Code No: **R1642013** **R16** **Set No. 1**

IV B.Tech II Semester Regular/Supplementary Examinations, June - 2022

PRESTRESSED CONCRETE

(Civil Engineering)

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

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
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PART–A *(14 Marks)*

1\. a) Differentiate between full prestressing and partial prestressing. [2]

b) List out various types of tensioning devices used in prestress concrete. [2]

c) How is the loss of stress, due to elastic deformation of concrete in post-tensioned members with several cables which are successively tensioned, calculated? [2]

d) Under what situations and types of structures would you recommend the use of unbonded tendons? [2]

e) Distinguish between web-shear, flexural and flexure-shear cracks in concrete beams. [3]

f) Explain with sketches the variation of bond stress, stress in steel and concrete in the transmission zone of pretensioned members. [3]

PART–B *(4x14 = 56 Marks)*

2\. Explain the following basic concepts of prestressed concrete with neat stress strain diagrams.

a) Stress concept: Prestressing to transform concrete into an elastic material [4]

b) Strength concept: Prestressing for combination of high strength steel concrete [4]

c) Load bearing concept: Prestressing to achieve load balancing [6]

3\. A Prestressed concrete beam supports a live load of 4 kN/m over a simply supported a span of 8 m. The beam has an I-section with an overall depth of 400 mm. The thickness of the flange and web are 60 and 80 mm, respectively. The width of the flange is 200 mm. The beam is to be prestressed by an effective prestressing force of 235 kN at a suitable eccentricity such that the resultant stress at the soffit of the beam at the centre of the span is zero.
Find the eccentricity required for the force.
If the tendon is concentric, what should be the magnitude of the prestressing for the resultant stress to be zero at the bottom fibre of the central span? [14]

4. A pretensioned beam 150 mm wide and 300 mm deep is prestressed by eight 7 mm wires located 100 mm from the soffit of the beam. If the wires are initially tensioned to a stress of $1100\ \mathrm{N/mm^2}$, Calculate their stress at transfer and the effective stress after all losses for the following data. Take $E_s = 210\ \mathrm{kN/mm^2}$, $E_c = 31.5\ \mathrm{kN/mm^2}$

	Up to time of transfer	Total
Relaxation of steel	$35\ \mathrm{N/mm^2}$	$70\ \mathrm{N/mm^2}$
Shrinkage of concrete	100×10^{-6}	300×10^{-6}
Creep coefficient	--	1.6

[14]

5. A post-tensioned prestressed concrete T-beam with unbonded tendons is made up of a flange 300 mm wide by 150 mm thick and the width of the rib is 150 mm. The effective depth of section is 320 mm. The beam is prestressed by 24 wires each of 5 mm diameter having characteristic strength of $1650\ \mathrm{N/mm^2}$. The effective stress after all loses is $900\ \mathrm{N/mm^2}$. If the cube strength of concrete is $56\ \mathrm{N/mm^2}$, estimate the flexural strength of the section using IS:1343 provisions. [14]

6. A prestressed concrete beam having an unsymmetrical I-section has a fibre stress distribution of $13\ \mathrm{N/mm^2}$ (compression) at the top edge and linearly reducing to zero at the bottom. The top flange width and thickness are 2400 and 400 mm respectively, bottom flange width and thickness are 1200 and 900 mm respectively, and the depth and thickness of the web are 1000 and 600 mm respctively. The total vertical service-load shear in the concrete at the section is 2350 kN. Compute and compare the principal tensile stress at the centroidal axis and at the junction of the web with the lower flange. [14]

7. The end block of prestressed concrete beam, 200 mm wide and 400 mm deep, has two anchor plates 200×50 mm deep, at 80 mm from top and 200×80 mm deep, located at 100 mm from bottom of the beam, transmitting forces of 250 and 300 kN respectively
Find the position and magnitude of maximum tensile stress on a horizontal section passing through the centre of the beam using Guyon's method.
Evaluate the maximum tensile stress on sections passing through the larger and smaller prestressing forces using Guyon's and Rowe's method. [14]

Code No: **R1642013** **R16** **Set No. 2**

IV B.Tech II Semester Regular/Supplementary Examinations, June - 2022

PRESTRESSED CONCRETE

(Civil Engineering)

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

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
*****

<u>PART–A</u> *(14 Marks)*

1. a) What is debonding? [2]
   b) Distinguish between pretensioned and post-tensioned members. [2]
   c) Explain why post-tensioned members do not suffer the loss of prestress due to elastic deformation. [2]
   d) What are the different types of flexural failure modes observed in prestressed concrete beams? Explain with sketches. [3]
   e) How is the ultimate shear strength of prestressed concrete sections with web-shear cracks estimated? [2]
   f) What is transmission length? List the various factors influencing transmission length. [3]

<u>PART–B</u> *(4x14 = 56 Marks)*

2. a) Classify prestressed concrete depending on design construction and method of applying prestressing and purpose of structure. [7]
   b) Explain various linear pre-tensioning systems and end anchorages [7]

