assume Ec = 38kN/mm^2	*BT - 4*	*Analyse*
17.	A prestressed concrete sleeper produced by pre-tensioning method has a rectangular cross-section of 300mm × 250 mm (*b* × *h*). It is prestressed with 9 numbers of straight 7mm diameter wires at 0.8 times the ultimate	*BT - 4*	*Analyse*

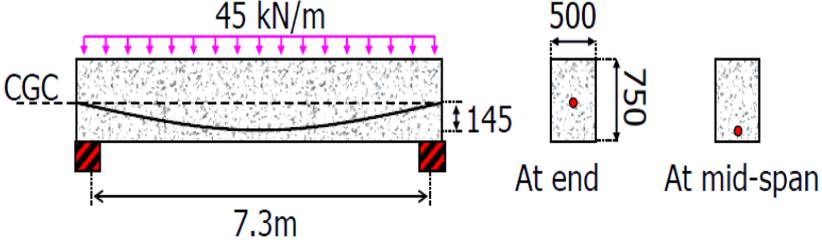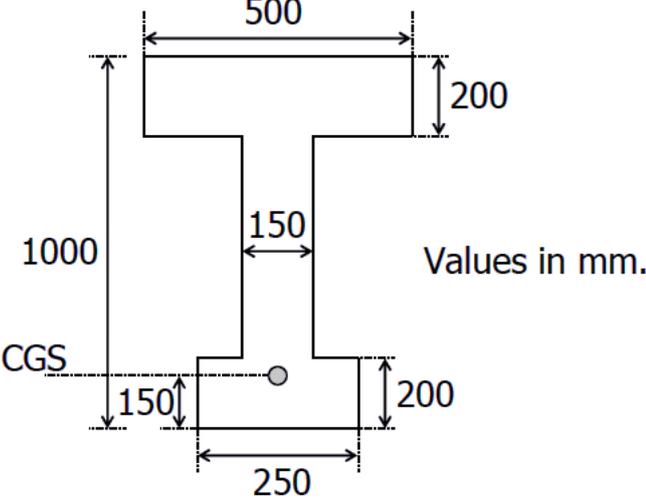|	strength of 1570 N/mm². Estimate the percentage loss of stress due to elastic shortening of concrete. Consider $m = 6$.		
18.	A concrete beam of dimension 100 mm × 300 mm is post-tensioned with 5 straight wires of 7mm diameter. The average prestress after short-term losses is $0.7f_{pk} = 1200$ N/mm² and the age of loading is given as 28 days. Given that $E_p = 200 \times 10^3$ MPa, $E_c = 35000$ MPa, find out the losses of prestress due to creep, shrinkage and relaxation. Neglect the weight of the beam in the computation of the stresses.	*BT - 4*	*Analyse*

UNIT II - DESIGN OF FLEXURAL MEMBERS

Behaviour of flexural members, determination of ultimate flexural strength– Various Codal provisions- Design of flexural members, Design for shear, bond and torsion. Transfer of prestress– Box girders.

PART – A

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Give the different stages of loading of prestressed members.	*BT - 1*	*Remember*
2.	Give the forms of prestressing steel.	*BT - 1*	*Remember*
3.	Define thrust line.	*BT - 1*	*Remember*
4.	What is meant by flexural behaviour of prestressed concrete beams?	*BT - 1*	*Remember*
5.	State the assumptions made in flexural design of prestressed members.	*BT - 1*	*Remember*
6.	Define Type 1, 2 and 3 structure of prestress.	*BT - 1*	*Remember*
7.	What are the stages of operation involved in pre tensioning?	*BT - 1*	*Remember*
8.	What is meant by shear span?	*BT - 1*	*Remember*
9.	State any two types of shear failure in prestressed concrete members.	*BT - 1*	*Remember*
10.	What is bond stress in prestressed concrete?	*BT - 1*	*Remember*
11.	Write the Permissible stresses in concrete as per IS 1343-1980.	*BT - 1*	*Remember*
12.	Write the Permissible stresses in steel as per IS 1343-1980.	*BT - 1*	*Remember*
13.	Define torsion in prestressed concrete members.	*BT - 1*	*Remember*
14.	What is a box girder?	*BT - 1*	*Remember*
15.	Give the equation for "limiting zone" for pre stressing force.	*BT - 1*	*Remember*
16.	Differentiate web shear crack and flexural shear crack.	*BT - 1*	*Remember*
17.	What are the stages of operation involved in post tensioning?	*BT - 1*	*Remember*
18.	How does prestressing influence the flexural capacity of a beam?	*BT - 1*	*Remember*
19.	Define kern zone of a section.	*BT - 1*	*Remember*
20.	Why is bond important between concrete and prestressing steel?	*BT - 1*	*Remember*
21.	What are the grades of concrete to be used in pre tensioned and post tensioned works?	*BT - 1*	*Remember*
22.	Differentiate between concentric and eccentric prestressing.	*BT - 2*	*Understand*
23.	Why box girders are preferred for long-span bridges?	*BT - 1*	*Remember*
24.	Give the modulus of elasticity values for Cold-drawn wires, Strands and High tensile steel bars.	*BT - 1*	*Remember*
25.	What are the attributes for a good quality Prestressing Steel?	*BT - 1*	*Remember*

