CBCS SCHEME

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18AE/AS33

Third Semester B.E. Degree Examination, Feb./Mar. 2022
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 the state of stress in 3-dimensions. **(10 Marks)**

b. Define the following: (i) True stress (ii) Engineering stress (iii) Hooke's law (iv) Poisson's ratio (v) Volumetric strain **(10 Marks)**

OR

2 a. Derive an equation to establish the relationship between Bulk Modulus and Shear Modulus. **(10 Marks)**

b. A flat steel bar 200 mm × 20 mm × 8 mm is placed between two aluminium bars 200 mm × 20 mm × 6 mm so as to form a composite bar as shown in Fig.Q2(b).

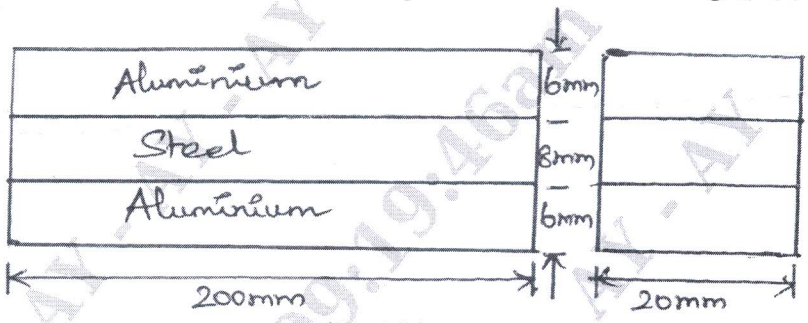

Fig.Q2(b)

All the three bars are fastened together at room temperature. Find the stresses in each bar where the temperature of the whole assembly is raised through 50°C.

Assume: Young's modulus for steel = 200 GPa

Young's modulus for aluminium = 80 GPa

Coefficient of expansion for steel = 12×10^{-6}/°C

Coefficient of expansion for aluminium = 24×10^{-6}/°C **(10 Marks)**

Module-2

3 a. A simply supported beam AB, 6 m long is loaded as shown in Fig.Q3(a). Draw the shear force and bending moment diagrams for the beam.

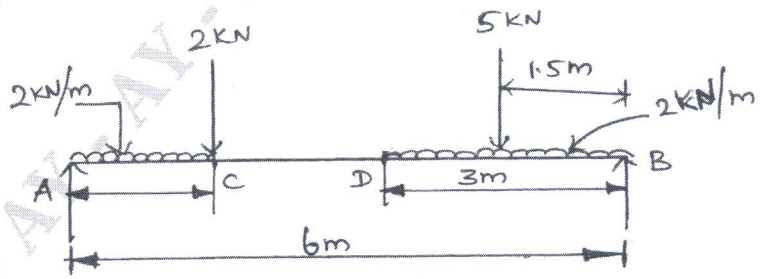

Fig.Q3(a) **(10 Marks)**

b. A beam ABCD, 4 m long is overhanging by 1 m and carries load as shown in Fig.Q3(b). Draw the shear force and bending moment diagrams for the beam and locate the point of contraflexure.

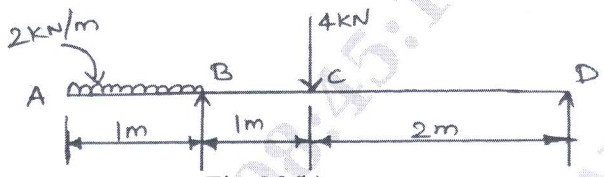

Fig.Q3(b) **(10 Marks)**

OR

4 a. What are the assumptions made in theory of simple bending? Derive an equation for bending stress. **(10 Marks)**

b. An I – section beam 350 mm × 200 mm has a web thickness of 12.5 mm and a flange thickness of 25 mm. It carries a shearing force of 200 kN at a section. Sketch the shear stress distribution across the section. **(10 Marks)**

Module-3

5 a. Derive an equation to enumerate the relation between slope, deflection and radius of curvature. **(10 Marks)**

b. Find the slope and deflection for cantilever with a point load at its free end using Double Integration Method. **(10 Marks)**

OR

6 a. A hollow shaft is to transmit 200 KW at 80 rpm. If the shear stress is not to exceed 60 MPa and internal diameter is 0.6 of the external diameter, find the diameters of the shaft. **(06 Marks)**

b. A solid shaft of 200 mm diameter has the same cross-sectional area as a hollow shaft of the same material with inside diameter of 150 mm. Find the ration of:
(i) Power transmitted by both the shafts at the same angular velocity.
(ii) Angles of twist in equal lengths of these shafts, when stressed to the same velocity. **(08 Marks)**

c. A solid shaft of 80 mm diameter is to be replaced by a hollow shaft of external diameter 100 mm. Determine the internal diameter of the hollow shaft if the same power is to be transmitted by both the shafts at the same angular velocity and shear stress. **(06 Marks)**

Module-4

7 a. Explain principle of virtual work for a particle and a rigid body. **(10 Marks)**

b. Explain the virtual work done by internal force systems. **(10 Marks)**

OR

8 a. State and prove Maxwell's Reciprocal Theorem. **(10 Marks)**

b. A copper bar of 12 mm diameter gets stretched by 1 mm under a steady load of 4 kN. What stress would be produced in the bar by a weight 500 N, the weight falls through 80 mm before striking the collar rigidity fixed to the lower end of the bar? Take Young's modulus for the bar material as 100 GPa. **(06 Marks)**

c. Define: (i) Flexural Rigidity (ii) Proof Resilience **(04 Marks)**

Module-5

9 a. Define fracture. Explain the types of fractures in detail. **(10 Marks)**

b. Define creep. Explain the three stages of creep. **(10 Marks)**

OR

10 a. Define fatigue and explain the types of fatigue in detail. **(10 Marks)**

b. With neat sketch, explain S-N diagram. **(10 Marks)**