CBCS SCHEME

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18AU34

Third Semester B.E. Degree Examination, Jan./Feb. 2021
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. With a neat sketch explain stress-strain relation for mild steel. **(08 Marks)**

b. Determine the stresses in various segments of the circular bar shown in Fig.Q1(b). Compute the total Elongation taking Young's modulus to be 195 GPa. **(12 Marks)**

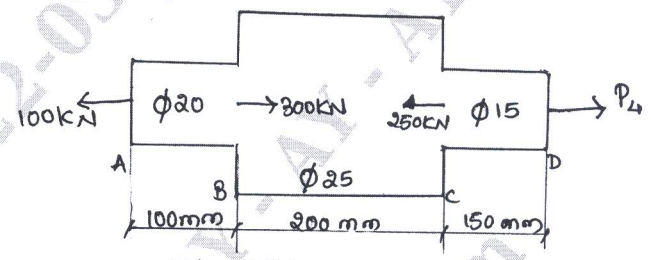

Fig.Q1(b)

OR

2 a. Derive an expression for analysis of tapering-rectangular bar. **(08 Marks)**

b. A stepped bar of steel held between two supports as shown in Fig.Q2(b) is subjected to load $P_1 = 80KN$ and $P_2 = 60KN$. Find the reaction developed at End A and B. **(12 Marks)**

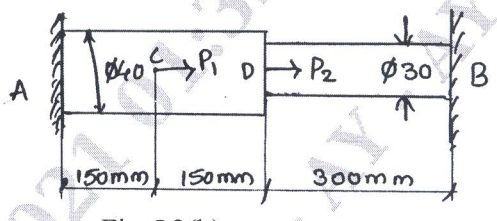

Fig.Q2(b)

Module-2

3 a. The state of stress at a point in a strained material is as shown in Fig.Q3(a). Determine,
i) Direction of principle planes.
ii) Magnitude of principle stresses
iii) Magnitude of shear stress and its direction. **(14 Marks)**

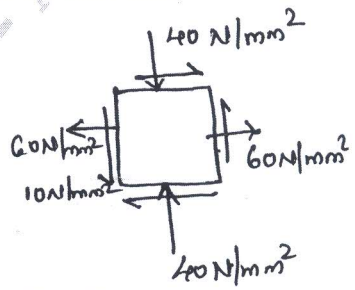

Fig.Q3(a).

b. Show that the sum of the normal stress on any two planes at right angles in a general two dimensional stress system is constant. **(06 Marks)**

OR

4 a. Derive Lame's equation for radial and hoop stress in case of thick cylinders. **(12 Marks)**

b. A thin cylinder shell 1M in diameter and 3m long has a metal thickness of 10mm. It is subjected to an internal fluid pressure of 3Mpa. Determine,

i) Circumferential and longitudinal stress.

ii) Circumferential, longitudinal and volumetric strain.

iii) Change in length, diameter and volume. Also find the maximum shearing stress in the shell. Assume Poisson's ratio as 0.3 and E = 210GPa. **(08 Marks)**

Module-3

5 a. A simply supported beam AB of 6m span is loaded as shown in Fig.Q5(a). Draw SFD and BMD. Also indicated the point of contra flexure. if any. **(12 Marks)**

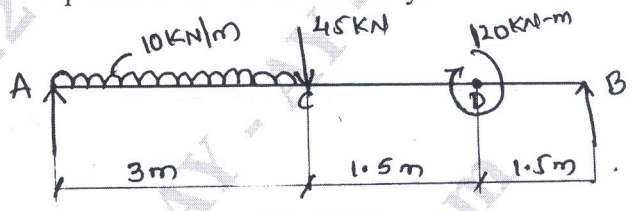

Fig.Q5(a)

b. Draw SFD and BMD for the cantilever beam shown in Fig.Q5(b). **(08 Marks)**

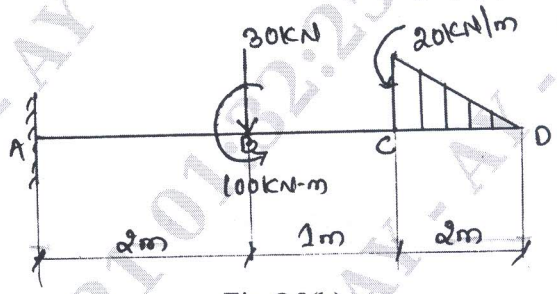

Fig.Q5(b)

OR

6 a. Prove that in case of rectangular section of beam, the maximum shear stress is 1.5 times average shear stress. **(10 Marks)**

b. Determine the slope and deflection at the free end of the cantilever shown in Fig.Q6(b). Take $I = 200\times10^{-6} m^4$, $E = 2\times10^8$ KN/m^2. **(10 Marks)**

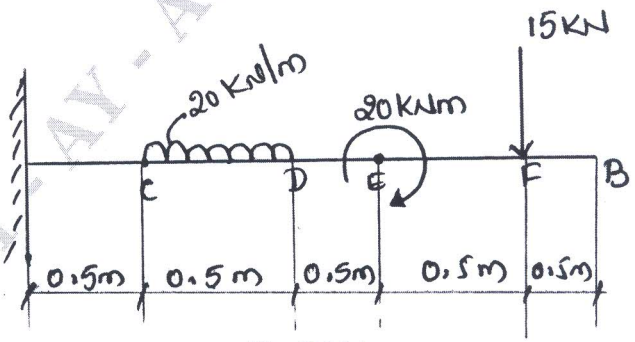

Fig.Q6(b)

Module-4

7 a. Derive the equation of torsion $\frac{T}{J}=\frac{\tau}{R}=\frac{G\theta}{L}$. **(12 Marks)**

b. A solid shaft rotating at 100rpm transmits 50KW. Maximum torque is 20% more than the mean torque. Material of the shaft has the allowable shear stress of 50 MPa and modules of rigidity 80 GPa. Angle of twist in the shaft should not exceed 1° in one meter length. Determine the diameter of the shaft. **(08 Marks)**

OR

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

b. A 1.5m long column has a circular cross section of 50mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking the factor of safety as 3, calculate the safe load using,

i) Rankine's formula taking yield stress 560 N/mm^2 and $\alpha = 1/1600$

ii) Euler's formula, taking $E = 1.2\times10^5\ N/mm^2$. **(10 Marks)**

Module-5

9 a. Derive an expression for load deformation diagram. **(12 Marks)**

b. A simply supported beam of length 'L' carries uniformly distributed load 'W' per unit length over the entire span length as shown in Fig.Q9(b). Determine the strain energy stored by the beam. **(08 Marks)**

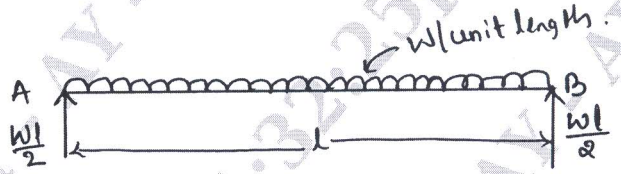

Fig.Q9(b)

OR

10 a. Explain maximum principal stress theory and maximum shear stress theory. **(12 Marks)**

b. A plate of 45C8 steel (σ_{yt} = 353MPa) is subjected to the following stresses, $\sigma_x = 150\ N/mm^2$, $\sigma_y = 100\ N/mm^2$, $\tau_{xy} = 50\ N/mm^2$. Find the factor of safety by

i) Maximum principal stress theory.

ii) Maximum shear stress theory. **(08 Marks)**

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