CBCS SCHEME

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17MT33

Third Semester B.E. Degree Examination, June/July 2023
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. Define the following:
(i) Hooke's law (ii) Poisson's ratio (iii) Principle of superposition
(iv) Proof stress (v) Bulk modulus **(10 Marks)**

b. Find the extension of the bar shown in Fig.Q1(b) under axial load of 20 kN, E = 200 GN/m^2.

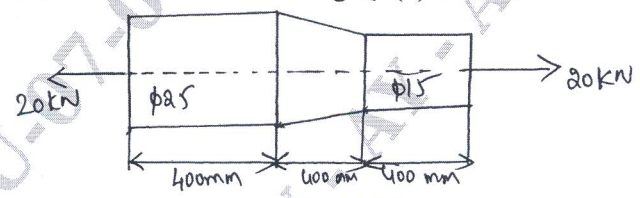

Fig.Q1(b) **(10 Marks)**

OR

2 a. Derive the expression for analysis of deformation of uniformly tapering circular bar. **(10 Marks)**

b. Determine the stresses in various segments of circular bar shown in Fig.Q2(b). Compute the total Elongation taking Young's modulus = 195 GPa.

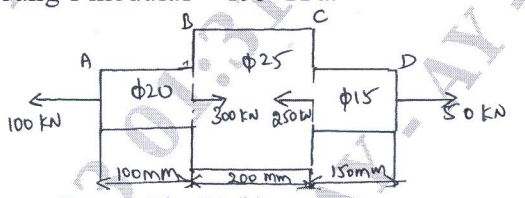

Fig.Q2(b) **(10 Marks)**

Module-2

3 a. Derive an expression for normal stress, shear stress and resultant stress on a oblique plane inclined at angle "θ" with vertical axis [x – plane] in biaxial stress system subjected δ_x, σ_y and τ_{xy}. **(10 Marks)**

b. The state of stress at a point in a strained material is as shown in Fig Q3(b). Determine :
i) Direction of principle planes
ii) magnitude of principal stresses
iii) Magnitude of maximum shear stress and their location.

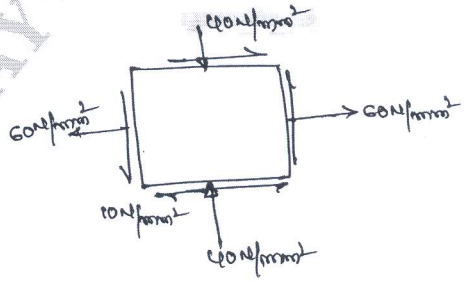

Fig Q3(b) **(10 Marks)**

OR

4 a. An element with stress acting on it is as shown in Fig Q4(a), using the Mohr's circle method determine :

i) Principle and orientation of their plane
ii) Maximum and minimum shear stress and their orientation of their planes
iii) Normal stress shear stress acting on a plane whose Normal is at an angle of 120° with respect to x – axis.

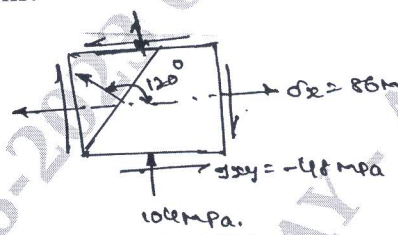

Fig Q4(a) **(12 Marks)**

b. What is principal plane and principle stress? Derive an equation for principle stress when 2D stress system subjected to pure shear stress.. **(08 Marks)**

Module-3

5 a. Define statically determined and statically indetermined beam. **(04 Marks)**

b. Draw shear force and bending moment diagram for a beam shown in the Fig.Q5(b). Locate point of inflextion if any.

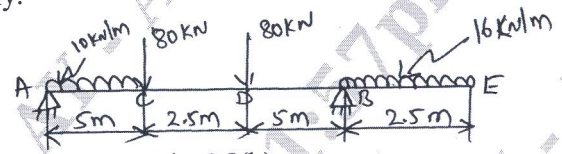

Fig.Q5(b) **(16 Marks)**

OR

6 a. Define beam. Explain the types of beams. **(06 Marks)**

b. A beam ABCD is simply supported at B and C, 4.5 m apart. Overhanging part AB and CD are 1.5 m and 2m long respectively. The beam carries a uniformly distributed load of 10 kN/m between A and C. There is a clockwise couple at 60 kNm at D. Draw shear force and bending moment diagram and mark salient features on beam. **(14 Marks)**

Module-4

7 a. What are the assumptions made in theory of bending? **(04 Marks)**

b. Prove that $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$ with usual notations. **(08 Marks)**

c. A beam of an I-section consists of 180 mm × 15 mm flanges and a web of 280mm depth × 15mm thickness. It is subjected to a bending moment of 120 KNm and a shear force of 60kN. Sketch the bending stress distribution along the depth of the section. **(08 Marks)**

OR

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

b. A simply supported beam [steel] having uniform cross-section is 14m span and is simply supported at its ends. It carries a concentrated load of 120kN and 80kN at two points 3m and 4.5m from the left and right end respectively. If the moment of inertia of the section is 160×10^7 mm^4 and E = 210GPa calculate the deflection of the beam at load points. **(10 Marks)**

Module-5

9 a. Write the assumption mode in torsion of shaft. **(06 Marks)**

b. Derive an equation for torque and shear stress in torsion of shaft. **(06 Marks)**

c. A Hollow circular steel shaft has to transmit 60 kW at 210rpm such that the maximum shear stress does not exceed 60MN/m^2. If the ratio of internal dia 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. **(08 Marks)**

OR

10 a. Derive Euler's theory for axially loaded long column, when the one end of column is fixed and other end is pinned. **(07 Marks)**

b. Write the assumption in Euler's column theory. **(04 Marks)**

c. A 2m long column has square cross section of side 40mm. taking the factor of safety as 4. Determine safe load for end conditions:

i) Both ends are hinged
ii) One end if fixed and other end is free
iii) Both ends are free
iv) One end is fixed and other end is hinged.

Take E = 210GPa. **(09 Marks)**

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