USN

17ME34

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. Derive an expression for deformation of tapering bar having circular cross-section. **(08 Marks)**

b. Define:
i) True stress ii) Rigidity Modulus iii) Poisson's Ratio iv) Resilience. **(04 Marks)**

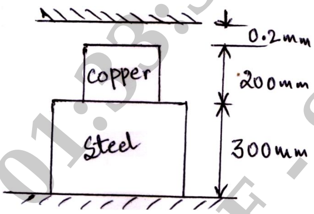
c. A steel tie rod 50mm in diameter and 5m long is subjected to a pull of 100kN. To what length the bar should be bored centrally so that the total extension will increase by 20% under the same pull, the bore being 25mm diameter. Take: E = 200GPa. **(08 Marks)**

OR

2 a. Establish the relationship between modulus of elasticity and bulk modulus in case of a cube subjected to three mutually perpendicular like tensile stresses of equal intensity 'P'. **(10 Marks)**

b. The composite bar shown in Fig.Q.2(b) is 0.2mm short of distance between the rigid support at room temperature. What is the maximum temperature rise which will not produce stresses in the bar? Find the stresses induced when temperature rise is 40°C.
Given: $\alpha_s = 12 \times 10^{-6}/°C$; $E_s = 210GPa$; $A_s : A_c = 5:4$; $\alpha_c = 17.5 \times 10^{-6}/°C$; $E_c = 120GPa$. **(10 Marks)**

Fig.Q.2(b)

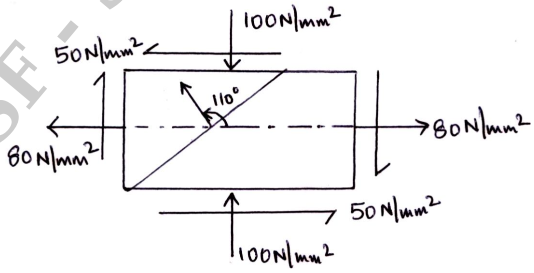


Module-2

3 a. Derive an expression for normal and shear stress on an inclined plane of member. **(08 Marks)**

b. An element with the stresses acting on it, is as shown in Fig.Q3(b) by Mohr's circle method. Determine:
i) Normal and shear stress acting on a plane whose normal is at an angle of 110° with respect to x-axis.
ii) Principal stresses and its locations.
iii) Maximum shear stresses and its location. **(12 Marks)**

Fig.Q.3(b)



OR

4 a. Derive the expressions for circumferential and radial stresses in the wall of thick cylinder (Lame's equation). **(10 Marks)**

b. A pipe of 500mm internal diameter and 75mm thick is filled with a fluid at a pressure of $6N/mm^2$. Find the maximum and minimum hoop stress across the cross section of the cylinder. Also sketch the radial pressure and hoop stress distribution across the section. **(10 Marks)**

Module-3

5 a. Define point of contraflexure. Draw the SFD and BMD for overhanging beam shown in below Fig.Q.5(a) and locate the point of centraflexure. **(15 Marks)**

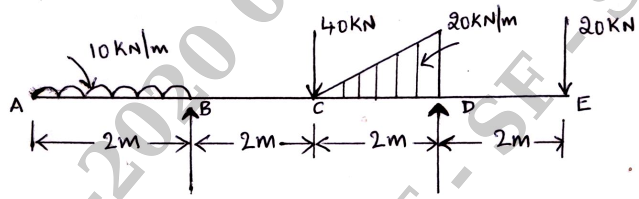


Fig.Q.5(a)

b. Explain the fire types of beam. **(05 Marks)**

OR

6 a. An I-section beam 350mm × 200mm has a web thickness of 12.5mm and a flange thickness of 25mm. It carries a shearing force of 200kN at a section. Sketch the shear stress distribution across the section. **(10 Marks)**

b. Derive an expression for differential equation for deflection curve. **(10 Marks)**

Module-4

7 a. Derive the relation for a circular solid shaft when subjected to torsion as given by $\frac{T}{J}=\frac{\tau}{R}=\frac{G\theta}{\ell}$ and state the assumptions. **(10 Marks)**

b. A hollow diameter circular shaft has to transmit 60kW at 210rpm such that the maximum shear stress does not exceed $60MN/m^2$, If the ratio of internal diameter to external diameter equal to 3/4 and the value of G = 84GPa, find the dimensions of the shaft and angle of twist in a length of 3m. **(10 Marks)**

OR

8 a. Derive an expression for Euler's crippling load for a column when both of its ends are hinged or pinned. **(10 Marks)**

b. Derive an expression for Euler's crippling load for a column when one of its ends are hinged or pinned. **(10 Marks)**

Module-5

9 a. Explain Rankin's theory and Guest's theory. **(08 Marks)**

b. Find the deflection at the centre of simply supported beam of length 'l' carrying UDL of 'W' per unit length over its entire length using castigliano's theorem. **(12 Marks)**

OR

10 a. Derive an expression for strain energy stored in an elastic bar when subjected to torque and bending moment. **(10 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 maximum principal stress theory. Given: The elastic limit in tension = $225N/mm^2$, FOS = 3 and Poisson's Ratio = 0.3. **(10 Marks)**

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