SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK

II SEMESTER

PST 403 – ADVANCED PRESTRESSED CONCRETE

M.E STRUCTURAL ENGINEERING

Regulation – 2023

Academic Year 2024 – 2025 (EVEN)

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SUBJECT : PST 403 – ADVANCED PRESTRESSED CONCRETE
SEM / YEAR: II / I

UNIT I - PRINCIPLES AND BEHAVIOR OF PRESTRESSING			
Basic concepts of Prestressing - Types and systems of prestressing - Analysis methods, losses of prestress – Short and Long term deflections – Cable layouts.			
PART – A (2 Marks)			
Q. No.	**Questions**	**BT Level**	**Competence**
1.	What is " pressure or thrust line"?	BT-1	Remember
2.	Define creep coefficient.	BT-1	Remember
3.	Describe the expression for the deflection of a straight tendon with uniform eccentricity below the centroidal axis.	BT-1	Remember
4.	Describe the expression for the deflection of a parabolic tendon with central anchors.	BT-1	Remember
5.	Describe the expression for the deflection of a parabolic tendon with eccentric anchors.	BT-1	Remember
6.	Define reduction factor.	BT-1	Remember
7.	Is the deflection control essential? Discuss.	BT-2	Understand
8.	Discuss about anchorage slip.	BT-2	Understand
9.	How does the loss of stress due to friction occur? Discuss?	BT-2	Understand
10.	Mention the prestressing systems adopted in concrete structure.	BT-2	Understand
11.	Classify pretensioned and post-tensioned concrete.	BT-3	Application
12.	Demonstrate the basic concepts of pre - stressing.	BT-3	Application
13	Illustrate any two advantages of pre – stressed concrete.	BT-3	Application
14.	Classify the losses of prestress.	BT-4	Analyse
15.	Explain the principles of prestressing.	BT-4	Analyse
16.	Classify the systems of prestressing.	BT-4	Analyse
17.	Compose the types of deflection.	BT-5	Evaluate

18.	Compose the factors influencing the deflection of prestressed concrete member.	BT-5	Evaluate
19.	Explain the effect of shrinkage loss.	BT-6	Create
20.	Summarize, why is high tensile steel needed for prestressed concrete construction?	BT-6	Create

PART – B (16 Marks)

1.	A concrete beam with a rectangular section 300 mm wide and 500 mm deep is prestressed by two post tension cables of area 600 mm^2 each initially stressed to 1600 N/mm^2,the cables are located at a constant eccentricity of 100 mm throughout the length of the beam having span of 10 m. Modulus of elasticity of steel and concrete is 210 kN/mm^2 and 38 kN/mm^2 i) Neglecting all losses, examine the deflection at the center of span when it is supporting its own weight. (8) ii)Allowing for 20 percentage loss in prestress, examine the final deflection at the center of the span when it carries an imposed load of 18kN/m. Adopt unit weight of concrete as 24 kN/m^3. (8)	BT-1	Remember
2.	A concrete beam having a rectangular section, 200 mm wide and 400mm deep is prestressed by parabolic cable having an eccentricity of 120mm at the centre of span, reducing to zero at the supports. The span of the beam is 7m the beam supports on imposed load of 2 KN/m, determine the effective force in the cable to balance the dead load and imposed load on the beam. Also estimate the principal stresses at the support section.	BT-1	Remember
3.	Concrete beam of rectangular section 100 mm wide and 300 mm deep is prestressed by parabolic cable, carrying an initial force of 240 kN. The cable has an eccentricity of 50 mm at the center of the span and concentric at the supports. If the span of beam is 10 m and live load is 2 kN/m. Examine the short term deflection at the center of span. Modulus of elasticity of concrete is 38 kN/mm^2, creep coefficient (ϕ) = 2, loss of prestress (L_p) = 20 percentage of initial stress after 6 months. Examine the long term deflection at center of span at this stage, assuming that the dead load and live loads are simultaneously applied after the release of prestress.	BT-1	Remember
4.	Find the final stress in concrete and the percentage loss of stress is steel after all losses, given the following data: a prestressed concrete pile, 350 mm square, contains 80 pretensioned wires, each of 6 mm diameter, uniformly distributed over the section, wires are initially tensioned on the prestressing bed with a total force of 450 kN. E_s = 210 kN/mm^2, E_c= 32 kN/mm^2, shortening due to creep = 30 x 10^{-6} mm/mm per N/mm^2 of stress, total shrinkage = 200 x 10^{-6} per unit length, relaxation of steel stress = 5 percent of initial stress.	BT-1	Remember

