27

CBCS SCHEME

USN | | | | | | | | | |

18MN34

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. Define : i) Resilience ii) Stiffness iii) Hardness iv) Toughness v) Brittleness. **(05 Marks)**

b. Draw stress – strain diagram for mild steel :
i) What does the area under the stress – strain curve represent?
ii) Distinguish between proportionality limit and elastic limit.
iii) What do you mean by yielding?
iv) Name the test by which the stress-strain relation on a ductile material is obtained. **(05 Marks)**

c. The following data for refer to a mild steel specimen tested in a laboratory. Diameter of specimen = 25mm, gauge length of specimen = 200mm, Extension under a load of 20kN = 0.04mm, Maximum load = 225kN load at yield point = 150kN, Neck diameter = 18.25mm length of specimen after failure = 275mm. Determine :
i) Young's modulus ii) Yield stress iii) Ultimate stress iv) Percentage elongation
v) Percentage reduction in area. **(10 Marks)**

OR

2 a. Define compound Bar. **(02 Marks)**

b. Derive the expression for elongation in toper circular bar of length 'ℓ' tapering uniformly for diameter 'd_1' and 'd_2' and subjected to an axial load of 'P' modulus of elasticity 'E'. **(08 Marks)**

c. Determine the magnitude of the load P necessary to produce zero net change in the length of the straight bar shown in Fig Q2(c). Take Area = 400mm^2.

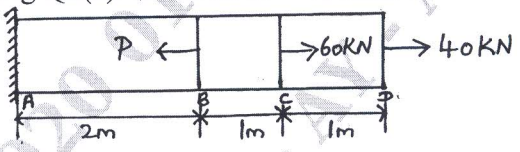

Fig Q2(c) **(10 Marks)**

Module-2

3 a. Why thermal stresses are induced in a body? **(02 Marks)**

b. What is the purpose of Mohr's circle? A plane element is subjected to stresses as shown in Fig Q3(b). Determine principal stresses, maximum shear stress and their planes sketch the planes.

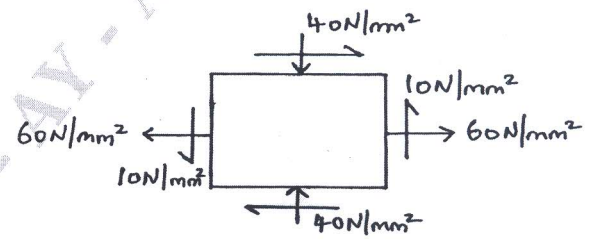

Fig Q3(b) **(12 Marks)**

c. Establish a relationship between the modulus of elasticity, modulus of rigidity and Bulk modulus. **(06 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 thin cylinder, 2m long and 200mm in diameter with 10mm thickness is filled completely with a fluid, at the atmospheric pressure. If an additional 25000mm^3 fluid is pumped in, find the longitudinal and hoop stress developed, also determine the changes in diameter and length if E = 2 × 10^5 N/mm^2 and Poisson's ratio = 0.3. **(10 Marks)**

Module-3

5 a. Define Beams. What do you mean by statically indeterminate beams? **(03 Marks)**

b. Obtain an expression for shear force, bending moment and rate of loading. **(07 Marks)**

c. A Cantilever 2m long is loaded with a uniformly distributed load of 10kN/m run over a length of 1.5m from the free end. It also carries a point load of 10kN at a distance of 0.5m from the free end. Draw the shear force and bending moment diagram for the beams. **(10 Marks)**

OR

6 a. Define Bending moment and uniformly distributed load. **(02 Marks)**

b. What influences the bending moment in a beam to become maximum and why? **(04 Marks)**

c. Draw SFD and BMD for the loaded beam shown in Fig Q6 (c). Mark the salient point, locate the maximum bending moment and point of contraflexure.

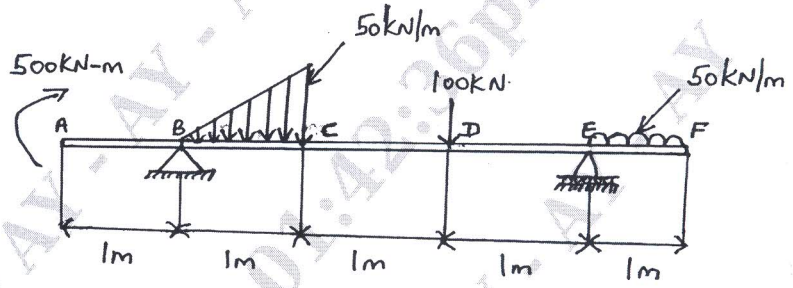

Fig Q6(c) **(14 Marks)**

Module-4

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

b. A beam of an I-section consists of 180mm × 15mm flanges and a web of 280mm depth × 15mm thickness. It is subjected to a bending moment of 120kNm and a shear force of 60kN. Sketch the bending and shear stress distribution along the depth of the section.

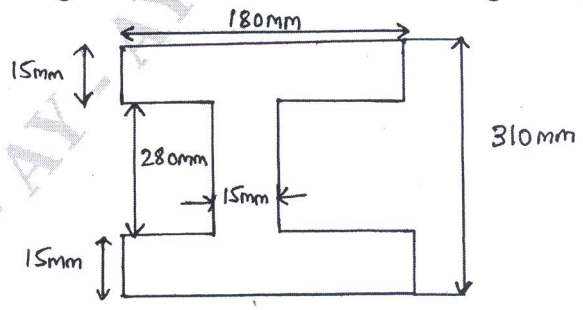

Fig Q7(b) **(10 Marks)**

OR

8 a. Derive an expression relating slope, deflection and radius of curvature in a beam from first principle in terms of E, I and M with usual notations. **(10 Marks)**

b. Explain Macaulay's method. **(06 Marks)**

c. State the assumption made in moment curvature relationship. **(04 Marks)**

Module-5

9 a. Derive the torsional equation $\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{L}$ with usual notation. **(10 Marks)**

b. A solid circular shaft is required to transmit 80kW at 160rpm. The permissible shear stress in the shaft material is 60N/mm^2. The maximum torque transmitted exceeds the mean torque by 20%. The angle of twist is not to exceed 1° in a length of 20 times the diameter of shaft. The value of rigidity modulus is 0.8×10^5 N/mm^2. Find the diameter of shaft. **(10 Marks)**

OR

10 a. How Rankine's formula overcomes the limitation of Euler's theory? **(05 Marks)**

b. State the assumptions made in Euler's column theory. **(05 Marks)**

c. Find the Euler's critical load for a column 1.2m long by rectangular cross section 90mm wide, 60mm depth with both ends hinged modulus of elasticity is 200GPa. Compare it with Rankine's critical load taking Rankine's constants $\sigma = 300$MPa and $\alpha = \frac{1}{7500}$. **(10 Marks)**

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