3 A prestressed concrete beam, 200 mm wide and 300 mm deep, is used over an effective span of 6 m to support an imposed load of 4 kN/m. The density of concrete is 24 kN/m^3. At the quarter-span section of the beam, find the magnitude of The concentric prestressing force necessary for zero fibre stress at the soffit when the beam is fully loaded; and The eccentric prestressing force located 100 mm from the bottom of the beam which would nullify the bottom fibre stress due to loading. [14]

4. A prestressed concrete pile of cross section, 250 mm by 250 mm, contains 60 pretensioned wires, each of 2 mm dia distributed uniformly over the section. The wires are initially tensioned in the prestressing bed with a total force of 300 kN. If $E_s = 210\ kN/mm^2$, $E_c = 32\ kN/mm^2$,
   Calculate the respective stresses in steel and concrete immediately after the transfer of prestress, assuming that up to this point the only loss of stress is that due to elastic shortening.
   If the concrete undergoes a further shortening due to shrinkage of 200×10^{-6} per unit length, while there is a relaxation of five percent of steel stress due to creep of steel, find the greatest tensile stress which can occur in a pile 20 m long when lifted at two points 4 m from each end. Assume creep coefficient as 1.6. [14]

5. A double T-section having a flange of 1200 mm wide and 150 mm thick is prestressed by 4700 mm^2 of high tensile steel located at an effective depth of 1600 mm. The ribs have a thickness of 150 mm each. If the cube strength of concrete is 40 N/mm^2 and tensile strength of steel is 1600 N/mm^2, determine the flexural strength of double T-girder using IS:1343 provisions. [14]

6. A concrete beam of rectangular section, 200 mm wide and 600 mm deep is prestressed by a parabolic cable located at an eccentricity of 100 mm at mid span and zero at the supports. If the beam has a span of 10 m and carries a uniformly distributed load of 4 kN/m, find the effective force necessary in the cable for zero shear stress at the support section. For this condition, calculate the principal stresses. The density of concrete is 24 kN/m^3 [14]

7. The end block of prestressed beam, 250 mm wide and 500 mm deep in section, is prestressed by two cables carrying forces of 450 kN each. One of the cables is parabolic, located 125 mm below the centre line at the centre of the span (10 m) and anchored at a point 125 mm above the centre line at the ends. The second cable is straight and located 100 mm from the bottom of the beam. The distribution plates for the cables are 100 mm deep and 250 mm wide. Calculate the maximum tensile stress along the axis of the beam using Guyon's method. Also evaluate the maximum tensile stress on horizontal section passing through the centre of the anchor plates using Guyon's and Rowe's method. [14]

Code No: **R1642013** **R16** **Set No. 3**

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PRESTRESSED CONCRETE

(Civil Engineering)

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

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
*****

PART–A *(14 Marks)*

1. a) What is the necessity of using high strength concrete and high tensile steel in prestressed concrete? [2]
   b) Explain with sketches Hoyer's long line system of pretensioning. [2]
   c) Explain the loss of stress due to elastic deformation of concrete. [2]
   d) Distinguish clearly between short term and long term deflections of prestressed concrete beams. [2]
   e) Outline the factors influencing the ultimate shear resistance of prestressed concrete sections with flexure-shear cracks. [3]
   f) What are flexural bond stresses? How do you compute bond stress between (a) High tensile wire and grout, and (b) the cable hose and concrete? [3]

PART–B *(4x14 = 56 Marks)*

2. a) What are the advantages and disadvantages of Prestressed Concrete over Reinforced concrete? [7]
   b) Explain Magnel Blaton system of mechanical Pre-stressing post tensioning systems [7]

3 A concrete beam of symmetrical I-section spanning 8 m has flange width and thickness of 200 and 60 mm, respectively. The overall depth of the beam is 400 mm. The thickness of the web is 80mm. The beam is prestressed by a parabolic cable with an eccentricity of 15 mm at the centre and zero at the supports with an effective force of 200 kN. The live load on the beam is $2\ \mathrm{kN/m}$. Draw the stress distribution diagram at the central section for
Prestress + self weight (density of concrete $= 24\ \mathrm{kN/m^3}$); and
Prestress + self weight + live load [14]

4. A post-tensioned cable of a beam $10\ \mathrm{m}$ long is initially tensioned to a stress of $1000\ \mathrm{N/mm^2}$ at one end. If the tendons are curved so that the slope is 1 in 15 at each end with an area of $6000\ \mathrm{mm^2}$, calculate the loss of prestress due to friction for the given data:
Coefficient of friction between duct and cable $= 0.55$
Friction coefficient for wave effect $= 0.0015/\mathrm{m}$
During anchoring, if there is a slip of $3\ \mathrm{mm}$ at the jacking end, calculate the final force in the cable and percentage loss of prestress due to friction and slip. [14]