5.	A pre-tensioned concrete beam, 100mm wide & 300mm deep, is prestressed by straight wires carrying an initial force of 150 kN at an eccentricity of 50mm. The modulus of elasticity of steel and concrete are 210 & 35 kN/mm^2respectively. Estimate the percentage loss of stress in steel due to elastic deformation of concrete if the area of steel wires is $188mm^2$.	BT-2	Understand
6.	A pretensioned beam of size 300x600mm, simply supported over a span of 6m is pre stresses with $2000mm^2$ of HT steel of straight profile with a transfer stress of 1000 mPa. If the eccentricity of cable is 110mm, Es is 210 GPa and Ec is 300GPa, estimate the loss of prestress.	BT-2	Understand
7.	A prestressed concrete beam, 200 mm wide and 300 mm deep, is pretstressed with wires (area = 320 mm^2) located at a constant eccentricity of 50 mm and carrying an initial stress of 1000 N/mm^2. The span of the beam is 10 m. Predict the percentage loss of stress in wires if i)The beam is pretensioned (8) ii)The beam is post-tensioned (8) Using the following data: E_s = 210 kN/mm^2 ,E_c= 35 kN/mm^2 , shortening of concrete = 300 x 10^{-6} for pretensioning N/mm^2 of stress & 200 x 10^{-6} for post-tensioning, relaxation of steel stress = 5 percent of initial stress, creep coefficient = 1.6, slip at anchorage = 1 mm, frictional coefficient for wave effect = 0.0015 per m.	BT-2	Understand
8.	A simply supported beam with a uniform section spanning over 6m is post-tensioned by two cables, both of which have an eccentricity of 100 mm below the centroid of the section at mid-span. The first cable is parabolic and is anchored at an eccentricity of 100 mm above the centroid at each end, the second cable is straight and parallel to the line joining the supports. The cross-sectional area of each cable is 100 $mm^2$and they carry an initial stress of 1200 N/mm^2 .The concrete has a cross section of 2 x 10^4 $mm^2$and a radius of gyration of 120 mm. The beam supports two concentrated loads of 20 kN each at the third points of the span, E_c= 38 kN/mm^2. Calculate using Lin's method i)The instantaneous deflection at the centre of span (8) ii)The deflection at the centre of span after two years for 20 percent loss in prestress and the effective modulus of elasticity to be one-third of the short-term modulus of elasticity. (8)	BT-3	Application
9.	A concrete beam AB of span 12m is post-tensioned by a cable which is concentric at supports A and B, has an eccentricity of 200 mm in the mid-third span with a linear variation towards the supports. If the cable is tensioned at the jacking- end A, solve for	BT-3	Application

	the jacking stress in the wires if the stress at B is to be 1000 N/mm^2. Assume the coefficient of friction between the cable duct and concrete as 0.55 and the friction coefficient for the wave effect as 0.0015/m.		
10.	A concrete beam is prestressed by a cable carrying an initial prestressing force of 300kN. The cross-sectional area of the wires in the cable is $300mm^2$. Examine the percentage loss of stress in the cable only due to shrinkage of concrete for the conditions i) pre-tensioned (8) ii) post-tensioned. (8) Assume E_s= 210 kN/mm^2& age of concrete at transfer =8 days.	BT-3	Application
11.	A concrete beam of rectangular section 100 mm wide and 300 mm deep is prestressed by 5 wires of 7 mm diameter, located at an eccentricity of 50 mm. The initial stress in the wire is 1200 N/mm^2. The modulus of elasticity of steel and concrete is 210 $kN/mm^2$and 35 kN/mm^2.Analyse the loss of stresses in steel due to creep of concrete, using ultimate creep strain method and creep coefficient method.	BT-4	Analyse
12.	A concrete beam AB of 20m span is post-tensioned by end a cable carrying a stress of 1000 N/mm^2 at the jacking end A. The cable is parabolic between the supports A and B and is concentric at the supports with an eccentricity of 400 mm at the centre of span. The coefficient of friction between duct and cable as 0.35 and friction coefficient for wave effect is 0.15 for 100 m. Investigate the stress allowing for losses due to friction and wave effect at the following points: i) Assuming the jacking end as A, compute the effective stress at B ii) If the cable is tensioned from both ends A and B, calculate the minimum stress after losses in the cable and its location.	BT-4	Analyse
13.	A pre-tensioned beam 200mm wide & 300mm deep is prestressed by 10 wires of 7mm diameter initially stressed to 1200 $N/mm^2$with their centroids located 100mm from the soffit. Compose the maximum stress in concrete immediately after transfer, allowing only for elastic shortening of concrete. If the concrete undergoes a further shortening due to creep & shrinkage while there is a relaxation of 5 percent of steel stress, estimate the final percentage loss of stress in the wires , E_s= 210 kN/mm^2,E_c = 5700 $(f_{cu})^{1/2}$,f_{cu} = 42N/mm^2,Creep coefficient = 1.6, total shrinkage strain = 3 x 10^{-4}.	BT-5	Evaluate
14.	A rectangular concrete beam, 300mm deep & 200mm wide is prestressed by means of 15nos. of 5mm diameter wires located 65 mm from the bottom of the beam & 3 nos. of 5mm wires, located 25mm from the top of the beam. If the wires are initially tensioned	BT-6	Create

	to a stress of 840 N/mm^2, summarize the percentage loss of stress in steel immediately after transfer, allowing for the loss of stress due to elastic deformation of concrete only.		
15	A rectangular concrete beam 300 mm wide and 800 mm deep supports two concentrated loads of 20 kN each at the third point of a span of 9 m. i) Suggest a suitable cable profile. If the eccentricity of the cable profile is 100 mm for the middle third portion of the beam, compose the prestressing force required to balance the bending effect of the concentrated loads, (8) ii)For the same cable profile, compose the effective force in the cable if the resultant stress due to self-weight, imposed loads and prestressing force is zero at the bottom fibre of the mid-span section. (8)	BT-5	Evaluate
16	Design a pres stressed concrete beam of rectangular section to carry a live load of 12KN/m over a span of 20m. the concrete used is M40 grade and the strength of the concrete at transfer is 30MPa. The loss of prestress may be assumed as 15% and the permissible tensile stress at any stage is 1MPa. the effective pre stress in the tendon is 980MPa.	BT-3	Application
17	A beam of symmetrical I- section spanning 8 m has a flange width of 250 mm and a flange thickness of 80 mm respectively. The overall depth of the beam is 450 mm. Thickness of the web is 80 mm. The beam is prestressed by a parabolic cable with an eccentricity of 150 mm at the centre of the span and zero at the supports. The live load on the beam is 2.5 kN/m. i)Assess the effective force in the cable for balancing the dead and live loads on the beam, (8) ii)Measure the distribution of resultant stress at the centre of span section, (4) iii) Grade the shift of the pressure line from the tendon centre line. (4)	BT-6	Create
18	A pretensioned beam 80mm and 110mm deep is to be designed to support working load of 3.5 KN, each concentrated at the third points over a span of 3m. If the permissible stresses in tension are zero at transfer and 1.30N/mm2 under working loads, design the number of 3 mm wires, and the corresponding eccentricity required at the mid span section. permissible tensile stress in wires is 1400N/mm2, loss of prestress is 20% and the density of the concrete is 24 KN/m^3	BT-1	Remember

