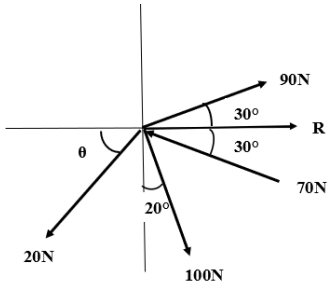
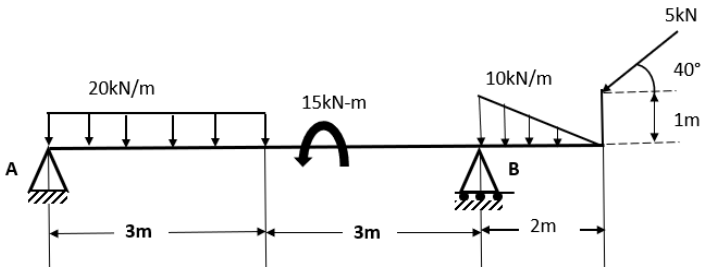
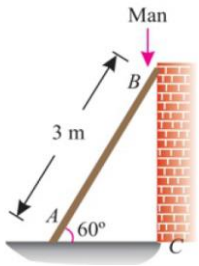
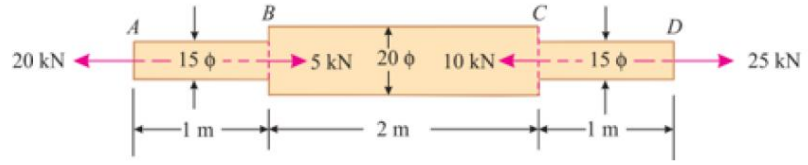
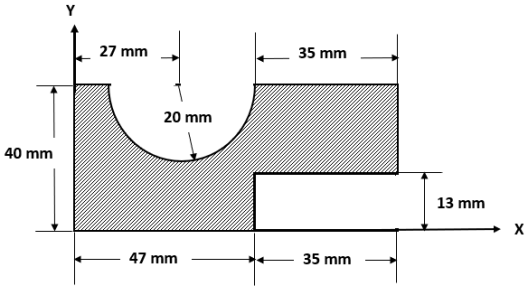
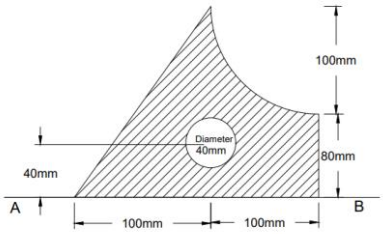
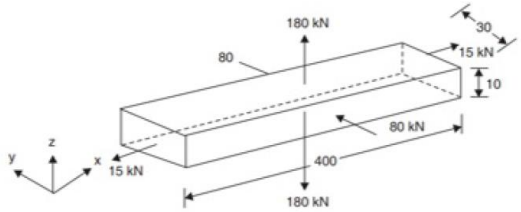
MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

DEPARTMENT OF CIVIL ENGINEERING
I SEMESTER B.TECH. (ALL BRANCHES)
END SEMESTER EXAMINATIONS, MAY 2023
SUBJECT: Mechanics of Solids (CIE 1071)

Time: 9:30AM to 12:30 PM Date: 24/05/2023 MAX.MARKS: 50

Instructions to Candidates:
- Answer **ALL** the questions.
- Any data not provided may be suitably assumed.

Q. No	Question	M	CO
1A	The resultant of four forces is acting horizontally as shown in the figure. Find the magnitude of the resultant (R) and the direction of 20N force. Locate the actual position of 20N force in the diagram. 	5	CO1
1B	Determine the reactions that develop at the supports A and B, for the beam loaded as shown in the figure. 	5	CO2
2 (A)	A uniform ladder 3 m long weighs 200 N. It is placed against a wall making an angle of 60° with the floor as shown in Figure. The coefficient of friction between the wall and the ladder is 0.25 and that between the floor and ladder is 0.35. The ladder, in addition to its own weight, has to support, a man of 1000 N at its top at B. Calculate: (i) The horizontal force P to be applied to ladder at the floor level to prevent slipping. (ii) If the force P is not applied, what should be the minimum inclination of the ladder with the horizontal, so that there is no slipping of it with the man at its top. 	**5**	**CO2**

2B	A steel bar ABCD 4m long is subjected to forces as shown in figure. Find the elongation of the bar. Take E = 200 GPa. The diameter is provided in mm. 	**5**	**3**
3A	Determine the moment of inertia of the compound lamina with respect to OX and OY axes. 	4	CO3
3B	Derive the expression for the centroid of a rectangle from first principles. Also, derive the moment of inertia for the same.	3	CO3
3C	Locate the horizontal centroidal axis of the shaded area shown in figure, with respect to axis AB. 	3	CO3
4A	A bar of 25 mm diameter is tested in tension. It is observed that when a load of 60kN is applied, the extension measured over a gauge length of 200 mm is 0.12 mm and contraction in diameter is 0.0045 mm. Find Poisson's ratio and elastic constants E, G, K.	**4**	**4**
4B	A 400 mm long bar has rectangular cross-section 10 mm × 30 mm. This bar is subjected to:. (i) 15 kN tensile force on 10 mm × 30 mm faces, (ii) 80 kN compressive force on 10 mm × 400 mm faces, and (iii) 180 kN tensile force on 30 mm × 400 mm faces. Find the change in volume if E = 2×10^5 N/mm2 and μ = 0.3 	**3**	**4**
4C	A thin cylindrical shell is 3m long and 1m in internal diameter. It is subjected to internal pressure of 1.2 MPa. If the thickness of the sheet is 12mm, find the circumferential strain, longitudinal strain, Take E=200 GPa and μ= 0.3.	**2**	**4**
5A	A load of 3000 kN is supported by a short concrete column 230mm × 230mm cross section. The column is strengthened by reinforcing steel bars of total cross sectional area of 2000 mm^2, symmetrically placed inside concrete. Determine the stresses in steel and concrete. Take E_{steel} = 12	5	CO5

	$E_{concrete}$.. Comment if the column is safe under this condition if allowable stress in concrete and steel is limited to 35 MPa and 500 MPa respectively.		
5B	Steel rails of 20 m long are at a temperature of 18˚C. Calculate the thermal stress in the rail when temperature is raised to 50ºC, if a no gap is provided between the rails. Also, evaluate the stress in the rail if 5mm gap is provided between the rails. Take α as 12×10^{-6} /ºC and Modulus of elasticity as 200 GPa.	3	CO5
5C	Explain temperature stress and its significance with suitable examples	2	CO5