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CBCS SCHEME

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18MN34

Third Semester B.E. Degree Examination, Aug./Sept. 2020
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Missing data can be assumed accordingly.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Explain the stress-strain curve for ductile material indicating all the salient points on the curve. **(10 Marks)**

b. A round bar with stepped potions is subjected to forces as shown in the Fig. Q1 (b). Determine the magnitude of force P such that the net deformation is not to exceed 1 mm. Young's modulus is 2×10^5 MPa for steel and 70×10^3 MPa for aluminium. Big end and small end diameters of the tapering bar are 40 mm and 12.5 mm respectively. **(10 Marks)**

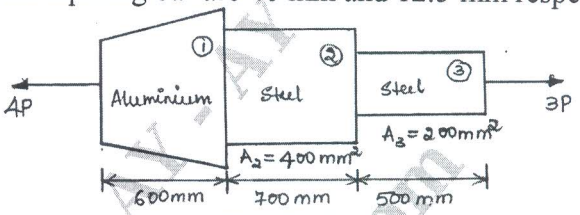

Fig. Q1 (b)

OR

2 a. Derive the expression for the deformation of a uniformly tapered bar with rectangular cross-section subjected to tensile load. **(10 Marks)**

b. A compound bar of length 500 mm consists of a strip of Al 50 mm wide and 20 mm thick. Another strip of steel 50 mm wide and 15 mm thick rigidly joined at the ends. If the bar is subjected to a load of 50 kN, find the stress developed in each material and the extension of the bar.

$E_{steel} = 2\times10^5$ N/mm^2, $E_{Al} = 1\times10^5$ N/mm^2 **(10 Marks)**

Module-2

3 a. Derive an expression to obtain the relationship between Young's Modulus (E) and Bulk Modulus (K). **(10 Marks)**

b. Determine the normal, shear and resultant stress for a tensile stress of 100 MPa and a compressive stress of 60 MPa acting on a plane at an angle of 50° with the axis of major stress. Also determine the maximum shear stress. Use Mohr's circle method. **(10 Marks)**

OR

4 a. Derive an expression for circumferential stress and longitudinal stress for a thin cylinder. **(10 Marks)**

b. A cylindrical vessel is 1.5 m diameter and 4 m long and is closed at ends by rigid plates. It is subjected to an internal pressure of 3 N/mm^2. If the maximum principal stress is not to exceed 150 N/mm^2, find the thickness of the shell. Assume E = 2×10^5 N/mm^2 and the Poisson's ratio is 0.25. Find the changes in diameter, length and volume of the shell. **(10 Marks)**

Module-3

5 Draw the shear force and bending moment diagram for a cantilever subjected to the forces as shown in Fig. Q5. **(20 Marks)**

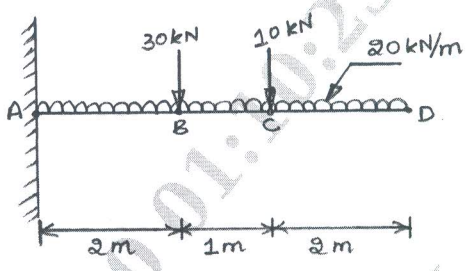

Fig. Q5

OR

6 Draw the shear force and bending moment diagrm for the simply supported beam subjected to forces as shown in the Fig. Q6. **(20 Marks)**

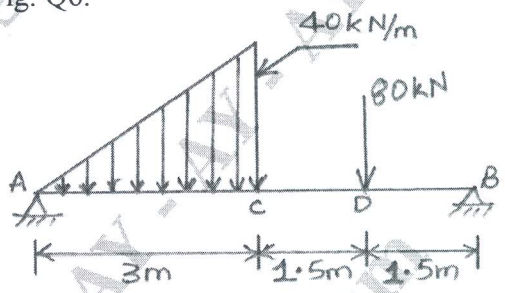

Fig. Q6

Module-4

7 a. State the assumptions made in theory of pure bending. Derive the expression for relationship between bending moment and radius of curvature. **(10 Marks)**

b. The cross section of a beam which is subjected to a shear force of 60 kN is shown in the Fig. Q7 (b). Show the shear stress distribution across the section. **(10 Marks)**

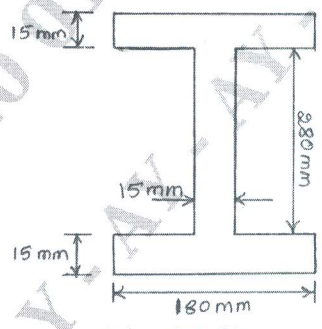

Fig. Q7 (b)

OR

8 a. Derive an expression for deflection, $M = EI\left[\frac{d^2y}{dx^2}\right]$ with usual notations. **(10 Marks)**

b. Determine the slope and deflection of the free end of a Cantilever of length 3 m which is carrying a uniformly distributed load of 10 kN/m over a length of 2 m from the fixed end. Take $I = 10^8\ mm^4$ and $E = 2 \times 10^5\ N/mm^2$. **(10 Marks)**

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Module-5

9 a. State the assumptions made in theory of pure torsion. Derive an expression for relationship between Torque and shear stress of a circular shaft. **(10 Marks)**

b. A solid shaft is to transmit 60 kW at 400 rpm. The maximum torque is not to exceed 25% more than the mean torque. The maximum shear stress for the material of the shaft is not to exceed 50 MPa. Determine the angle of twist in 1 m length of the shaft. Take the value of G as 80 GPa. **(10 Marks)**

OR

10 a. Derive Euler's equation for buckling load for column when both the ends are hinged. **(10 Marks)**

b. A simply supported beam of length 4 m is subjected to a uniformly distributed load of 30 kN/m over the entire span and deflects 15 mm at the center. Determine the crippling loads when this beam is used as column with the following conditions:

(i) One end fixed and other end hinged.

(ii) Both the ends pin joined. **(10 Marks)**

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