UNIT- II: DESIGN OFFLEXURE,SHEAR AND TORSION
Behaviour of flexural members, determination of ultimate flexural strength using various Codal provisions - Design for Flexure, Shear, Torsion and bond of prestressed concrete elements- Transfer of prestress - Camber, deflection and crack control.
PART – A (2 Marks)

Q. No.	Questions	BT Level	Competence
1.	What are the stages of loading to be considered in design of prestressed concrete section for flexure?	BT-1	Remember
2.	List out the steps followed in strain compatibility method.	BT-1	Remember
3.	DescribeSt.Venant'sprinciple.	BT-1	Remember
4.	Describe Guyon'smethod.	BT-1	Remember
5.	Examine how the transverse does & shear stresses develop in the end block?	BT-1	Remember
6.	Write what is anchorage reinforcement?	BT-1	Remember
7.	Discuss Magnel'smethod.	BT-2	Understand
8.	Discuss bursting forces.	BT-2	Understand
9.	Discuss Zielinski-Rowe's method.	BT-2	Understand
10.	Outline the factors for distribution of torsion reinforcement?	BT-2	Understand
11.	Classify the types of anchor plate.	BT-3	Application
12.	What do you mean by flexural shear cracking?	BT-3	Application
13.	Examine the functions of end blocks.	BT-3	Application
14.	Analyse what is zone of spalling?	BT-4	Analyse
15.	Analyse what is loop reinforcement?	BT-4	Analyse
16.	Analyse what are hair pin bars?	BT-4	Analyse
17.	Compose how to design for shear as per codal provisions.	BT-5	Evaluate
18.	Compose about anchorage zone.	BT-5	Evaluate
19.	Explain the types of flexural failures.	BT-6	Create
20.	Explain about end blocks.	BT-6	Create

PART– B (16 Marks)

1.	The end block of a post-tensioned beam is 80 mm wide & 160 mm deep. A prestressing wire, 7 mm in diameter stressed to 1200 N/mm^2 has to be anchored against the end block at the centre. The anchorage plate is 50mm by 50mm. The wire bears on the plate through a female cone of 20 mm diameter. The permissible shear in steel is 94.5N/mm^2f_{ci} = 20N/mm^2, Examine the thickness of the anchorage plate.	BT-1	Remember
2.	The end block of a post-tensioned bridge girder is 600 mm wide by 1200 mm deep. Two cables each comprising 97 high-tensile wires of 7mm diameter, are anchored using square anchor-plates of side length 410 mm with their centers located at 600mm from the top	BT-1	Remember

	and bottom edges of the beam. The jacking force in each cable is 4500kN. Examine the anchorage zone reinforcement.		
3.	A pretentioned prestressed concrete beam having rectangular section 150 mm wide and 300 mm deep has an effective cover 50 mm if compressive strength of concrete is 40 N/mm^2, prestressing force is 1600 N/mm^2 and area of prestressing steel is 461 mm^2. Examine the ultimate flexural strength of the section.	BT-1	Remember
4.	A prestressed girder has to be designed to cover a span of 12 m, to support an uniformly distributed live load of 15 kN/m. M-45 grade concrete is used for casting the girder. The permissible stress in compression may be assumed as 14 N/mm^2 and 1.4 N/mm^2 in tension. Assume 15% losses in prestress during service load conditions. The preliminary section proposed for the girder consists of a symmetrical I-section with flanges 300 wide and 150 mm thick. The web is 120 mm wide by 450 mm deep. i) Find the adequacy of the section provided to resist the service loads. (8) ii) Find the minimum prestressing force and the corresponding eccentricity for the section. (8)	BT-1	Remember
5.	A prestressed beam has a symmetrical I-section in which the depth of each flange is one-fifth of the overall depth and the web is thin enough to be neglected in bending calculations. At the point of maximum bending moment, the prestressing force is located at the centre of the bottom flange and the total loss of prestress is 20 percent. If there is to be no tensile stress in the concrete at any time, outline that the dead load must be at least one-seventh of the live load.	BT-2	Understand
6.	A pretensioned beam, 80 mm wide and 120 mm deep, is to be designed to support working loads of 4 kN, each concentrated at the third points over a span of 3 m. If the permissible stresses in tension are zero at transfer and 1.4 N/mm^2 under working loads, predict the number of 3 mm wires and the corresponding eccentricity required at the mid-span section. Permissible tensile stress in wires is 1400 N/mm^2. The loss of prestress is 20 percent and the density of concrete is 24 kN/m^3.	BT-2	Understand
7.	End block of post tensioned prestressed member is 450mm wide 450mm deep,4 cables each made up of 7 wires of 12mm diameter carries a force of 1000kN anchored by plate anchorages 150mm by 150mm located with their centers at 125mm from the edge of the end block. The diameter of the conduct is 50mm. The 28days cube strength of the concrete is 45N/mm^2. The cube strength of concrete at transfer is 25N/mm^2. Provide mild steel reinforcement and Predict the suitable anchorage for the end block.	BT-2	Understand

