Reg. No. : E N G G T R E E . C O M

Question Paper Code : 50025

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Third Semester

Aeronautical Engineering

AE 3352 — SOLID MECHANICS

(Common to : Aerospace Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by coplanar concurrent forces?

2. List the different types of supports and draw its schematics.

3. Define Hogging and Sagging moment.

4. Identify the centroid for an equilateral triangle, with dimensions as 30 cm for all sides.

5. State Hooke's law.

6. A rectangular object of size 300 cm × 100 cm × 100 cm undergoes tension load of 10 kN. Calculate the stress on the object.

7. A solid circular shaft with diameter 10 cm is subjected to a torque of 38 kNm. Calculate the shear stress acting on the shaft.

8. Illustrate the stress distribution diagram for I-section.

9. What are the different types of indeterminate beams?

10. List the different end conditions for a column.

PART B — (5 × 13 = 65 marks)

11. (a) The resultant of two concurrent forces is 850N and the angle between the force is 90°. The resultant force makes an angle of 36° with one of the force. Find magnitude of each force. (13)

Or

(b) Calculate the support reactions for the structures shown in figure 1 and 2. (7 + 6)

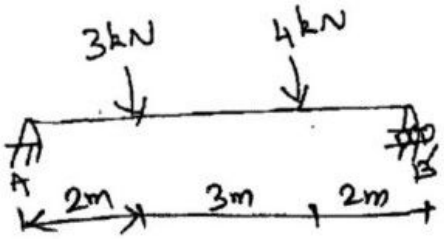

Figure 1

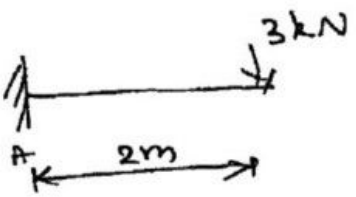

Figure 2

12. (a) Calculate the moment of inertia for an I-section shown in figure. 3. (13)

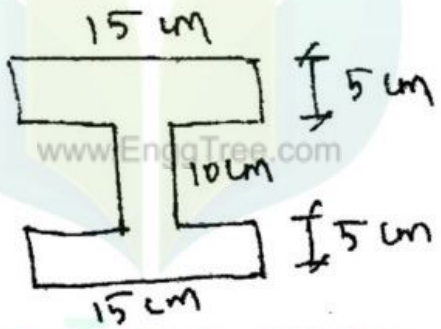

Figure 3

Or

(b) Draw Shear force diagram and bending moment diagram for the simply supported beam shown in figure. 4. (13)

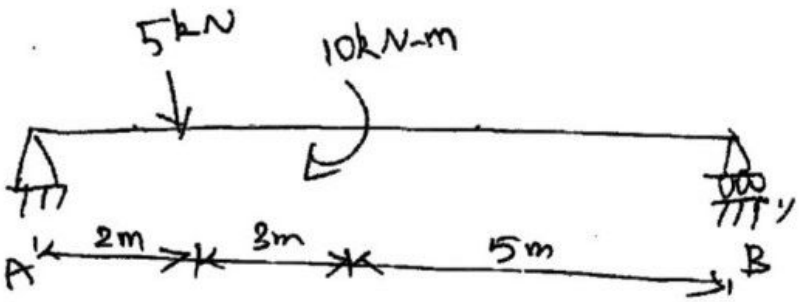

Figure 4

13. (a) Three bars made of copper, zinc and aluminium are of equal length and have cross section 500, 700 and 1000 sq.mm respectively They are rigidly connected at their ends. If this compound member is subjected to a longitudinal pull of 250kN. Estimate the proportional of the load carried on each rod and the induced stresses.

Take $E_{copper} = 1.3 \times 10^5$ N/mm^2, $E_{zinc} = 1 \times 10^5$ N/mm^2 and

$E_{aluminium} = 0.8 \times 10^5$ N/mm^2. (13)

Or

(b) Derive the relationship between Young's modulus, rigidity modulus and the bulk modulus. (13)

14. (a) A solid circular shaft transmits 75kW power at 200 rpm. Calculate the shaft diameter if the twist in the shaft is not to exceed 1° in 2m length of the shaft and shear stress is limited to 50MN/m^2. Take G = 100 GN/m^2. (13)

Or

(b) (i) A hollow circular shaft has an external diameter of 120 mm and internal diameter of 90 mm. If the stress at a finer inside is 36 N/mm^2 due to torque, then find the torque, the maximum shear stress and the angle of twist per unit length. Take G = 80GPa . (6)

(ii) Determine the diameter of a solid shaft which will transmit 90kW power at 160 rpm. Also determine the length of the shaft if the twist must not exceed 1° over the entire length. The maximum shear stress is limited to 60 MPa. Take G = 80GPa. (7)

15. (a) At a point in a strained material, the principal stresses are 100N/mm^2 and –40 N/mm^2. Determine the resultant stress in magnitude and direction in a plane inclined at 60° to the axis of major principal stress. Find the shear stress in the material at that point? (13)

Or

(b) A slender pin ended column 1.8m long and of circular cross section is to have an outside diameter of 50 mm. Calculate the necessary internal diameter to prevent failure by buckling if the actual load applied is 13.6 kN and the critical load applied is twice the external diameter. (13)

PART C — (1 × 15 = 15 marks)

16. (a) A simply supported beam of length 4 m is subjected to a uniformly distributed load of 30 kN/m over the whole span deflects 15 mm at the centre. Determine the crippling load when it is used as a column with the following conditions:

(i) Both ends are pin jointed

(ii) One end fixed and the other hinged

(iii) Both ends fixed. (15)

Or

(b) A compound tube consists of a steel tube 200 mm internal diameter, 10 mm thickness and an outer brass tube 220 mm internal diameter 10 mm thickness. The two tubes are of the same length. The compound tube carries an axial load of 1500kN. Find the stresses and the loads shared by each tube. Take $E_s = 2 \times 10^5$ N/mm², $E_b = 1 \times 10^5$ N/mm². (15)