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Explain about transfer of prestressing in detail.	BT - 3	*Apply*
2.	A concrete beam prestressed with a parabolic tendon is shown in the figure. The prestressing force applied is 1620 kN. The uniformly distributed load includes the self weight. Compute the extreme fibre stress at the mid-span by applying the three concepts. Draw the stress distribution across the section at mid-span.	BT - 4	*Analyse*
3.	For the post-tensioned beam with a flanged section as shown, the profile of the CGS is parabolic, with no eccentricity at the ends. The live load moment due to service loads at mid-span (M_{LL}) is 648 kNm. The prestress after transfer (P_0) is 1600 kN. Assume 15% loss at service. Grade of concrete is M30.	BT - 4	*Analyse*
4.	a) How prestressed concrete structures are classified? Explain b) Give the maximum shear stress in various section with neat sketch.	BT - 4	*Analyse*
5.	A pre-tensioned pre stressed concrete beam having a rectangular section, 150 mm wide and 350 mm deep, has an effective cover of 50 mm. If fck = 40 N/mm², fp = 1600 N/mm², and the area of pre stressing steel Ap = 461 mm², calculate the ultimate flexural strength of the section using IS:1343 code provisions.	BT - 4	*Analyse*
6.	A pre-tensioned Tee section has a flange 1200mm wide and 150 mm thick. The width and depth of rib are 300mm and 1500 mm respectively. The high tensile steel has an area 4700mm² and is located at an effective depth of 1600mm.If the characteristic cube strength of concrete and tensile strength of steel are 40 N/mm² and 1600 N/mm² respectively.	BT - 4	*Analyse*

	Calculate the flexural strength of the Tee section using IS:1343 code provisions.		
7.	A pretensioned prestressed concrete beam having a rectangular section, 150 mm wide and 350 mm deep, has an effective cover of 50 mm. If $f_{ck} = 40 \text{ N/mm}^2$, $f_p = 1600 \text{ N/mm}^2$, and the area of prestressing steel $A_p = 461 \text{ mm}^2$, calculate the ultimate flexural strength of the section using IS:1343 code provisions.	*BT - 4*	*Analyse*
8.	A pretensioned T-section has a flange 300 mm wide and 200 mm thick. The rib is 150 mm wide by 350 mm deep. The effective depth of the cross-section is 500 mm. Given $A_p = 200 \text{ mm}^2$, $f_{ck} = 50 \text{ N/mm}^2$, and $f_p = 1600 \text{ N/mm}^2$, estimate the ultimate moment capacity of the T-section using the Indian Standard code regulations.	*BT - 4*	*Analyse*
9.	A pretensioned T-section has a flange 1200 mm wide and 150 mm thick. The width and depth of the rib are 300 mm and 1500 mm respectively. The high tensile steel has an area of 4700 mm² and is located at an effective depth of 1600 mm. If the characteristic strength of the concrete and the tensile strength of steel are 40 N/mm² and 1600 N/mm² respectively, calculate the flexural strength of the T-section.	*BT - 4*	*Analyse*
10.	A post-tensioned beam with unbonded tendons of rectangular section 400 mm wide with an effective depth of 800 mm. The cross-sectional area of the prestressing steel is 2840 mm². The effective prestress in the steel after all losses is 900 N/mm². The effective span is 16 m. If $f_{ck} = 40 \text{ N/mm}^2$, estimate the ultimate moment of resistance of the section using IS:1343 code recommendations.	*BT - 4*	*Analyse*
11.	A post-tensioned bridge girder with unbonded tendons of box section of overall dimensions 1200 mm wide by 1800 mm deep, with wall thickness of 150 mm. The high tensile steel has an area of 4000 mm² and is located at an effective depth of 1600 mm. The effective prestress in steel after all losses is 1000 N/mm² and the effective span of the girder is 24 m. If $f_{ck} = 40 \text{ N/mm}^2$ and $f_p = 1600 \text{ N/mm}^2$, estimate the ultimate flexural strength of the section.	*BT - 4*	*Analyse*
12.	The support section of a prestressed concrete beam, 100 mm wide and 250 mm deep, is required to support an ultimate shear force of 60 kN. The compressive prestress at the centroidal axis is 5 N/mm². The characteristic cube strength of concrete is 40 N/mm². The cover to the tension reinforcement is 50 mm. If the characteristic tensile strength of steel in stirrups is 250 N/mm², design suitable reinforcements at the section using the Indian standard code IS:1343 recommendations.	*BT - 4*	*Analyse*
13.	A pretensioned girder having a T-section is made up of a flange 200 mm wide and 60 mm thick. The overall depth of the girder is 660 mm. The thickness of the web is 60 mm. The horizontal prestress at a point 300 mm from the soffit is 10 N/mm². The shear stress due to transverse load acting at the same point is 2.5 N/mm². Determine the increase in the principal tensile stress at this point if the T-section is subjected to a torque of 2 kN·m.	*BT - 4*	*Analyse*
14.	A post tension prestressed beam a rectangular cross section 250 mm wide is to be designed for an imposed load of 12 kN/m on a span of 12 m. The stress in concrete must not exceed 17 N/mm² in compression and 1.4 N/mm² in tension at any time the loss of prestress maybe assumed to be 15%. Calculate a) the minimum possible depth of the beam	*BT - 4*	*Analyse*