8.	An unsymmetrical I-section having the following section properties is used for a bridge girder. The thickness of top and bottom flanges are 200 and 250 mm respectively. The width of top and bottom flanges are 750 and 450 mm, respectively. The thickness of web is 150 mm, overall depth is 1000 mm and the area of section is 345000 mm^2.Z_t = 95 x $10^6 mm^3$,Z_b = 75 x 10^6 $mm^3$and the position of the centroid of the section is 440 mm from the top. If the permissible tensile and compressive stresses at transfer and working loads are not to exceed zero in tension and 15 N/mm^2in compression, examine the prestressing force required and the corresponding eccentricity to resist self-weight and applied moments of 1012 and 450 kNm respectively. The loss ratio is 0.85.	BT-3	Application
9.	The end block of a prestressed concrete beam, rectangular in section, is 100mm wide & 200mm deep. The prestressing force of 100kN is transmitted to concrete by a distribution plate, 100 mm wide & 50 mm deep, concentrically located at the ends. Demonstrate the position and magnitude of the maximum tensile stress on the horizontal section through the centre & edge of the anchor plate. Demonstrate the bursting tension on these horizontal planes.	BT-3	Application
10.	The end block of a post-tensioned prestressed member is 550 mm wide & 550 mm deep. Four cables, each made up of 7 wires of 12 mm diameter strands and carrying a force of 1000 kN are anchored by plate anchorages, 150 mm by 150 mm, located with their centers at 125 mm from the edges of the end block. The cable duct is of 50 mm diameter. The characteristic yield stress in mild steel anchorage reinforcement is260 N/mm^2. f_{cu}= 45 N/mm^2, f_{ci} = 25N/mm^2. Examine suitable anchorages for the end block.	BT-3	Application
11.	Explain the Magnel's method of investigation on anchorage zone stresses.	BT-4	Analyse
12.	A pretensioned Tee-section has flange 1200mm wide and 150mm thick the width and depth of the rib 300mm and 1500mm, represents high tensile steel has an area of 4700mm^2 and located at an effective depth of 1600mm. If the characteristic strength of steel and concrete is 1600 and 40N/mm^2 respectively. Analyse ultimate flexural strength of T section.	BT-4	Analyse
13.	The end block of a post-tensioned prestressed concrete beam, 300 mm wide & 300 mm deep is subjected to a concentric anchorage force of 832800 N by a Freyssinet anchorage of area 11720 mm^2. Design and detail the anchorage reinforcement for the end block.	BT-5	Evaluate
14.	Post tension bridge girder with unbounded tendons is of box section of overall dimension 1200mm wide and 1800mm deep with wall thickness 150mm. the high tensile steel has an area of 4000mm^2 and is located at an effective depth of 1600mm. The rib	BT-6	Create

	width is 300mm. The effective prestress in steel after all losses is 1000N/mm^2 and effective span of the girder is 24m. If the characteristic strength of steel and concrete is 1600 and 40N/mm^2 respectively. Assess ultimate flexural strength of T section.		
15	A concrete beam having a rectangular section, 150 mm wide and 300 mm deep, is prestressed by a parabolic cable having an eccentricity of 100 mm at the centre of span, reducing to zero at the supports. The span of the beam is 8 m. The beam supports a live load of 2 kN/m. Estimate the effective force in the cable to balance the dead and live loads on the beam. Estimate the principal stresses at the support section.	BT-2	Evaluate
16	A post-tensioned beam of rectangular cross-section, 200 mm wide and 400 mm deep is 10 m long and carries an applied load of 8 kN/m, uniformly distributed on the beam. The effective prestressing force in the cable is 500 kN. The cable is parabolic with zero eccentricity at the supports and a maximum eccentricity of 140 mm at the centre of span. i)Examine the principal stresses at the supports. (8) ii)Examine the magnitude of the principal stresses at the supports in the absence of prestress. (8)	BT-5	Evaluate
17	The cross section of a prestressed concrete beam is rectangular with a width of 350 mm and an overall depth of 700 mm. The prestressing force of 180 kN acts at an eccentricity of 190 mm. If the bending and twisting moments at the section are 80 and 20 kNm respectively, Assess the maximum principal tensile stress at the section.	BT-3	Application
18	i)A rectangular concrete box section has an overall depth of 1200 mm and an overall width of 900 mm. The concrete walls are 150 mm thick on both horizontal and vertical parts of the box. ii)Compose the maximum permissible torque if the section is uniformly prestressed by a force of 450 kN. The maximum permissible diagonal tensile stress in concrete is 0.63 N/mm 2 iii)Compose also the amount of non-prestressed reinforcement required for the box section if the torsional resistance moment of the section is to be increased to 345 kNm. The permissible tensile stress in steel is 230 N/mm^2 .	BT-6	Create

UNIT- III: DESIGN OF CONTINUOUS AND CANTILEVER BEAMS			
Analysis and design of continuous beams - Methods of achieving continuity - concept oflinear transformations- concordant cable profile and gap cables – Composite sections of prestressed concrete beam and cast in situ RC slab - Design of composite sections - Partial prestressing - Analysis and design of cantilever beams.			
PART – A (2 Marks)			
Q. No.	**Questions**	**BT Level**	**Competence**
1.	List out the advantages of continuous members.	BT-1	Remember

