CBCS SCHEME

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18MT33

Third Semester B.E. Degree Examination, Aug./Sept. 2020
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: 1. *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *Missing data may suitably be assumed.*

Module-1

1 a. Define:
i) Hook's Law
ii) Poisson's law
iii) Bulk modulus
iv) Modulus of elasticity
v) Factor of softy. **(05 Marks)**

b. Derive an equation for deformation induced in a tapering bar of rectangular section, when it subjected to an force 'P'. **(06 Marks)**

c. A stepped bar with three different, portions has a fixed support at one end. The stepped bar subjected to force as shown in Fig Q1(c). Determine the stresses and deformation induced in each portion, Also find the total deformation induced in the bar.

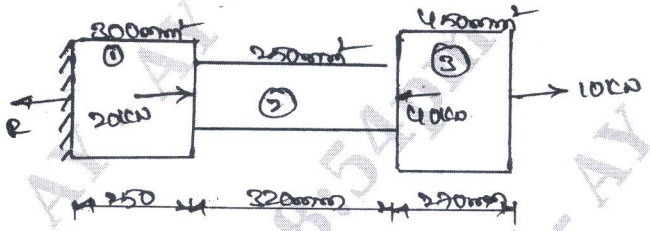

Fig Q1(c) **(09 Marks)**

OR

2 a. A block of size 200×80×20mm is subjected to the forces as shown in Fig Q2(a). Determine:
i) Change in dimension
ii) Change in volume.
Take E = 200GPa and $\mu = Y_m = 0.3$.

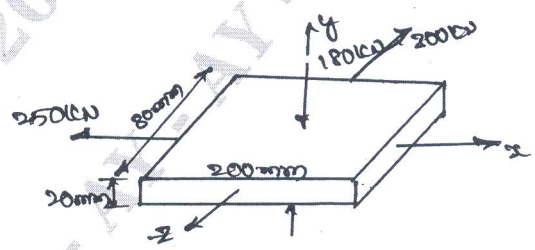

Fig Q2(a) **(05 Marks)**

b. A compound bar consists of a 40mm diameter steel bar surrounded by a closely fitting cast iron tube of 4mm wall thickness, length of the compound bar is 1.8m. Determine the load required to compress the compound bar so that the deformation induced in it is 1mm. Take E_s = 200GPa and E_{CI} = 100GPa. **(05 Marks)**

c. Derive a rotation between Young's modulus, Bulk modulus and modulus of rigidity. **(10 Marks)**

Module-2

3 a. An element of unit thickness is subjected to the mutually perpendicular stresses δx and δy and shear stress τxy as shown in Fig Q3(a). Determine equation for normal stress on arbitrary plane and shear stress an arbitrary plane.

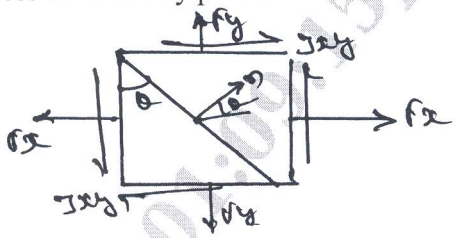

Fig Q3(a) **(10 Marks)**

b. An element is subjected to stresses as shown in Fig Q3(b). Determine :
   i) Principal stress and their directions
   ii) Normal and tangential stress on plane AC.

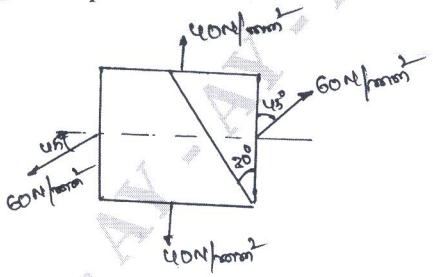

Fig Q3(b) **(10 Marks)**

OR

4 The state of stress at a point in a stained material is shown in Fig Q4. Determine :
   i) Direction of principal planes
   ii) magnitude of principal stresses
   iii) Magnitude of maximum shear stress and its direction
   iv) Normal stress on maximum shear stress plane
   v) Verify the answers by Mohr's circle method.

