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Question Paper Code : 20315

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2022.

Third Semester

Civil Engineering

CE 8301 — STRENGTH OF MATERIALS – I

(Regulations 2017)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. A bar of diameter 30 mm is subjected to a tensile load such that the measured extension on a gauge length of 200 mm is 0.09 mm and the change in diameter is 0.0045 mm. Determine the Poisson's ratio.

2. Sketch the stress – strain curves of Ductile and Brittle Material and highlight the major differences.

3. Draw the SF and BM diagrams of simply supported beam of span 'l' m carries UDL throughout its length.

4. A rectangular beam of width 100 mm is subjected to maximum shear force of 60 kN. The corresponding maximum shear stress in the cross section is 4 N/mm^2. Find the depth of the beam.

5. State the moment area theorem.

6. Establish the governing differential equation of beams.

7. Write the maximum shear stress expression for solid shaft and hollow shaft.

8. A solid shaft rotating of 180 rpm is subjected to a mean torque of 5000 N-m. what is the power transmitted by the shaft in kW?

9. Differentiate determinate and indeterminate trusses with an example.

10. Illustrate the steps involved in tension coefficient method.

PART B — (5 × 13 = 65 marks)

11. (a) Determine the dilatation e and the change in volume of the 200-mm length of the rod shown in figure-1 if (i) the rod is made of steel with E = 200 GPa and μ = 0.30, (ii) the rod is made of aluminum with E =70 GPa and μ = 0.35.

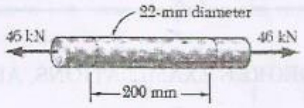

Figure 1

Or

(b) For the given state of stress as shown in figure-2, determine (i) the orientation of the planes of maximum in-plane shearing stress, (ii) the maximum in-plane shearing stress, (iii) the corresponding normal stress.

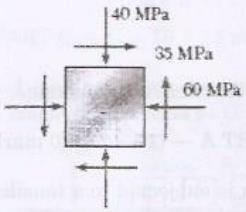

Figure 2

12. (a) A beam ABCDE is simply supported over B and E. AB = CD = DE = 1 m, BC = 3 m. The beam is subjected to a concentrated load of 60 kN at A, and UDL of intensity 40 kN/m over the portion BC and a clockwise moment of 120kN-m at D. Draw shear force and bending moment diagrams. Locate the point of contra flexure, if any.

Or

(b) Draw the shear and moment diagrams for the overhang beam shown in the figure-3 subjected to uniform distributed load.

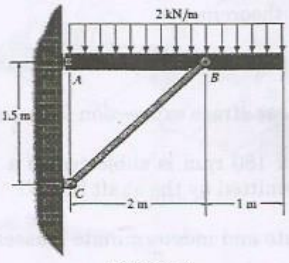

Figure 3

13. (a) A simply supported beam of uniform rectangular cross-section carries a point load at mid span. It is given that, the ratio of depth to span of the beam section is 1:24 and the ratio of the maximum deflection to the span is 1:500. Show that, the maximum bending stress in the beam is E/2000, where E is the young's modulus of the material of the beam. Use double integration method.

Or

(b) A simply supported beam of span 3m and cross-sectional area 100 mm × 300 mm carries a point load of 10 kN at a distance of 1 m from the left end. Find the slope at its two ends and deflection under the point load. Take $E = 2 \times 10^4$ N/mm². Use Macaulay's Method.

14. (a) The solid rod *AB* has a diameter $dAB = 60$ mm and is made of a steel for which the allowable shearing stress is 85 MPa. The pipe *CD*, which has an outer diameter of 90 mm and a wall thickness of 6 mm as shown in figure-4, is made of an aluminum for which the allowable shearing stress is 54 MPa. Determine the largest torque T that can be applied at *A*.

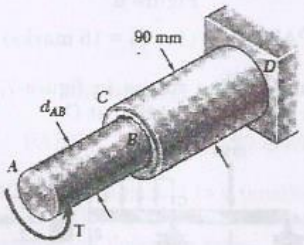

Figure 4

Or

(b) A composite spring has two close coiled helical steel springs in series. Each spring has a mean coil diameter of 8 times diameter of its wire. One spring has 20 coils and wire diameter of 2.5mm. Find the diameter of the wire in the other spring if it has 15 coils and the stiffness of the composite spring is 1.25 N/mm.

15. (a) Determine the forces in member of truss shown in figure-5

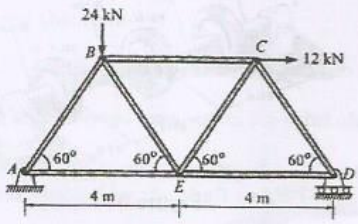

Figure 5

Or

(b) For the truss shown in figure-6

(i) Identify the zero-force members without any calculations.

(ii) Calculate the forces in the remaining members.

(iii) Verify the forces in the members AE, by the method of sections by taking a section m-n as shown in figure- 12 and

Using the value of the forces found in the members meeting at support F; find the reaction at joint F.

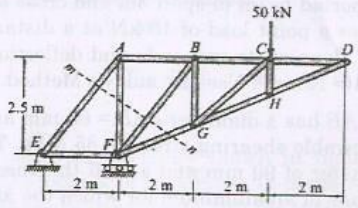

Figure 6

PART C — (1 × 15 = 15 marks)

16. (a) For the beam and loading shown in figure-7, determine the maximum normal stress on transverse section at C.

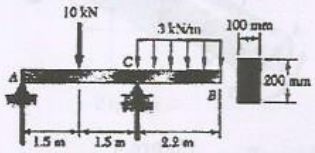

Figure 7

Or

(b) The torques shown in figure-8 are exerted on pulleys *B*, *C*, and *D*. Knowing that the entire shaft is made of aluminum (G = 27 GPa), determine the angle of twist between (i) *C* and *B*, (ii) *D* and *B*.

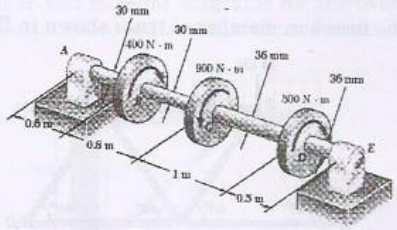

Figure 8