	b) the cross section provided, the minimum prestressig force and corresponding eccentricity.		
15.	The support section of pre stressed concrete beam, 100mm wide and 250 mm deep is required to support an ultimate shear force of 60kN. The compressive pre stress at the centroidal axis is $5 N/mm^2$. The characteristic cube strength of concrete is $40 N/mm^2$. The cover to the tension reinforcement is 50mm. If the characteristic tensile strength of steel in stirrups is $250 N/mm^2$, design suitable reinforcement at the section using the Indian standard code IS: 1343 recommendations.	*BT - 4*	*Analyse*
16.	Design a post tensioned roof girder to suit the following data Effective span = 35m Live load = 10 kN/m Dead load (excluding self-weight) = 2kN/m Load factors For dead load = 1.4 For live load = 1.6 Cube strength of concrete fcu = $50 N/mm^2$ Cube strength at transfer, fci = $35 N/mm^2$ Tensile strength of concrete, ft = $1.7 N/mm^2$ Modulus of elasticity of concrete ,Ec = $34 kN/mm^2$ Loss ratio η= 0.85; 8 mm diameter high tensile wires having a characteristic tensile strength fpu = $2100 N/mm^2$ are available for use. The modulus of elasticity of hightensile wires is $200 kN/mm^2$. Design the beam as a class 1 structure according to IS code provisions.	*BT - 4*	*Analyse*
17.	A Prestressed concrete beam of rectangular cross section is required to support a design ultimate moment of 100 kN.m. Design a section if f_{ck} = $50 N/mm^2$ and f_p = $1600 N/mm^2$.	*BT - 4*	*Analyse*
18.	Discuss in detail about box girders and highlight the design procedure of it.	*BT - 3*	*Apply*

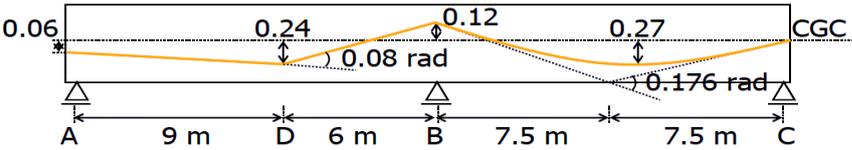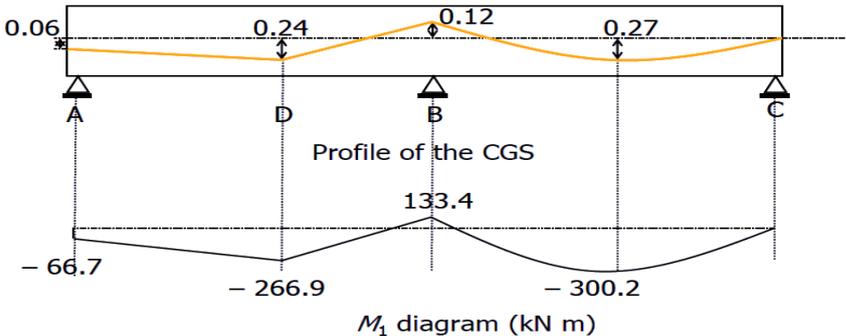## UNIT III - DESIGN OF CONTINUOUS BEAMS

Analysis and design of continuous beams- Methods of achieving continuity- concept of linear transformations, concordant cable profile and gap cables.

