Question Paper

Exam Date & Time: 26-Dec-2018 (08:30 AM - 11:30 AM)

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

FIRST SEMESTER B.TECH END SEMESTER MAKE-UP EXAMINATIONS, DECEMBER 2018

Mechanics of Solids [CIE 1051 - 2018 -PHY]

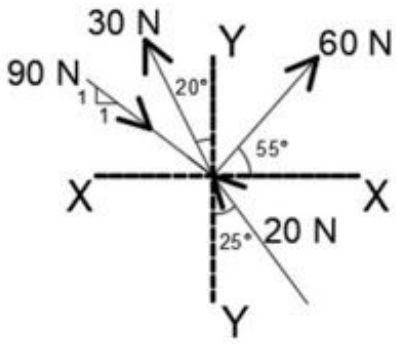
Marks: 50 **Duration: 180 mins.**

A

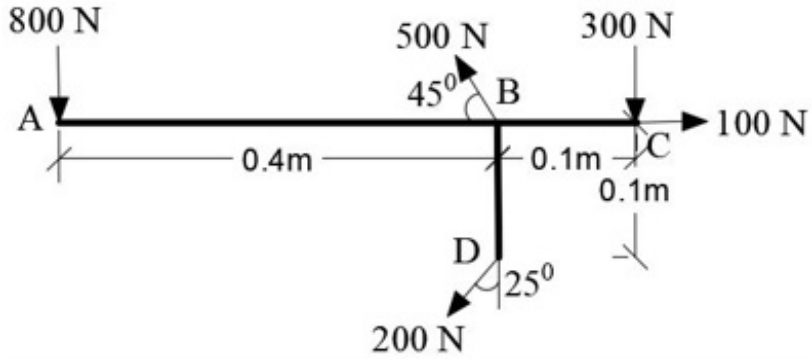
Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

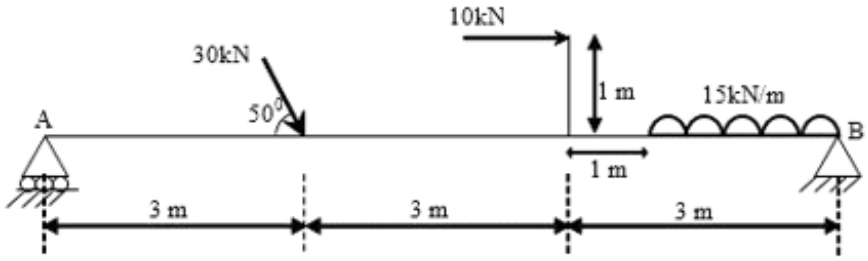
1) A) Determine the resultant of force system comprising of four forces shown in the figure. (2)



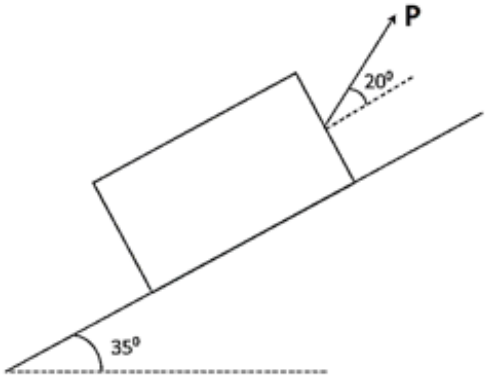
B) A bracket ABCD is subjected to a system of coplanar forces as shown in the figure. Determine the magnitude of resultant and locate it w.r.t A. (4)



C) Determine the reactions at the supports A and B for the beam loaded as shown in the figure. (4)

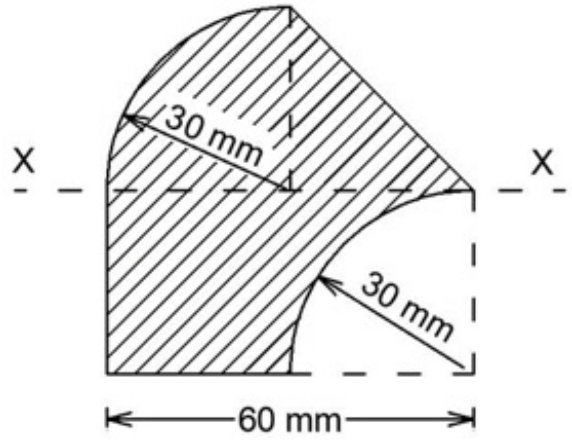


2) A) A block weighing 200 kN is resting on an inclined plane and is acted upon by force P as shown in the figure. If the coefficient of friction between the inclined plane and block is 0.3, calculate force P required to impend the block up the plane. (3)