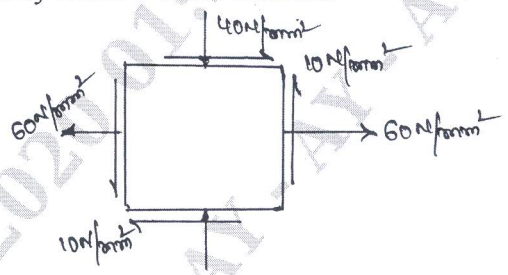

Fig Q4 **(20 Marks)**

Module-3

5 a. Derive the relationship between load, shear force and bending moment for UDL. **(05 Marks)**

b. Write the classification of Beams, loads and supports. **(05 Marks)**

c. A cantilever beam carries UDL and point loads as shown in Fig Q5(c). Draw SFD and BMD.

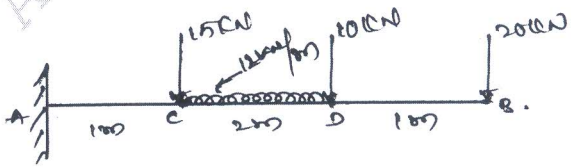

Fig Q5(c) **(10 Marks)**

OR

6 A simply supported Beam AB of 6m span is loaded as shown in Fig Q6. Draw shears force and bending moment diagrams. Also indicate the point of contraflexure, if any.

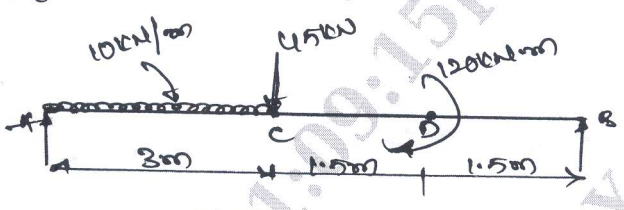

Fig Q6 **(20 Marks)**

Module-4

7 a. Derive the relationship between bending stress and Radius of curvature of the beam subjected to sagging bending moment and also mention the assumption in theory of pure bending. **(10 Marks)**

b. A beam with "I" section as shown in Fig Q7(b) is subjected to a bending moment 120kN.m and shear force of 60kN. Determine the bending stress and shear stress distribution along the depth of the section and write the distribution.

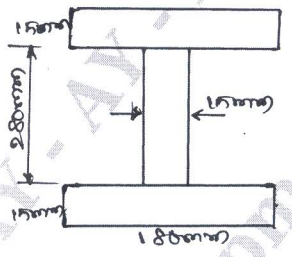

Fig Q7(b) **(10 Marks)**

OR

8 a. Derive an equation for finding slope and deflection of simply supported beam subjected to UDL over the span of the beam. **(10 Marks)**

b. Derive the expression for Euler's Bernoulli's equation for deflection. **(10 Marks)**

Module-5

9 a. Write the assumptions and derive the expression for torsion of equation for a circular shaft. **(10 Marks)**

b. A solid circular shaft has to transmit power of 1000kW at 120rpm. Find the diameter of the shaft, if the shear stress of the material must not exceed 80N/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 hallow one whose internal diameter is 0.6 times of its external diameter, the length, material and maximum shear stress are being same. **(10 Marks)**

OR

10 a. Derive an equation for critical load of column one end is free and other end is fixed and subjected to buckling load "P". **(10 Marks)**

b. A hallow column (circular) is used to carry an automobile of mass 2000kg through a height of 3m. Material of column has yield stress of 300 MPa. Outer diameter of column is 100mm and thickness of the wall is 5mm. One end of the column is fixed and other end is free. Taking E = 200GPa, determine : i) FOS ii) Ratio of crushing stress at yield point to crippling stress. **(10 Marks)**

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