CBCS SCHEME

USN | | | | | | | | | | |

17AE/AS34

Third Semester B.E. Degree Examination, June/July 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. Derive the Equilibrium Equations for a 3-dimensional stress system. **(10 Marks)**

b. Define stress at a point and explain. **(06 Marks)**

c. Define plane stress and plane strain. **(04 Marks)**

OR

2 a. Enumerate the state of Tresca's criteria and Von-Mises criteria. **(06 Marks)**

b. Write a note on material selection for structured performance and explain strength design. **(08 Marks)**

c. The bar shown below is tested in UTM it is observed that at a load of 40kN the extension of bar is 0.285mm. Determine Young's modulus.

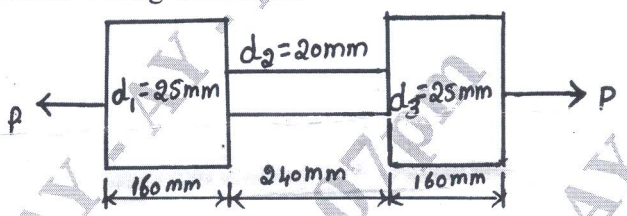

Fig Q2(c) **(06 Marks)**

Module-2

3 a. What are Euler Bernoulli assumption and its implication explain. **(08 Marks)**

b. A beam of 'T' section has a length of 2.5M and is subjected to a point load as shown in the Fig Q3(b). Calculate the compressive bending stress and plot the stress distribution across the cross section of the beam. The maximum tensile stress is limited to 300MPa. Calculate the value of 'W'.

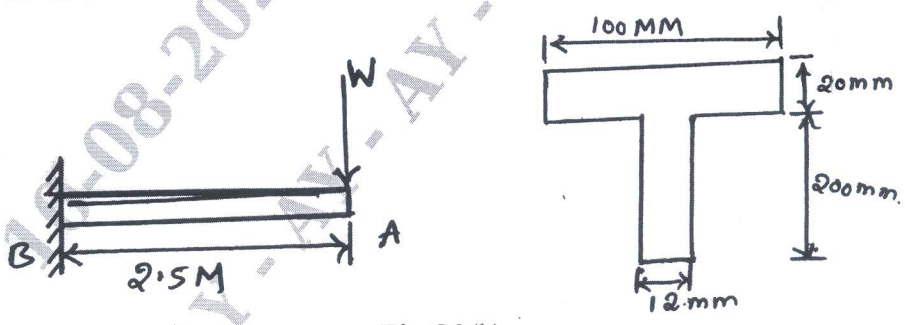

Fig Q3(b) **(12 Marks)**

OR

4 a. Give the kinematic Description and Equilibrium Equation for beams subjected to axial load and explain. **(10 Marks)**

b. Give the kinematic Description and Equilibrium Equation for Beams subjected to Transverse load and explain. **(10 Marks)**

Module-3

5 a. A 2 meters long hollow cylinder shaft has 80 mm outer diameter and 10 mm wall thickness. When the torsional load on the shaft is 6kN-m, determine :
i) Maximum shear stress induced
ii) Angle of twist. Also draw the distribution of shear stress in the wall of the shaft.
Take G as 80 Gpa. Also find torsional stiffness. **(12 Marks)**

b. Discuss the application of Von Mises criterion and Tresca's criterion for a propeller shaft under torsion, bending and thrust. **(08 Marks)**

OR

6 a. Explain the following terms with respect to the basic equations for thin walled beam:
i) The thin wall assumption
ii) Stress flows
iii) Stress resultants. **(12 Marks)**

b. What is wraping of thin- walled beam under torsion? Give the kinematic description. **(08 Marks)**

Module-4

7 a. Explain the principle of virtual work for a particle under equilibrium state. **(10 Marks)**

b. Derive for the virtual work in truss system by taking truss as example. **(10 Marks)**

OR

8 a. Define conservative force. Derive the expression for work done by conservative forces along any path joining two points. **(08 Marks)**

b. Consider a beam of length 2 m and diameter 100 mm is applied with point load at the end 2000 N and other end is fixed as cantilever. Determine the strain energy of the beam. Take E = 200 GPa. **(08 Marks)**

c. Define the following: (i) Betti's reciprocity theorem (ii) Clapeyson's theorem **(04 Marks)**

Module-5

9 a. Explain the following theories of failures:
i) Maximum Principal stress theory
ii) Maximum shear stress theory
iii) Von misses stress theory **(10 Marks)**

b. If the principal stresses at a point in an elastic material are 2F tensile, 1.5E tensile and F compressive. Calculate the value of F at failure according to four different failure theories. The elastic limit in simple tension is 210 N/mm^2 and $\mu = 0.3$. **(10 Marks)**

OR

10 a. Mention the Kirchhoff's assumption for the plate bending and explain the displacement field for the plate. **(10 Marks)**

b. Derive for the bending stiffness in the plate. **(10 Marks)**

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