6

CBCS SCHEME

USN

17MN34

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

b. Define Poisson's ratio and Young's modulus. **(02 Marks)**

c. A steel specimen of 12.5mm diameter and 150mm gauge length is subjected to tensile test. It is observed that load at yield point is 43kN and maximum load is 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. **(10 Marks)**

OR

2 a. Derive an expression for the elongation of uniformly tapering circular bar subjected to axial load P. **(10 Marks)**

b. A brass bar having cross-sectional area $300mm^2$ is subjected to axial forces as shown in Fig.Q.2(b). Find the total elongation of the bar. E = 84 GPa. **(10 Marks)**

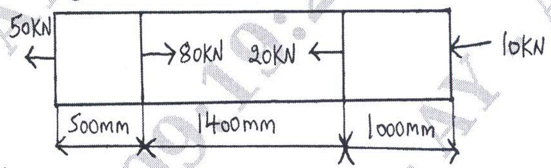

Fig.Q.2(b)

Module-2

3 a. Derive an expression for establishing the relationship between Young's modulus (E), Rigidity Modulus (G), and Bulk modulus (K). **(08 Marks)**

b. Define principal stresses and principal planes. **(02 Marks)**

c. At a certain point in a strained material the values of normal stresses across two planes at right angles to each other are 80MPa and 32MPa; both tensile and there is a shear stress of 32MPa CW on the plane carrying 80MPa stresses across the planes as shown in Fig.Q.3(c). Determine:
i) Maximum and minimum normal stresses and locate their planes
ii) Maximum shear stress and specify its plane
iii) Normal stress on maximum shear stress plane. **(10 Marks)**

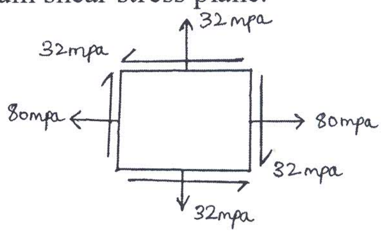

Fig.Q.3(c)

OR

4 a. Derive an expression for circumferential and longitudinal stress of a thin cylinder subjected to internal pressure. **(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 stress and circumferential stress developed also determine the changes in diameter and length if E = 2 × 10^5 N/mm^2 and Poisson's ratio as 0.3. **(10 Marks)**

Module-3

5 a. Define shear force and Bending moment. **(02 Marks)**

b. Derive an expression for establishing relationship between shear force, bending moment and rate of loading. **(08 Marks)**

c. Draw shear force and Bending Moment Diagram for the cantilever beam shown in Fig.Q.5(c). **(10 Marks)**

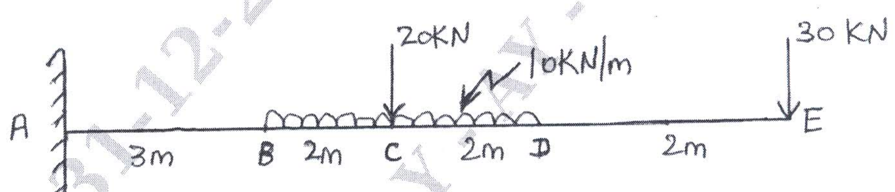

Fig.Q.5(c)

OR

6 a. A simply supported beam AB of span 6m is loaded as shown in the Fig.Q.6(a) draw the shear force diagram and Bending Moment Diagram. **(10 Marks)**

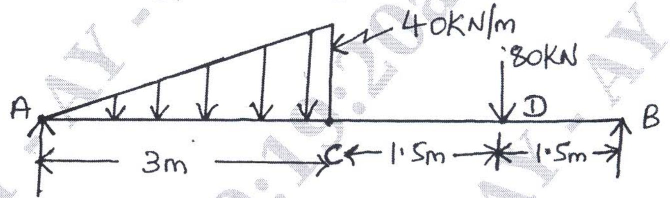

Fig.Q.6(a)

b. Define beam. Classify and explain various types of beams. **(10 Marks)**

Module-4

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

b. The cross-section of a beam is as shown in Fig.Q.7(b). If permissible stress is 150N/mm^2 find its moment of resistance. Compare it with equivalent section of the same area for a square section. **(10 Marks)**

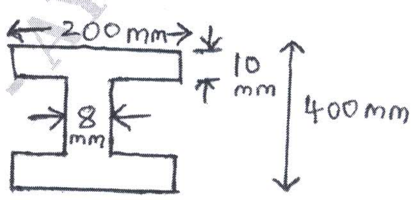

Fig.Q7(b)

OR

8 a. Derive an expression $EI\frac{d^2y}{dx^2} = M$, with usual notations. **(10 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 9kN/m run over the entire length. Calculate the width and depth of the beam if permissible bending stress is $7N/mm^2$ and central deflection is not to exceed 1cm. Take $E = 1 \times 10^4\ N/mm^2$. **(10 Marks)**

Module-5

9 a. Derive torsional equation with usual notations. State the assumptions made in the theory of pure torsion. **(10 Marks)**

b. A solid shaft is to transmit 192kW at 450rpm taking the allowable shear stress for the shaft material as 70MPa. Find the diameter of the solid shaft. What percentage of saving in weight would be obtained, if this shaft were to be replaced by a hollow shaft, whose internal diameter is 0.8 times its external diameter, the length, material, power to be transmitted and speed are equal in both cases. Torsional strength of both solid and hollow shafts should be equal. **(10 Marks)**

OR

10 a. Derive an expression for Euler's buckling load for column with both ends hinged and state the assumptions made in the same. **(10 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 wall is 20mm. Find the safeload 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 $\sigma_c = 550N/mm^2$, $\alpha = \frac{1}{1600}$, $E = 8 \times 10^4\ N/mm^2$. **(10 Marks)**

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