CBCS SCHEME

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17MN34

Third Semester B.E. Degree Examination, July/August 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. A rod 150cm long and diameter 2.0cm is subjected to an axial pull of 20kN. If the modulus of elasticity of the material of the rod is $2 \times 10^5 N/mm^2$, determine: the stress, the strain and the elongation of the rod. **(06 Marks)**

b. Prove that the total extension of a uniformly tapering rod of diameter D_1 and D_2, when the rod is subjected to an axial load P is given by $dL = \frac{4PL}{\pi E D_1 D_2}$. **(14 Marks)**

OR

2 a. A steel tube of 30mm external diameter and 20mm internal diameter encloses a copper rod of 15mm diameter to which it is rigidly joined at each end. If at a temperature of 10°C there is no longitudinal stress, calculate the stresses in the rod and tube when the temperature is raised to 200°C. Take E for steel and copper as $2.1 \times 10^5 N/mm^2$ and $1 \times 10^5 N/mm^2$ respectively. The value of co-efficient of linear expansion for steel and copper is given as 11×10^{-6} per °C and 18×10^{-6} per °C respectively. **(14 Marks)**

b. Find an expression for the total elongation of a bar due to its own weight. **(06 Marks)**

Module-2

3 A body is subjected to direct stresses in two mutually perpendicular directions accompanied by a simple shear stress.

a. Draw the Mohr's circle of stresses. **(10 Marks)**

b. Explain how you will obtain the principal stresses, principal planes, maximum shear stress and maximum shear plane. **(10 Marks)**

OR

4 a. Determine the Poisson's ratio and bulk modulus of a material, for which Young's modulus is $1.2 \times 10^5 N/mm^2$ and modulus of rigidity is $4.8 \times 10^4 N/mm^2$. **(05 Marks)**

b. Calculate: the change in diameter, change in length and change in volume of a thin cylindrical shell 100cm diameter, 1cm thick and 5m long when subjected to internal pressure of $3N/mm^2$. Take the value of $E = 2 \times 10^5 N/mm^2$ and Poisson's ratio, $\pi = 0.3$. **(15 Marks)**

Module-3

5 a. What are the different types of beams? Differentiate between a cantilever and a simply supported beam. **(08 Marks)**

b. Draw the S.F. and B.M. diagrams for a cantilever of length L carrying a uniformly distributed load of W per unit length over its entire length. **(12 Marks)**

OR

6 a. What are the different types of loads acting on a beam? **(06 Marks)**

b. Draw the S.F. and B.M. diagrams for the beam which is loaded as shown in Fig.Q.6(b). Determine the points of contraflexure within the span AB.

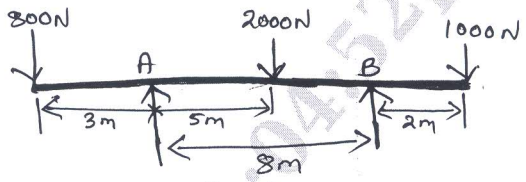

Fig.Q.6(b)

(14 Marks)

Module-4

7 a. A circular beam of 100mm diameter is subjected to a shear force of 5kN. Calculate average shear stress, maximum shear stress and shear stress at a distance of 40mm from N.A. **(10 Marks)**

b. Prove that relation: $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$.

where M = Bending moment
I = Moment of inertia
σ = Bending stress
y = distance from N.A.
E = Young's modulus
R = Radius of curvature

(10 Marks)

OR

8 a. A beam of uniform rectangular section 200mm wide and 300mm deep is simply supported at its ends. It carries a uniformly distributed load of 9kN/m run over the entire span of 5m. if the value of E for the beam material is $1 \times 10^4 N/mm^2$. Find the slope at the supports and maximum deflection. **(10 Marks)**

b. Derive an expression for the slope and deflection of a cantilever of length L, carrying a point load W at the free end by double integration method. **(10 Marks)**

Module-5

9 a. Derive the relation for a circular shaft when subjected to torsion as given below:
$\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{L}$. **(16 Marks)**

b. In a hallow circular shaft of outer and inner diameters of 20cm and 10cm respectively, the shear stress is not to exceed $40N/mm^2$. Find the maximum torque which the shaft can safety transmit. **(04 Marks)**

OR

10 A 2 meters long column has a square cross-section of side 40mm. Taking the fos as 4, determine the safe load for the end conditions,

i) Both ends are hinged
ii) One end is fixed and other end is free
iii) Both ends are fixed
iv) One end is fixed and other end is hinged

Take E = 210GPa. **(20 Marks)**

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