2.	List out the methods of achieving continuity.	BT-1	Remember
3.	List out the disadvantages of continuous members.	BT-1	Remember
4.	Define primary and secondary moment.	BT-1	Remember
5.	Describe redistribution of moments.	BT-1	Remember
6.	What is concordant cable profile?	BT-1	Remember
7.	Discuss about cap cables.	BT-2	Understand
8.	Discuss about line of prestress.	BT-2	Understand
9.	Summarize the tendon reactions according to different shapes of cable profile?	BT-2	Understand
10.	Explain pressure line or thrust line.	BT-2	Understand
11.	Illustrate the three moment equation.	BT-3	Application
12.	Demonstrate the assumptions made in the analysis of secondary moments in continuous prestressed concrete members.	BT-3	Application
13.	Illustrate the method of analyzing statically indeterminate prestressed structures to compute the secondary moments.	BT-3	Application
14.	Explain the following (i) primary moment (ii) secondary moment.	BT-4	Analyse
15.	Explain briefly about concordant cable profile.	BT-4	Analyse
16.	Explain transformation profile.	BT-4	Analyse
17.	Assess flexibility influence coefficient.	BT-5	Evaluate
18.	Justify the Guyon's theorem.	BT-5	Evaluate
19.	Compose the assumptions in analysis of secondary moment.	BT-6	Create
20.	Construct briefly about consistent deformation method.	BT-6	Create

PART – B (16 Marks)

1.	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 600mm. It is prestressed by a concordant cable located 100 mm from the soffit at midspan points and from the top of the beam at supports B and C. The cross-sectional area of the cable is 600mm^2. The ultimate strength of the cable & concrete is 1600 N/mm^2& 40N/mm^{2}respectively. If the density of concrete is 24 kN/m^3 , Examine the magnitude of the live load supported by the beam at the limit state of collapse, assuming, i) Elastic distribution of moments. (8) ii)Full redistribution of moments.(8)	BT-1	Remember
2.	Two simply supported beams, AB= BC = 10 m, of rectangular cross section, each post-tensioned by means of two parabolic cables(P=300kN each) with eccentricities of zero at the supports & 150 mm	BT-1	Remember

	at mid-span, are converted into a continuous beam by tensioning a parabolic cap cable carrying a force of 300kN. The ends of the cap cable are located at 3m from the central support. The cable centre is 50 mm from the top of the beam over the central support B. The beam is 200mm wide and 600mm deep. i)Examine the secondary moment induced at B (7) ii)Examine the resultant line of thrust through the beam (3) iii)Examine the resultant prestress along the top and bottom of the beam.(3)		
3.	A prestressed concrete continuous beam of two equal spans AB = BC= 10 m is prestressed by a continuous cable having a parabolic profile between the supports. The eccentricity of the cable is zero at all the three supports & 100 mm towards the soffit at centers of spans. The beam is of rectangular section, 100mm wide & 300mm deep. The effective force in the cable is 100 kN. Identify the resultant thrust line in the beam. Show that there is no change in the thrust line if the cable is linearly transformed with a vertical shift of 100mm towards the top of beam at interior support B.	BT-1	Remember
4	A continuous concrete beam ABC (AB=BC=8m) has a uniform rectangular cross section 100 mm wide and 300 mm deep. A cable carrying an effective prestressing force of 500 kN is parallel to the axis of the beam and located at a constant eccentricity of 50 mm towards the soffit. The continuous beam supports, in addition to the self-weight, concentrated loads of 20 kN at the centre of each span. Find the resultant moment developed at centre support B and locate the position of the pressure line at this section.	BT-1	Remember
5.	Outline the Guyon's Theorem.	BT-2	Understand
6.	Predict the codal provisions for moment redistribution.	BT-2	Understand
7.	A continuous prestress concrete beam ABC (AB=BC=10m) has a uniform rectangular cross section with the width of 100mm and depth of 300mm. The cable carrying effective prestressing force of 360kN parallel to axis of the beam and located at 100mm from the bottom portion. If the beam supports an imposed load of 1.5kN/m. Estimate the secondary and resultant moment at central support "B". i) Estimate the resultant stresses at the top and bottom of the beam at "B". (8) ii) Predict the resultant line of thrust through the beam AB. The density of concrete is $24kN/m^3$. (8)	BT-2	Understand
8.	A continuous beam ABC (AB = BC = 20m) with an overall depth of 1 m is prestressed by a continuous cable carrying a force of 300kN.The cable profile is parabolic between the supports, with zero eccentricity at ends A and C. The cable has an eccentricity of	BT-3	Application

	100 mm towards the soffit at midspansectionsand 200mm towards the top fibre at the mid support section. Calculate the reactions developed at the supports due to prestress& show that the cable is concordant.		
9.	A continuous beam ABC (AB=BC=10 m) is prestressed by a parabolic cable carrying an effective force of live loads of 0.24 and 2.36 kN/m respectively, solve the resultant moments developed in the beam and locate the pressure line.	BT-3	Application
10.	A two-span continuous beam ABC (AB=BC=10 m) is of rectangular section, 200 mm wide by 500 mm deep. The beam is prestressed by a parabolic cable, concentric at end supports and having an eccentricity of 100 mm towards the soffit of the beam at centre of spans and 200 mm towards the top at mid-support. The effective force in the cable is 500 kN. i) Show that the cable is concordant (7) ii) Locate the pressure line in the beam when it supports a live load of 5.6 kN/m in addition to its self-weight. (6)	BT-3	Application
11.	A continuous beam ABC (AB = BC = 10 m) has a rectangular section, 400 mm wide and 600 mm deep. The beam is prestressed by a concordant cable having a cross-sectional area of 1200mm^2, located 50 mm from the soffit at mid-span points and 50 mm from the top of beam at B. If the beam supports two concentrated loads of 200kN each at mid-span points,f_p = 1600N/mm^2, f_{ck} = 40N/mm^2 ,Analyse the load factor against collapse assuming, i)Elastic distribution of moments (8) ii)Complete redistribution of moments (8)	BT-4	Analyse
12.	Investigate the methods of achieving continuity in prestressed beams.	BT-4	Analyse
13.	A prestress beam of rectangular cross section width of 120mm and depth 300mm is continuous over 2 span AB=BC=8m. The cable with zero eccentricity at the end and an eccentricity of 50mm towards the top fiber of beam over the central support carries an effective force of 500kN. If beam support concentrated loads of 20kN each of the midpoint of the span. Assess the secondary moment and resultant moment developed at point B. Assess the resultant stress at the center support section B. Assess the position of pressure line at B?	BT-5	Evaluate
14.	Compose the methods of analysis of secondary moments in continuous prestressed concrete members.	BT-6	Create
15	A continuous concrete beam ABC (AB=BC=8 m) has a uniform rectangular cross-section 100 mm wide and 300 mm deep. A cable carrying an effective prestressing force of 500 kN is parallel to the axis of the beam and located at a constant eccentricity of 50 mm towards the soffit. The continuous beam supports in addition to the self-weight, concentrated loads of 20 kN at the centre of each span.	BT-3	Application

