CBCS SCHEME

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15AU34

Third Semester B.E. Degree Examination, June/July 2023
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. State Hooke's law. **(02 Marks)**

b. Determine an expression for shortening/ extension of bar. **(04 Marks)**

c. A bar of 30mm diameter is subjected to a pull of 60kN. The measured extension on gauge length of 200mm is 0.1mm and change in diameter is 0.004mm. Determine :
i) All three modulii ii) Poisson's ratio. **(10 Marks)**

OR

2 a. A rectangular bar made of steel is 2.8m long and 15mm thick. The rod is subjected to an axial tensile load of 40kN. The width of rod varies from 75mm at one end to 30mm at the other. Find the extension of rod if E = 200 GPa. **(02 Marks)**

b. Derive an expression for deformation of tapered bar (CIRCULAR Cross – section). **(06 Marks)**

c. A steel tube of 30mm external diameter and 20mm internal diameter encloses a copper rod of 15mm diameter to which it is rigidly joined at each end. If, at a temperature of 10°C there is no longitudinal stress, calculate the stresses in the rod and tube at a rise of 200°C
Take: $E_s = 210GPa$, $E_c = 100GPa$, $\alpha_s = 11\times10^{-6}$ per °C and $\alpha_c = 18\times10^{-6}$ per °C. **(08 Marks)**

Module-2

3 a. Explain :
i) Principal planes and Principle stresses and
ii) Maximum and Minimum shear stresses with respect to compound stresses. **(08 Marks)**

b. Describe the construction of Mohr's circle for plane stress. **(08 Marks)**

OR

4 a. A thin cylindrical shell with following dimensions is filled with a liquid at atmospheric pressure. Length = 1.2m, External diameter = 200mm, Thickness of metal = 8mm. Find the value of the pressure exerted by the liquid on the walls of the cylinder and the hoop stress induced if an additional volume of 25000mm^3 of liquid is pumped into the cylinder. Take $E = 2.1 \times 10^5$ N/mm^2 and $\mu = 0.33$. **(08 Marks)**

b. Explain the concept of circumferential stress and longitudinal stress corresponding to thin cylinders. **(08 Marks)**

Module-3

5 Draw SFD and BMD for the overhang beam shown in Fig Q5. Indicate all significant values including point of contraflexure, if any. **(16 Marks)**

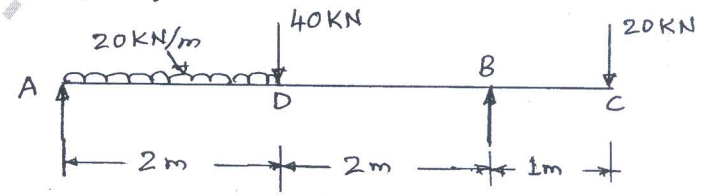

Fig. Q5

OR

6 a. Write bending equation and explain each notation with units. Also list the assumptions made theory of simple bending. **(08 Marks)**

b. A uniform beam of I-section is 100mm wide and 200mm deep with a flange thickness of 10mm and web thickness of 5mm. The beam is simply supported over a span of 10m. It carries an udl and 10kN/m throughout its length. Determine and sketch the variation of bending stress distribution across the section. **(08 Marks)**

Module-4

7 a. Derive the torque equation with usual Notations. **(06 Marks)**

b. A solid circular shaft has to transmit a power of 1000kW at 120 rpm. Find the diameter of the shaft, if the shear stress of the material must not exceed $80N/mm^2$. The maximum torque 1.25time of its mean. What percentage of saving in material would be obtained if the shaft is replaced by hollow one whose internal diameter is 0.6 times its external diameter, the length, material and maximum shear stress being same? **(10 Marks)**

OR

8 a. Derive a Euler's Crippling load for a column when both of its ends are hinged. **(08 Marks)**

b. A 1.5m long column has a circular cross section of 50mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking the factor of safety as 3, calculate the safe load using Euler's formula. Taking $E = 1.2 \times 10^5 N/mm^2$. **(08 Marks)**

Module-5

9 a. Explain maximum shear stress theory and state the need of theories of failures. **(06 Marks)**

b. Determine the diameter of a bolt which is subjected to an axial pull of 9kN together with a transverse shear force of 4.5kN using

i) Maximum Principal Stress theory ii) Maximum Shear Stress theory. **(10 Marks)**

OR

10 a. Define strain energy, Resilience, proof resilience and modules of Resilience. **(08 Marks)**

b. A tension bar 5m long is made up of two parts 3 meter of its length has a cross section area of $10cm^2$ while the remaining 2 meter has a cross section area of $20cm^2$. An axial pull of 80kN is gradually applied. Find the total strain energy produced in the bar and compare this value with that obtained in a uniform bar of same length and have same volume under same loading condition. Take E = 200GPa. **(08 Marks)**

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