CBCS SCHEME

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18MT33

Third Semester B.E. Degree Examination, Feb./Mar. 2022
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. Derive an expression for extension of a uniformly tapering circular bar. **(10 Marks)**

b. A brass bar having of uniform cross sectional area of 300mm^2 is subjected to a load as shown in Fig.Q1(b). Find the total elongation of bar and the magnitude of load P if Young's modulus is 84 GPa.

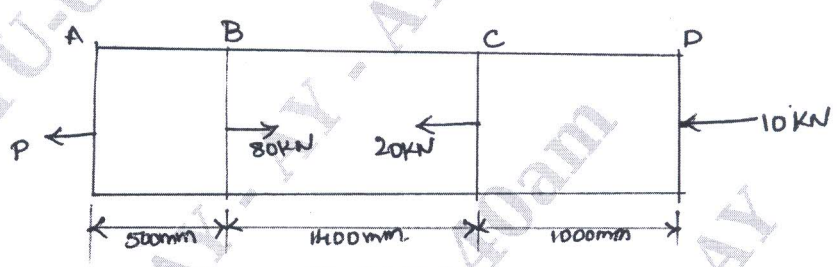

Fig.Q1(b) **(10 Marks)**

OR

2 a. Derive an expression for volumetric strain due to three mutually perpendicular stresses. **(10 Marks)**

b. Derive the relationship between modulus of elasticity modulus of rigidity and bulk modulus. **(10 Marks)**

Module-2

3 a. Derive an expression for element subjected to biaxial direct stresses. **(10 Marks)**

b. The state of stress in two dimensionally stressed body is as shown in Fig.Q3(b). Determine the principal planes principal stresses, maximum shear stress and their planes.

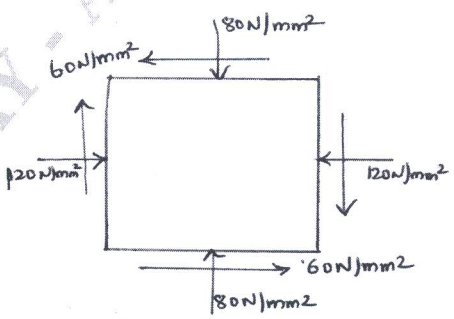

Fig.Q3(b) **(10 Marks)**

OR

4 For the state of stress shown in Fig.Q4 determine :

a. The principal stresses and principal planes

b. Maximum in plane shear stress and plane on which it is acting. Also find the normal stress on the maximum shear plane.

c. Sketch the element aligned with planes of principal stresses and planes of maximum shear. Also draw the Mohr's circle for the above stress state.

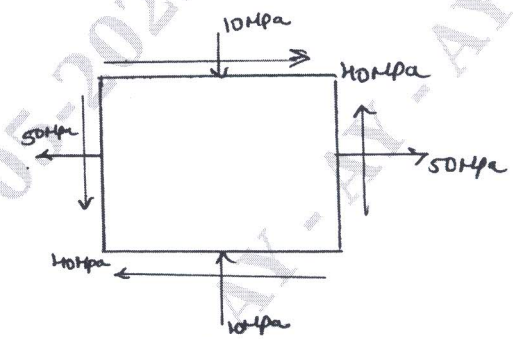

Fig.Q4 **(20 Marks)**

Module-3

5 a. Define beams and mention the types of beams with sketches. **(06 Marks)**

b. A Cantilever beam is loaded as shown in Fig.Q5(b). Draw shear force and bending moment diagram for the beams.

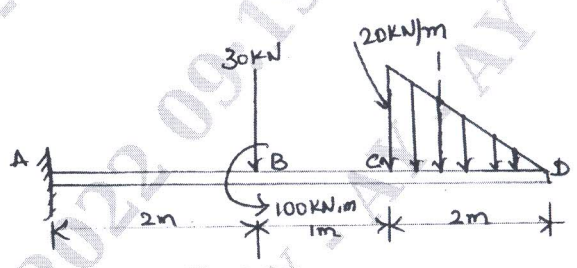

Fig.Q5(b) **(14 Marks)**

OR

6 Draw the shear force diagram and bending moment diagram for the beam shown in Fig.Q6. Calculate the maximum bending moment.

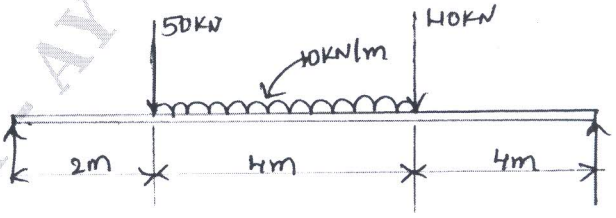

Fig.Q6 **(20 Marks)**

Module-4

7 a. State the assumptions made in simple bending and derive the expression for general equation for bending. **(12 Marks)**

b. A simple steel beam of 4m span carries a uniformly distributed load of 6kN/m over its entire span and a point load 2kN at its centre. If the permissible stress does not exceed 100MPa, find the cross section of the beam. Assuming depth to be twice of breadth. **(08 Marks)**

OR

8 a. Explain Macaulay's method for simply supported beam for point load. **(10 Marks)**

b. A 2m simple beam having cross section 150mm × 500mm carries a point load of 20kN at a distance of 0.5m from the left end. Find the slope at the two ends, deflection under the load and the maximum deflection. Take $E = 2 \times 10^4 N/mm^2$. **(10 Marks)**

Module-5

9 a. Derive the relation for a circular shaft when subjected to torsion as given below :

$$\frac{T}{Jp} = \frac{\tau}{R} = \frac{G\theta}{\ell}.$$ **(10 Marks)**

b. A hollow circular steel shaft has to transmit 60 kW 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 84GPa. Find the dimensions of the shaft and angle of twist in a length of 3m. **(10 Marks)**

OR

10 a. State the assumptions in Euler's column theory. **(04 Marks)**

b. State the derivation of Euler's load for Euler's crippling load for a column when both of its ends are hinged (or) pinned. **(10 Marks)**

c. A solid round bar of 60mm diameter and 25m is used as a strut, find the safe compressive load for the strut if :

i) Both ends are hinged

ii) Both ends are fixed

Take $E = 2 \times 10^5 N/mm^2$ and FOS = 3. **(06 Marks)**

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