	Solve the resultant moment developed at centre support B and discover the position of the pressure line at this section.		
16	A continuous beam ABC (AB=BC=10 m) is prestressed by a parabolic cable at an eccentricity of 100 mm towards the soffit carrying an effective force of 200 kN. The beam supports dead and live loads of 0.24 and 2.36 kN/m respectively. Compose the resultant moments developed in the beam and invent the pressure line.	BT-5	Evaluate
17	A continuous concrete beam ABC (AB=BC) has a uniform cross-section throughout its length. The beam is prestressed by a straight cable carrying an effective force of P. The cable has an eccentricity e towards the soffit at end supports A and C and e/2 towards the top fibre at the central support B. Describe that the cable is concordant.	BT-1	Remember
18	A continuous beam ABC (AB=BC= 20 m) with an overall depth of 1 m is prestressed by a continuous cable carrying a force of 300 kN. The cable profile is parabolic between the supports, with zero eccentricity at ends A and C. The cable has an eccentricity of 100 mm towards the soffit at mid span sections and 200 mm towards the top fibre at the mid support section. Analyse the reactions developed at the supports due to prestress and show that the cable is concordant.	BT-4	Analyse

UNIT-IV: DESIGN OF TENSION AND COMPRESSION MEMBERS

Pre-stressed concrete compression and 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 of piles, flag masts and similar structures–Connections for pre-stressed concrete elements.

PART – A (2 Marks)

Q. No.	Questions	BT Level	Competence
1.	List out the steps in design of prestressed concrete pipes.	BT-1	Remember
2.	List out the shapes of prestressed concrete tanks.	BT-1	Remember
3.	List out the types of prestressed concrete piles.	BT-1	Remember
4.	Describe the function of water stopper in water tank construction.	BT-1	Remember
5.	Describe the design criteria for prestressed concrete tanks.	BT-1	Remember
6.	Write down the types of composite construction.	BT-1	Remember
7.	Discuss the advantages of prestressed concrete piles.	BT-2	Understand
8.	Discuss about monolyte construction.	BT-2	Understand
9.	Discuss about two stage construction.	BT-2	Understand
10.	Outline the limitations of circular prestressing.	BT-2	Understand
11.	Illustrate the expression for bursting fluid pressure.	BT-3	Application
12.	Illustrate the failure of compressing members with flexure.	BT-3	Application
13.	Illustrate the failure of compressing members without flexure.	BT-3	Application

14.	Explain about circular prestressing	BT-4	Analyse
15.	Compare the types of prestressed concrete pipes?	BT-4	Analyse
16.	Define differential shrinkage.	BT-4	Analyse
17.	Assess the expression for number of turns of circumferential wire winding.	BT-5	Evaluate
18.	Assess the expression for number of turns of circumferential wire winding.	BT-5	Evaluate
19.	Compose the major factors included in the design of flag-mast.	BT-6	Create
20.	Compose the wind pressure considered in the design of tall structures.	BT-6	Create

PART – B (16 Marks)

1.	Design a non-cylinder prestressed concrete pipe of 600mm 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. Find 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= 210 kN/mm^{2}and E_c= 35 kN/mm^2	BT-1	Remember
2.	A non-cylinder prestressed concrete pipe of 1.6m diameter with a core thickness of 100mm is required to withstand a working pressure of 1 N/mm^2.Estimate the pitch of a 5mm diameter wire winding if the high-tensile initial stress in the wire is limited to 1000N/mm^2 . The permissible maximum and minimum stresses in concrete are 12 N/mm^2(compression) and zero(tension). The loss ratio is 0.8. If the direct tensile strength of concrete is 2N/mm^2 , estimate the load factor against cracking	BT-1	Remember
3.	A multi-storeyed building is to be supported on prestressed concrete pile foundations. The piles have an effective height of 5m and they have to support a total axial service load of 1100 kN together with a moment of 37.5 kNm. Design a suitable pile to support these loads for a load factor of 2 against collapse.	BT-1	Remember
4.	Explain the design procedure of non-cylindrical pipes.	BT-1	Remember
5.	Describe the design procedure of cylindrical pipes.	BT-2	Understand
6.	Summarize the general features of prestressed concrete tanks.	BT-2	Understand
7.	A prestressed cylindrical pipe is to be designed using a steel cylinder of internal diameter 1000 mm and thickness 1.6 mm. the circumferential wire winding consists of a 4 mm high tensile wire, initially tensioned to a stress of 1000 N/mm^2. Ultimate tensile stress of wire is 1600 N/mm^2, yield stress of steel cylinder is 280 N/mm^2.The maximum permissible compressive stress in concrete	BT-2	Understand

