

# CBCS SCHEME

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18AE/AS33

## 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

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

**OR**

- Draw a stress-strain diagram for ductile material and mention the salient points. (04 Marks)
  - Obtain the relation between modulus of elasticity and modulus of rigidity. (08 Marks)
  - 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:
    - Young's modulus
    - Proportionality limit
    - True breaking stress
    - Percentage elongation(08 Marks)

### Module-2

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

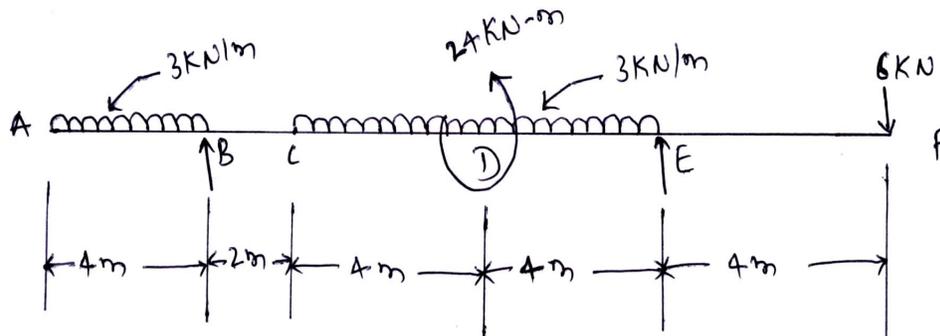


Fig.Q3(b)

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

OR

- 4 a. What are the Euler-Bernoulli assumptions? (04 Marks)  
 b. Derive the Bending Stress equation. (06 Marks)  
 c. A symmetric 'I' 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  $120 \text{ kN-m}$  and a shear force of  $60 \text{ kN}$ . 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  $14 \text{ m}$  span and is simply supported at its ends. It carries a concentrated load of  $120 \text{ kN}$  and  $80 \text{ kN}$  at two points  $3 \text{ m}$  and  $4.5 \text{ m}$  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  $2 \text{ m}$  long hollow cylinder shaft has  $80 \text{ mm}$  outer diameter and  $10 \text{ mm}$  wall thickness. When the torsional load on the shaft is  $6 \text{ kN-m}$ , 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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