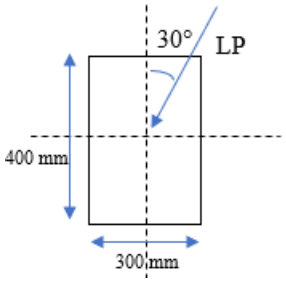
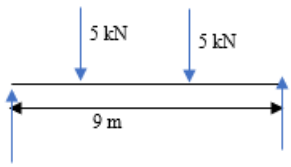
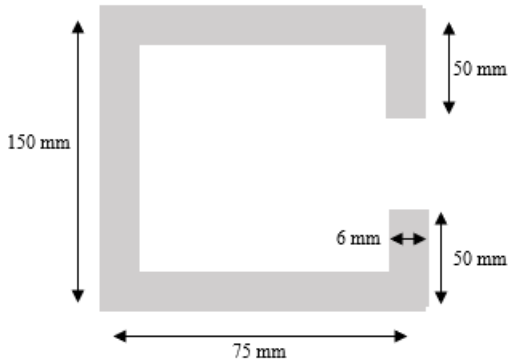
MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

SECOND SEMESTER M.TECH (CIVIL ENGINEERING)
END SEMESTER EXAMINATION, APRIL-MAY 2024
Open Elective - ADVANCED STRENGTH OF MATERIALS (CIE 5301)
(– 05 - 2024)

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

Note: 1. Answer all questions.
2. Any missing data may be suitably assumed.

Q.No	Question	Marks	CO	BL
1A.	A shaft of an elliptical section is subjected to a torque of 3 kN-m. If the maximum shear stress is not to exceed 70 MN/m^2. Determine i). Length of major and minor axis if their ratio is 1.5 ii). Angle of twist/ meter length if G = 80 GN/m^2 iii). Evaluate the diameter of a solid circular section if the maximum torque is expected to exceed the mean toque by 20%	**5**	**1**	**5**
1B	With a neat sketch illustrate Product of Inertia and mention the salient points	**5**	**2**	**4**
2A	A beam of rectangular cross section 300 x 400 mm deep is 9 m long carrying two point loads of 5kN each placed at 1/3rd span. The plane of loads make an angle of 30° with the vertical plane of symmetry as shown in figure. Evaluate the stresses at four corners.  	**5**	**2**	**4**
2B	Evaluate the principal moments of inertia of the equal angle section 30x30x10 mm.	**5**	**2**	**4**
3A	Evaluate and draw the shear stress distribution across an inverted T-section of overall depth 250 mm, width of flange 200 mm, both flange and web 50 mm thick, if it carries a shear force of 100 kN.	**5**	**3**	**4**
3B	Evaluate the shear center for the section shown in the figure (All dimensions are center line dimensions) 	**5**	**3**	**4**
4A	Illustrate the terms in the Winkler-Bach formula as applicable to beams curved in the plane of loading and deduce their relationship.	**5**	**4**	**4**

4B	A cantilevered beam, curved in plan in the form of a quadrant of a circle of radius 2m, carries a uniformly distributed load of 10 kN/m over its entire span. Analyze the beam and illustrate the variations of SF, BM, and TM.	**5**	**4**	**4**
5A	An open steel ring has a circular section at the principal horizontal diameter and supports a compressive load of 30 kN along its vertical diameter. The diameter of the principal circular section is 120 mm, and the inner radius of curvature is 75 mm. Evaluate the resultant stresses at the extreme fibers of the principal horizontal diameter.	**5**	**4**	**4**
5B	The wheel load on a rail is 10 kN the tie depresses by an amount of 6 mm. The spacing between ties is 550 mm. Evaluate the modulus of subgrade as well as the maximum bending stress in the rail under the single wheel load. Take $E=2x10^5$ N/mm^2, $I= 5x10^6$ mm^4 and depth of rail = 100 mm	**5**	**5**	**5**