PART – A

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Sketch different types of tendon profile.	*BT - 1*	*Remember*
2.	State Müller-Breslau Principle.	*BT - 1*	*Remember*
3.	Give moment diagram due to prestressing force for a two-span beam.	*BT - 1*	*Remember*
4.	State Principle of linear transformation.	*BT - 1*	*Remember*
5.	Give any two conditions for moment redistribution.	*BT - 1*	*Remember*
6.	What is Concordant Tendon Profile?	*BT - 1*	*Remember*
7.	State the important characteristics of the pressure line.	*BT - 1*	*Remember*
8.	State the important characteristics of the moment diagrams.	*BT - 1*	*Remember*
9.	List the several disadvantages of a continuous beam as compared to a simply supported beam.	*BT - 1*	*Remember*

10.	Point out the several advantages of a continuous beam as compared to a simply supported beam.	BT - 1	Remember
11.	Distinguish between primary and secondary moment.	BT - 2	Understand
12.	State Clapeyron's theorem.	BT - 1	Remember
13.	State any two methods of achieving continuity in prestressed concrete beams.	BT - 1	Remember
14.	Define linear transformation in the analysis of continuous prestressed beams.	BT - 1	Remember
15.	What is meant by a gap cable?	BT - 1	Remember
16.	Why are gap cables provided in continuous prestressed concrete beams?	BT - 1	Remember
17.	Differentiate between concordant cable and non-concordant cable.	BT - 2	Understand
18.	State the significance of a concordant cable in continuous beams.	BT - 1	Remember
19.	Why do secondary stresses arise in continuous prestressed beams?	BT - 1	Remember
20.	Sketch a typical moment diagram for a continuous PSC beam.	BT - 1	Remember
21.	Sketch the cable layout for a continuous PSC beam.	BT - 1	Remember
22.	Define pressure line.	BT - 1	Remember
23.	Sketch a pressure line diagram for a continuous PSC beam.	BT - 1	Remember
24.	Define transformation profile.	BT - 1	Remember
25.	State Guyon's theorem.	BT - 1	Remember

PART – B

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Give the steps of selecting a tendon profile (profile of the CGS).	BT - 3	Apply
2.	The profile of the CGS for a post-tensioned beam is shown in the sketch. Plot the pressure line due to a prestressing force Pe = 1112 kN. Values of eccentricity in metres. Plot M_1 diagram	BT - 4	Analyse
3.	The profile of the CGS with M diagram for a post-tensioned beam is shown in the sketch. Plot the pressure line due to a prestressing force Pe = 1112 kN. Plot V diagram	BT - 4	Analyse

