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Question Paper Code : 30015

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

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. Write the different force systems in mechanics.
2. Draw the different types of support in two dimensional system.
3. Differentiate centroid and centre of gravity of an object.
4. Define Poisson's ratio.
5. Differentiate statically determinate and statically indeterminate beams.
6. State yield point of stress — strain diagram.
7. Write the assumptions made in a bar subjected to pure torsion.
8. Define Moment of resistance.
9. State the radius of Mohr's circle.
10. Write down the stresses which are to be considered when cylindrical shell subjected to internal fluid pressure.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Four forces act on an eye bolt. Determine the resultant of the forces on the bolt as shown in Figure 1. (7)

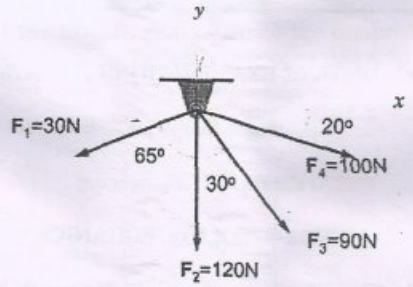

Fig 1.

(ii) Explain the concept of free body diagram. (6)

Or

(b) (i) Determine the external reactions for the beam as shown in Figure 2. (7)

Fig 2.

(ii) A smooth sphere of 2kN weight and 2cm radius is resting against the walls as shown in figure 3. Determine the reaction at supporting points. (6)

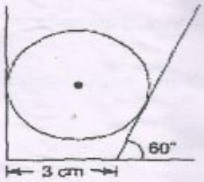

Fig 3.

12. (a) A channel section is of size 300mm × 100mm overall. The base as well as the flange of the channel are 10mm thick. Determine the moment of inertia about x axis I_{xx} and y axis I_{yy}. (13)

Or

(b) Draw the shear force and bending moment diagrams for the beam shown in Figure 4, indicating principal values. (13)

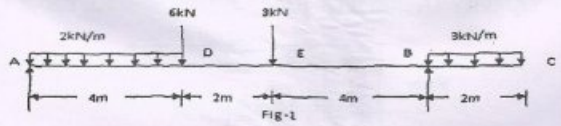

Fig 4.

13. (a) Determine the percentage change in volume of a steel bar 40mm square in section and 1m long when subjected to an axial compressive load of 15kN. What change in volume would a 100mm cube of steel suffer at a depth of 4km in sea water (w = 10080 N/m³)? Take E = 2 × 10⁵ N/mm² and G = 0.81 × 105 N/mm². (13)

Or

(b) Derive the relationship between the Elastic constants. (13)

14. (a) A cast iron beam section is of I section with a top flange 80mm × 20mm thick, bottom flange 160mm × 40mm thick and web 200mm deep and 20mm thick. The beam is freely supported on a span of 5m. If tensile stress is not to exceed 20N/mm², Find the safe uniformly distributed load which the beam can carry. Find also the maximum compressive stress. (13)

Or

(b) A solid shaft of aluminium of length 1.5m and 60mm diameter is to be replaced by a tubular steel shaft of same length and same outside diameter, such that each of the two shafts have the same angle of twist per unit torsional moment over the total length. Determine the inner diameter of the tubular steel shaft, if the modulus of rigidity of steel is three times that of aluminium. (13)

15. (a) A rectangular block of material is subjected to a tensile stress of 100N/mm² on one plane and a tensile of 50N/mm² on a plane at right angles, together with shear stresses of 60N/mm² on the same planes, Find (i) The direction of the principal planes, (ii) The magnitude of the principal stresses (iii) The magnitude of the greatest shear stress. (13)

Or

(b) A thin cylindrical shell of 1m internal diameter and 10 mm thickness is subjected to an internal pressure of 4Mpa. If the length of the shell is 3.25m determine hoop and longitudinal stresses, maximum shear stress and the change in the dimensions of the shell. The modulus of elasticity and Poisson's ratio for the shell material are 200Gpa and 0.3 respectively. (13)

PART C — (1 × 15 = 15 marks)

16. (a) The cross section of the beam is shown in Figure 5. The beam is made of a material with permissible stress in compression and tension equal to 100 N/mm² respectively. Calculate the moment of resistance of the cross section when subjected to a moment causing compression at the top and tension at the bottom, Also calculate the compression in the top flange and the tension in the bottom flange corresponding to this moment. (15)

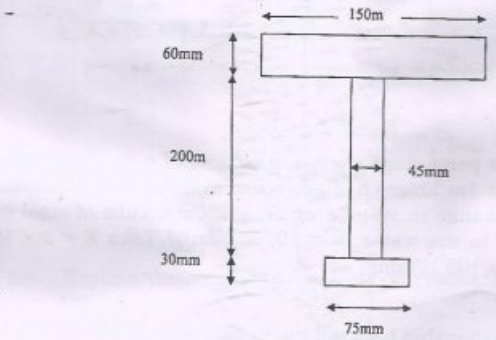

Fig 5.

Or

(b) An overhanging beam ABC supported at A and B is loaded as shown in Figure 6. Determine the deflection at the free end, and maximum deflection between A and B. Take I = 600 cm⁴ and E = 2 × 10⁵ N/mm². (15)

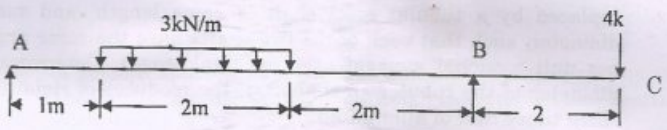

Fig. 6