MANIPAL INSTITUTE OF TECHNOLOGY
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MANIPAL INSTITUTE OF TECHNOLOGY

THIRD SEMESTER B. TECH (CIVIL ENGINEERING)

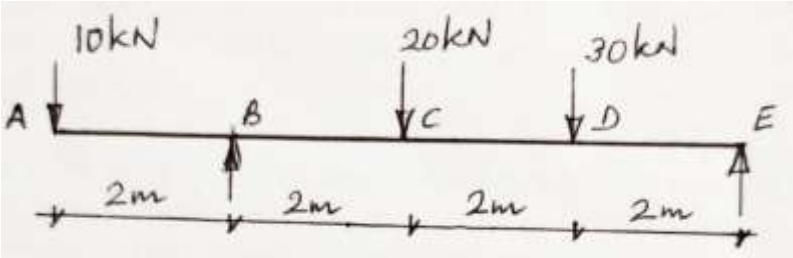
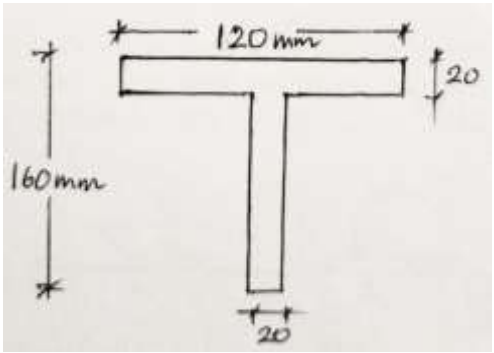
END SEMESTER EXAMINATION, DEC 2022

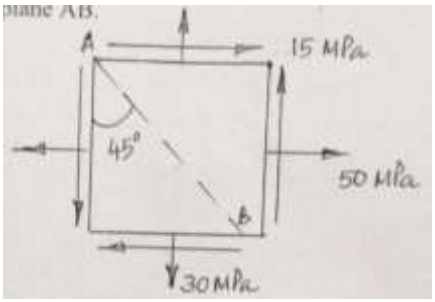
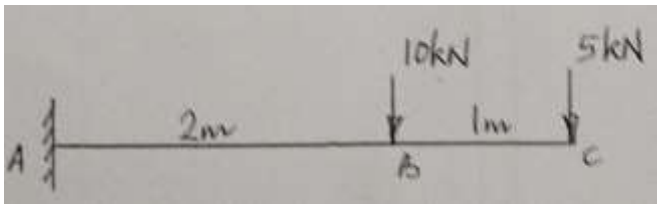
MECHANICS OF SOLIDS (CIE 2153)

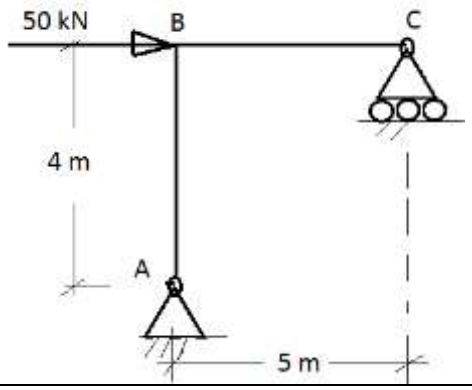
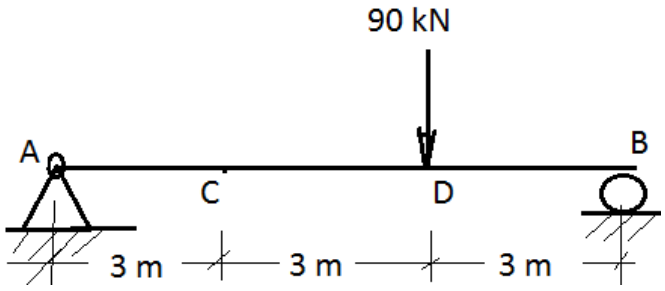
(–11 - 2022)

TIME: 3 HRS. **MAX. MARKS: 50**

Note: 1. Answer all questions.
2. Any missing data may be suitably assumed.
3. Use of FORMULA BOOK is permitted

Q. No.	QUESTION	MARKS	CO
1A	A simply supported beam with an overhang is loaded as shown in the below Figure. Draw the Shear Force and Bending Moment Diagrams. Locate the points of contra-flexure, if any. 	**5**	**1**
1B	A cantilever beam of span 3 m has the cross section shown in the below Figure. Determine what is the maximum intensity of UDL it can carry over its entire length, if the maximum tensile stress due to bending is not to exceed 50 MPa. 	**3**	**2**
1C	For the two-dimensional stress system shown in the below Figure, determine the normal and tangential stresses acting on the inclined plane AB.	**2**	**2**

			
2A	A three hinged parabolic arch of horizontal span 24 m and central vertical rise 4 m carries a point load 50 kN at a horizontal distance of 6 m from the left support, and also a UDL 30 kN/m over the right half of its span. Determine the bending moment, normal thrust and radial shear at a point 6 m from the right support.	**5**	**3**
2B	A three hinged parabolic arch of horizontal span 20 m and central vertical height 5 m carries a point load 80 kN at a distance of 5 m from the right support. Determine the bending moment under the point load and also at a point 5 m from the left support.	**3**	**3**
2C	A column of effective length 4 m has a hollow circular section of outer diameter 160 mm, and wall thickness 10 mm. Determine the Euler's buckling load on the column if the E = 200 GN/m^2.	**2**	**3**
3A	A simply supported beam AB of span 5 m carries a point load 200 kN at 3 m from the support A. Determine the slope and deflection at mid span. Use Moment area theorem. Take constant EI.	**5**	**4**
3B	A cantilever beam is loaded as shown in the below Figure. Determine the slope and deflection at the point C using Macaulay's method. Take E = 200 GPa, I = 450 x 10^6 mm^4. 	**3**	**4**
3C	A simply supported beam of span 4m and constant EI is loaded with a central concentrated load 20 kN. Adopt the Conjugate Beam method and determine the maximum deflection in the beam.	**2**	**4**
4A	Using Unit-Load method, determine the horizontal displacement at support C for the frame shown in the figure. The support A is hinged and the support C is roller. Assume constant EI throughout the frame. Take E = 200 x 10^6 kN/m^2 and moment of Inertia, I = 300 x 10^{-6} m^4.	**5**	**5**

			
4B	A cantilever beam AB, of length 1500 mm carries a point load of 10 kN at the free end. Determine the strain energy stored in the beam. Take EI = 10,000 kN-m^2. Using this strain energy determine the deflection under the point load.	**3**	**5**
4C	A cantilever beam AB, of length 3 m, fixed at A, carries an UDL of 12 kN/m over entire length. Using Conjugate beam method determine the slope at the free end.	**2**	**4**
5A	The below Figure shows a simply supported beam AB, of span 9 m, carrying a point load of 90 kN at 3 m from the support B. Use Castigliano's Theorem, determine deflection at 3 m from the support A. Take E = 200 GPa and I = 18 x 10^6 mm^4. 	**5**	**5**
5B	A solid rectangular bar of cross-section 200 mm (wide) and 400 mm (deep) is placed as a simply supported beam of span 2 m. If this beam is loaded with a point load of 30 kN at mid-span, determine the strain energy stored in the bar. Take E = 20 kN/mm^2.	**3**	**5**
5C	A solid rectangular bar of length 1500 mm and cross-section 8 mm (wide) x 15 mm (deep) is subjected to an axial tensile load of 20 kN. Determine the strain energy stored in the bar. Take modulus of elasticity of the material as 200 GPa.	**2**	**5**