CBCS SCHEME

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18AU34

Third Semester B.E. Degree Examination, June/July 2024
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. Explain the stress-strain diagram for mild steel depicting all the salient points in it. **(10 Marks)**

b. A stepped bar is subjected to an external loading as shown in Fig.Q1(b). Calculate the change in the length of bar. Take E = 200GPa for steel. E = 70GPa for Aluminum and E = 100GPa for Copper. **(10 Marks)**

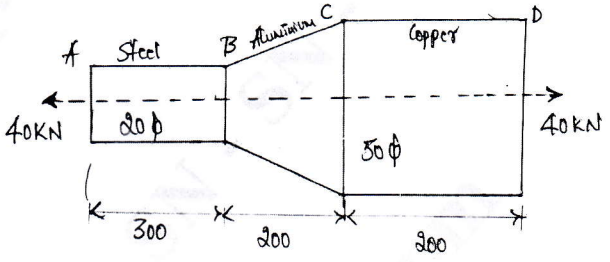

Fig.Q1(b)

OR

2 a. Derive the relation between Young's modulus and modulus of rigidity. **(10 Marks)**

b. A steel bar is placed between two copper bars, each having the same area and of length 'L' as the steel bar at 15°C. At this stage, they are rigidity connected together at the both ends. The length of composite bar is also L. When the temperature is raised to 315°C, the length of the bar increase by 1.5mm. Determine the original length and find the stresses in th bars. Take : $E_S = 2.1 \times 10^5 N/mm^2$, $E_C = 1 \times 10^5 N/mm^2$,

$\alpha_S = 0.000012$ per °C, $\alpha_C = 0.00001 + 5$ per °C. **(10 Marks)**

Module-2

3 a. Explain :

i) Principal planes and principle stresses

ii) Maximum and minimum shear stresses with respect to compound stresses **(10 Marks)**

b. Describe the construction of Mohr's circle for plane stress. **(10 Marks)**

OR

4 a. A thin cylindrical shell 1m in diameter and 3m long has a metal thickness of 10mm. It is subjected to an internal fluid pressure of 3 MPa. Determine

(i) Circumferential and longitudinal stress.

(ii) Circumferential, longitudinal and volumetric strain

(iii)Change in length, diameter and volume

Also find the maximum shearing stress in the shell. Assume Poisson's ratio as 0.3 and E = 210 GPa. **(10 Marks)**

b. Explain the concept of circumferential stress and longitudinal stress corresponding to thin cylinders. **(10 Marks)**

Module-3

5 a. Define and explain the following terms :
i) Shear force ii) Bending moment
iii) Shear force diagram iv) Bending moment diagram **(04 Marks)**

b. Define and explain the following types of load :
i) Concentrated load ii) Uniformly distributed load iii) Uniformly varying load. **(06 Marks)**

c. A simply supported beam of length 6m, carries point load of 3kN and 6kN at distances of 2m and 4m from the left end. Draw the shear force and bending moment diagram for the beam. **(10 Marks)**

OR

6 a. What do you mean by 'Simple Bending'? What are the assumptions made in the theory of simple bending. **(08 Marks)**

b. Derive the deflection equation $EI = \frac{d^2y}{dx^2} = M$. **(06 Marks)**

c. An I–section beam 350m × 150mm has a web thickness of 10mm and a flange thickness of 20mm. If the shear force acting on the section is 40kN, find the maximum shear stress developed n the I–section. **(06 Marks)**

Module-4

7 a. Derive the relation for a circular shaft when subjected to torsion as given by

$$\frac{T}{J} = \frac{\rho}{R} = \frac{G\theta}{L}$$

Also list out the assumption made while deriving the relation. **(10 Marks)**

b. A hollow circular steel shaft has to transmit 60 kW at 210 rpm such that the maximum shear stress does not exceed 60 MN/m^2. If the ratio of internal to external diameter is equal to 3/4 and the value of rigidity modulus is 84 GPa, find the dimensions of shaft and angle of twist in a length of 3m. **(10 Marks)**

OR

8 a. Derive a Euler's Crippling load for a column when both of its ends are hinged. **(10 Marks)**

b. A 1.5 m long column has a circular cross section of 50mm diameter. One end of the column is fixed in direction and position of the other end is free. Taking the factor of safety as 3, calculate the safe load using Euler's formula. Taking $E = 1.2 \times 10^5$ N/mm^2. **(10 Marks)**

Module-5

9 a. Derive an expression for strain energy due to shear stress. **(10 Marks)**

b. Write short notes on :
i) Castigliano's theorem I & II
ii) Modulus of resilience of strain energy. **(10 Marks)**

OR

10 a. Explain :
i) Maximum principal stress theory
ii) Maximum shear stress theory. **(10 Marks)**

b. Determine the strain energy and hence the deflection at the free end of a cantilever beams of length 'L' carrying a point load 'W' at its free end. **(10 Marks)**

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