B) Obtain the relationship between angle of limiting friction and angle of repose. (2)

C) Determine the second moment of area for the shaded area shown in the figure w.r.t given axis X-X. (5)

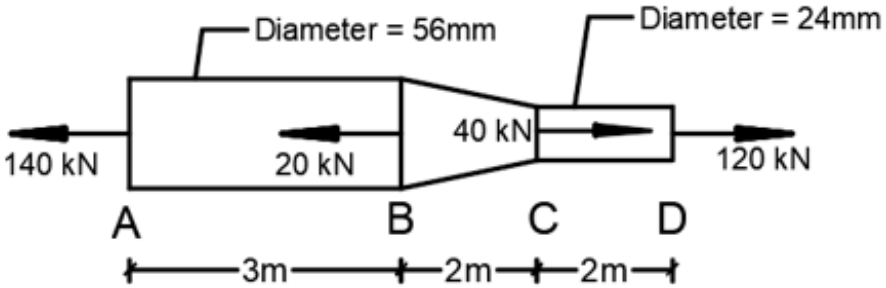


3) A) State and prove parallel axis theorem to obtain second moment of area w.r.t any axis parallel to centroidal axis. (2)

B) Obtain the centroid for right angled triangle with respect to its base from first principle. (3)

C) (5)

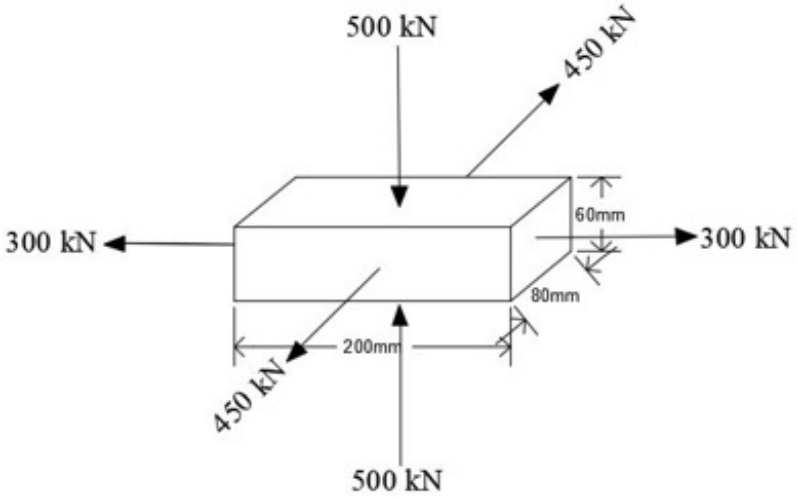
A composite circular bar of total length 7m is subjected to axial loads as shown in the figure. Determine the stress and deformation in portion AB, BC and CD. Also calculate the total deformation for the designated conditions. Take E = 210 GPa for sections AB and CD; E = 90 GPa for section BC.



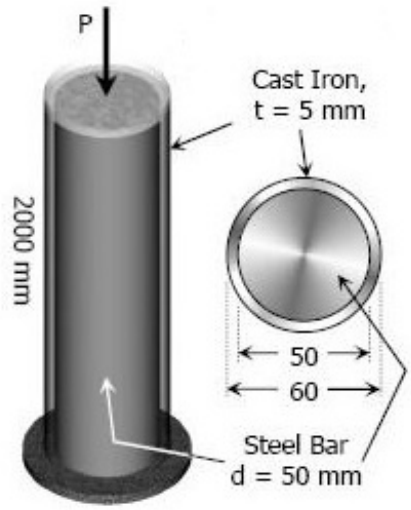
4) A boiler of 1000 mm internal diameter is subjected to an internal fluid pressure of 1.5 MPa. Wall thickness of the boiler is such that the safe maximum tensile stress of 30 MPa is developed. Calculate circumferential, longitudinal and volumetric strains in the boiler wall. Take E = 210 GPa and μ = 0.28. (3)

A)

