Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering
End Sem Examination Dec-2023
CE3ES11 Strength of Material

Programme: B.Tech. Branch/Specialisation: CE

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. Hooke's law relates stress to strain for materials within their elastic limit- **1**

(a) Stress= strain* Young's modulus (b) Stress= strain* length
(c) Stress= force/area (d) Stress= deformation/load

ii. Which type of stress occurs when forces act parallel to the cross-sectional area of a material? **1**

(a) Tensile stress (b) Compressive stress
(c) Shear stress (d) Torsional stress

iii. The moment of inertia is a measure of beam- **1**

(a) Flexural rigidity (b) Shear capacity
(c) Tensile strength (d) Compressive strength

iv. When calculating the shear stress in a circular shaft the formula for shear stress is related to the applied torque (T) and the polar moment of inertia. What is the formula? **1**

(a) $\tau=T/I_p$ (b) $\tau=T/A$ (c) $\tau=T/r$ (d) $\tau=T/2\pi r$

v. To apply the double integration method, what information about the beam's loading and geometry is needed? **1**

(a) Only Loading (b) Only Geometry
(c) Both (a) and (b) (d) None of these

vi. In the context of Strength of Materials, the Area Moment method is primarily used for the beam- **1**

(a) Prismatic beam (b) Non-Prismatic beam
(c) Both (a) and (b) (d) None of these

vii. What is the primary cause of bending stress in a structural element? **1**

(a) Axial loading (b) Torsional loading
(c) Shear loading (d) Bending moments

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viii. What is the primary purpose of calculating bending stress in a beam during the design process? **1**
(a) To determine the beam's weight
(b) To evaluate the effect of thermal expansion
(c) To ensure the beam can safely carry applied loads
(d) To assess the impact of corrosion

ix. In structural engineering, a column is typically subjected to- **1**
(a) Axial tensile loads (b) Axial compressive loads
(c) Shear loads (d) Bending moments

x. Buckling in columns and struts is primarily caused by- **1**
(a) Torsional loading
(b) Lateral-torsional instability due to compressive loads
(c) Shear loading
(d) Axial loading

Q.2 i. What do you mean by principal plane and principal stress. **2**

ii. Define the following terms- **3**
(a) Poison's ratio (b) Young's modulus
(c) Modulus of rigidity (d) Bulk modulus and their relationship.

iii. Two planes AB and BC which are at right angles carry shear stresses of intensity 22 N/mm^2, while these planes also carry a tensile stress of 42 N/mm^2 respectively. Determine the principal planes and principal stresses. Also determine the maximum shear stress. **5**

OR iv. Explain the following terms- **5**
(a) Proportional limit (b) Elastic limit
(c) Yield point (d) Ultimate point and
(e) Fracture point
Also, show theses points on the curve for mild steel bar specimen.

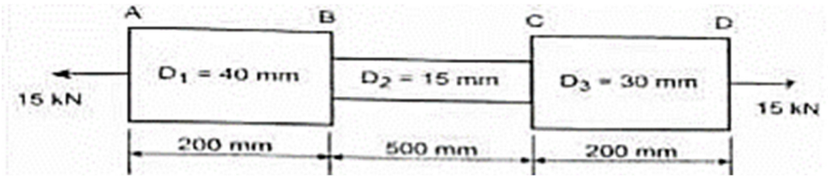
Q.3 i. What is pure bending and assumptions considered in the theory of pure bending? **2**

ii. Define section modulus. What is its expression for rectangular and circular section? **3**

iii. Derive the shear stress distribution for the rectangular section. **5**

OR iv. A steel bar 900 mm long. Its two ends are 40mm and 30mm diameter and the length of each rod is 200 mm. The middle portion of the bar is 15mm in diameter and 500 mm long. If the bar is subjected and axial tensile load of 15 kN, determine (a) Stress in each section, **5**

(b) Total extension.



Q.4 i. Explain the double integration method. Discuss the advantages and limitations of the double integration method. **2**

ii. Explain the following- **3**
(a) Area moment method (b) Conjugate beam method

iii. A simply supported beam with a length (L) of 8 meters and a point load of 40 kN applied at the mid-point of the length. Calculate the vertical deflection (δ) at the midpoint of the beam and the slope at the support. **5**

OR iv. A simply supported beam of length 4 m with a concentrated load of 10 kN located 2 m from the left support. Using the conjugate beam method, calculate the reactions at the supports and the shear force at a point 2 m from the left support. **5**

Q.5 i. Define circumferential stress and longitudinal stress in case of a thin cylinder. **2**

ii. What is Torsion equation? Also state the assumptions made in the theory of torsion. **3**

iii. A seamless pipe 800 mm diameter contains a fluid under a pressure of 2 N/mm^2. If the permissible or safe tensile stress be 100 N/mm^2, find the minimum thickness of the pipe. **5**

OR iv. A solid circular shaft is subjected to a torsional moment of 120N-m having a diameter of 50mm whose length is 5m. (G=3500MPa). Find out the angle of twist and the shear stress applied on the shaft. **5**

Q.6 i. What are the classifications of column? **2**

ii. Write the Euler's formula for different end conditions. **3**

iii. Write a note on significance of theories of failure. **5**

OR iv. A solid round bar of 50 mm diameter and 3 m long is used as a strut. Find the safe compressive load for the strut using Euler's formula if, (a) one ends is fixed and other ends is hinged (b) both ends are hinged. Take $E=2.5*10^5$ N/mm^2 and FOS= 1.5. **5**

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