CBCS SCHEME

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17CV/CT32

Third Semester B.E. Degree Examination, Feb./Mar. 2022
Strength of Materials

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

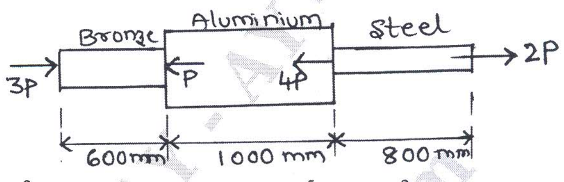
Module-1

1 a. Sketch and explain a typical stress curve for mild steel specimen subjected to axial tension indicating the salient points. **(05 Marks)**

b. Derive an expression for elongation of a circular tapering bar subjected to an axial load P, using the standard notations. **(05 Marks)**

c. Determine the value of P that will not exceed a maximum deformation of 2mm or a stress of $120 N/mm^2$ in steel, $80 N/mm^2$ in aluminum and $115 N/mm^2$ in bronze. Refer Fig. Q1(c).

Fig.Q1(c)



Given : A_b : $600 mm^2$, E_b : $0.84 \times 10^5 N/mm^2$.
A_a : $800 mm^2$, E_a : $0.7 \times 10^5 N/mm^2$.
A_s : $400 mm^2$, E_s : $2.1 \times 10^5 N/mm^2$. **(10 Marks)**

OR

2 a. Define the terms : i) Poisson's Ratio ii) Volumetric strain. **(04 Marks)**

b. Derive the relationship between Young's modulus and Bulk modulus. **(06 Marks)**

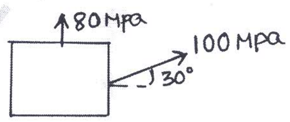
c. A bar of brass 25mm diameter is enclosed in a steel tube of 50mm external diameter and 25mm internal diameter. The bar and the tube are both initially 1m long and rigidly fastened at both ends. Find the stresses in the two materials when the temperature rises from 15°C to 95°C. If the composite bar is then subjected to an axial tensile load of 60kN, find the resulting stresses.
$E_s = 200 \times 10^3$ MPa , $\alpha_s = 11.6 \times 10^{-6}/°C$
$E_b = 100 \times 10^3$ MPa , $\alpha_b = 18.7 \times 10^{-6}/°C$. **(10 Marks)**

Module-2

3 a. Derive expressions for principal stresses and their planes for two dimensional stress systems. **(08 Marks)**

b. At a point in a strained material, the state of stress is as shown in Fig. Q3(b). Sketch the orientation of the principal planes and mark the stresses. **(12 Marks)**

Fig.Q3(b)



OR

4 a. Distinguish clearly between Thin and Thick Cylinders. **(03 Marks)**

b. Derive Lame's equations for radial and hoop stresses for a thick cylinder. **(07 Marks)**

c. Find the thickness of metal necessary for a cylindrical shell of internal diameter 160mm to withstand a internal fluid pressure of 8MPa. The maximum hoop stress shall not increase 35MPa. **(10 Marks)**

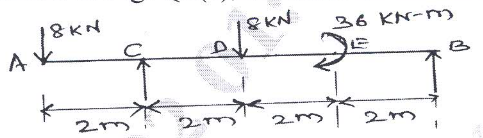
Module-3

5 a. Define the term : i) Bending moment ii) Point of contra flexure. **(04 Marks)**

b. For a simply supported beam with udℓ through out, plot the shear force and bending moment diagrams. Indicate the value of maximum bending moment on the diagram. **(06 Marks)**

c. For the beam loaded as shown in Fig. Q5(c), draw the SFD and BMD.

Fig.Q5(c)



(10 Marks)

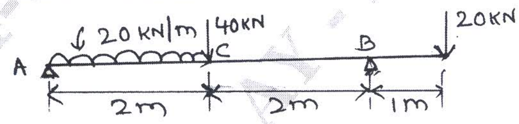
OR

6 a. Define the terms Hogging and Sagging Bending moment. **(03 Marks)**

b. Establish the relationship between SF, BM and Intensity of loading. **(05 Marks)**

c. Draw SFD and BMD for the beam shown in Fig. Q6(c). Locate the point of maximum bending moment and point of contra flexure. **(12 Marks)**

Fig.Q6(c)



Module-4

7 a. List the assumptions in Pure Torsion theory. **(04 Marks)**

b. Explain : i) Maximum Shearing Stress theory ii) Maximum Strain theory. **(08 Marks)**

c. Find the diameter of a solid circular shaft to transmit 6000 Watts at 150 RPM if the maximum torque is likely to exceed the mean torque by 25% for a shear stress of 60MPa. Also find the angle of twist over a length of 2.5m. Take $C = 7.85 \times 10^4 N/mm^2$. **(08 Marks)**

OR

8 a. Derive an expression for the theory of Pure Torsion with standard notations. **(08 Marks)**

b. A solid cylindrical shaft is to transmit 300KW at 100 RPM. If the shear stress is not to exceed 80 MPa, find the diameter. Also, what percentage saving in weight would be obtained if this shaft is replaced by a hollow one, whose internal diameter equals 0.6 external diameters. The length, material and maximum stress being the same. **(12 Marks)**

Module-5

9 a. Derive the expression for the theory of pure bending $\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$. **(08 Marks)**

b. A beam of I section consists of 180mm × 15mm flanges and a web of 280mm × 15mm. It is subjected to a bending moment of 120KN – m and shear force of 60KN. Sketch the distribution of bending and shearing stresses across the section. **(12 Marks)**

OR

10 a. Distinguish clearly between short and long columns. **(04 Marks)**

b. Derive Euler's equation for crippling load for a column whose ends are hinged with the standard notations. **(06 Marks)**

c. Compare the crushing load for a hollow C.I. column 150mm outer diameter and 20mm thick if it is 6m long and hinged at both ends, using Euler's and Rankine's formula.

$E = 0.8 \times 10^5 N/mm^2$ and Yield stress = 550MPa. $\alpha = \frac{1}{1600}$.

Also for what length of the strut of this cross section does the Euler's formula cease to apply? **(10 Marks)**

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