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

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 bat 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.

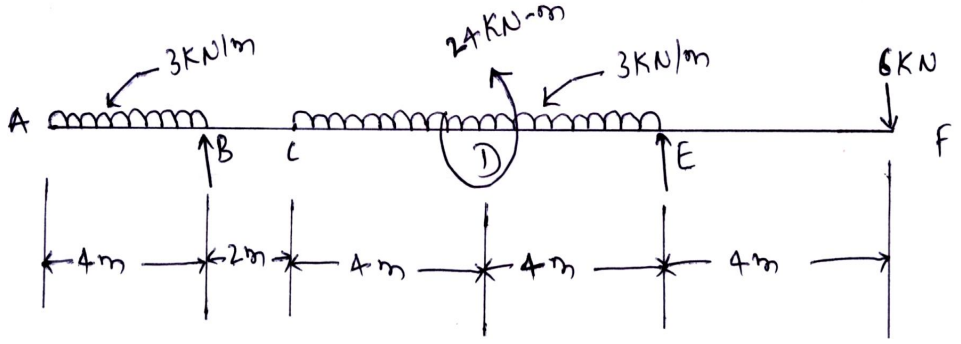

Fig.Q3(b) **(12 Marks)**

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 'I' section beam with flanger dimension 180 mm × 15 mm and web dimension 280 mm × 15 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 3m and 4.5m from the left and right ends respectively. If the moment of inertia of the section is 160×10^7 mm^4 and E = 210 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 2m 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 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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