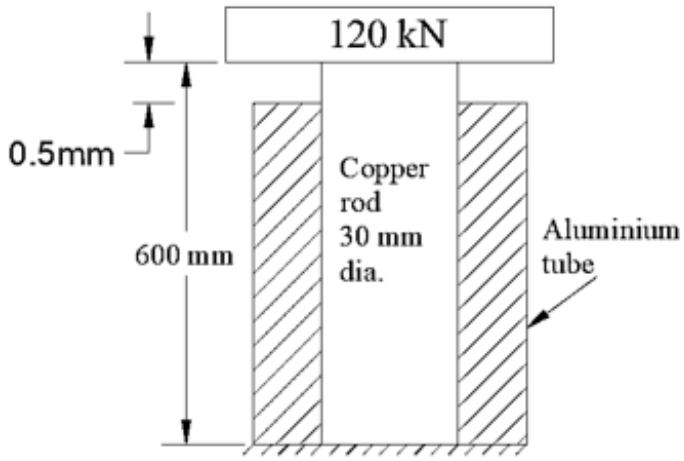
B) A rectangular bar of cross section (80mm X 60mm) is 200mm long. It is loaded with normal forces as shown in the figure. Calculate change in length, breadth, thickness and volume. Take E = 205 GPa and μ = 0.3. (5)



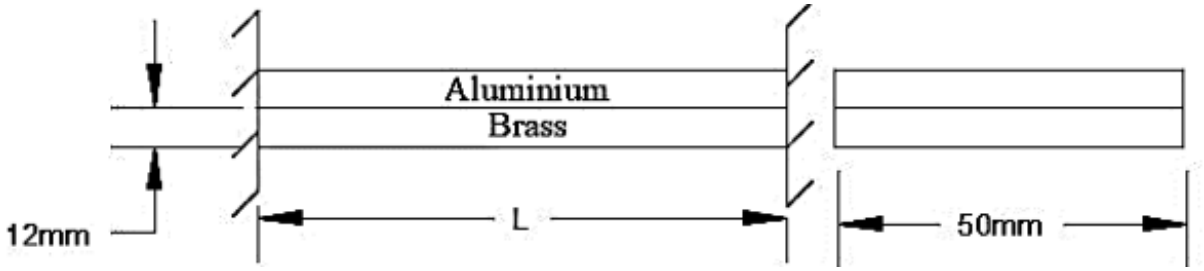
C) A steel bar 50 mm in diameter and 2 m long is surrounded by a shell of a cast iron 5 mm thick as shown in the figure. Compute the load that will compress the combined bar to a total of 0.8 mm in the length of 2 m, if load resisted by cast iron is 34.56kN. For steel, E = 200 GPa, and for cast iron, E = 100 GPa. (2)



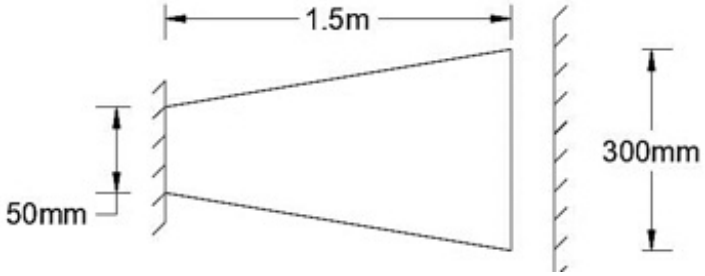
5) A) A composite member made up of an aluminium tube and copper rod supports a load of 120 kN through a rigid plate. There is a gap of 0.5 mm between aluminium tube and the support as shown in the figure. The thickness of aluminium tube is 3 mm. What are the stresses developed in each of the materials of the composite bar? Consider E_{copper} = 110 GPa and $E_{aluminium}$ = 69 GPa. (5)



B) A compound bar of length L is made of two bars (aluminium and brass), each of which has cross section (50 mm X 12 mm). The bars are fastened together at the ends as shown in the figure. $E_{aluminium}$ = 70 GN/m^2 and E_{brass} = 100 GN/m^2. If the bars are initially fastened at 18°C and the temperature of the whole assembly is then raised to 50°C, determine the stresses developed in brass and aluminium. Take coefficients of expansion for brass and aluminium as 18 X 10^{-6}/°C and 22 X 10^{-6}/°C respectively. (3)



C) A tapered flat of uniform thickness 10mm throughout the length has width varying from 50mm to 300mm. The bar is placed between two supports as shown in the figure. If the temperature of the bar is raised by 70°C, calculate the maximum stress developed in the bar if a gap provided between the bar and one of the supports is of 1mm. E = 200 GN/m^2; $\alpha = 12X10^{-6}$/ °C. (2)



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