B.E. Fourth Semester (Aeronautical Engineering) (C.B.S.)

Aircraft Structures - I Paper – IV

P. Pages : 3 **KNT/KW/16/7316**

Time : Three Hours * 0 1 7 9 * Max. Marks : 80

Notes : 1. All questions carry marks as indicated.
2. Assume suitable data whenever necessary.
3. Illustrate your answers whenever necessary with the help of neat sketches.
4. Use of non programmable calculator is permitted.

1. a) A brass plate of uniform thickness 6 mm varies in width from 100 mm to 180 mm, and is subjected to a load of 4 kN as shown in fig. 1 (a). Find the elongation of the bar. E for brass = 82 GPa. **7**

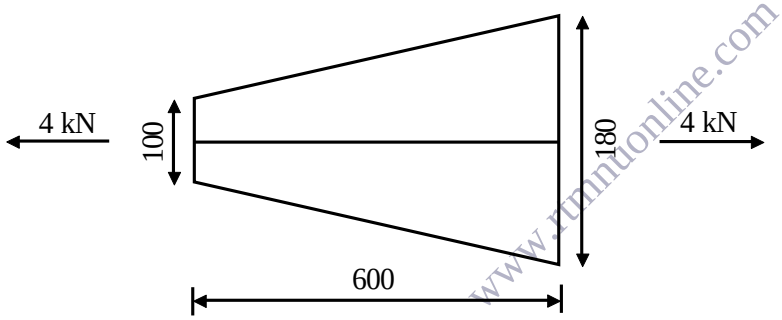

fig. 1 (a)

b) A hollow circular shaft has an external diameter of 120 mm and the internal diameter is three-fourth the external diameter. If the stress at a fiber inside is 36 Mpa, due to Torque T applied. Find this torque the maximum shear stress and the angle of twist per unit length. G = 85 MPa. **7**

OR

2. a) Explain Poisson's Ratio, thereby derive the relation between elastic constants E and K. **7**

b) Find the maximum power transmitted by a shaft at 200 rpm without exceeding the permissible stress of 100 MPa if the shaft is **7**

i) a solid circular shaft of dia. 60 mm.
ii) a hollow shaft of the same internal diameter and has the same weight as the solid shaft.

3. a) Prove that: $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$; **8**

Where symbols carry their usual meaning

b) In a thin tube. Show that the maximum shear stress is twice the average shear stress over the cross section. **6**

OR

4. A simply supported beam carries a UDL of 20 kN/m over its span of 8 m. Determine the slope at the ends and the deflection at mid-span if. E = 200 GN/m^2 and I = 30,000 CM^4. **14**

5. a) Find the deflection at the free end of a cantilever beam carrying a point load P at that end. Flexural rigidity = E I. (use strain energy method). **6**

b) Analyse the pin-jointed plane frame shown in fig. 5 (b) and determine the forces in all the members. **7**

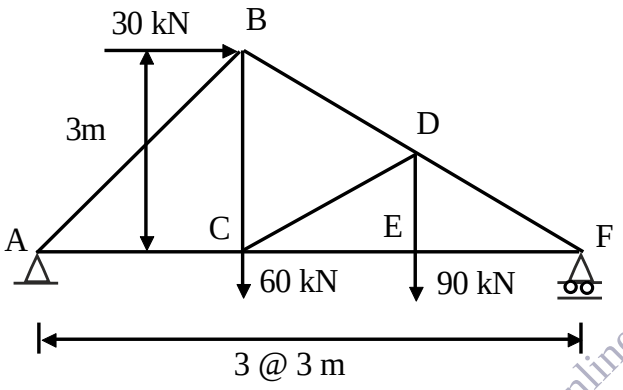

Fig. 5 (b)

OR

6. a) A steel sheet of dimension 2000 mm x 500 mm x 0.4 mm is bent to form a cylinder 500 mm long. Find the strain energy stored in the material due to bending. **6**

b) Find the forces in different members of the roof truss shown in fig. 6 (b). **7**

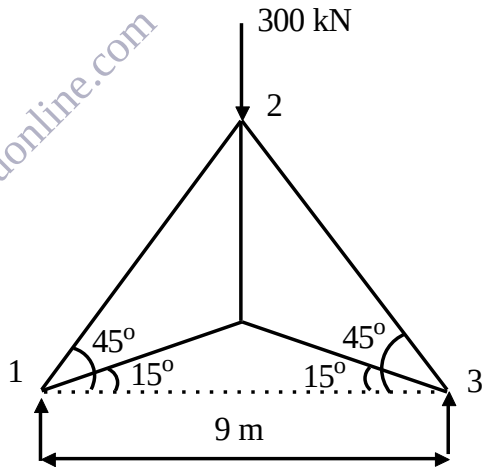

Fig. 6 (b)

7. a) State the assumptions and limitations of Euler's theory for long columns. **5**

b) A metal column of external diameter 300mm and thickness 20 mm carries a load of 400 kN at an eccentricity of 50 mm. Determine the maximum and minimum stresses in the column if its length is 5 m, and both ends of the column are fixed. E = 95 GPa. **8**

OR

8. A hollow cylindrical column, with both ends hinged, is 6 m long, and has an outer diameter of 120 mm and an inner diameter of 80 mm. Compare the crippling load obtained by Euler's and Rankine's formulae. E = 80,000 N/mm^2 and $\sigma_y = 550\ N/mm^2$. **13**

The Rankine constant = 1/1600. What is the length of the column if both crippling loads are equal?

9. a) Show that in a strained material subjected to two-dimensional stress, the sum of the normal components of stresses on any two mutually perpendicular planes is constant. **6**

b) At a point in a piece of material there is a tensile stress of 90 MPa upon the horizontal plane, and compressive stress of 45 MPa upon the vertical plane. There is also a shear stress of 45 MN/m^2 on each of these planes. Determine the planes of maximum shear stress and the value of maximum shear stress at the point from the first principles. **7**

OR

10. a) The principal stresses at a point in a strained material are σ_x and σ_y. Show that the resultant stress σ_r on the plane carrying the maximum shear stress is given by **5**

$$\sigma_r = \left[\frac{\sigma_x^2 + \sigma_y^2}{2}\right]^{1/2}$$

b) An element in a stressed material has tensile stress of 500 MPa and a compressive stress of 350 MPa acting on two mutually perpendicular planes and equal shear stresses of 100 MN/m^2 on these planes. Find principal stress and position of the principal planes. Find also maximum shearing stress. **8**

11. a) State and explain "Distortion energy theory" of failure. **7**

b) Design a solid circular shaft subjected to a BM of 20 kNm and a torque of 12 kNm at a section. The maximum normal stress and shear stress are limited to 150 MPa and 120 MPa, respectively. **6**

OR

12. A load of 75 kN is carried by a column made of cast-iron. The external and internal diameters are 200 mm and 180 mm respectively. If the eccentricity of the load is 35 mm, find: **13**

i) The maximum and minimum stress intensity.

ii) Upto what eccentricity there is no tensile stress in the column?

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