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BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

Term-End Examination

June, 2011

BME-017 : STRENGTH OF MATERIALS

Time : 3 hours *Maximum Marks : 70*

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

1. (a) How many independent elastic constants does an elastic isotropic material have ? Define three constants. 3

   (b) Derive the relationship between modulis of elasticity and rigidity.

2. A bronze cylinder (dia. 25 mm) is inserted in a hollow aluminium cylinder (outside dia. 50 mm) and placed on a rigid support. A rigid plate is placed on top of two cylinders which are of equal length. A load of 450 kN is applied on top plate such that line of action of force is along the common axis of two cylinders. Calculate the stresses in bronze and aluminium cylinders. E for bronze $= 25.8 \times 10^5$ MPa and E for aluminium is 17×10^5 MPa. 10

3. A steel pipe 150 mm in internal dia, has to with stand an internal pressure of 2.8 MPa. Find necessary thickness if the intensity of tensile stress is not to exceed 42 MPa. **10**

If this pipe is closely wound with a layer of round steel wire 1.25 mm in dia. having uniform tension of 106 MPa before the pressure is applied, find the intensity of stress in pipe and wire before and after the pressure of 2.8 MPa in the pipe.

4. (a) Two shafts transmit same power at rpm of N_1 and N_2. Find the ratio of torques carried by two shafts. **3**

   (b) A solid shaft is replaced by a hollow shaft to transmit same power at same speed. The internal dia. of hollow shaft is 40% of its external dia. What % of material is saved ? **7**

5. Draw the B.M.D and S.F.D for the beam shown in Fig.1. Determine the position of point of contraflexure. **10**

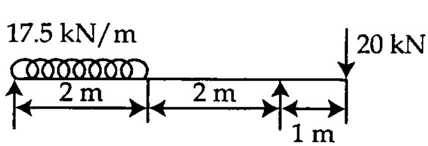

Fig. 1

6. A cantilever of length l is loaded by a uniformly increasing load, starting from zero at free end to W_0 at the fixed end. The free end is propped to the level of fixed end. Determine the reaction at the prop and equation to elastic curve. Also determine the slope at the propped end. Assume EI to be constant. **10**

7. (a) Differentiate between close coiled and open coiled helical springs and define spring constant. **2**

   (b) Three springs with spring constants of k_1, k_2 and k_3 are combined in series and parallel. Determine the effective spring constant of both combinations. **3**

   (c) A close coiled helical spring is made of wire of dia. 13.5 mm mean coil dia. of 300 mm. If the spring carries an axial force of 200 N which compresses it, find the stress and deflection. The number coils is 12. $G = 84 \times 10^3$ MPa. **5**

8. (a) A cylindrical vessel with internal radius of r_i and thickness of $r_i/10$ is pressurized from inside with a pressure p_i. Find hoop stress σ_t by thin cylinder formula and by using Lame's equations for thick cylinder and compare two valves. **5**

(b) The pressure within the cylinder of a hydraulic press is 9 MPa. The inside diameter of the cylinder is 25 mm. The permissible tensile stress is 18 N/mm^2. Determine the thickness of cylinder wall. **5**

9. A C.I column of 200 mm outside diameter and inside dia. of 160 mm carries a central axial load of 800 kN and a load of P kN parallel to axis but at a distance of 300 mm from the axis. If the allowable stresses are 125 N/mm^2 compressive and 31 N/mm^2 tensile, find value of P. **10**

10. (a) Write down expressions for strains along x and y axis and the shearing strain at a point where state of stress is described by σ_x, σ_y and τ_{xy}. **5**

(b) At a point in a stressed body the normal stresses are 83 N/mm^2 (tensile) on a vertical plane and 27.5 N/mm^2 (compressive) on a horizontal plane. A shearing stress of 41.4 N/mm^2 acts at this point. Determine and show on a sketch the principal stresses and the max. shearing stress at this point. **5**