CBCS SCHEME

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17AE34

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 200mm × 20mm × 8mm is placed between two aluminium bars 200mm × 20mm × 6mm. So as to form a composite bar as shown in Fig.Q.2(b).

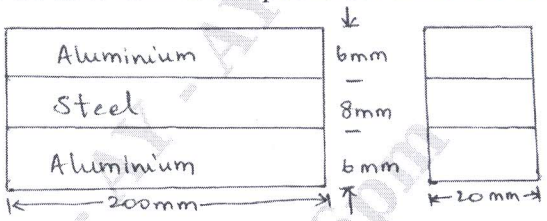

Fig.Q.2(b)

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 = 200GPa
Young's modulus for aluminium = 80GPa
Co-efficient of expansion for steel = 12×10^{-6}/°C
Co-efficient of expansion for aluminium = 24×10^{-6}/°C. **(10 Marks)**

Module-2

3 a. A simply supported beam AB, 6m long is loaded as shown in Fig.Q.3(a). Draw the shear force and bending moment diagrams for the beam. **(10 Marks)**

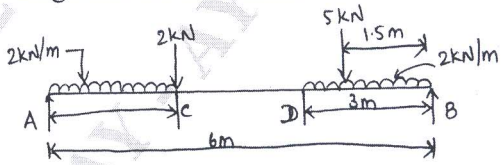

Fig.Q.3(a)

b. A beam ABCD, 4m long is overhanging by 1m and carries load as shown in Fig.Q.3(b). Draw the shear force and bending moment diagrams for the beam and locate the point of contra flexure. **(10 Marks)**

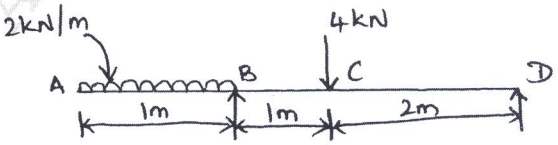

Fig.Q.3(b)

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 350mm × 200mm has a web thickness of 12.5mm and a flange thickness of 25mm. It carries a shearing force of 200kN 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 a cantilever with a point load at its free end using double Integration method. **(10 Marks)**

OR

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

b. A solid shaft of 200mm diameter has the same cross-sectional area as a hollow shaft of the same material with inside diameter of 150mm. Find the ratio of

i) Power transmitted by both the shafts at the same angular velocity.

ii) Angles of twist in equal lengths of there, shafts when stressed to the same velocity. **(08 Marks)**

c. A solid shaft of 80mm diameter is to be replaced by a hollow shaft of external diameter 100mm. 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 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 maxwells reciprocal theorem. **(10 Marks)**

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

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