Bengal Engineering and Science University, Shibpur

B.E. 2nd Semester Final Examinations, 2012

Elements of Mechanics of Materials (AM 202)

[Only for AE & ME]

Full marks – 70 ***Time – 3 hrs.***

1st Half

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

1. Determine the forces in the members AC, DE, and GH of the truss loaded and supported as shown in Fig. Q1. 11

2. Two identical rods MP and MN, each of mass m are hinged together at M and supported by two pegs at B and C such that each of the bars make an angle α with horizontal in equilibrium position, as shown in Fig. Q2. The pegs are in the same level horizontally and x-distance apart. If the bars are each of length l, express α as function of x and l. 12

3. Determine the centroid of the shaded composite area as shown in Fig. Q3 12

4. Compute the second moment of area bounded by two curves as shown in Fig. Q4, about x and y axes. You may use separate differential element 12

5. Referring to Fig. Q5, determine the least value of P to cause motion to impend rightwards. Assume the pulley frictionless and coefficient of friction for all contiguous surface is 0.20 12

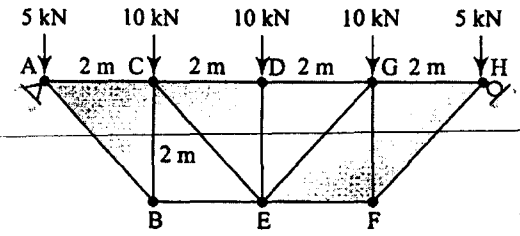

Fig. Q1

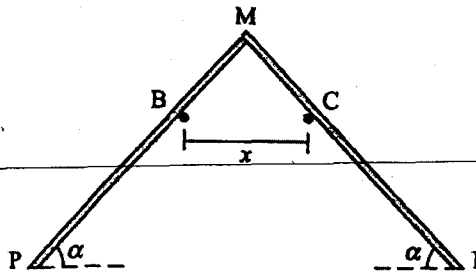

Fig. Q2

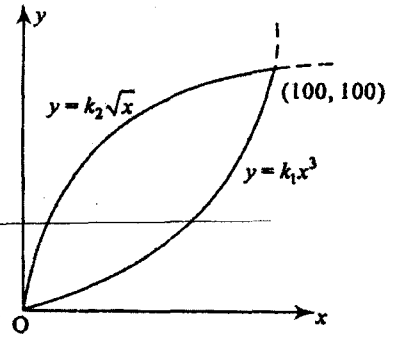

Fig. Q4

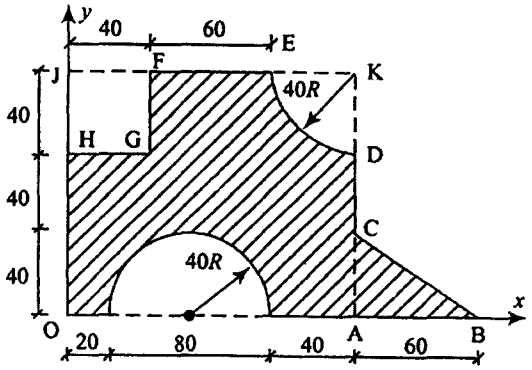

Fig. Q3

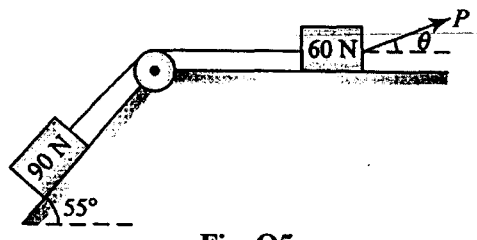

Fig. Q5

Second Half

6. A rectangular block 250 mm x 100 mm x 80 mm is subjected to axial loads as follows : 480 kN tensile in the direction of length ; 900 kN tensile on 250 mm x 80 mm faces and 1000 kN compressive on 250 mm x 100 mm faces. Assuming Poisson's ratio as 0.25 and Young's modulus for the material as 2.0×10^5 N/mm^2 , compute the change in volume of the block in mm^3.

7. A gun metal rod 22 mm diameter screwed at the ends passes through a steel tube 25 mm and 30 mm internal and external diameters respectively. The temperature of the whole assembly is raised to 116^0 C and the nuts on the rod are then screwed lightly home on the ends of the tube. Find the intensity of stress in the rod and the tube when the common temperature has fallen to 16^0 C. Given : $\alpha_s = 12 \times 10^{-6}$ per ^{0} C ; $\alpha_g = 20 \times 10^{-6}$ per ^{0} C ; $E_s = 2.1 \times 10^5$ N/mm^2 ; $E_g = 0.94 \times 10^5$ N/mm^2 .

8(a) Starting from fundamentals, deduce expressions giving the relationships amongst the elastic constants Young's modulus , modulus of rigidity, the Poisson's ratio and the bulk modulus of an elastic material.

(b) A material has a Young's modulus of 1.25×10^5 N/mm^2 and a Poisson's ratio of 0.25. Calculate the modulus of rigidity and the bulk modulus for the material.

9. A beam ABCD 10 m long is simply supported on B and C on a span of length 6 m. AB and CD are overhangs of length 1 m and 3 m respectively. A u.d.l of intensity 180 N/m acts on the entire length of the beam. Also a downward concentrated load of 400 N acts on the left free end A. Draw the shear force and bending moment diagrams for the beam showing the significant values. Also find the point of contraflexure, if any. Draw the diagrams in pencil distinctly indicating the values. Marks will be deducted for untidiness.

10. A water main of 1200 mm internal diameter and 12 mm thickness is running full. If the bending stress is not to exceed 56 N/mm^2 , find the greatest span over which the pipe may be freely supported. Steel and water weigh 76800 N/mm^3 and 10000 N/mm^3 respectively.