CBCS SCHEME

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17AE/AS34

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. Derive the equilibrium equations in polar coordinates for a two dimensional state of stress. **(12 Marks)**

b. Explain Lame's ellipse. **(08 Marks)**

OR

2 a. A compound bar made of Aluminium and steel bars connected in series is fixed rigidly at its two ends in vertical position. Determine the stresses and deformations inducted in the two portions. Take $E_{Al} = 70$ GPa, $A_{Al} = 1000$ mm^2, $E_S = 200$ GPa and $A_S = 1200$ mm^2. **(10 Marks)**

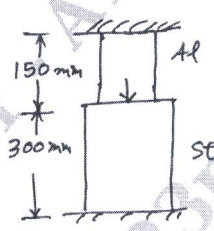

Fig. Q2 (b)

b. A cylindrical pressure vessel has inner and outer radii of 200 mm and 250 mm respectively. The material of cylinder has an allowable stress of 75 MN/m^2. Determine the maximum internal pressure that can be applied and draw a sketch of radial pressure and circumferential stress distribution. **(10 Marks)**

Module-2

3 a. What are the Euler-Bernoulli assumptions and its implications? **(08 Marks)**

b. An I section beam with flange dimension 180 mm $\times$ 15 mm and web dimension 15 $\times$ 280 mm is subjected to a bending moment of 120 kN-m and a shear force of 60 kN. Determine the bending stress and shear stress distribution along the depth of the section and also draw the distribution. **(12 Marks)**

OR

4 a. What is three dimensional beam theory? Give its kinematic distribution. **(10 Marks)**

b. Find the principal centroidal bending stiffness of the beam shown in Fig. Q4 (b). The axial stiffness of section is $S = Et(b+h)$.

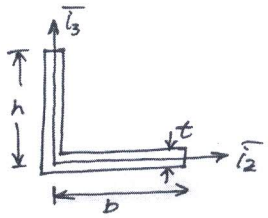

Fig. Q4 (b) **(10 Marks)**

Module-3

5 a. A 2 meters long hollow cylinder shaft has 80 mm outer diameter and 10 mm wall thickness. When torsional load on the shaft is 6 kNm, 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 = 80 GPa. **(12 Marks)**

b. Discuss the application of Vonmises criterion and Trescas criterion for a propeller shaft under torsion and bending. **(08 Marks)**

OR

6 a. Determine the direct stress distribution in the thin walled Z section shown in Fig. Q6 (a) produced by a positive bending moment M_x.

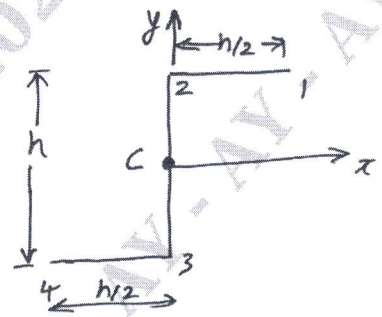

Fig. Q6 (a) **(12 Marks)**

b. Derive an equation for shear flow distribution in open section beams. **(08 Marks)**

Module-4

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

b. What are the differences between principle of virtual work and principle of complementary virtual work? **(10 Marks)**

OR

8 a. Explain (i) Castiglioano's theorem. (ii) Clapeyron's theorem (iii) Maxwell's theorem. **(12 Marks)**

b. Derive expressions for slope and deflection at the free end of a Cantilever beam of length and carrying a point load w at its free end using Castigliano's theorem. **(08 Marks)**

Module-5

9 a. At a certain position along one member with diameter 'd', the loading is found to consist of shear force of 10 kN together with an axial tensile load of 20 kN. If the elastic limit in tension of material is 270 MN/m^2 and n = 4, estimate the magnitude of 'd' required according to (i) Maximum principal stress theory (ii) Max shear strain energy theory. Take $\mu = 0.283$. **(12 Marks)**

b. Explain Tresca's and Von Miser criterions. **(08 Marks)**

OR

10 a. Explain Kirchoff plate theory and mention its assumptions. **(10 Marks)**

b. What are the constitutive laws for laminated composite plates? **(10 Marks)**

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