CBCS SCHEME

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15MT33

Third Semester B.E. Degree Examination, June/July 2019
Mechanics of Materials

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain stress – strain diagram for mild steel with salient features. **(06 Marks)**

b. Determine the stress in various segments of a circular bar shown in Fig Q1(b). Compute the total change in length of bar, take E = 200GPa.

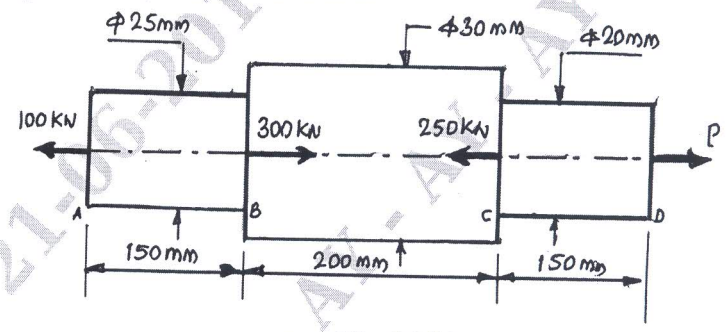


Fig Q1(b) **(10 Marks)**

OR

2 a. Derive the relationship between Young's modulus and modulus of rigidity and Bulk modulus. **(06 Marks)**

b. A cast Iron flat, 300mm long, 40mm wide and 25mm thick is subjected to the following forces ; 20kN tensile in the direction of length ; 150kN tensile in the direction of thickness and 300kN compressive on the direction of width. Determine the change in volume, modulus of rigidity and bulk modulus. Take E = 140GN/m^2, $\gamma = 0.25$. **(10 Marks)**

Module-2

3 a. Derive the expression for normal and tangential stress on a plane inclined at 'θ' to the plane of stress in x-direction in a general two dimensional stress system. **(08 Marks)**

b. The state of stress at a point in a strained material is as shown in Fig Q3(b). Determine,

i) Direction of principal planes
ii) Magnitude of principal stresses
iii) Magnitude of maximum shear stress
iv) Verify the answer by Mohr's circle method.

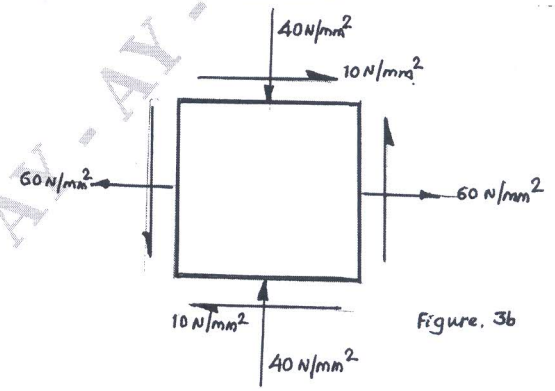


Figure. 3b

Fig Q3(b) **(08 Marks)**

OR

4 a. Derive the expression for circumferential stress and longitudinal stress of a thin cylinder. **(08 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 5 N/mm^2. Determine the maximum Loop stress developed. Draw the variation of loop stress and radial stress across the thickness indicating the values at every 25mm interval. **(08 Marks)**

Module-3

5 A horizontal beam CD, 10m long carries a uniformly distributed load of 1600N/m together with a concentrated load of 4000N at the left and C. The beam is supported at a point A which is 1m from C and at B which is on the right side half of the beam and 'x' meter from end D. Determine the value of x, if the midpoint is the point of contra flexure and for this arrangement draw SF and BM diagram. **(16 Marks)**

OR

6 a. List the assumption made in simple theory of bending. Also derive an expression for relationship between bending stress and radius of curvature. **(08 Marks)**

b. A simply supported beam 100mm × 200mm carries a central concentrated load W. The permissible stress in bending and shear are 15N/mm^2 and 1.2 N/mm^2 respectively. Determine the safe load 'W' if the span of the beam is 3m. **(08 Marks)**

Module-4

7 a. Compare the torsional strength of hollow and solid shaft of same material, length and weight. **(08 Marks)**

b. A solid circular shaft has to transmit a power of 900kW at 110rpm. Find the diameter of the shaft, if the shear stress of the martial must not exceed 80 N/mm^2. The maximum torque is 1.25 times of its mean. What percentage of saving in material would be obtained, if the shaft is replaced by a hollow one whose internal diameter is 0.6 times its external diameter, the length, material and maximum shear stress being same? **(08 Marks)**

OR

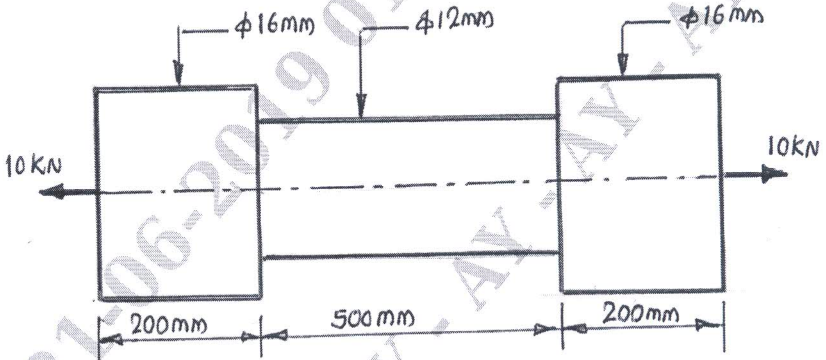
8 a. Derive the Euler's expression for a column subjected to an axial compressive load. Consider both ends of the column as hinged. **(08 Marks)**

b. Designs the section of a circular cast iron column that can safety carry a load of 1000kN. The length of the column is 6 meters. Rankine's constant is $\frac{1}{1600}$, factor of safety is 3. One end of the column is fixed and other end is free, critical stress is 560MPa. **(08 Marks)**

Module-5

9 a. Derive an expression for strain energy stored in a body when the load is i) gradually applied ii) Suddenly applied. **(10 Marks)**

b. A bar with circular cross section as shown in Fig Q9(b) is subjected to a load of 10kN. Determine the strain energy in it. Take $E = 2.1 \times 10^5$ N/mm^2. **(06 Marks)**



OR

10 a. Write a note on the following :
   i) Maximum normal stress theory
   ii) Maximum shear stress theory **(08 Marks)**

b. A plate of 45C8 steel is subjected to the following stresses. $\sigma_x = 150$ N/mm^2, $\sigma_y = 100$N/mm^2 and $\tau_{xy} = 50$N/mm^2. Find the factor of safety by,
   i) Maximum principal stress theory
   ii) Maximum shear stress theory

Take σ_{yt} of 45C8 Steel = 353 MPa. **(08 Marks)**

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