	at transfer is 14 N/mm^2 and no tensile stress are permitted under working pressure of 0.8 N/mm^2, modular ratio = 6, loss ratio = 0.8. Calculate the thickness of concrete lining required, the number of turns of circumferential wire winding and the factor of safety against bursting.		
8.	A concrete column 406 × 406 mm in cross-section and 5.5 m high. It is pretentioned with 8 number 9.5 mm wires which are end anchored to concrete. The effective prestress is 690 N/mm^2. For a concentric compressive load of 356 kN and a horizontal load of 33.6 kN at the mid height of the column, Analyse the maximum and minimum stresses in column for the hinged end of column. Investigate the secondary moment in the column due to deflection. The value of modular ratio is 7. $f_{c'}$ = 27.6 N/mm^2. Ultimate prestress = 1.379 N/mm^2. Modulus of elasticity of concrete = 27580 N/mm^2.	BT-3	Application
9.	A pretentioned concrete pin ended column has an effective prestress of 1034 N/mm^2 with 6 numbers of 9.52 mm diameter wire strands with area of prestressing steel as 51.6 mm^2 each. Modulus of elasticity of steel and concrete is 206800 and 27600 N/mm^2. The concrete has a cylinder strength of 39.3 N/mm^2 and modulus of rupture of 4.14 N/mm^2.It is loaded by a load P vertically along the axis at an eccentricity of 38 mm from the central axis. The column is of size 203 × 305 mm and height of the column is 6325 mm. Examine the deflection of the column and the stresses.	BT-3	Application
10.	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 6m. The maximum direct compressive stresses in concrete are 15 & 2 N/mm^2 . The loss ratio is 0.8.	BT-3	Application
11.	Investigate the shearing stress in the circular pipe section.	BT-4	Analyse
12.	Illustrate in detail regarding the wind effect of flagmast.	BT-4	Analyse
13.	Analyze the failure behaviors of prestressed water tanks	BT-5	Evaluate
14	Explain about prestressed concrete piles	BT-6	Create
15	A prestressed concrete compression member with square cross-section and a side of 350 mm is reinforced with eight 12.7 mm diameter seven wire stress-relieved strands distributed equally on the opposite faces. The effective prestress after all losses is 1000 N/mm^2. Label the load-moment interaction diagrams with appropriate strength-reduction factors. Consider strands that are fully developed throughout the length of the member.	BT-1	Remember
16	A square tied prestressed bonded unbraced column in a framed building is subjected to uniaxial bending. Clear height of the column= 5 m Factored design external load, P_{ud}= 1200 kN Factored end moments, M_1= 40 kN-m & M_2= 100 kN-m fc'= 40 N/mm2, E_c=36 kN/mm^2	BT-5	Evaluate

	The ratios of factored dead-load moments to total moments, $\beta = 0.4$. Ratio of stiffness of column to beams at the top (ΨA) and bottom (ΨB) of the column being 1 and 2 respectively. Adopting 12.7 mm diameter 7-ply stress-relieved strands with fpu = 1860 N/mm^2, design the column section and the required number of strands, considering gravity loads only and assuming negligible lateral side sway due to wind.		
17	A square tied prestressed bonded corner column of a multistorey building frame is subjected to an ultimate load Pu= 2142 kN at an equal eccentricity of 70 mm along the x and y axis respectively. fc'= 40 N/mm2. Assess a suitable column section and reinforcements for the column subjected to biaxial bending moments.	BT-6	Create
18	Explain the advantages of prestressed concrete poles.	BT-4	Analyse

UNIT-V: DESIGN OF PRESTRESSED CONCRETE BRIDGES			
Review of IRC and IRS loadings. Effect of concentrated loads on deck slabs, load distribution methods for concrete bridges. Design of pre- tensioned and post tensioned girder bridges - Partial prestressing - advantages and applications.			
PART – A (2 Marks)			
Q. No.	**Questions**	**BT Level**	**Competence**
1.	Quote the allowable flexural tensile stress of 25 & 30 grade of insitu concrete.	BT-1	Remember
2.	Label the composite bridge deck	BT-1	Remember
3.	Describe about composite behavior.	BT-1	Remember
4.	Describe the stress distribution due to differential shrinkage	BT-1	Remember
5.	Describe partial prestressing.	BT-1	Remember
6.	List out the advantages of partial prestressing?	BT-1	Remember
7.	Discuss how an effective bonding provided between two parts of a composite beam does.	BT-2	Understand
8.	Discuss about shear connectors.	BT-2	Understand
9.	Discuss about horizontal shear.	BT-2	Understand
10.	Outline the assumptions made in estimation of stresses due to differential shrinkage?	BT-2	Understand
11.	Illustrate what is meant by composite construction of prestressed and insitu concrete?	BT-3	Application
12.	Classify the types of composite construction?	BT-3	Application
13.	Examine ultimate design and elastic design.	BT-3	Application

14.	Analyse how to achieve compositeness between precast and cast in situ part and show the sketches.	BT-4	Analyse
15.	Classify the different types of flexural failures of composite members under bending load.	BT-4	Analyse
16.	Explain about differential shrinkage	BT-4	Analyse
17.	What is propped construction?	BT-5	Evaluate
18.	What is unpropped construction?	BT-5	Evaluate
19.	Conclude about the deflection of composite member. .	BT-6	Create
20.	Grade the advantages of composite construction?	BT-6	Create

PART-B (16 Marks)

