CBCS SCHEME

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18MA34

Third Semester B.E. Degree Examination, Jan./Feb. 2021
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) Poisson's ratio ii) Bulk Modulus iii) Rigidity modulus iv) Young's modulus v) Hooke's law vi) Proof stress vii) Principle of super position viii) Normal stress ix) strain x) Factor of safety. **(10 Marks)**

b. Derive an expression for the extension of uniformly tapering rectangular bar subjected to axial load 'P' with assumptions. **(10 Marks)**

OR

2 a. Derive relation between modulus of elasticity and modulus of Rigidity. **(10 Marks)**

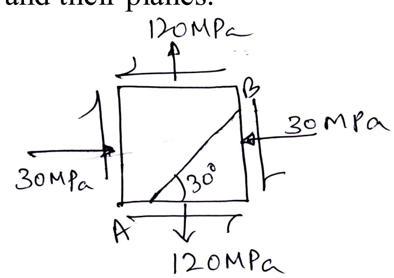
b. Draw the stress – strain diagram for steel indicating all salient points and zones on it. **(04 Marks)**

c. Calculate the modulus of rigidity and bulk modulus of a cylindrical bar of diameter 25mm and length 1.6m, if the longitudinal strain in the bar during tensile test is four times the lateral strain. Also find the change in volume, when the bar is subjected to hydrostatic pressure of 100MPa, $E = 1 \times 10^5$ MPa. **(06 Marks)**

Module-2

3 a. At a certain point in a strained material the stress condition shown in Fig. Q3(a). Find
i) Normal and tangential stresses on the inclined plane AB.
ii) Principal stresses and principal planes.
iii) Maximum shear stresses and their planes. **(12 Marks)**

Fig. Q3(a)



b. Derive an expression for normal stress, tangential stress, resultant stress and its direction for the member subjected to direct stresses on two mutually perpendicular directions (Bi – axial stress). **(08 Marks)**

OR

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

b. Derive Lame's equation for thick cylinder. **(10 Marks)**

c. Define Principal stress and Principal Plane. **(02 Marks)**

Module-3

5 a. Derive general equation for bending $M/I = \sigma/y = E/R$ with assumptions. **(10 Marks)**

b. Explain different types of Beams. **(04 Marks)**

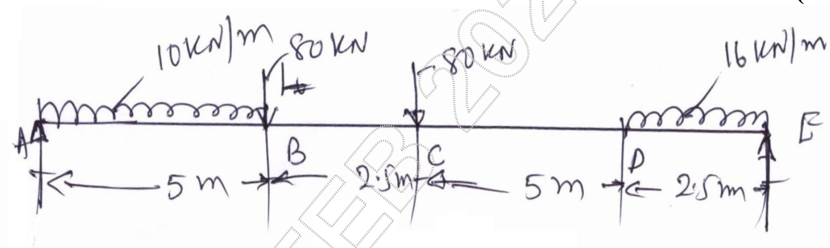
c. Explain different types of loads. **(04 Marks)**

d. Define 'Sagging and Hogging moment'. **(02 Marks)**

OR

6 Draw Shear force and bending moment diagrams for the beam shown in Fig. Q6, locate point of contraflexure. **(20 Marks)**

Fig. Q6



Module-4

7 a. Derive general expression for torsion with assumptions

$$T/J = \frac{G\theta}{L} = \frac{\tau}{R}.$$ **(12 Marks)**

b. Explain the following theories of failure :
i) Maximum Principal Stress theory ii) Maximum Shear Stress theory. **(08 Marks)**

OR

8 a. A solid shaft subjected to a maximum torque of 25 kN-m. Find a suitable diameter of a solid shaft, if the allowable shear stress and the twist are limited to 80MPa and 1^0 respectively for a length of 20 times the diameter of the shaft. **(08 Marks)**

b. Derive polar section modulus for i) Solid shaft ii) Hallow shaft. **(04 Marks)**

c. Define i) Torsional strength ii) Torsional rigidity iii) Torsional flexibility . **(08 Marks)**

Module-5

9 a. State the assumptions made in the derivation of Euler's Expression. Derive the Euler's Expression for a column subjected to axial compressive load for both ends hinged condition. **(10 Marks)**

b. A solid round bar of 60mm diameter and 2.5m is used as a strut. Find the safe compressive load for the strut i) Both ends are hinged ii) Both ends are fixed Take $E = 2 \times 10^5$ MPa and FOS = 3. **(10 Marks)**

OR

10 a. Derive an expression for Internal strain energy stored within an elastic bar subjected to i) Axial tensile force F ii) Torque 'τ' iii) Bending Moment 'M'. **(12 Marks)**

b. A tension bar 6m long is made up of two parts, 4m of its length has a cross – sectional area 1250 mm^2 while the remaining 2m length has a cross sectional area of 2500mm^2. An axial load of 50kN is gradually applied. Find the total strain energy produced in the bar and compare this value with that obtained in a uniform bar of same length and having the same volume when under the same load. Take $E = 2 \times 10^5$ MPa. **(08 Marks)**

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