CBCS SCHEME

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15MN34

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

Time: 3 hrs. Max. Marks: 80

***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. Explain stress-strain diagram for mild steel with salient features. **(08 Marks)**

b. A steel specimen of 12.5mm diameter and 150mm gauge length is subjected to tensile test. It is observed that the load at yield point is 43kN and maximum load of 60kN. A load of 16.4kN is required to cause an elastic extension of 0.1mm final length of specimen is 190mm and the diameter of neck after the fracture is 8mm. Determine:
i) Yield stress
ii) Young's Modulus
iii) Ultimate stress
iv) Percentage increase in length
v) Percentage reduction in area. **(08 Marks)**

**OR**

2 a. Derive an expression for stress and total elongation in an uniformly tapering circular bar. **(08 Marks)**

b. A bar of diameter 20mm and length 100mm extends by 0.2mm. If E of the material of the rod is $2 \times 10^5 N/mm^2$. What load and type of load applied to the rod? If an extension of 20% greater is required for the same load applied above, how much the diameter of the bar need to be reduced. **(08 Marks)**

### Module-2

3 a. Define the following:
i) Young's Modulus
ii) Shear Modulus
iii) Bulk Modulus
iv) Poisson's ratio **(08 Marks)**

b. Determine the changes in length, width and thickness of a steel bar which is 4m long, 30mm wide and 20mm thick and is subjected to an axial pull of 30kN in the direction of length. $E = 2 \times 10^5 N/mm^2$ and Poisson's ratio = 0.3, also determine the volumetric strain, change in volume and final volume of the given bar. **(08 Marks)**

**OR**

4 a. Define thin cylinder. **(02 Marks)**

b. A steel penstock of 1.5m diameter and 15mm thick is subjected to 100m head of water. Calculate the hoop stress and longitudinal stress at the bottom of the penstock. **(07 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 $40N/mm^2$. **(07 Marks)**

## Module-3

5 Draw shear force and bending moment diagram for the beam shown in Fig.Q.5 marking values at salient points. Locate the point of contra flexure and point of maximum bending moment. Determine the values of maximum bending moment. **(16 Marks)**

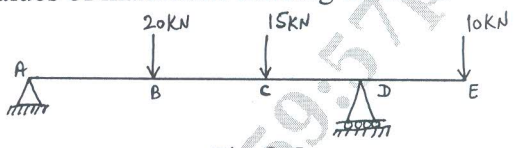


Fig.Q.5

**OR**

6 a. Define shear force diagram and bending moment diagram. **(04 Marks)**

b. Draw shear force diagram and bending moment diagram for the beam shown in Fig.Q.6(b). **(12 Marks)**

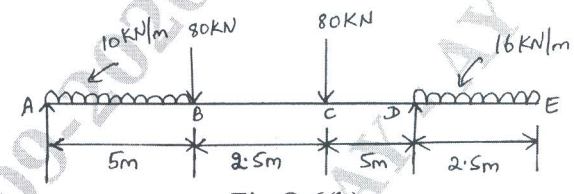


Fig.Q.6(b)

## Module-4

7 a. Derive Bernoulli-Euler's bending equation. **(08 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. **(08 Marks)**

**OR**

8 a. Prove that in case of a rectangular section of a beam, the maximum shear stress is 1.5 times average shear stress. **(08 Marks)**

b. A simply supported beam of 200mm wide and 300mm deep supports an uniformly distributed load of intensity WkN/m over a span of 4m. Calculate the safe intensity of load that the beam can carry if the permissible stresses in bending and shear are $56N/mm^2$ and $4N/mm^2$ respectively. **(08 Marks)**

## Module-5

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

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

**OR**

10 a. Derive an expression for Euler's crippling load of a column when both ends are fixed. **(08 Marks)**

b. A hollow CI circular section column is 7.5m long and is pinned at its both ends. The inner diameter of the column is 160mm and the thickness of the wall is 20mm. Find the safe load by Rankine's formula, using a factor of safety of 5. Also find the slenderness ratio and ratio of Euler's and Rankine's critical loads. For cast iron take $\sigma_c = 550N/mm^2$, $\alpha = \frac{1}{1600}$, $E = 8 \times 10^4 N/mm^2$. **(08 Marks)**

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