USN 17MR34

Third Semester B.E. Degree Examination, July/August 2021
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Define the following terms : i) Stress ii) Strain iii) Young's modulus iv) Poisson's ratio v) Hooke's law. **(05 Marks)**

b. Derive an expression for the total elongation of a rectangular cross section bar. **(06 Marks)**

c. The tensile test was conducted on a mild steel bar. The following data was obtained from the test : Diameter of steel bar = 16mm ; Gauge length of the bar = 80mm
Load at proportionality limit = 72kN ; Extension at a load at 60kN = 0.115mm
Load at failure = 80kN ; Final gauge length of bar = 104mm ;
Diameter of the rod at failure = 12mm. Determine
i) Young's modulus ii) Proportionality limit iii) True breaking stress
iv) Percentage elongation. **(09 Marks)**

2 a. With neat sketch, explain the Stress – strain diagram for mild steel. **(10 Marks)**

b. Determine the stress in different segments of a circular bar shown in figure Q.2(b). Also compute the total elongation of the bar if E = 200 GPa. **(10 Marks)**

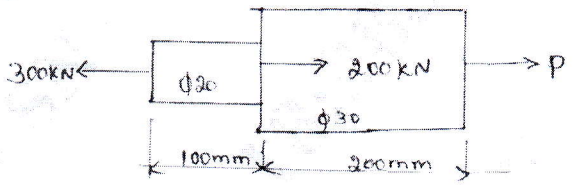

Fig. Q2(b)

3 At a certain point in a strained material the values of normal stresses across two planes at right angles to each other are 80MPa and 32Mpa, both tensile and there is a shear stress of 32MPa. CW on the plane carrying 80MPa stresses across the planes as shown in figure Q3. Determine
i) Maximum and minimum normal stresses and locate their planes.
ii) Maximum shear stress and specify its plane.
iii) Normal stress on maximum shear stress plane.
iv) Verify the answer by Mohr's circle method. **(20 Marks)**

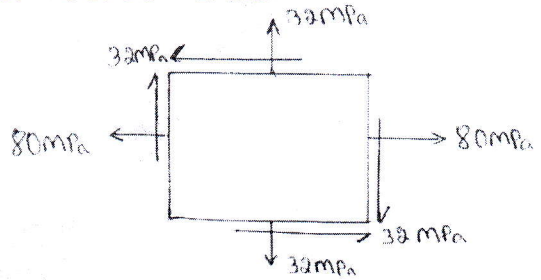

Fig. Q3

4 a. Derive the equations for changes in dimensions of thin cylinder. **(10 Marks)**

b. A thick cylindrical pipe of outside diameter 300mm and internal diameter 200mm is subjected to an internal fluid pressure of $20N/mm^2$ and external fluid pressure of $5N/mm^2$. Determine the maximum hoop stress developed. Draw the variation of hoop stress and radial stress across the thickness indicating the values at every 25mm interval. **(10 Marks)**

5 a. With neat sketch, explain the types of loads. (06 Marks)

b. Establish the relationship between load, shear force and bending moment. (07 Marks)

c. A cantilever beam carries Udℓ and point load's as shown in Figure Q5(c). Draw shear force diagram and bending moment diagram. (07 Marks)

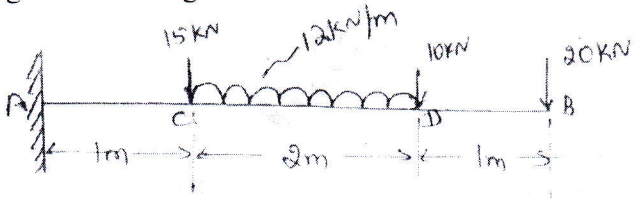

Fig. Q5(c)

6 Draw shear force and bending moment diagrams for the loading pattern on the beam shown in Figure Q6. Indicate where the contraflexure points are located. Also locate the maximum BM with its magnitude. (20 Marks)

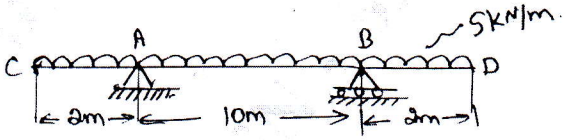

Fig. Q6

7 a. Derive an equation for bending stress and radius of curvature. (10 Marks)

b. A cantilever beam has a length of 3m. Its cross section is of T – section with flange 100mm × 20mm and web 200mm × 12mm, the flange is in tension. What is the intensity of UDL that can be applied if the maximum tensile stress is limited to 30N/mm^2. Also compute the maximum compressive stress. (10 Marks)

8 a. Derive Euler Bernoulli equation for deflection. (10 Marks)

b. A cantilever beam 2m long is carrying a load of 20kN at its free end and 30kN at a distance of 1m from the free end. Find the slope and deflection at the free end.
Take I = 15 × 10^{7}mm^4 ; E = 2 × 10^5 N/mm^2. (10 Marks)

9 a. Derive an equation for shear stress produced in a circular shaft subjected to torsion. (10 Marks)

b. A hollow circular steel shaft has to transmit 60KW at 210 rpm such that the maximum shear stress does not exceed 60MN/m^2. If the ratio of internal to external diameter is equal to ¾ and the value of rigidity modulus is 84 GPa. Find the dimensions of the shaft and angle of twist in a length of 3m. (10 Marks)

10 a. Derive an equation for Euler's cripping load for a column when one end of the column is fixed and other end is free. (10 Marks)

b. Determine the cripping load for 'T' section of dimension's 100mm × 100mm × 20mm and length of column 12m with both ends fixed. Take E = 210 GPa. (10 Marks)

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