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B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Third Semester

Aeronautical Engineering

CE 6452 – SOLID MECHANICS

(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Draw the stress strain curve for ductile and brittle materials.
2. What is meant by statically determinate and indeterminate structures ?
3. How 'force-couple' is different from 'moment-couple' in their actions on beams ?
4. What is meant by 'modular ratio' of materials ?
5. Explain the concept behind the conjugate beam method.
6. What are the advantages of using Macaulay's method over double integration method ? Explain with an example.
7. A solid circular shaft is 100 mm in diameter. It transmits 120 kW at 200 rpm. If C is 80 GPa, compute the angle of twist for a length of 6 meters.
8. A rectangular cross section column of length 6m has width 150mm and depth 250mm. Compute the slenderness ratio if both the ends are hinged.
9. A thin cylinder of radius r subjected to internal pressure p. Write down the expression for the principal stresses developed and the maximum shear stress.
10. Distinguish between circumferential and longitudinal stress in a cylindrical shell when subjected to an internal pressure.

PART – B (5×13=65 Marks)

11. a) A plane truss is as shown in Figure Q. 11(a). Using method of joints find the forces in all the members and identify the members which are subjected to maximum tension and compression.

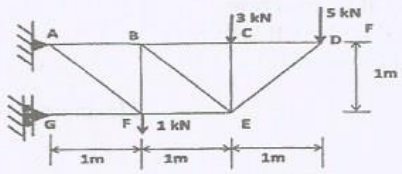

Figure Q. 11(a)

(OR)

b) i) Derive expression for the change in volume for a rectangular prism of length 'L', breadth 'a' and height 'b' subjected to σ_{xx}, σ_{yy} and σ_{zz} along the length, breadth and height respectively. (5)

ii) A rectangular prism of length L = 500 mm, breadth a = 50 mm and height b = 20 mm is subjected to σ_{xx} = 100 MPa and σ_{yy} = 50 MPa along the length and breadth respectively. Find the change in dimensions and the change in volume. Assume E = 200 GPa and Poisson's ratio μ = 0.3. (8)

12. a) A cantilever of 2 m length carries a point load of 20 kN at 0.8 m from the fixed end and another point load of 5 kN at the free end. In addition, a u.d.l. of 15 kN/m is spread over the entire length of the cantilever. Draw the S.F.D. and B.M.D.

(OR)

b) Determine the shear force and bending moment at the fixed end of the cantilever beam subjected to uniformly varying load, for

i) the load gradually increases from fixed end and

ii) the load gradually increases from free end.

Also draw the S.F.D. and B.M.D.

13. a) i) Appropriately define the following theorems : two theorems of moment area method; principle of superposition; and Maxwell's reciprocal theorem. **(6)**

ii) A cantilever beam carries a load of 10 kN which is 1 m from the support. Find the slope at that point. Take EI as constant. **(7)**

(OR)

b) i) Appropriately state the concepts behind: Macaulay's method; moment-area method and conjugate beam method for deflection of beams. **(5)**

ii) Using conjugate beam method find the central deflection of a simply supported beam of span 4m and subjected to a mid span point load of 60 kN. Take EI is constant with a value of 40000 kNm^2. **(8)**

14. a) Using Euler's formula, calculate the critical stresses for a series of struts having slenderness ratio of 40, 80, 120 and 160 under the following condition : (i) both ends hinged and (ii) both end fixed. $E = 2.05 \times 10^5 N/mm^2$.

(OR)

b) Two closed coiled concentric helical springs of the same length, are wound out of the same wire, circular in cross section and supports a compressive load 'P'. The inner spring consists of 20 turns of mean diameter 16 cm and the outer spring has 18 turns of mean diameter 20 cm. Calculate the maximum stress produced in each spring if the diameter of wire is 1 cm and P = 1000N.

15. a) A two dimensional state of stress at a point is given by $\sigma_x = 60$ MPa, $\sigma_y = 20$ MPa and T_{xy}. Determine the maximum permissible magnitude of the shear stress T_{xy} if the larger principle stress is not to exceed 75 MPa. Also draw the Mohr's circle.

(OR)

b) A hollow shaft of 40 mm external diameter and 25 mm internal diameter is subjected to a twisting moment of 120 Nm, bending moment of 800 Nm and an axial compressive force of 10kN. Calculate the maximum compressive and shear stress.

PART – C **(1×15=15 Marks)**

16. a) A solid steel cylinder of 60 mm diameter is concentrically placed inside an aluminium pipe of 75 mm internal diameter and 15 mm thickness. If both cylinder and the pipe have the same length and the temperature of the assembly is raised by 80°C, find the stresses induced in each of the material.
$E_s = 200$ GPa $E_a = 70$ GPa
$\alpha_s = 12 \times 10^{-6}/°C + \alpha_a = 18 \times 10^{-6}/°C$.

(OR)

b) A simply supported beam of span 4 metres is subjected to udl on its full length. The cross section of the beam is of 'T' section with 150 mm × 10 mm flange dimensions and 90 mm × 10 mm web dimensions. If the maximum permissible bending stress in the material of the beam is 165 N/mm^2, find the maximum udl that can be applied on the beam.

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