CBCS SCHEME

USN | | | | | | | | | |

17AE/AS34

Third Semester B.E. Degree Examination, Dec.2023/Jan.2024
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Assume any missing data suitably.***

Module-1

1 a. Derive the equilibrium equation for a 3 dimensional stress system. **(10 Marks)**

b. State of stress at a point is given as follows :
$\sigma_x = x^3yz + x^2y^2$; $\sigma_y = 3y^2z + yz$; $\sigma_z = x^2y^2z^2 + xz$; $\tau_{xy} = x^2yz$; $\tau_{yz} = xy^2z$; $\tau_{xz} = xyz^2$.
In the absence of body force determine the equilibrium conditions are satisfied or not at points (3, -4, 2). **(06 Marks)**

c. Explain plane stress and plain strain, with example. **(04 Marks)**

OR

2 a. Tensile test is conducted for specimen and the following data are obtained.
i) initial Diameter = 25mm
ii) initial length = 300mm
iii) Extension under 15kN load is = 0.0.45mm
iv) Load at yield point = 127.65kN
v) Maximum load = 208.6kN
vi) Length of specimen at failure = 375mm
vii) Neck diameter = 17.75mm.

Determine :
i) Young's modulus
ii) Yield stress
iii) Ultimate stress
iv) % Elongation
v) % Reduction in area
vi) Safe stress if factor of safety is 2. **(10 Marks)**

b. Draw stress strain diagram fro ductile and Brittle material, and explain its salient points. **(10 Marks)**

Module-2

3 a. A beam of T section has a length of 2.5m is fixed at one end and is subjected to a point load 'P' at other end. The flange of T section is 200mm × 20mm and web is 200mm × 12mm. Calculate the compressive bending stress and plot the stress distribution across the cross section of the beam. The maximum tensile stress is limited to 300N/mm^2. Calculate the value of 'P'. **(12 Marks)**

b. What are Euler – Bernoulli assumptions? Explain its Implications. **(08 Marks)**

OR

4 a. What is 3-Dimensional beam theory? Give its kinematic description. **(10 Marks)**

b. Explain the principal centroidal axes of bending and give its computed equations. **(10 Marks)**

Module-3

5 a. Derive an equation showing relation between torque and shear stress in a hollow circular shaft. **(06 Marks)**

b. Compare the weight, strength and stiffness of hollow shaft of same external diameter as that of solid shaft. The inner diameter of hollow shaft is half the external diameter. Both shaft have same material and length. **(06 Marks)**

c. A solid circular shaft has to transmit a power of 10KW at 120rpm. Find the diameter of the shaft if the shear stress of the material must not exceed 80N/mm^2. The maximum torque is 1.25 times its mean torque. What parentage of saving in material would be obtained? If the shaft is replaced by hallow shaft having internal diameter 0.6 times external diameter, length and material are same. **(08 Marks)**

OR

6 a. Derive equation for shear flow distribution in open section beams. **(10 Marks)**

b. Calculate the position of the shear centre of the thin walled channel section shown in Fig Q6(b) the thickness 't' of the wall is constant.

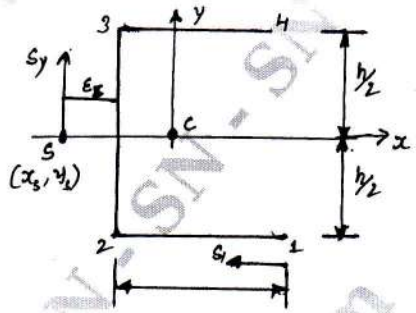

Fig Q6(b) **(10 Marks)**

Module-4

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

b. What is the difference between principle of virtual work and principle of complementary virtual work? Explain. **(10 Marks)**

OR

8 a. Define : i) Betti' theorem
ii) Maxwell's theorem
iii) Clapeyrons theorem
iv) Castiglione's first and second theorem. **(10 Marks)**

b. Two bars are subjected to equal gradually applied tensile load as shown in Fig Q8(b). Compare :
i) The strain energies of two bars assuming that they are of same material
ii) The amount of energy per unit volume if the maximum stress is to be the same for both bars
iii) The strain energies of the two bars assuming that they are of different materials and $E_1/E_2 = 3/4$.

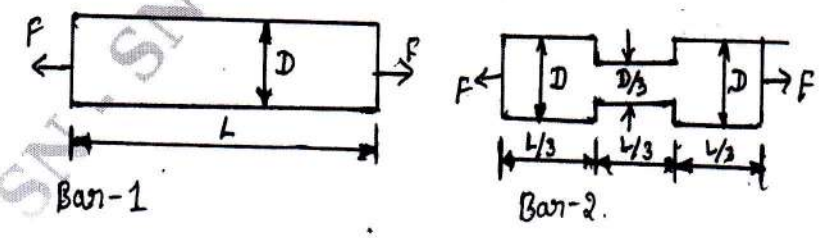

Fig Q8(b) **(10 Marks)**

Module-5

9 a. Explain Von Mises and Tresca's yield criterion. **(10 Marks)**

b. A uniform rod of length 2m is hinged at A and supported at B and C by aluminium and steel wire of area of cross section $3mm^2$ and $2mm^2$ respectively. A load of 30kN is applied midway between B and C as shown in Fig Q9(b). If $E_{AL} = 10^5 MPa$; $E_{Steel} = 2 \times 10^2 MPa$. Determine :

i) Stress in two wires

ii) Elongation of wires if the length of wire is 1.5m each. **(10 Marks)**

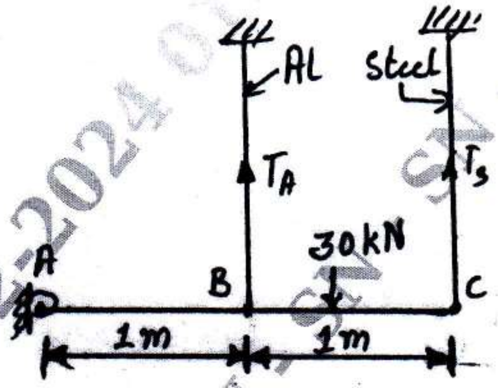

Fig Q9(b)

OR

10 a. Deduce the principle of minimum total potential energy for Kirchhoff plates. **(10 Marks)**

b. Derive Total displacement field of Kirchhoff plate theory with assumptions. **(10 Marks)**

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