CBCS SCHEME

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18AU34

Third Semester B.E. Degree Examination, Aug./Sept.2020
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) Bulk Modulus (iii) Lateral strain
(iv) Poisson's ratio (v) Stress **(10 Marks)**

b. Find the total elongation and the maximum stress in the material of the bar shown in Fig.Q1(b) under an axial load of 20 kN, E = 200 GN/m^2.

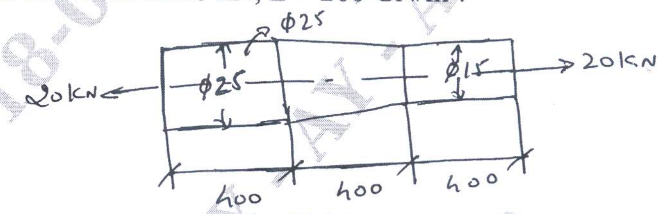

Fig.Q1(b) **(10 Marks)**

OR

2 a. Derive the relation between Young's Modulus and Modulus of Rigidity. **(10 Marks)**

b. For the laboratory tested specimen the following data were obtained :
(i) Diameter of specimen = 25 mm
(ii) Length of specimen = 300 mm
(iii) Extension under the load of 15 kN = 0.045 mm
(iv) Load at yield point = 127.65 kN
(v) Maximum load = 208.6 kN
(vi) Length of specimen after failure = 375 mm
(vii) Neck diameter = 17.75 mm
Determine
(i) Young's modulus (ii) Yield point stress (iii) Ultimate stress
(iv) Percentage elongation (v) Percentage reduction in area
(vi) Safe stress adopting a factor of safety of 2. **(10 Marks)**

Module-2

3 a. Explain :
(i) Principal planes and principle stresses
(ii) Maximum and minimum shear stresses with respect to compound stresses **(10 Marks)**

b. Describe the construction of Mohr's circle for plane stress. **(10 Marks)**

OR

4 a. A thin cylindrical shell 1m in diameter and 3m long has a metal thickness of 10mm. It is subjected to an internal fluid pressure of 3 MPa. 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 = 210 GPa. **(10 Marks)**

b. Explain the concept of circumferential stress and longitudinal stress corresponding to thin cylinders. **(10 Marks)**

Module-3

5 a. Define and explain the following types of load :

(i) Concentrated load

(ii) Uniformly distributed load

(iii) Uniformly varying load. **(06 Marks)**

b. Draw SFD and BMD for a simply supported beam loaded as shown in Fig.Q5(b).

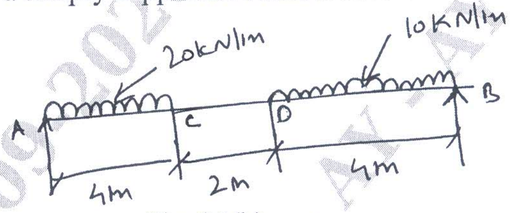

Fig.Q5(b) **(14 Marks)**

OR

6 a. Derive a relationship between bending stress and radius of curvature. **(10 Marks)**

b. Derive the deflection equation, $EI = \frac{d^2y}{dx^2} = M$. **(10 Marks)**

Module-4

7 a. Derive the relation for a circular shaft when subjected to torsion as given by

$$\frac{T}{J} = \frac{\rho}{R} = \frac{G\theta}{L}$$

Also list out the assumption made while deriving the relation. **(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 60 MN/m^2. If the ratio of internal to external diameter is equal to 3/4 and the value of rigidity modulus is 84 GPa, find the dimensions of shaft and angle of twist in a length of 3m. **(10 Marks)**

OR

8 a. Derive a Euler's Crippling load for a column when both of its ends are hinged. **(10 Marks)**

b. A 1.5 m long column has a circular cross section of 50mm diameter. One end of the column is fixed in direction and position of the other end is free. Taking the factor of safety as 3, calculate the safe load using Euler's formula. Taking $E = 1.2\times10^5$ N/mm^2. **(10 Marks)**

Module-5

9 a. Derive an expression for strain energy due to shear stress. **(10 Marks)**

b. A tensile load of 50 kN is gradually applied to a circular bar of 50mm diameter and 4m long is the value of $E = 2\times10^5$ N/mm^2. Determine (i) Stress induced in rod (ii) Deformation of the rod (iii) Strain energy absorbed by the rod. **(10 Marks)**

OR

10 a. Explain (i) Maximum Principal stress theory (ii) Maximum shear stress theory. **(10 Marks)**

b. A machine element is loaded so that $\sigma_1 = 120$ MPa, $\sigma_2 = 0$ and $\sigma_3 = -90$ MPa; the material has a yield strength in tension and compression of 360 MPa. Find the factor of safety for each of the following failure theories:

(i) Maximum normal stress theory (ii) Maximum shear stress theory. **(10 Marks)**

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