CBCS SCHEME

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15AE34

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.

Module-1

1 a. Derive equilibrium equation for three dimensional state of stress in rectangular coordinate system. **(08 Marks)**

b. A point in a strained member is subjected to biaxial stress 85 MPa (tensile) and 60 MPa (compressive). The point is also subjected to a shear stress of 45 MPa, such that shear force on vertical forced gives rise to clockwise couple. Determine:

(i) Stress acting on a plane whose normal is at an angle of 40° with reference to 85 MPa stress direction.

(ii) Magnitude of principal stresses and orientations of principal planes.

(iii) Magnitude of maximum and minimum shear stress and orientations of maximum and minimum shear stress planes. **(08 Marks)**

OR

2 a. Draw stress-strain curve for a ductile material and mention the salient points. **(08 Marks)**

b. A stepped bar shown in Fig.Q2(b). Determine the stresses induced and deformation induced in each portion. Also find the net deformation is stepped bar. Take E = 200 GPa.

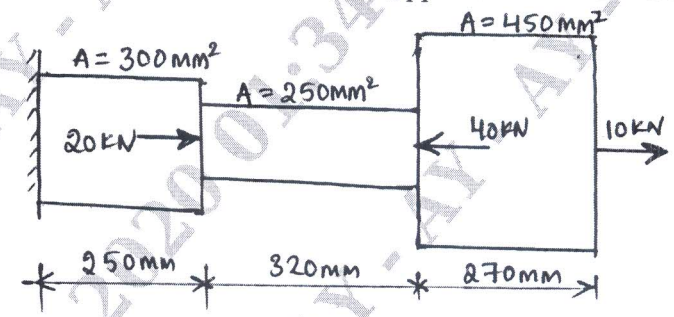

Fig.Q2(b) **(08 Marks)**

Module-2

3 a. Explain in detail the implications of Euler-Bernoulli assumptions and derive the expression for the same. **(08 Marks)**

b. A 1 meter long cantilever with T section is subjected to a point load of 10 kN at its free end. The size of flange is 140 mm × 10 mm and overall depth of the section is 150 mm. Thickness of web is 10 mm. Determine the maximum tensile stress and maximum compressive stress induced in the section and draw the stress distribution. **(08 Marks)**

OR

4 What is three dimensional beam theory? Formulate sectional constitutive laws of three dimensional Euler Bernoulli beam theory. **(16 Marks)**

Module-3

5 a. A solid shaft rotating at 500 rpm transmits 30 KWatts power. Maximum torque is 20% more than the mean torque. Material of the shaft has allowable shear stress of 65 MPa. Modulus of rigidity is 81 GPa. Angle of twist in shaft should not exceed 1° in 1m length. Determine the diameter of the shaft. **(10 Marks)**

b. Briefly explain the application of Tresca's criteria for a propeller shaft subjected to torsion and bending moment. **(06 Marks)**

OR

6 a. What is warping of thin walled beam under torsion? Give its kinematic description. **(08 Marks)**

b. Formulate Bredt-Batho equation for torsion of closed section. **(08 Marks)**

Module-4

7 a. Explain the steps involved in unit load method applied to truss structures. **(06 Marks)**

b. Define the principle of virtual work for a particle. Obtain the equilibrium of a particle. **(10 Marks)**

OR

8 a. Define a conservative force and obtain the work done by conservative force along any path joining two points. **(08 Marks)**

b. State and prove Maxwell's reciprocal theorem. **(08 Marks)**

Module-5

9 a. Explain Tresca's and Vonmise's criterion in detail for uniaxial, plane and pure shear state of stress. **(08 Marks)**

b. A propeller shaft is subjected to a turning moment of 500 Nm and axial thrust of 20 kN. Allowable stress of material is 80 MPa. Determine the diameter of the propeller shaft based on Tresca's criterion. **(08 Marks)**

OR

10 a. Briefly explain Kirchoff's plate theory and mention the assumptions. **(08 Marks)**

b. Obtain the expressions for equilibrium equations of Kirchoff's plate theory. **(08 Marks)**

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