CBCS SCHEME

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18AU34

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. 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)**

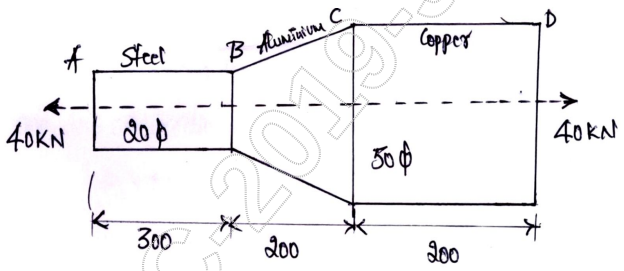

Fig.Q1(b)

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 principal stresses

ii) Maximum and minimum shear stresses with respect to compound stress. **(06 Marks)**

b. Describe the construction of Mohr's circle for plane stress. **(06 Marks)**

c. A point in a beam is subjected to maximum tensile stress 110MPa and shear stress 30MPa. Find the magnitudes and directions of principal stresses. If the point in the beam is in the compression zone under the same magnitude of bending stress and shear stress. Find the magnitudes of principal stresses and their directions. **(08 Marks)**

OR

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

b. A thin cylindrical shell 1m in diameter and 3m long has a metal thickness of 10mm. If is subjected to an internal fluid pressure of 3MPa. 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)**

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 $\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{L}$. **(10 Marks)**

b. A solid circular shaft has to transmit a power of 1000 KW at 120rpm. Find the diameter of the shaft, if the shear stress of the material must not exceed 80N/mm^2. The maximum torque 1.25 times of its mean. What percentage of saving in material would be obtained if the shaft is replaced by hollow one whose internal diameter is 0.6 times its external diameter, the length, material and maximum shear stress being same? **(10 Marks)**

OR

8 a. Derive an expression for the Euler's crippling load for a long column when both the ends of the column are hinged. **(10 Marks)**

b. A Hollow CI column whose outside diameter is 200mm has a thickness of 20mm. It is 4.5m long and is fixed at both ends. Calculate the safe load by Rankine's formula using a factor of safety of 4. Calculate the slenderness ratio and the ratio of Euler's and Rankine's critical loads. Take f_c = 550 N/mm^2, $\alpha = \frac{1}{1600}$ in Rankine's formula and E = 9.4 × 10^4 N/mm^2. **(10 Marks)**

Module-5

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

b. A cantilever beam of uniform cross-section carries a point load at the free end. Determine :
i) Strain energy stored by the cantilever beam and the deflection at the free end
ii) If the load P = 200kN. E = 2 × 10^8 kN/m^2, l = 3m and I = 10 –3m^4, determine the above values. **(10 Marks)**

OR

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

b. A bolt is subjected to an axial pull of 10kN together with a transverse shear of 5kN. Determine the diameter of the bolt using.
i) Maximum principal stress theory ii) Maximum shear stress theory. **(10 Marks)**