Bengal Engineering and Science University, Shibpur

B.E. 2nd Semester Final Examinations, 2013

Elements of Mechanics of Materials (AM 202)

[Only for AE & ME]

Full marks – 70 ***Time – 3 hrs.***

1st Half

In 1st Half, answer Q.4 and any two (2) questions from the rest
In 2nd Half, answer any three (3) questions

1. A rigid 'T' as shown in Fig. Q1 is made out of metal bars MN and PQ, each 1.4 m long and weigh 40 kg and 30 kg respectively. It is suspended in a vertical plane. Compute angle φ for equilibrant, subjected to a load of 500 N. 12

2. Determine the member forces of the overhang truss, supported and loaded as shown in Fig. Q2. 12

3. A smooth uniform roller of weight W rests on a 90° rough V-groove, as shown in Fig. Q3. An inextensible rope is passed around its midsection and a tension T is applied to take roller out of the groove. Prove that it is possible only when the coefficient of friction is greater than 0.414. If the coefficient of friction is less than 0.414 derive the expression of T at which slipping occurs. 12

4. (i) State Pappus theorems
   (ii) Determine the inner surface area generated by revolving line ABC completely about y axis of the hopper, as shown in Fig. Q4. 11

5. Referring to Fig. Q5, compute the second moment of composite area with respect to x-axis. 12

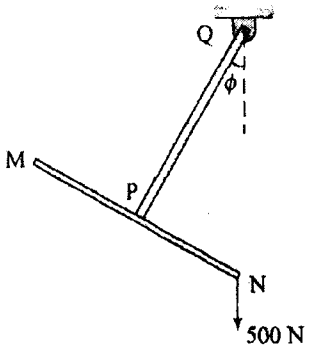

Fig. Q1

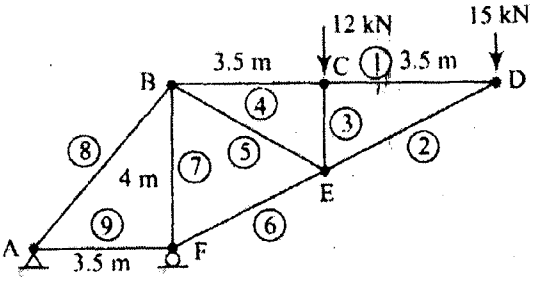

Fig. Q2

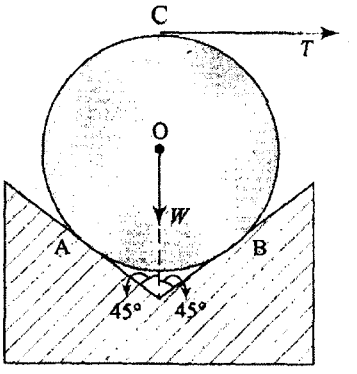

Fig. Q3

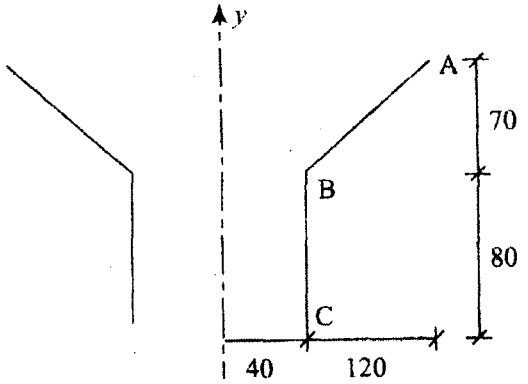

Fig. Q4

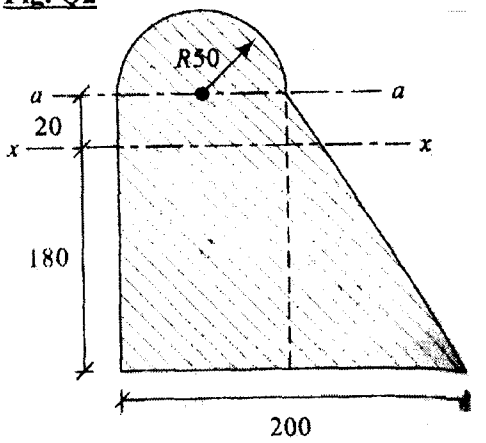

Fig. Q5

6. A 15 mm diameter steel rod passes centrally through a copper tube 50 mm external diameter and 40 mm internal diameter. The tube is closed at each end by rigid plates of negligible thickness. The nuts at the ends are tightened lightly home so that no stress is generated. If the temperature of the assembly is raised by 60^0 C, compute the stresses developed in copper and steel. Given : $\alpha_s = 12 \times 10^{-6}$ per ^{0} C ; $\alpha_c = 17.5 \times 10^{-6}$ per ^{0} C ; $E_s = 2.1 \times 10^5$ N/mm^2 ; $E_c = 1.05 \times 10^5$ N/mm^2 .

7. A square prism of wood 50 mm x 50 mm in cross-section and 300 mm long is subjected to a tenslie stress of 40 N/mm^2 along its longitudinal axis and lateral compressive stresses of 20 N/mm^2 on one set of lateral faces and 10 N/mm^2 on the other set of lateral faces. Find the change of volume of the bar if $\mu = 0.4$ and $E = 1.5 \times 10^4$ N/mm^2 .

8. A beam ABCD 8m long is simply supported on A and C on a span of 6m. A u.d.l. of total intensity 80 kN acts on AB which is 3 m long. The part CD is an overhang of length 2m and on the free end D a downward concentrated lod of 15 kN acts. Draw the shear force and bending moment diagrams for the beam mentioning the vales at significant points. Also find the point of contra-flexure, if any.

9(a) A bar of 30 mm diameter is subjected to a pull of 60 kN. The measured extensions on a gauge length of 200 mm is 0.09 mm and the change in diameter is 0.0039 mm. Calculate the Poisson's ratio and bulk modulus of the material.

(b) Find the width and depth of the strongest beam that can be cut out of a cylindrical log of wood whose diameter is 500 mm.

10. The moment of inertia of a beam section 500 mm deep is 69.49×10^7 mm^4 . Find the longest span over which a beam of this section , when simply supported, could carry a uniformly distributed load of 50 kN per meter run. The maximum bending stress is not to exceed 110 N/mm^2.