CSLH005
12

CBCS SCHEME

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Third Semester B.E. Degree Examination, June/July 2019
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. Explain Stress – strain diagram for mild steel depicting all the salient points in it. **(06 Marks)**

b. A circular bar of metal has a diameter 'd_1' at one end which tapers uniformly to diameter 'd_2' at the other end. Find the elongation of the bar under an axial tensile load 'P'. The length of bar is L. **(06 Marks)**

c. A steel tube 30mm in internal diameter and 40mm is external diameter contains a copper rod of 20mm in diameter. The tube is 500mm long and is closed by rigid washers that are fastened by nuts threaded on the copper rod. The nuts are tightened until the compressive load on tube is 30kN, what are the stresses on tube and rod? Find the increase in these stresses when the nut is further tightened by one quarter of a turn. There are 4 thread per 10mm. Take $E_s = 200$ GPa , $E_b = 100$ GPa. **(08 Marks)**

OR

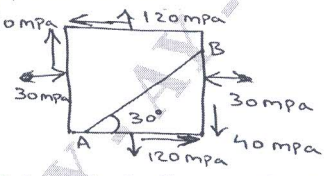
2 a. A steel bar is sandwiched between 2 copper bars of same area and same length , with their ends rigidly connected. The temperature of the assembly is maintained at 30^0C on raising temperature to 150^0C, it was found that length of the unit increased by 5mm. Determine the original length and stress in bars. Take $E_s = 200$GPa , $E_c = 100$GPa , $\alpha_s = 12 \times 10^{-6} / {}^0$C , $\alpha_c = 17 \times 10^{-6}/{}^0$C. **(12 Marks)**

b. With usual notations establish relation between Young's modulus , rigidity modulus and bulk modulus. **(08 Marks)**

Module-2

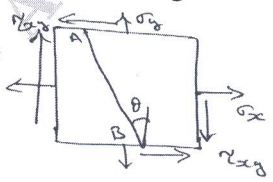
3 a. At a certain point in a strained material the stress condition is as shown in fig. Q3(a). Find
i) Normal and shear stresses on inclined plane AB
ii) Principal stresses and principal planes.
iii) Maximum shear stresses and their planes. **(14 Marks)**

Fig.Q3(a)



b. Explain the procedure to draw Mohr's circle diagram for figure shown below : **(06 Marks)**

Fig.Q3(b)



OR

4 a. Derive Lame's equation for radial and circumferential stress in thick cylinder theory. **(12 Marks)**

b. A thick cylindrical pipe of outside diameter 300mm and internal diameter 200mm is subjected to an internal pressure of 20MPa and external pressure of 5MPa. Draw the variation of hoop stress and radial stress across thickness of pipe. **(08 Marks)**

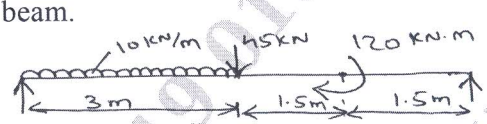
Module-3

5 a. Explain different types of loads in beams. **(04 Marks)**

b. Explain Hogging , Sagging and point of contraflexure. **(06 Marks)**

c. Draw shear force diagram and bending moment diagram and mark all salient points for given simply supported beam. **(10 Marks)**

Fig.Q5(c)

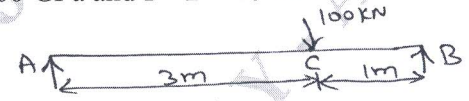


OR

6 a. Prove that in case of a rectangular section the maximum shear is 3/2 times average shear stress. **(10 Marks)**

b. Determine the deflection at point C and maximum deflection and its location for beam shown below, take E = 200 GPa and I = $2 \times 10^8 mm^4$. **(10 Marks)**

Fig.Q6(b)



Module-4

7 a. Write the assumptions made in torsion theory and derive torsion equation for circular shaft. **(10 Marks)**

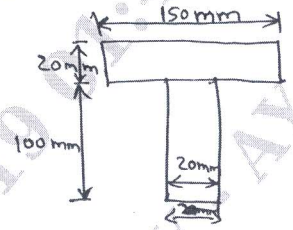
b. Show that hollow shaft is stronger and rigid than solid shaft of same material, length and weight. **(10 Marks)**

OR

8 a. Derive expression for Euler's critical load for column with both ends fixed. **(10 Marks)**

b. A T – section shown in fig. Q8(b) below is used as a strut of 3m length with one end fixed and other end free. Find crippling load if E = 150 GPa. **(10 Marks)**

Fig.Q8(b)



Module-5

9 a. Determine the internal strain energy stored within elastic bar subjected to
i) torque ii) Bending moment. **(10 Marks)**

b. A load of 200N falls through a height of 25mm on to a collar rigidly attached to a lower end of vertical bar 2m long and of $300mm^2$ cross sectional area. The upper end of the vertical bar is fixed. Determine i) Maximum instantaneous stress in bar ii) Maximum instantaneous elongation iii) Strain energy stored in vertical bar. **(06 Marks)**

c. Explain Castigliano's theorem. **(04 Marks)**

OR

10 a. Explain Maximum Principal stress theory. **(07 Marks)**

b. Explain Maximum Shear stress theory. **(07 Marks)**

c. A steel plate with yield stress of 353 MPa is subjected to stresses of $\sigma_x = 50$ MPa , $\sigma_y = 100$ MPa and $\tau_{xy} = 50$MPa. Find factor of safety by
i) Maximum Principal stress theory ii) Maximum shear stress theory. **(06 Marks)**

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