4.	Sketch and discuss the cable layout for a continuous PSC beam in detail.	BT - 3	Apply
5.	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 360 kN is parallel to the axis of the beam and located at 100 mm from the soffit. a) Find the secondary and resultant moment at the central support B. b) 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/m³. c) Locate the resultant line of thrust through beam AB.	BT - 4	Analyse
6.	A prestressed beam having a rectangular cross-section with a width of 120 mm and a depth of 300 mm is continuous over two spans, AB = BC = 8 m. The cable with zero eccentricity at the ends and an eccentricity of 50 mm towards the top fibres of the beam over the central support carries an effective force of 500 kN. a) Calculate the secondary moment developed at B. b) If the beam supports concentrated loads of 20 kN each at midpoints of span, evaluate the resultant stresses at the central support section B. c) Locate also the position of the pressure line at section B.	BT - 4	Analyse
7.	Discuss in detail merits and demerits of a continuous beam as compared to a simply supported beam.	BT - 3	Apply
8.	Discuss about the methods of achieving continuity in continuous beams.	BT - 3	Apply
9.	Elaborate the incorporation of moment due to reactions for PSC beam.	BT - 3	Apply
10.	Write the detailed design procedure for the design of PSC beam.	BT - 3	Apply
11.	A continuous beam ABCD (AB = BC = CD = 10 m) supports a uniformly distributed live load of q kN/m. The beam has a rectangular section with a width of 300 mm and overall depth 600 mm throughout. It is prestressed by a concordant cable located 100 mm from the soffit at mid-span points and from the top of the beam at supports B and C. The cross-sectional area of the cable is 600 mm². The ultimate strength of the cable and concrete is 1600 N/mm² and 40 N/mm² respectively. If the density of concrete is 24 kN/m³, estimate the magnitude of the live load supported by the beam at the limit state of collapse, assuming: a) Elastic distribution of moments b) Full redistribution of moments.	BT - 4	Analyse
12.	A continuous beam ABC (AB = BC = 10 m) has a rectangular section, 400 mm wide and 650 mm deep. The beam is prestressed by a concordant cable having a cross-sectional area of 1200 mm², located 50 mm from the soffit at mid-span points and 50 mm from the top of the beam at B. If the beam supports two concentrated loads of 200 kN each at mid-span points, determine the load factor against collapse assuming: a) Elastic distribution of moments b) Complete redistribution of moments.	BT - 4	Analyse
13.	Discuss in detail about methods for analysing the secondary moments in PSC beam.	BT - 3	Apply
14.	A two-span continuous beam ABC (AB = BC = 10 m) is of rectangular section, 300 mm wide and 600 mm deep. The beam is prestressed by a parabolic cable, concentric at the end supports and having an eccentricity of 100 mm towards the soffit at the centre of spans and 200 mm towards the top at the mid-support. The effective force in the cable is 500 kN.	BT - 4	Analyse

	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.		
15.	Show the steps for development of the moment diagram due to prestressing force with neat sketch.	*BT - 3*	*Apply*
16.	Write short note on a) Principle of linear transformation b) Concordant tendon profile.	*BT - 3*	*Apply*
17.	Write the steps of selecting a tendon profile (profile of the CGS).	*BT - 3*	*Apply*
18.	Write about a) Gap cables b) conditions for moment redistribution.	*BT - 3*	*Apply*

UNIT IV - DESIGN OF TENSION AND COMPRESSION MEMBERS

Design of tension members- application in the design of prestressed pipes and prestressed concrete cylindrical water tanks- Design of compression members with and without flexure- its application in the design piles, flag masts and similar structures.

PART – A

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	What are the provisions for handling, transportation, and erection of prestressed concrete poles as per IS 784?	*BT - 1*	*Remember*
2.	How are prestressed concrete poles classified based on shape and method of prestressing?	*BT - 1*	*Remember*
3.	What is a prestressed concrete tension member?	*BT - 1*	*Remember*
4.	State few advantages of prestressed concrete tension members.	*BT - 1*	*Remember*
5.	What is circumferential prestressing?	*BT - 1*	*Remember*
6.	What is meant by handling stress in prestressed concrete piles?	*BT - 1*	*Remember*
7.	State the general design requirements for prestressed concrete poles according to IS 784.	*BT - 1*	*Remember*
8.	Mention few applications of prestressed concrete poles.	*BT - 1*	*Remember*
9.	What is meant by eccentric prestressing?	*BT - 1*	*Remember*
10.	Why prestressing is preferred for piles compared to RCC piles?	*BT - 1*	*Remember*
11.	What is meant by handling stress in prestressed concrete piles?	*BT - 1*	*Remember*
12.	Why prestressing is advantageous for slender members like poles?	*BT - 1*	*Remember*
13.	According to IS 784 (Clause on Design Loads and Stresses), what load combinations and permissible stresses are to be considered in the design of prestressed concrete poles?	*BT - 1*	*Remember*
14.	Give the general failures of prestressed concrete tanks.	*BT - 1*	*Remember*
15.	Write about two types of construction of prestressed concrete pipes.	*BT - 1*	*Remember*

16.	What are the permissible stresses in concrete and prestressing steel as per IS 784?	BT - 1	Remember
17.	Define surge pressure.	BT - 1	Remember
18.	As per IS 784 (Clause on Materials), state the requirements for concrete grade and prestressing steel used in prestressed concrete poles.	BT - 1	Remember
19.	Define vertical prestressing.	BT - 1	Remember
20.	Differentiate prestressed cylinder and non-cylinder pipe.	BT - 2	Understand
21.	Enlist some design criteria for prestresses concrete tanks.	BT - 1	Remember
22.	Enlist some design criteria for prestresses concrete pipes.	BT - 1	Remember
23.	Define longitudinal prestressing.	BT - 1	Remember
24.	Differentiate between pre-tensioned poles and post-tensioned poles.	BT - 2	Understand
25.	Differentiate between circumferential prestressing and longitudinal prestressing.	BT - 2	Understand