5. A concrete beam with a rectangular cross section, 100 mm wide and 300 mm deep, is stressed by three cables, each carrying an effective force of 240 kN. The span of the beam is 10 m. The first cable is parabolic with an eccentricity of 50 mm below the centroidal axis at the centre of the span and 50 mm above the centroidal axis at the supports. The second cable is parabolic with zero eccentricity at the supports and an eccentricity of 50 mm at the centre of the span. The third cable is straight with uniform eccentricity of 50 mm below the centroidal axis. If the beam supports a uniformly distributed live load of 5 kN/m and $E_c = 38\ \mathrm{kN/mm^2}$, estimate the instantaneous deflection at the following stages:
   Prestress + self weight of the beam
   Prestress + self weight + live load [14]

6. The shear stress due to the imposed load at the centre of the web in an I-section is $3\ \mathrm{N/mm^2}$ and horizontal prestress at this point is $8.4\ \mathrm{N/mm^2}$. The details of the cross section are:
   Width of top and bottom flanges = 250 mm, average thickness of the top and bottom flanges equals 120 and 80 mm respectively, overall depth = 750 mm, and thickness of the web = 80 mm. Find the increase in the principal tensile stress if, due to eccentricity of load, a torque of 5 kN m is applied on the section. [14]

7. A Freyssinet anchorage (125 mm diameter) carrying 12 wires of 7 mm diameter stressed to $950\ \mathrm{N/mm^2}$, is embedded concentrically in the web of an I-section beam at the ends. The thickness of the web is 225 mm. Evaluate the maximum tensile stress and the bursting tensile force in the end block using Rowe's method. Design the reinforcement for the end block. [14]

Code No: **R1642013** **R16** **Set No. 4**

IV B.Tech II Semester Regular/Supplementary Examinations, June - 2022

PRESTRESSED CONCRETE

(Civil Engineering)

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

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
*****

PART–A *(14 Marks)*

1. a) What is the minimum grade of concrete to be used in prestressed concrete? Explain. [2]
   b) What are supplementary anchoring devices? [2]
   c) List out the various types of loss of prestress in pretensioned and post-tensioned members. [3]
   d) List the various factors influencing the deflection of prestressed concrete members. [2]
   e) List some practical examples of structures subjected to combined bending, shear in torsion. [2]
   f) Explain the terms end block, anchorage zone and bursting tension with respect to post-tensioned prestressed members. [3]

PART–B *(4x14 = 56 Marks)*

2. a) Write the applications of Prestressed Concrete and Write the different grades of concrete? [7]
   b) Explain Freyssinet system of pre-stressing post tensioning systems. [7]

3 A concrete beam with a double overhang has the middle span equal to 10 m and an equal overhang of 2.5 m on either side. Determine the profile of the prestressing cable with an effective force of 250 kN which can balance a uniformly distributed load of 8 kN/m on the beam, inclusive of self weight of the beam. Sketch the cable profile marking the eccentricity of the cable at the support and mid span. [14]

4. A post-tensioned concrete beam with a cable of 24 parallel wires (total area $= 80\ \mathrm{mm}^2$) is tensioned with two wires at a time. The cable with zero eccentricity at the ends and 150 mm at the center is on a circular curve. The span of the beam is 10 m. The cross section is 200 mm wide and 450 mm deep. The wires are to be stressed from one end to a value of f_1 to overcome frictional loss and then released to a value of f_2 so that immediately after anchoring, an initial prestress of $840\ \mathrm{N/mm}^2$ would be obtained. Compute f_1 and f_2 and the final design stress in steel after all losses, given the following data:
   Coefficient of friction for curvature effect = 0.6
   Friction coefficient for wave effect = 0.003/m
   Deformation and slip of anchorage = 1.25 mm
   $E_s = 210\ \mathrm{kN/mm}^2$, $E_c = 28\ \mathrm{kN/mm}^2$
   Shrinkage in concrete = 0.0002
   Relaxation of steel stress = 3 percent of the initial stress [14]

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5. A simply supported concrete beam of span 8 m and rectangular cross section 125 mm wide and 250 mm deep, is prestressed by a single cable in which the total tensile force is 220 kN. The centre line of the cable is parallel to the axis of the beam and 75 mm above the soffit over the middle third of the span and is curved upwards in a parabola over the outer-thirds of the span to a distance of 175 mm above the soffit at the supports. If the modulus of elasticity of concrete is 35 $\mathrm{kN/mm^2}$ and the density of concrete is 24 $\mathrm{kN/m^3}$. Calculate
   The upward deflection at mid span due to prestress only.
   The deflection when the beam is supporting its own weight. [14]

6. A concrete beam of rectangular section, 250 mm wide and 650 mm overall depth, is subjected to a torque of 20 kN m and a uniform prestressing force of 150 kN. Calculate the maximum principal tensile stress. Assuming 15% loss of prestress, calculate the prestressing force necessary to limit the principal tensile stress to 0.4 $\mathrm{N/mm^2}$. [14]

7. The end block of a prestressed beam, 500 mm wide and 1050 mm deep contains 6 Freyssinet cables, each carrying a force of 266 kN anchored through 100 mm diameter anchorages, which are spaced 150 mm apart at the end of the beam. Calculate the maximum tensile stress and the bursting tension and design the reinforcement for the end block using Rowe's method. Adopt yield stress in mild steel reinforcement as 260 $\mathrm{N/mm^2}$. [14]