BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

03127

Term-End Examination

December, 2010

BME-017 : STRENGTH OF MATERIALS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any seven questions. Use of calculator is permitted.*

1. (a) Distinguish between direct and shearing stress. Define Poisson's ratio and modulus of elasticity. 3

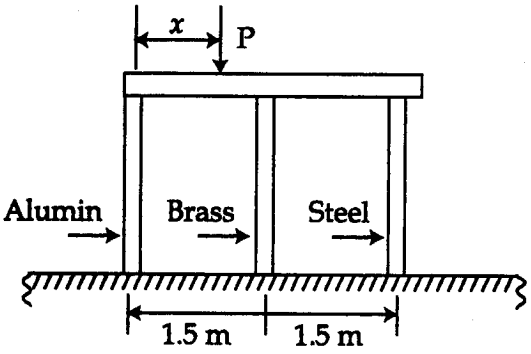
   (b) A specimen of an alloy steel is made of a cylindrical bar of 12.827 mm diameter and 203.2mm length. The bar is loaded in axial tension upto proportional limit, when load is 42.85 kN. At this load the length was measured as 204.1mm and diameter was measured as 12.808mm. Determine 7

   (i) Proportional limit.

   (ii) Modulus of elasticity.

   (iii) Poisson's ratio.

2. Three short columns, each with cross sectional area of 100 mm^2 support a weightless beam. The columns are made of aluminium, brass and steel as shown in Fig.1 A load P is to be applied on beam such that the beam remains horizontal. Determine x. 10



E_{alum} $=69x10^3$ N/mm^2

E_{Brass} $=103.5x10^3$ N/mm^2

E_{Steel} $=206x10^3$ N/mm^2

3. The drum of a boiler is made from 20 mm thick steel plate. It has internal dia. of 1.2 m and length of 3 m. The pressure in the boiler is to be brought to the operating pressure of 1.0 MPa by pumping water after the drum is full. What is the amount of water to be pumped in ? E for steel is $2.1x10^5$ MPa. υ=0.28. Bulk modulus, K for water is $2.4x10^3$ MPa. 10

4. (a) Define principal plane. 2

(b) The state of stress at point with respect to x-y axes is unknown. The principal stresses at that point are known: the maximum principal stress, σ_{p1}=250N/mm^2. The main. Principals stress, σ_{p2} = 20N/mm^2. The plane of σ_{p1} makes an angle of 15° with y-axis. Determine the state of stress $(\sigma_x, \sigma_y, \tau_{xy})$ with respect to x-y axes. Also determine the max. shearing stress. 8

5. (a) Define shearing force and bending moment at a section of a beam. 4

(b) A simply supported beam is loaded by a uniformly varying load with zero at left hand support and 10kN/m at right hand support. Draw S.F and B.M diagrams. 6

6. An I - section is 800 mm deep, each flange is 100 mm deep and 300 mm wide. The web is 100 mm wide. Calculate moment of inertia of the section and compare it with the moment of inertia of a rectangular section which is 600 mm deep and has the same area as the I - section. If beams with above I - section and rectangular section are loaded such, that maximum B.M is both cases is 140kNm, calculate the maximum bending stresses in I - section and rectangular section. 10

7. A simply supported beam is loaded by a uniformly distributed load of w/unit length over entire span. Find expression for deflection at a distance $l/4$ from support where l is the span. E - modulus of elasticity of beam material and I is the moment of inertia of beam section which is uniform. 10

8. (a) What do you understand by statically in determinate shaft ? If two shafts of dia. d_1 and d_2 are joined at section C and their other ends A and B distances l_1 and l_2 are rigidly held write conditions of equilibrium in terms of torque and angle of twist, when a torque T acts at C. 3

(b) A solid shaft of 6 m length is securely fixed at ends A and B. A torque of 8.5Nm is applied at a distance of 2 m from end A. Find the fixing torque at ends A and B. If the shaft is 30 mm dia. Calculate maximum shearing stresses in two portions. Also calculate the angle of twist of the section where torque is applied $G=8.4\times10^4$ N/mm^2 7

9. (a) A load P is gradually applied upon a close coiled helical spring which extends it through a deflection δ what energy is stored in the spring ? If the torsional shearing stress in the spring is T show that the strain energy 4

$$W = \frac{T^2}{3G} \times \text{volume of spring wire.}$$

(b) A closely coiled helical spring is made of 12.5 mm dia. steel wire and its 10 coils have a mean dia of 250 mm. Find the elongation, intensities of torsional and total shearing stresses and strain energy per cubic cm, when spring carries an axial load of 180N. $G=84x10^3$ MPa. 6

10. (a) Describe Lame's equations for thick cylinder. If a thick cylinder is subjected to internal pressure P_i and external pressure P_o, find expressions for radial and tangential stresses and show them plotted on radial thickness. 4

(b) A steel cylinder of inside dia 200 mm and outside dia of 300 mm is subjected to an internal pressure of 70 MPa. Determine 6

(i) the maximum tensile stress and minimum tensile stress in the cylinder.

(ii) the radial and tensile stresses at a point midway the cylinder wall.