CBCS SCHEME

USN

17ME34

Third Semester B.E. Degree Examination, Jan./Feb. 2023
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 the following terms :
(i) Strength (ii) Stress (iii) Ductility (iv) Young's modulus. **(04 Marks)**

b. Derive expression for elongation of uniform bar. **(04 Marks)**

c. The tensile test was conducted on a mild steel rod and the following observations mode :
(i) Diameter of steel rod = 16 mm
(ii) Gauge length of rod = 80 mm
(iii) Load at proportionality limit = 72 kN
(iv) Extension at load of 60 kN = 0.115 mm
(v) Load at failure = 80 kN
(vi) Final gauge length of rod = 104 mm
(vii) Diameter of rod at failure = 12 mm

Find : (i) Young's modulus (ii) Stress at proportionality limit
(iii) Percentage elongation **(12 Marks)**

OR

2 a. Determine the magnitude of load 'P' necessary to produce zero net change in the length of straight bar. Take A = 400 mm^2.

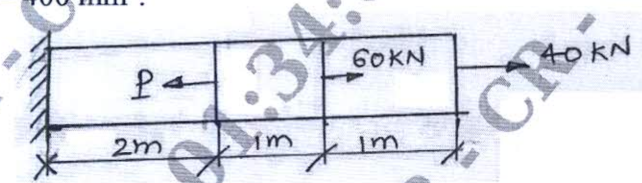

Fig. Q2 (a) **(10 Marks)**

b. Derive relationship between Elastic modulus and Modulus of Rigidity. **(10 Marks)**

Module-2

3 a. Derive expression for normal stress and shear stress on a plane inclined at 'θ' to vertical axis in a state of biaxial stress along with shear stress. **(10 Marks)**

b. The state of stress at a point in a strained material is shown in Fig. Q3 (b).

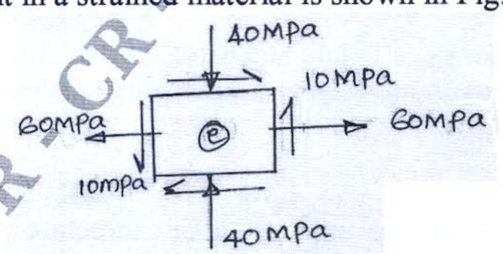

Fig. Q3 (b)

Determine : (i) Principal stress
(ii) Orientation of Principal plane.
(iii) Maximum shear stress

Verify the results using Mohr's circle. **(10 Marks)**

OR

4 a. Derive expression for hoop stress and longitudinal stress in thin cylinder. **(10 Marks)**

b. A pipe of 500 mm inside diameter and 75 mm thick is filled with a fluid at a pressure of 6 MPa. Find the maximum and minimum hoop stress across the cross section of cylinder. Also sketch the radial pressure and stress distribution across the section. **(10 Marks)**

Module-3

5 a. Classify the beams in detail and also define point of contraflexure in beams. **(08 Marks)**

b. A beam is loaded as shown in Fig. Q5 (b). Plot SFD and BMD.

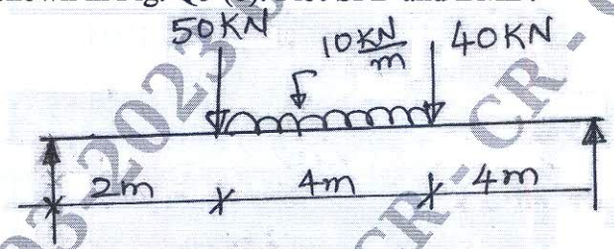

Fig. Q5 (b) **(12 Marks)**

OR

6 a. Derive simple bending equation with usual assumptions. **(12 Marks)**

b. A C.I. beam 25mm × 25mm cross section and 1 m long, supported at its ends fail when a central load of 800 N is applied on it. What UDL will break a Cantilever of same material 50 mm wide, 100 mm deep and 2 m long. **(08 Marks)**

Module-4

7 a. Derive simple torsion equation with usual assumptions. **(10 Marks)**

b. A solid shaft is subjected to a maximum torque of 25 kNm. Find the diameter of shaft, if the allowable shear stress and twist is limited to 80 MPa and twist 1° respectively for a length of 20 times diameter of shaft. **(10 Marks)**

OR

8 a. Derive Crippling load for a column with both ends Hinged. **(10 Marks)**

b. A solid round bar of 60 mm diameter and 2.5 m long is used as a strut. Find the safe compressive load for the strut. If

(i) Both ends Hinged.

(ii) Both ends fixed.

Take E = 200 GPa, Factor of safety = 3.0 **(10 Marks)**

Module-5

9 a. Define theories of failure and explain its relevance in design of members. **(08 Marks)**

b. Explain maximum Normal stress theory and Maximum shear stress theories of failure. **(12 Marks)**

OR

10 a. Derive strain energy expression for a structure subjected to axial load. **(05 Marks)**

b. A rod of circular section is to sustain a twisting moment of 300 kNm and bending moment of 200 kNm. The material of the shaft is having $\sigma_y = 353$ MPa. Determine Diameter of shaft using Rankines theory and Guest's theory using factor of safety = 3.0. **(15 Marks)**

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