PART B

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Design a cylindrical prestressed concrete water tank to suit the following data: Capacity of tank = 24500 x 10^6 liters. Maximum compressive stress in concrete at transfer not to exceed 13 N/mm^2 (compression). Minimum compressive stress under working load to be 1 N/mm2. The prestress is to be provided by circumferential winding of 7 mm diameter with an initial stress of 1000 N/mm^2 and by vertical cables of 12 wires of 8 mm diameter which are stressed to 1200 N/mm^2. Loss ratio = 0.75. The cube strength of concrete is 40 N/mm^2. Design the walls of the tank and details of circumferential wire winding and vertical cables for the following joint condition at the base: elastomeric pads (assume coefficient of friction as 0.5).	BT - 4	Analyse
2.	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 are 14 and 0.7 N/mm^2. The loss ratio is 0.8. 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 E_S = 28 kN/mm^2 and E_C = 35 kN/mm^2.	BT - 4	Analyse
3.	A non – cylinder prestressed concrete pipe of internal diameter 1000 mm and thickness of concrete shell 75 mm is required to convey water at a working pressure of 1.5 N/mm^2. The length of each pipe is 6 m. the maximum direct compressive stresses in concrete are 15 N/mm^2 and 2 N/mm^2. The loss ratio is 0.8. a) Design the circumferential wire winding using 5 mm diameter wires stressed to 1000 N/mm^2. b) Design the longitudinal prestressing using 7 mm wires tensioned to 1000 N/mm^2. The maximum permissible tensile stress under the critical transient loading (wire wrapping at spigot end) should not exceed (0.8) $(f_{ci})^{1/2}$ of	BT - 4	Analyse

	concrete at transfer, where f_{ci} is the cube strength = 40 N/mm^2. c) Check for safety against longitudinal stresses that develop, considering the pipe as a hollow circular beam as per IS: 784 provisions.		
4.	A prestressed concrete pipe of 1.2 m diameter, having a core thickness of 75 mm is required to withstand a service pressure intensity of 1.2 N/mm^2. Estimate the pitch of 5 mm diameter high tensile wire winding if the initial stress is limited to 1000 N/mm^2. Permissible stresses in concrete being 12 N/mm^2 in compression and zero in tension. The loss ratio is 0.8, if the direct tensile strength of concrete is 2.5 N/mm^2, estimate load factor against cracking.	BT - 4	Analyse
5.	A cylindrical prestressed concrete 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 the minimum compressive stress under working pressure is 1 N/mm^2, the loss ratio is 0.75, Wires of 5 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 base as fixed. The cube strength of concrete is 40 N/mm^2. For the thickness of wall is 150 mm.	BT - 4	Analyse
6.	What are the advantages of prestressed concrete poles and piles?	BT - 4	Analyse
7.	Explain the general features of prestressed concrete tanks.	BT - 4	Analyse
8.	Briefly explain the design of prestressed concrete poles. Give some sketches suitable for prestressed concrete poles.	BT - 4	Analyse
9.	Design a suitable section for the tie member of a truss to support a maximum design tensile force of 500 kN. The permissible compressive stress in concrete at transfer is 15 N/mm^2 and no tension is permitted under working loads. The loss ratio is 0.8. 7mm diameter wires of ultimate tensile strength of 1700 N/mm^2 with an initial stress of 950 N/mm^2 may be used. The direct tensile strength of concrete is 3 N/mm^2. A load factor of 2 at the limit state of collapse and 1.25 against cracking is required.	BT - 4	Analyse
10.	Design a prestressed concrete column of 5m high for a combined, axial force of 500 kN and bending moment of 1000 kN.cm	BT – 4	Analyse
11.	A foundation pile is to carry an axial load of 600 kN with a possible moment of 800 kN.cm. Design the pile with M35 concrete.	BT - 4	Analyse
12.	Design a post-tensioned hanger to carry an axial tension of P_{DL} = 300 kN (dead load including self-weight) and P_{LL} = 130 kN. The dimension of the hanger is 250 × 250 mm^2. Design the section without considering non-prestressed reinforcement. Tension is not allowed under service loads. The grade of concrete is M 35. The age at transfer is 28 days. Assume 15% long term losses in the prestress. The following properties of the prestressing strands are available from tests. Type of prestressing tendon : 7 wire strand	BT - 4	Analyse

