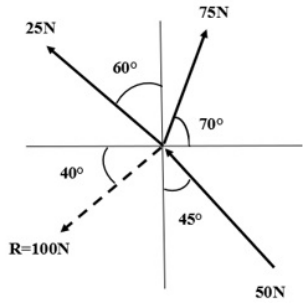
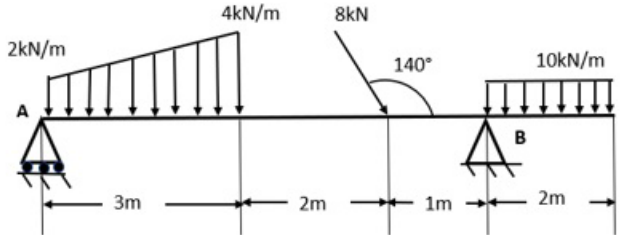
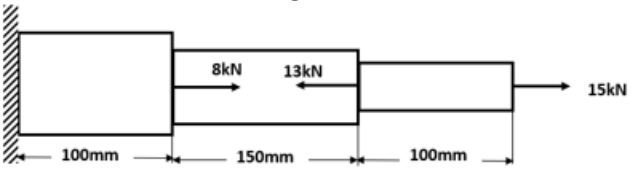
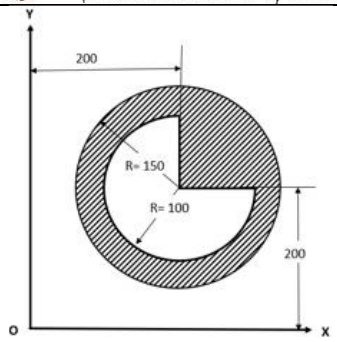
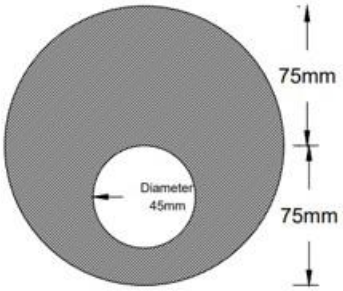
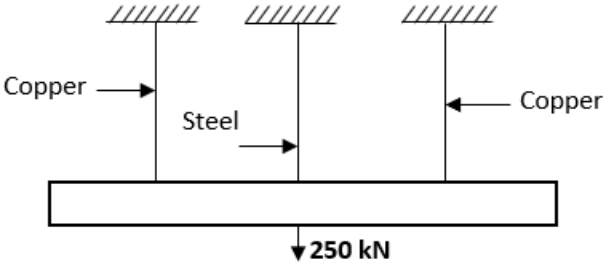
MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

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: 01/07/2023 MAX.MARKS: 50

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

Q. No	Question	M
1A	A system of concurrent coplanar forces has 4 forces, of which only 3 are shown in the figure. If the resultant is a force of magnitude 100N acting as indicated, find the magnitude and location of unknown fourth force. 	5
1B	Determine the support reactions for the beam loaded as shown in the figure. 	5
2A	A uniform ladder 6m long rests against vertical wall with which it makes an angle 40°. The coefficient of friction between the ladder and the wall is 0.3 and between the ladder and the floor is 0.5. If a man whose weight is 750N ascends it, how high will he be when the ladder slips? Self-weight of the ladder is 1250N.	5
2B	A stepped rod of circular cross section having diameter 70mm, 50mm and 40mm respectively is axially loaded at different points as shown in the figure. Calculate the value of modulus of elasticity, if the total extension of the bar is 0.01mm. Also obtain the extension in each segment. 	5
3A	Determine the moment of inertia of the shaded portion about OX and OY axes. All dimensions are in mm.	4

		
3B	Derive Second moment of area of a right angled triangle with respect to its base using first principles.	3
3C	A hole of 45mm diameter is created inside a thin circular disc of diameter 150mm, such that a point on the circumference of the hole just touches the centre of the thin disc as shown in figure. Evaluate the distance by which centroid of the disc shifts from the centre of the disc because of the hole. 	3
4A	A cylindrical vessel 2 m long and 500 mm diameter with 10 mm thick plates in subjected to an internal pressure of 3 MPa, calculate the changes in diameter, length and volume of the vessel. Here consider E = 200 GPa, μ =0.3 .	**5**
4B	A metal bar 5 cm × 5 cm section is subjected to an axial compressive load of 500 kN. The contraction on a 20 cm gauge length is found to be 0.5 mm and the increase in thickness 0.045mm. Find the value of Young's modulus and Poisson's ratio.	**3**
4C	Derive the relation between elastic constants - Young's modulus (E), Modulus of rigidity (G) and the Bulk modulus (K)	**2**
5A	A horizontal rigid bar weighing 250 kN is hung symmetrically by three vertical rods each of 1 m length and 500 mm2 c/s symmetrically as shown. Temperature rise is 36˚C. Determine the load carried by each rod and by how much the horizontal bar descends. Given E_s = 200 GPa. E_c=100 GPa. α_s =1.2 x 10^{-5}/˚C . α_c=1.8x 10^{-5} /˚C . What should be the temperature rise if the entire load of 250 kN is to be carried by steel alone. 	5
5B	A load of 350 kN is carried by a short concrete column 250 mm × 250 mm in size. The column is reinforced with 8 bars of 16 mm diameter. Find the stresses in concrete and steel, if the modulus of elasticity for the steel is 18 times that of concrete.	3
5C	A steel rail 35 m long is at a temperature of 27˚C. Estimate the elongation when temperature increases to 42˚C. Calculate the thermal stress in the rail when no gap expansion is provided.	2