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Third Semester B.E. Degree Examination, Dec.2019/Jan.2020 Mechanics of Materials

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Derive the equilibrium equations for a 3-D stress system. (08 Marks)
- b. Define plane stress and plane strain with equations. (04 Marks)
- c. Derive the total extension in a uniformly tapering rectangular bar with neat sketch. (08 Marks)

OR

- 2 a. Draw a stress-strain diagram for ductile material and mention the salient points. (04 Marks)
- b. Obtain the relation between modulus of elasticity and modulus of rigidity. (08 Marks)
- c. The tensile test was conducted on a mild steel bar. The following data was obtained from the test:
 Diameter of steel bar = 16 mm
 Gauge length = 80 mm
 Load at proportionality limit = 72 kN
 Extension at a load of 60 kN = 0.115 mm
 Load at failure = 80 kN
 Final gauge length = 104 mm
 Diameter of rod at failure = 12 mm
 Determine:
 (i) Young's modulus
 (ii) Proportionality limit
 (iii) True breaking stress
 (iv) Percentage elongation (08 Marks)

Module-2

- 3 a. Mention the sign conventions in SFD and BMD. (04 Marks)
- b. Draw the bending moment and shear force diagrams for the beams shown in Fig.Q3(b). Indicate the salient values on the diagram.

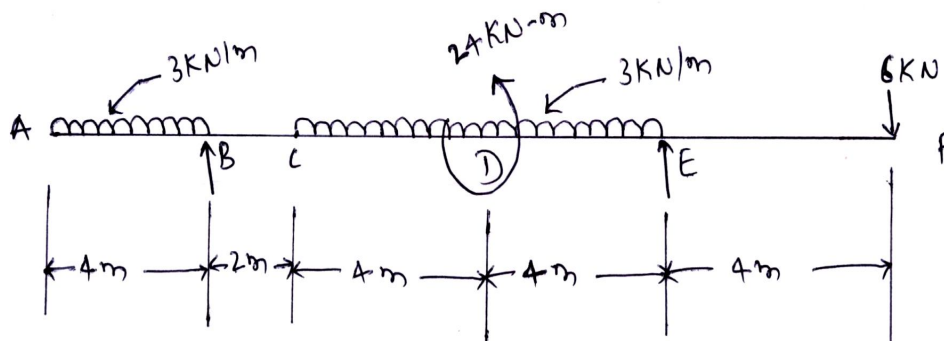


Fig.Q3(b)

- c. Derive the relationship between load, shear force and bending moment. (04 Marks)

OR

- 4 a. What are the Euler-Bernoulli assumptions? (04 Marks)
 b. Derive the Bending Stress equation. (06 Marks)
 c. A symmetric 'T' section beam with flanger dimension $180 \text{ mm} \times 15 \text{ mm}$ and web dimension $280 \text{ mm} \times 15 \text{ mm}$ is subjected to a bending moment of 120 kN-m and a shear force of 60 kN . Sketch the bending and shear stress distributions along the depth of the section. (10 Marks)

Module-3

- 5 a. Derive the differential equation for deflection. (10 Marks)
 b. A simply supported beam having uniform cross-section is 14 m span and is simply supported at its ends. It carries a concentrated load of 120 kN and 80 kN at two points 3 m and 4.5 m from the left and right ends respectively. If the moment of inertia of the section is $160 \times 10^7 \text{ mm}^4$ and $E = 210 \text{ GPa}$, calculate the deflection of the beam at load points and mid span. (10 Marks)

OR

- 6 a. Determine the rate of twist and shear stress distribution in a circular section bar of radius 'R' which is subjected to equal and opposite torque 'T' at each of its free end. (08 Marks)
 b. A 2 m long hollow cylinder shaft has 80 mm outer diameter and 10 mm wall thickness. When the torsional load on the shaft is 6 kN-m , determine:
 (i) Maximum shear stress induced
 (ii) Angle of twist.
 Also draw the distribution of shear stress in the wall of the shaft. Take $G = 80 \text{ GPa}$. (12 Marks)

Module-4

- 7 a. Define the principle of virtual work for a particle. Obtain the equilibrium of a particle. (10 Marks)
 b. What are the differences between principle of virtual work and principle of complementary virtual work? (10 Marks)

OR

- 8 a. Define a conservative force and obtain the work done by conservative force along any path joining two points. (10 Marks)
 b. Explain:
 (i) Clapeyron's theorem
 (ii) Maxwell's theorem (10 Marks)

Module-5

- 9 a. Define fracture. Explain about different types. (10 Marks)
 b. Explain the different stages of creep with neat sketch. (10 Marks)

OR

- 10 a. What do mean by term "Fatigue"? Explain the fatigue testing and S-N diagram. (10 Marks)
 b. Explain the creep phenomenon with examples. (10 Marks)

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