CBCS SCHEME

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15MN34

Third Semester B.E. Degree Examination, June/July 2019
Mechanics of Materials

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. State Hook's law and define Poisson's ratio. **(02 Marks)**

b. Explain stress-strain diagram for mild steel with salient features. **(06 Marks)**

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

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

Determine : (i) Young's modulus (ii) Proportionality limit (iii) True breaking stress (iv) Percentage Elongation. **(08 Marks)**

OR

2 a. Derive an expression for extension of uniformly tapering rectangular bar subjected to axial load P. **(08 Marks)**

b. Determine the stress in different segments of a circular bar shown in Fig.Q2(b). Also compute the total elongation of the bar if E = 200 GPa. **(08 Marks)**

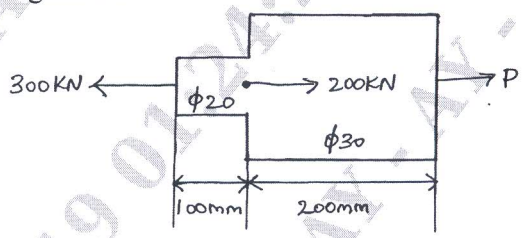

Fig.Q2(b)

Module-2

3 a. Establish a relationship between the modulus of elasticity and modulus of rigidity. **(08 Marks)**

b. A machine component is subjected to the stress as shown in Fig.Q3(b). Find the normal and shearing stresses on the section AB inclined at an angle of 60° with X – X axis. Also find the resultant stress on the section and also find angle of obliquity. **(08 Marks)**

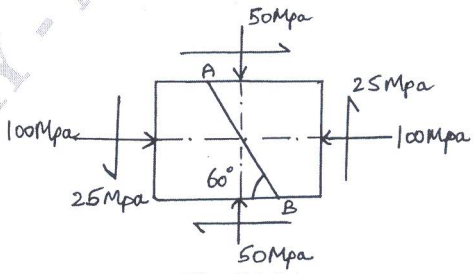

Fig.Q3(b)

OR

4 a. Derive an expression for circumferential stress and longitudinal stress subjected to internal pressure in a thin cylinder. **(08 Marks)**

b. A thin cylindrical shell 1m in diameter and 3m long has a metal thickness of 10mm. It is subjected to an internal fluid pressure of 3 MPa. 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. **(08 Marks)**

Module-3

5 a. Draw the shear force and bending moment diagrams for the cantilever beam shown in Fig.Q5(a). **(08 Marks)**

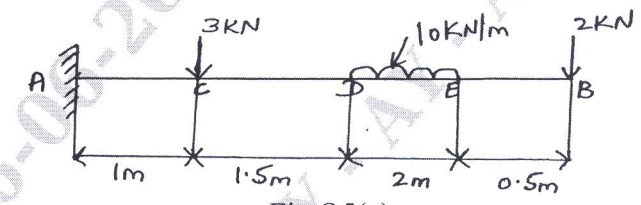

Fig.Q5(a)

b. Obtain an expression for shear force, bending moment and rate of loading. **(08 Marks)**

OR

6 Draw SFD and BMD for the beam shown in Fig.Q6. Locate maximum bending moment and point of contraflexure. **(16 Marks)**

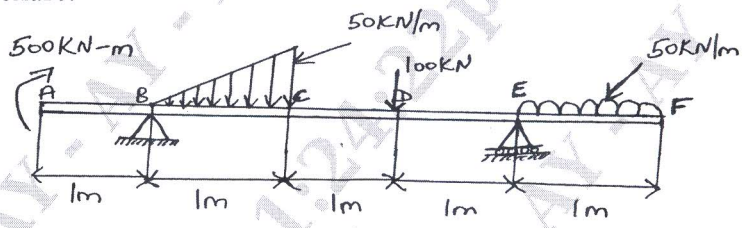

Fig.Q6

Module-4

7 a. Prove that $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$ with usual notations. **(08 Marks)**

b. A cantilever of square section 200mm × 200mm, 2m long just fails in flexure when a load of 12 kN 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. **(08 Marks)**

OR

8 a. Derive an expression $EI\frac{d^2y}{dx^2} = M$, with usual notations. **(08 Marks)**

b. A beam of length 5m and of uniform rectangular section is simply supported at its ends. It carries a uniformly distributed load of 9 kN.m run over the entire length. Calculate the width and depth of the beam if permissible bending stress is 7 N/mm^2 and central deflection is not to exceed 1 cm. Take E for beam material as 1×10^4 N/mm^2. **(08 Marks)**

Module-5

9 a. Derive torsional equation with usual notations. **(08 Marks)**

b. A hollow circular steel shaft has to transmit 60 kW at 210 rpm such that the maximum shear stress does not exceed 60 MN/m^2. If the ratio of internal to external diameter is equal to 3/4 and the value of rigidity modulus is 84 GPa, find the dimensions of the shaft and angle of twist in a length of 3m. **(08 Marks)**

OR

10 a. Define slenderness ratio. Derive an expression for Euler's buckling load for column with one end fixed and other end hinged. **(10 Marks)**

b. A 1.5 m long column has a circular cross section of 50 mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking the factor of safety as 3, calculate the safe load using

(i) Rankine's formula taking yield stress 560 N/mm^2 and $\alpha = \dfrac{1}{1600}$.

(ii) Euler's formula, taking $E = 1.2 \times 10^5$ N/mm^2. **(06 Marks)**

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