S.E / III / Prod / Strength of Materials / 3/15/10

**Con. 3008-10.** **AN-2464**

(3 Hours) **[ Total Marks : 100**

**N.B.** (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions of the remaining **six** questions.
(3) Assume missing data **suitably**.

1. (a) Determine the value of maximum bending stresses developed when the beam sections are placed as shown below : **8**

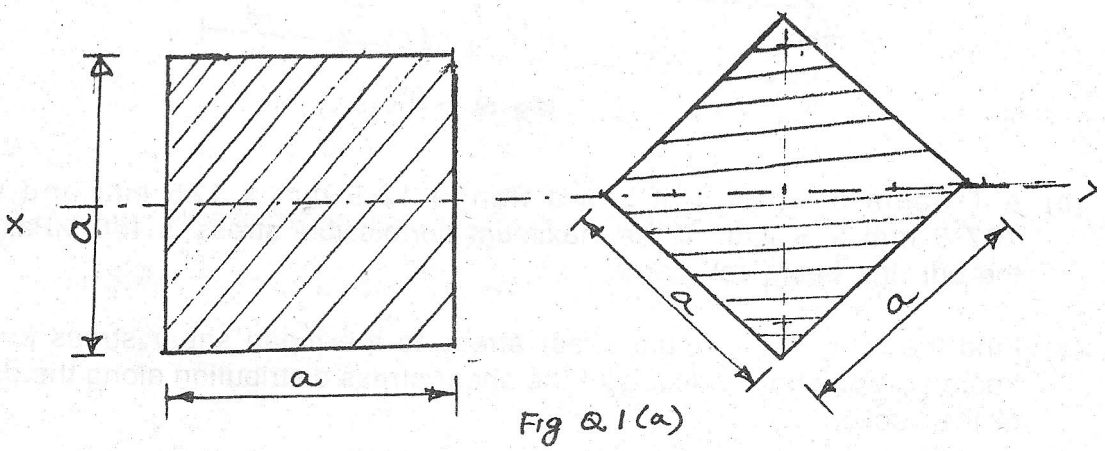
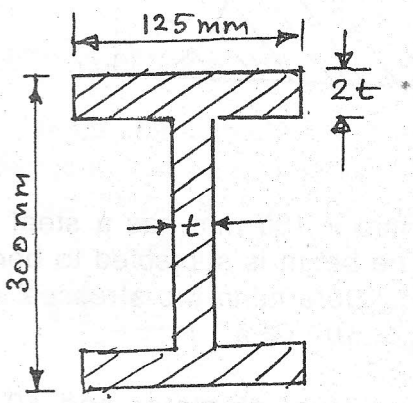



Fig Q.1(a)

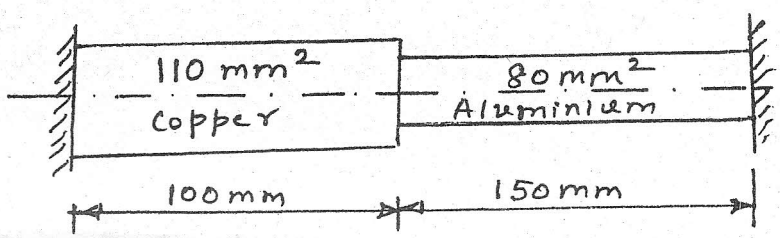
(b) Determine maximum thickness 't' if maximum bending compressive stress is not to exceed 150 N/mm$^2$ and maximum shear stress is not to exceed 100 N/mm$^2$. The beam carries udl of 25 kN/m over a span of 5 m. **8**




(c) Derive Rankine's formula for calculating buckling load with usual notation. **4**

2. (a) A cube of 250 mm side is subjected to a compressive force of 5 MN on each face. The change in volume of cube is 8000 mm$^3$. Compute Young's modulus and bulk modulus. Take Poisson's ratio = 0·28. **10**

(b) A stepped bar made of copper and aluminium is fixed at its ends as shown in **figure**. Determine the stresses induced and displacement in the junction when temperature of only copper portion is increased by 50 °C. **10**



3. (a) Draw shear force and bending moment diagram for the beam loaded as shown in the **figure**. Find the position and value of maximum bending moment from point A. **10**