	Nominal diameter = 12.8 mm Nominal area = 99.3 mm^2 Tensile strength f_{pk} = 1860 N/mm^2 Modulus of elasticity = 195 kN/mm^2.		
13.	Design a tension member of 21 m length having a square cross-section of 500 mm side. It is post-tensioned by means of four prestressing tendons placed concentrically, each having an initial stress of 1200 N/mm² and an effective stress of 960 N/mm². Each tendon consists of 12 wires of 7 mm diameter with an ultimate stress f_{pu} = 720 N/mm² and is housed in a duct of 50 mm diameter. The modulus of elasticity of concrete is Ec = 3.6 × 10⁴ N/mm². The member carries a dead load of 270 kN at the initial stage and an additional load of 1430 kN at the final stage, of which 60% of the total service load is permanent. Determine the stresses and deformations at the initial and final stages. Also determine the margins of safety against decompression, cracking, and ultimate strength. Take Es = 2 × 10⁵ N/mm², creep coefficient = 1.5, shrinkage strain εsh = 0.0002, and assume that restraint from the adjoining structure is negligible. Use f_n = f_{nw} = 2 N/mm², f_{ck} = 35 N/mm², and f_{ct} = 10.73 N/mm².	BT - 4	Analyse
14.	Discuss the merits and demerits of prestressed concrete tension members when compared with reinforced concrete tension members. State their typical applications.	BT - 3	Apply
15.	a) Briefly explain the design of prestressed concrete poles and flag masts. b) Give neat sketches suitable for prestressed concrete poles and flag masts.	BT - 1	Remember
16.	a) What are prestressed concrete compression members? b) What are the general features of prestressed concrete cylindrical water tanks?	BT - 1	Remember
17.	a) What are prestressed concrete compression members? b) Explain their classification, behavior, and advantages over reinforced concrete compression members.	BT - 1	Remember
18.	a) Explain the types of prestressed concrete pipes. b) Discuss their construction, advantages, and use in water supply systems.	BT - 3	Apply

UNIT V - DESIGN OF COMPOSITE MEMBERS

Composite beams- analysis and design, ultimate strength- their applications. Partial prestressing- its advantages and applications.

PART – A

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Name the codal provision used for design of prestressed concrete in India.	BT - 1	Remember
2.	State any two advantages of box girders.	BT - 1	Remember
3.	What do you understand by two stage construction?	BT - 1	Remember

4.	Define partial prestressing.	*BT - 1*	*Remember*
5.	State the methods of achieving partial prestressing.	*BT - 1*	*Remember*
6.	State prestressing index formula.	*BT - 1*	*Remember*
7.	Enlist the merits and demerits of partial prestressing.	*BT - 1*	*Remember*
8.	Quote some applications of partial prestressing.	*BT - 2*	*Understand*
9.	Define degree of prestressing.	*BT - 1*	*Remember*
10.	Define a composite beam.	*BT - 1*	*Remember*
11.	Sketch the typical cross section of precast prestressed concrete beam.	*BT - 1*	*Remember*
12.	Explain the term "shear connection" in composite beams.	*BT - 1*	*Remember*
13.	State the main advantage of composite beams over conventional reinforced concrete beams.	*BT - 1*	*Remember*
14.	Define "partial shear connection."	*BT - 1*	*Remember*
15.	Distinguish between propped and unpropped construction methods.	*BT - 2*	*Understand*
16.	Define the term "plastic moment capacity" of a composite beam.	*BT - 1*	*Remember*
17.	State the difference between elastic and plastic analysis of composite beams.	*BT - 2*	*Understand*
18.	What is meant by composite construction of prestressed and in situ concrete?	*BT - 1*	*Remember*
19.	Define "slip" in the context of composite beams.	*BT - 1*	*Remember*
20.	What is the typical use of composite beams in building construction?	*BT - 1*	*Remember*
21.	How does partial prestressing differ from full prestressing?	*BT - 1*	*Remember*
22.	Define "loss of prestress."	*BT - 1*	*Remember*
23.	Mention the limitation of partial prestressing.	*BT - 1*	*Remember*
24.	Explain why partial prestressing is suitable for retrofit or strengthening of existing structures.	*BT - 1*	*Remember*
25.	Define propped construction.	*BT - 1*	*Remember*

