**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**

**SECOND SEMESTER 2021 – 2022**

**DESIGN OF PRESTRESSED CONCRETE STRUCTURE (MID-SEMESTER EXAMINATION)**

**Course No: CE F415 (Close Book) Time = 1.5 hours Total Marks: 50**

**Attempt all questions. Assume suitable data if necessary.**

---

**Q1.** Answer the following questions 3 x 5 =15

a) What is the functional difference between an unbonded tendon with a bonded tendon?
b) What is flexure-shear crack?
c) What is the necessity of using only high strength concrete in pre-stressed concrete?
d) Differentiate between partial prestressing and full prestressing.
e) What is a Class-1 structure in prestressed concrete design?

**Q2.** A rectangular concrete beam having cross sectional dimensions- 200 mm width and 400 mm depth and having a span of 6 metres is pretensioned by a force of 200 kN at an eccentricity of +100 mm. If the beam is carrying a transversely acting concentrated load of 10 kN at mid-span, taking the weight density of concrete to be 24 kN/m$^3$, determine-

a) the stresses developed at top and bottom fibre of the beam cross section at the centre of the span of the beam.
b) determine the location of the pressure line at mid-span and at quarter spans. 15

**Q3.** A rectangular beam of length 8 meters and having cross section 250 mm wide and 500 mm deep is simply supported and post tensioned by 4 number of cables in two layers. The bottom two cables are straight and are located at 50 mm from the soffit. The top two cables are parabolic with eccentricities +150 mm. at midspan and -120 mm at support. The cables are stressed to an initial pre-stress of 1200 N/mm$^2$. The cross-sectional dimension of each cable is 100 mm$^2$. Compute the overall percentage loss of pre-stress due to elastic shortening of concrete, if the two cables at bottom layer are post-tensioned one-by-one first, followed by successive post-tensioning of the other two cables- one after another. Assume modular ratio to be 6. 10

**Q4.** A rectangular beam having span of 6 metre and cross sections 125 mm width and 250 mm depth is pretensioned with a straight cable at eccentricity +40 mm. The initial prestressing force is 190 kN. Assuming the beam to be un-cracked, compute-

a) The immediate short term maximum deflection due to pre-stress, self-weight and a live load of 3.75 kN/m. Deflection due to straight profile of the cable may be assumed as $a_p = -\frac{PeL^2}{8EI}$
b) The long-term maximum deflection considering 20% overall loss of prestress, using Lin's approximate formula: $a_s = \left[ a_{i1} - a_{ip} \frac{p_t}{p_i} \right] (1+\phi)$ . Weight density of concrete to be 24 kN/m$^3$, $E_c$ = 40 kN/mm$^2$, Creep coefficient =1.6. 10