1.	Define composite construction. Describe the types of composite construction?	BT-1	Remember
2.	The cross section of composite beam of T-section having a pretentioned rib 80mm wide 240mm deep and insitu cast slab 350mm wide and 80mm thick. The pretentioned beam is reinforced with 8wires of 5mm diameter with the ultimate tensile strength of 1600N/mm^{2}located at 60mm from the soffit of the beam. If the compressive strength of insitu and precast element is 20 and 40N/mm^2 resp. If adequate reinforcements are provided to prevent the shear failure at the interface, Examine the flexural strength of the composite section.	BT-1	Remember
3.	A precast pre-tensioned beam of rectangular section has a breadth of 100mm and a depth of 200mm. The beam, with an effective span of 5m, is prestressed by tendons with their centroids coinciding with the bottom kern. The initial force in the tendons is 150kN. The loss of prestress is 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 40mm. If the composite beam supports a live load of 8kN/m^2, Examine the resultant stresses developed in the precast and cast in situ concrete assuming the pre tensioned as (a) unpropped, (b) propped during the casting of the slab. Assume the same modulus of elasticity in precast beam and cast in situ slab.	BT-1	Remember
4.	Describe partial prestressing and its advantages.	BT-1	Remember
5.	Discuss the failure effect of composite beams	BT-2	Understand
6.	Discuss about the advantages of composite construction.	BT-2	Understand
7.	A composite beam of rectangular section is made up of a pre-tensioned inverted T-beam having a slab thickness and width of 150 and 1000 mm respectively. The rib size is 150 mm by 850mm. The cast in situ concrete has a thickness and width of	BT-2	Understand

	1000 mm with a modulus of elasticity of 30 kN/mm^2. If the differential shrinkage is 100 x 10^{-6} units, estimate the shrinkage stresses developed in the precast and cast in situ units.		
8.	A composite T-beam is made up of a pre-tensioned rib 100mm wide and 200mm deep, and a cast in situ slab 400mm wide and 40mm thick having a modulus of elasticity of 28kN/mm^2. If the differential shrinkage is 100 x 10^{-6} units. Calculate the shrinkage stresses developed in the precast and cast in situ units.	BT-3	Application
9.	Illustrate the characteristic features of partial prestressing	BT-3	Application
10.	Illustrate the applications of partial prestressing.	BT-3	Application
11.	Explain the processing difficulties of composite construction	BT-4	Analyse
12.	Explain the future research proposals of composite construction	BT-4	Analyse
13.	Design a precast prestressed inverted T- section to be used in a composite slab of total depth 600mm & width 300mm. The composite slab is required to support an imposed load of 16kN/m^{2}over a span of 14m. The compressive stress in concrete at transfer and the tensile stress under working loads is 20 and 1 N/mm^2. The loss ratio is 0.85. Invent the prestressing force required for the section.	BT-5	Evaluate
14.	A composite beam of rectangular section is made up of precast prestressed inverted T-beam having a rib 100 x 780mm and slab 400 x 200mm. The insitu cast concrete has a thickness of 800mm and width of 400mm. The precast T-beam is reinforced with high tensile wires with a stress value of 1600N/mm^2 having an area of 800mm^2 located 100mm from the soffit of the beam. The cube strength of concrete in situ cast slab and prestressed beam is 20 and 40N/mm^2 respectively. Assess the flexural strength of the composite section.	BT-6	Create
15	A composite T girder of span 5 m is made up of a pre-tensioned rib, 100 mm wide by 200 mm deep, with an in situ 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 an initial force of 150 kN. The loss of prestress may be assumed to be 15 percent. Examine the composite T-beam for the limit state of deflection if it supports an imposed load of 3.2 kN/m for a) unpropped construction (8) b) propped construction. (8) Assume a modulus of elasticity of 35 kN/mm^2 for both precast and in-situ cast elements.	BT-3	Application
16	Discuss about the disadvantages of composite construction.	BT-2	Understand
17	The cross-section of a composite beam is of T-section having a pre-tensioned rib,80 mm wide and 240 mm deep, and an in situ cast slab, 350 mm wide and 80 mm thick. The pre-tensioned beam is reinforced with eight wires of 5 mm diameter with an ultimate tensile strength of 1600 N/mm2, located 60 mm from the soffit of the beam. The compressive strength of concrete in	BT-5	Evaluate

	the in situ cast and precast elements is 20 and 40 N/mm2respectively. If adequate reinforcements are provided to prevent shear failure at the interface, compose the flexural strength of the composite section.		
18	A composite beam of rectangular section is made up of a precast prestressed inverted T-beam having a rib, 100 mm by 780 mm and a slab, 400 mm wide and 200 mm thick. The in situ cast concrete has a thickness of 800 mm and a width of 400 mm. The precast T-beam is reinforced with high-tensile wires having an area of 800 mm2and located 100mm from the soffit of the beam. If the cube strength of concrete in the in situ cast slab and prestressed beam is 20 and 40 N/mm2respectively, Analyze the flexural strength of the composite section.	BT-4	Analyse

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PST 403 – ADVANCED PRESTRESSED CONCRETE

Sl. No.	UNIT No.		BT1	BT2	BT3	BT4	BT5	BT6	Total Questions
1	Unit-1	Part-A	9	3	2	2	2	1	20
		Part-B	5	4	3	4	1	1	18
2	Unit-2	Part-A	10	5	3	3	2	2	25
		Part-B	5	4	3	4	1	1	14
3	Unit-3	Part-A	10	4	3	3	3	2	25
		Part-B	4	3	3	3	1	1	14
		Part- C			1	1	1	1	4
4	Unit-4	Part-A	10	5	3	3	2	2	25
		Part-B	4	3	2	3	1	1	14
		Part- C	1			1	1	1	4
5	Unit-5	Part-A	11	4	3	3	2	2	25
		Part-B	4	3	2	3	1	1	14
		Part- C	1	1		1		1	4

TOTAL NO.OF QUESTIONS IN EACH PART	
PART A	100
PART B	90
TOTAL	190