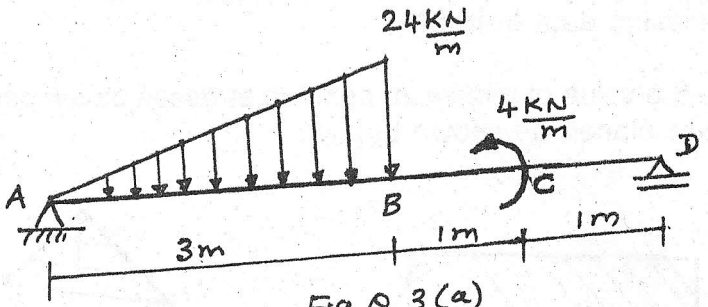
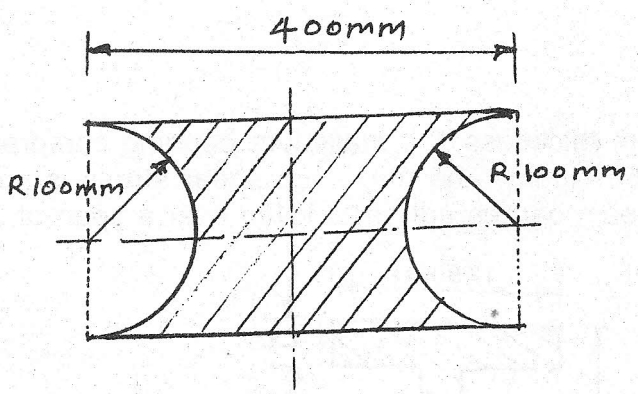



Fig Q 3(a)

(b) A T beam of span 5 m has a flange 12·5 mm × 125 mm and web 187·5 mm × 8 mm. If the maximum permissible stress is 150 MPa, find the udl the beam can carry. **10**

4. (a) Find the ratio of maximum shear stress to the mean shear stress for the beam section shown. Also plot the shear stress distribution along the depth of the section. **10**




(b) A wooden beam 250 mm × 150 mm has a steel strap 10 mm × 150 mm fixed at the bottom. The beam is subjected to bending moment of 3 kN.m around horizontal axis. Determine the stresses in steel and wood. Take $E_S$ = 200 GPa and $E_W$ = 100 GPa. **10**

5. (a) A shaft has 50 mm external diameter and 40 mm internal diameter. Determine twisting moment it can resist, if permissible shear stress is 100 MPa. Determine the diameter of solid circular shaft made of the same material which can transmit same twisting torque. Hence compare their weights per meter length. Take G = 80 GPa. Determine angle of twist for each shaft per meter length. **10**

(b) Determine the area of core of the following sections : **10**

(i) Hollow square section of outer width B and inner width 0·6B

(ii) Hollow circular section of outer diameter D and inner diameter 0·5 D.

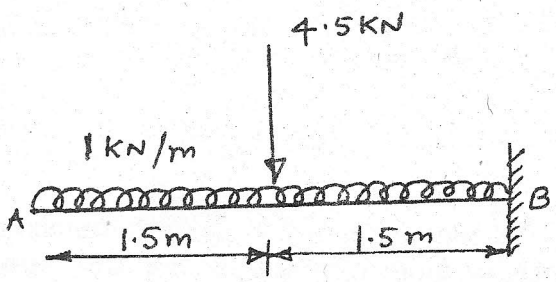
6. (a) Compare the crippling loads given by Euler's and Rankine formula for tabular strut 2·5 m having outer and inner diameters 40 mm and 30 mm respectively, loaded through pin joints at each end. Take yield stress at $320 \frac{N}{mm^2}$, the Rankine constant $\alpha = \frac{1}{7500}$ and $E = 2 \times 10^5 \frac{N}{mm^2}$. For what length of this strut of this cross section does Euler's formula cease to apply. **10**

(b) Obtain the following :—

(i) Expression for strain energy stored due to suddenly applied load with impact. **5**

(ii) Maximum deflection for simply supported beam carrying uniformly distributed load through out . **5**

7. (a) Compute the midspan and maximum deflection for the beam loaded as shown in **figure**. Take $E = 210 \frac{GN}{m^2}$ and $I = 36 \times 10^{-4}\ m^4$ **10**




(b) **Figure** shows a state of stress in strained material : Find— **10**

(i) Normal and tangential stresses on plane CE

(ii) Principal stresses and their directions.

(iii) Maximum shear stress and their directions.