PART B

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Design a precast prestressed inverted T – section to be used in a composite slab of total depth 600 mm and width 300 mm. the composite slab is required to support an imposed load of 16 kN/m^2 over a span of 14 m. the compressive stress in concrete at transfer and the tensile stress under working loads may be assumed to be 20 and 1 N/mm^2 respectively. The loss ratio is 0.85. Determine the prestressing force required for the section.	*BT - 4*	*Analyse*
2.	Explain the term shrinkage stresses in composite beams.	*BT - 3*	*Apply*
3.	A precast pretensioned beam of rectangular section has a breadth of 100 mm and a depth of 200 mm. the beam with	*BT - 4*	*Analyse*

	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 insitu concrete assuming the pretensioned beam as: (a) Unpropped, (b) propped during the casting of the slab. Assume the same modulus of elasticity for concrete in precast beam and insitu cast slab.		
4.	Discuss in detail about the factors which influence flexural strength and shear strength of composite prestressed section.	BT - 4	Analyse
5.	A precast PSC beam of rectangular 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 centroids coinciding with bottom kern. The initial force in the tendon is 150 kN. The loss ratio = 0.85. 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 insitu cast concrete assuming the pretensioned beam as unpropped during the casting of the slab. $E_{precastpsc}$ = 35 kN/mm^2, $E_{insitu\,con}$ = 28 kN/mm^2.	BT - 4	Analyse
6.	Write step by step design procedure for composite construction.	BT - 3	Apply
7.	Explain the advantages and disadvantages of using precast prestressed elements along with in-situ concrete.	BT - 3	Apply
8.	Explain different types of composite construction with sketches.	BT - 3	Apply
9.	A composite beam of rectangular section is made of inverted T-beam having a slab thickness of 150 mm and width of 1000 mm. the rib size in 150 mm x 850 mm. The in situ concrete slab has E_C = 30kN/m^2 and the thickness of cast in situ slab is 1000 mm. If the differential shrinkage in 100 x 10^{-6} units, estimate the shrinkage stress developed in the precast and cast in situ units.	BT - 4	Analyse
10.	A composite T - beam is made up of a pretensioned rib 100 mm wide and 200 mm deep and cast in situ slab 400 mm wide and 40 mm thick having a modulus of elasticity of 28kN/mm^2. If the differential shrinkage is 100 x 10^{-6} units, estimate the shrinkage stress developed in the precast and cast in situ units.	BT - 4	Analyse
11.	Design a composite slab for the bridge deck using a standard invested T-section. The top flange is 250 mm wide and 100 mm thick. The bottom flange is 500 mm wide and 250 mm thick. The web thickness is 100 mm and the overall depth of the inverted T-section is 655 mm. The bridge deck has to support a characteristic imposed load of 50 kN/m^2 over an effective span of 12 m. Grade 40 concrete is specified for the precast pretensioned T section with a compressive strength at	BT - 4	Analyse

	transfer of 36 N/mm². Concrete of grade 30 is used for the insitu part. Determine the minimum prestress necessary and check for safety under serviceability limit state. Section properties: Area = 180500 mm², position of centroid = 220 mm from the soffit. $I = 81.1 \times 10^8$ mm⁴, $Z_t = 18.7 \times 10^6$ mm³, $Z_b = 37 \times 10^6$ mm³. Loss ratio = 0.8, Mmin = 0.		
12.	Explain partial prestressing. Discuss its advantages and typical applications in buildings and bridges.	BT - 3	Apply
13.	Compare composite beams and partially prestressed beams in terms of strength, stiffness, cost, and applications. Provide examples.	BT - 2	Understand
14.	Describe the applications of composite beams in multi-story buildings. Explain why they are preferred over conventional reinforced concrete beams.	BT - 3	Apply
15.	Explain the advantages of partial prestressing in retrofitting existing structures. Give examples of how it enhances load-carrying capacity.	BT - 3	Apply
16.	An existing reinforced concrete beam is showing excessive deflection. Describe how partial prestressing can be applied to strengthen the beam. Discuss the advantages and expected improvements in serviceability and cracking.	BT - 3	Apply
17.	Discuss the serviceability criteria in composite beams and partially prestressed beams, including deflection and cracking control.	BT - 3	Apply
18.	Describe the design procedure for a steel-concrete composite beam under bending and shear.	BT - 3	Apply