CBCS SCHEME

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18AE/AS33

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. Draw a typical stress-strain curve for mild steel, indicate salient points and define them. **(08 Marks)**

b. What do you mean by 'thermal stresses'? Explain briefly with an example. **(04 Marks)**

c. A member ABC is formed by connecting steel bar of 20mm diameter and an aluminium bar of 30mm diameter, and is subjected to forces as shown in Fig.Q.1(c). Determine the total deformation of the bar, taking E for aluminium as $0.7 \times 10^5 N/mm^2$ and that for steel as $2 \times 10^5 N/mm^2$. **(08 Marks)**

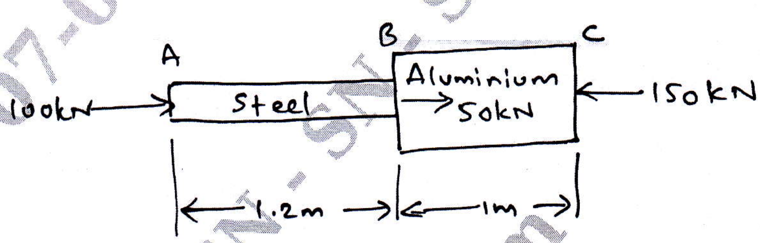

Fig.Q.1(c)

OR

2 a. Derive the relationship between 'Modulus of Elasticity' and 'Modulus of Rigidity'. **(08 Marks)**

b. A point in a strained material is subjected to stresses shown in Fig.Q.2(b). Using Mohr's circle method, determine normal and tangential stress across the oblique plane. Check the answer analytically. **(12 Marks)**

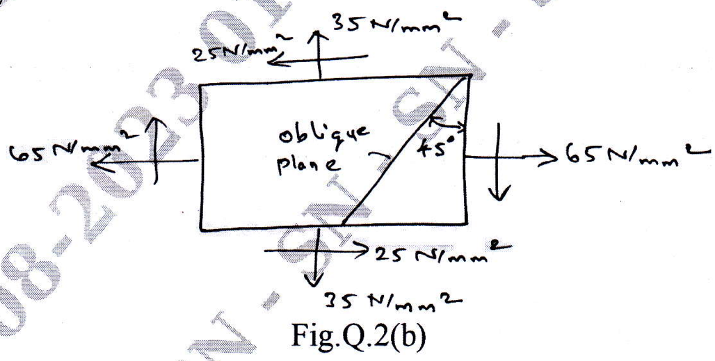

Fig.Q.2(b)

Module-2

3 a. Define the following terms:
i) Shear force
ii) Bending moment
iii) Shear Force Diagram (SFD)
iv) Bending Moment Diagram (BMD). **(08 Marks)**

b. A simply supported beam of length 6m, carries point load of 3kN and 6kN at distances of 2m and 4m from the left end. Draw the sheer force and bending moment diagrams for the beam. **(12 Marks)**

OR

4 a. State the assumptions made in 'Euler-Bernoulli' beam theory. **(02 Marks)**

b. Derive the bending equation of the beam with usual notations. **(08 Marks)**

c. Two wooden planks 150mm × 50mm each are connected to form a T-section of a beam. If a moment of 6.4kN-m is applied around the horizontal neutral axis, inducing tension below the neutral axis, find the bending stresses of both the extreme fibres of the cross- section. **(10 Marks)**

Module-3

5 a. Explain the following briefly:

i) Macaulay's method.

ii) Double integration method. **(10 Marks)**

b. Derive an expression for deflection and slope of a cantilever beam of length L, carrying a point load of W at the free end by double integration method. **(10 Marks)**

OR

6 a. Define the following terms:

i) Torsional rigidity

ii) Polar modulus. **(04 Marks)**

b. Derive the torsional equation of a solid shaft with usual notations. **(08 Marks)**

c. Determine the diameter of a solid steel shaft which will transmit 90kN of 160rpm. Also determine the length of the shaft if the angle of twist must not exceed 1° over the entire length. The maximum shear stress induced is limited to $60N/mm^2$. Take modulus of rigidity as $8 \times 10^4 N/mm^2$. **(08 Marks)**

Module-4

7 a. Write short notes on the following:

i) Principle of virtual work.

ii) Principle of complementary virtual work. **(10 Marks)**

b. What is 'Principle of minimum total potential energy'? Explain. **(10 Marks)**

OR

8 a. Explain the principle of virtual work for a particle connected to an elastic spring. **(10 Marks)**

b. State 'Saint-Venant's principle'. Explain with an example. **(10 Marks)**

Module-5

9 a. Define 'Creep'. **(02 Marks)**

b. Explain the three stages of creep using a creep curve for metals. **(08 Marks)**

c. Explain the three modes of crack surface displacement with neat sketches. **(10 Marks)**

OR

10 a. Define the term 'Fatigue'. **(02 Marks)**

b. List and explain the factors that affect the fatigue life. **(08 Marks)**

c. What is 'S-N curve' in fatigue? Explain its significance in predicting fatigue failure of materials. **(10 Marks)**

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