Total No. of Questions : 10 ] [ Total No. of Printed Pages : 4

Roll No. 0502ME101056

303(GS)/302(NGS)

B. E. (Third Semester) EXAMINATION, Dec., 2011

(Grading/Non-Grading)

(Common for AU, IP/IEM & ME Engg.)

STRENGTH AND MECHANICS OF MATERIALS

*Time : Three Hours*

*Maximum Marks :* { 100 (Non-Grading) / 70 (Grading)

**Note :** Attempt only *five* questions. There is internal choice within each question. Assume suitable missing data if necessary.

1. A steel bolt 20 mm diameter is passed through a brass tube having internal diameter of 20 mm and external diameter of 30 mm. Both the brass tube and the steel bolt are kept at a temperature of 10°C and in this condition, the nut on the bolt is tightened on the tube so that stress in the tube is 12 MN/mm$^2$. What will be the loads and the stresses in the bolt and tube if both are heated to a temperature 120°C ? Take coefficient of expansion of brass = $20{\cdot}69 \times 10^{-6}$ per°C and the coefficient of expansion of steel = $12 \times 10^{-6}$ per°C. E for brass and steel are 80 GN/m$^2$ and 200 GN/m$^2$ respectively Consider the bolt as if solid throughout.

P. T. O.

*Or*

2. (a) Explain the following :
   (i) Thermal stresses
   (ii) Significance of yield point in a material
   (b) A tapering bar 80 cm long has a diameter of 40 mm at top and 20 mm at the bottom. It is clamped at the top and carries an axial pull of 50 kN at its lower end. Calculate the elongation of the bar.
   Take $E = 2 \cdot 1 \times 10^5 \text{ N/mm}^2$.

3. (a) Define "Principal Planes" and "Principal Stress".
   (b) At a point the stress in two mutually perpendicular directions are 50 MPa tensile and 30 MPa compressive along with a shear stress of 2·1 MPa on these planes. Determine :
   (i) the principal planes.
   (ii) the principal stress.
   (iii) the maximum shear stress.
   (iv) the planes on which there is no normal stress.

*Or*

4. (a) Write a note on Mohr's circles of stresses.
   (b) A body is subjected to direct stresses in two mutually perpendicular directions accompanied by a simple shear stress. Draw the Mohr's circle of stresses and explain how will you obtain the principal stresses and principal planes.

5. (a) Derive the relation :

$$\frac{q}{r} = \frac{fs}{R} = \frac{N\theta}{l}$$

(b) Two solid shafts having diameters 10 cm are connected by means of a flange coupling. The bolt of 2 cm diameter are arranged on 22 cm diameter circle. If the allowable shear stress in the shaft and the bolt are 80 $N/mm^2$ and 60 $N/mm^2$, determine the minimum number of bolts.

*Or*

6. (a) Define helical spring. Name the *two* types of helical springs.

(b) Two closed-coiled concentric helical springs of the same length are wound of the same wire, circular in C/S and support a compressive load 'P'. The inner spring consists of 20 turns of mean diameter 16 cm and the outer spring has 18 turns of mean dia. 20 cm. Calculate the maximum stress produced in each spring. If the dia. of wire = 1 cm and P = 1000 N.

7. (a) What do you mean by shear stresses in beams ?

(b) A square beam 20 mm × 20 mm in section and 2 m long is supported at the ends. The beam fails when a point load of 400 N is applied at the centre of the beam. What uniformly distributed load per metre length will break a cantilever of the same material 40 mm wide, 60 mm deep and 3 m long.

*Or*

8. (a) Define and explain the terms—modular ratio, neutral axis, section modulus and moment of resistance.

(b) A timber beam of rectangular section is to support a load of 20 kN uniformly distributed over a span of 3·6 m when beam is simply supported. If the depth of

section is to be twice the breadth, and the stress in the timber is not to exceed 7 N/mm$^2$, find the dimensions of the cross-section. How would you modify the cross-section of the beam, if it carries a concentrated load of 20 kN placed at the centre with the same ratio of breadth to depth ?

9. (a) Define the terms column, strut and crippling load.

   (b) A hollow cast iron column 200 mm outside dia. and 150 mm inside dia, 8 metre long has both ends fixed. It is subjected to an axial compressive load. Taking a factor of s afety as 6, $f_c = 560\ \text{mm}^2$, $a = 1/1600$, determine the safe Rankine load.

*Or*

10. (a) What is equivalent length of a column ?

    (b) Prove that the crippling stress by Euler's formula is given by :

$$f_c = \frac{\pi^2 E}{\left(\frac{L}{K}\right)^2}$$