CBCS SCHEME

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18CV32

Third Semester B.E. Degree Examination, Jan./Feb. 2023
Strength 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 : i) Stress ii) Strain iii) Poisson's ratio iv) Bulk modulus **(04 Marks)**

b. Derive the equation for deformation in a tapering circular bar subjected to an axial force 'P'. **(06 Marks)**

c. A 18mm diameter steel rod passes centrally through a copper tube of 26mm internal diameter and 38mm external diameter. The rod 2.6m long and is closed at each end by rigid plates of negligible thickness. The nuts are tightened lightly home or projecting parts of the rod. If the temperature of the assembly is raised by 80°C, calculate the thermal stresses induced in copper and steel. Take $\alpha_{cu} = 17.5\times10^{-6}/°C$, $\alpha_{St} = 12\times10^{-6}/°C$, $E_{St} = 210$ GPa and $E_{cu} = 105$ GPa. **(10 Marks)**

OR

2 a. With usual notations, establish relationship between Young's modulus and Bulk modulus. **(05 Marks)**

b. Find the total elongation of the bar shown in Fig.Q2(b) subjected to an axial tensile load of 50 kN on the bar of the material having modulus of elasticity of 2.1×10^5 N/mm^2.

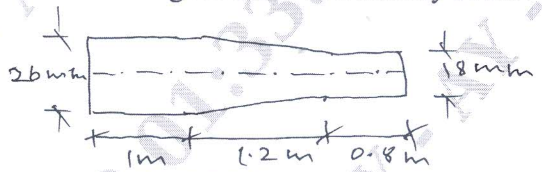

Fig.Q2(b) **(06 Marks)**

c. A 12mm diameter specimen is subjected to a tensile force of 20 kN and deformation is 0.3mm observed over a gauge length of 150mm. The reduction in diameter is 0.0079mm. Determine the elastic constants. **(09 Marks)**

Module-2

3 a. What are the Principal Stresses and Principal Planes? **(04 Marks)**

b. Explain the construction of Mohr's circle for compound stress in two dimensional system. **(06 Marks)**

c. The maximum stress permitted in a thick cylinder with radii 200mm and 300mm is 16 N/mm^2. If the internal pressure is 12 N/mm^2, what external pressure can be applied? Plot curves showing the variation of hoop stress and radial pressure through the material. **(10 Marks)**

OR

4 a. Show that in the case of a thin cylindrical shell subjected to internal fluid pressure, the volumetric strain is equal to the sum of twice the hoop strain and the longitudinal strain. **(06 Marks)**

b. Write short notes on Maximum Principal Stress Theory. **(04 Marks)**

c. The state of stress at a point in a strained material is as shown in Fig.Q4(c). Determine i) Magnitude of principal stresses ii) Direction of principal planes iii) Magnitude of maximum shear stress and direction.

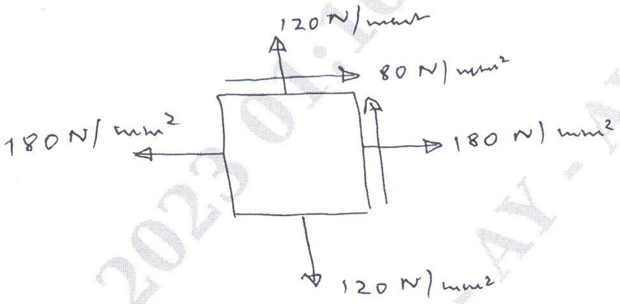

Fig.Q4(c) **(10 Marks)**

Module-3

5 a. Establish the relationship between bending moment, shear force and intensity of UDL. **(06 Marks)**

b. Draw the SFD and BMD for the beam shown in Fig.Q5(b).

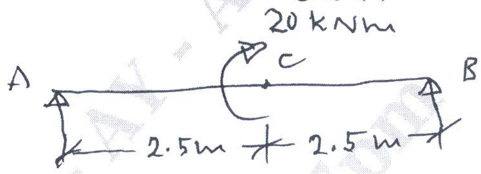

Fig.Q5(b) **(05 Marks)**

c. A simply supported beam is subjected to a point load of 15 kN together with udl of 15 kN/m applied as shown in Fig.Q5(c). Draw SFD and BMD. Find also point of zero shear and its corresponding BM.

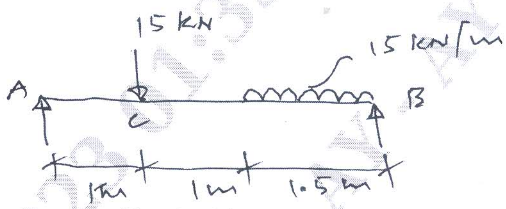

Fig.Q5(c) **(09 Marks)**

OR

6 a. Define : (i) Shear force (ii) Bending moment (iii) Point of contraflexure **(05 Marks)**

b. Show that the maximum bending moment in a simply supported beam subjected to udl throughout is $\frac{WL^2}{8}$ with usual notations. **(05 Marks)**

c. Draw SFD and BMD for the beam shown in Fig.Q6(c). Indicate the maximum bending moment and its location. Also indicate Point of Contraflexure.

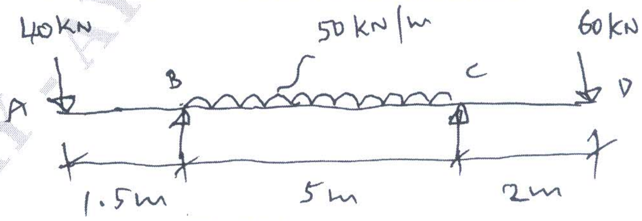

Fig.Q6(c) **(10 Marks)**

Module-4

7 a. Define : i) Neutral axis ii) Section modulus (02 Marks)

b. Prove that in case of a rectangular section of a beam, the maximum shear stress is 1.5 times average shear stress. (08 Marks)

c. A solid shaft has to transmit 150 kW of power at 180 rpm. If allowable shear stress is 70 MPa and allowable angle of twist is 1° in a length of 4m. Find the suitable diameter of solid circular shaft. Take G = 84 GPa. (10 Marks)

OR

8 a. Derive the torsion equation with usual notations. (08 Marks)

b. A beam with I-section as shown in Fig.Q8(b) is subjected to a bending moment of 120 kNm and a shear force of 60 kN. Sketch the bending stress and shear stress distribution.

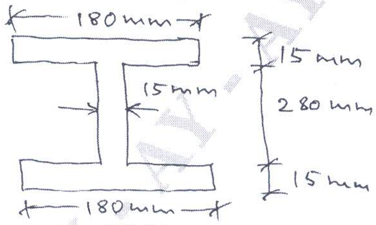

Fig.Q8(b) (12 Marks)

Module-5

9 a. Derive the differential equation for beam deflection with usual notations. (08 Marks)

b. The cross section of a column is a hollow rectangular section with its external dimensions 200mm × 150mm. The internal dimensions are 150mm × 100mm. The column is 5m long and fixed at both ends. If E = 120 GPa, calculate the critical load using Euler's formula. Compare the above load with the value obtained from Rankine's formula. The permissible compressive stress is 500 N/mm^2. The Rankine's constant is 1/6000. (12 Marks)

OR

10 a. Distinguish between Short and Long columns. (03 Marks)

b. Derive the Euler's expression for buckling load for columns with both ends hinged. (07 Marks)

c. Determine the maximum deflection for the simply supported beam ACDB with AC = 2m, CD = 3m and DB = 3m, carrying point loads of 200 kN and 120 kN acting at C and D respectively. Take EI = 2.1×10^{15} N-mm^2. (10 Marks)

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