CBCS SCHEME

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18MN34

Third Semester B.E. Degree Examination, Jan./Feb. 2023
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

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

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. Define Modules of Elasticity and Poisson's ratio. **(02 Marks)**

b. Draw stress-strain diagram for mild steel indicating all salient point and explain. **(08 Marks)**

c. The tensile test was conducted on a mild steel bar. The following data was obtained from the test.

Diameter of steel bar	=	16mm
Load at failure	=	80kN
Load at proportionality limit	=	72kN
Gauge length of bar	=	80mm
Diameter of rod at failure	=	12mm
Extension of load of 60kN	=	0.115mm
Find gauge length of bar	=	104mm

Determine :

i) Young's modulus
ii) Proportionality limit
iii) True breaking stress
iv) Percentage elongation **(10 Marks)**

OR

2 a. Define Compound bars. **(02 Marks)**

b. Derive an expression for the total deformation of the tapered circular bar cross-section of diameter D and d, when it is subjected to an axial load P. **(10 Marks)**

c. A solid light alloy bar of 40mm in diameter is used as tie. If the permissible tensile stress in the material is $320mN/m^2$, determine the capacity of the bar. If a hollow steel bar with internal diameter of 20mm is used instead of solid alloy bar. Determine its external diameter. For steel hollow bar the permissible stress is $150mN/m^2$. **(08 Marks)**

Module-2

3 a. Derive an expression for volumetric strain of a cylindrical bar subjected to axial load. **(08 Marks)**

b. Define principle plane A bar of rectangular cross section 20mm × 50mm is 400mm long and is subjected to an axial tensile load of 80kN. If the modulus of elasticity and modulus of rigidity of the material of bar are $1 \times 10^5 N/mm^2$ and $0.4 \times 10^5 N/mm^2$, determine bulk modulus, changes in dimensions and volume. **(12 Marks)**

OR

4 a. Derive an expression for circumferential stress and longitudinal stress subjected to internal pressure in a thin cylinder. **(10 Marks)**

b. A Steel penstock of 1.5m diameter and 15mm thick is subjected to 100mm head of water. Calculate the loop stress and longitudinal stress at the bottom of the penstock. **(05 Marks)**

c. A thin cylinder of internal diameter 2m contains a fluid at an internal pressure of $3N/mm^2$. Determine the maximum thickness of the cylinder if

i) Longitudinal stress is not to exceed $30N/mm^2$

ii) Circumferential stress is not to exceed $40N/mm^2$. **(05 Marks)**

Module-3

5 a. Draw the shear force and bending moment diagram for the cantilever beam shown in Fig Q 5(a).

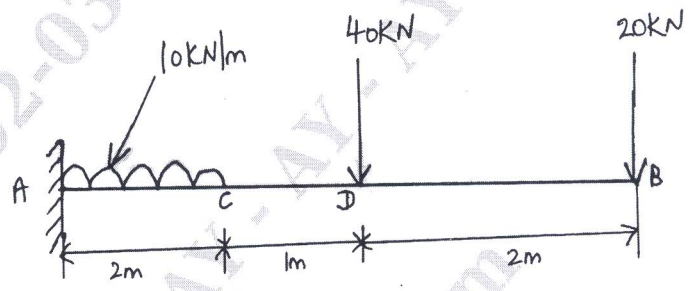

Fig Q5(a) **(10 Marks)**

b. A simply supported beam AB of 6m span is loaded as shown in Fig Q5(b). Draw the shear force and bending moment diagrams.

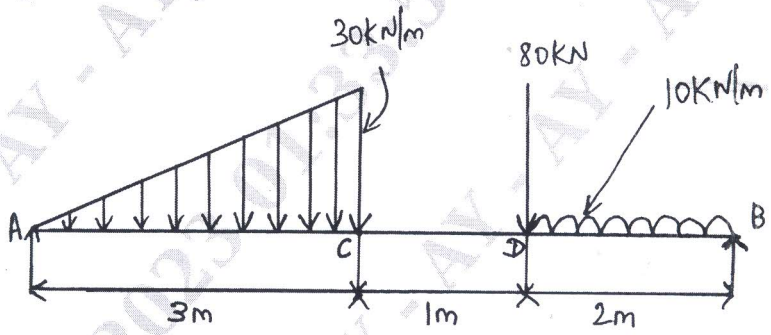

Fig Q5(b) **(10 Marks)**

OR

6 Draw shearforce and bending moment diagrams for the beam shown in Fig Q6. Making values at salient point. Locate the point of contraflexure and point of maximum bending moment. Determine the value of maximum bending moment.

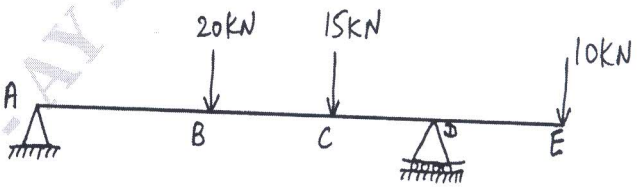

Fig Q6 **(20 Marks)**

Module-4

7 a. Prove that $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$ with usual notations. **(10 Marks)**

b. A cantilever of square section 200mm × 200mm, 2m long just fails in flexure when a load of 12kN is placed at its free end. A beam of same material and having a rectangular cross section 150mm wide and 300mm deep is simply supported over a span of 3m. Calculate the minimum central concentrated load required to break the beam. **(10 Marks)**

OR

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

b. A cantilever beam is subjected to forces as shown in Fig Q8(b). Determine the slope and deflection at the free end by double Integration method. Take $E = 2 \times 10^8 kN/m^2$, $I = 10^{-4}m^4$.

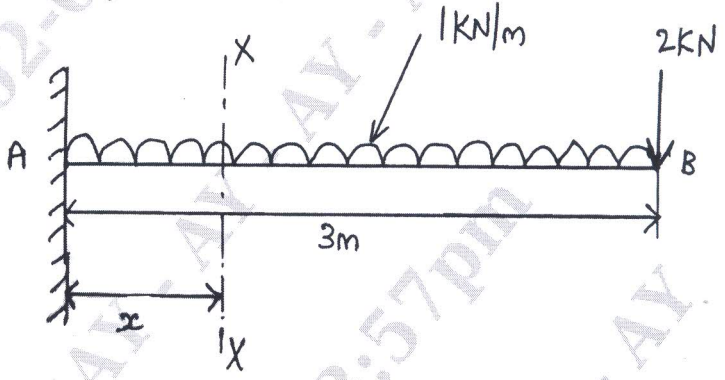

Fig Q8(b) **(10 Marks)**

Module-5

9 a. Derive torsional equation with usual notations. **(10 Marks)**

b. A solid shaft is subjected to a maximum torque of 25kNm, find a suitable diameter of a solid shaft, if the allowable shear stress and the twist are limited to $80N/mm^2$ and 1° respectively for a length of 20 times the diameter of the shaft. **(10 Marks)**

OR

10 a. Derive the expression for Euler's buckling load for a column with its one end fixed and the other end free. **(10 Marks)**

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

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