JHARKHAND UNIVERSITY OF TECHNOLOGY

Diploma 3rd Semester Examination

MECHANICS OF MATERIALS (MEC 301)

Time: 3 Hours **Full Marks: 70** **SET: 1**

INSTRUCTIONS:

1. Question No. 1 is Compulsory.
2. Answer any **FOUR** questions from the remaining (Q.2 to Q.7).
3. Figures in the margin indicate full marks.

Q.1. Multiple Choice Questions [2 × 7 = 14]

(i) The ratio of lateral strain to linear strain is known as:

(a) Modulus of Elasticity (b) Modulus of Rigidity
(c) Poisson's Ratio (d) Bulk Modulus

(ii) The bending stress in a beam is maximum at the:

(a) Neutral Axis (b) Extreme Fibers
(c) Centroid (d) Junction of web and flange

(iii) For a cantilever beam carrying a UDL, the Shear Force diagram is a:

(a) Rectangle (b) Triangle
(c) Parabola (d) Cubic curve

(iv) Polar Moment of Inertia (J) for a solid circular shaft of diameter D is:

(a) $\pi D^4/32$ (b) $\pi D^4/64$
(c) $\pi D^3/16$ (d) $\pi D^3/32$

(v) A column that fails primarily due to buckling is called a:

(a) Short column (b) Long column
(c) Medium column (d) Strut

(vi) The unit of Strain is:

(a) N/mm^2 (b) N-m
(c) Dimensionless (d) kg/m^3

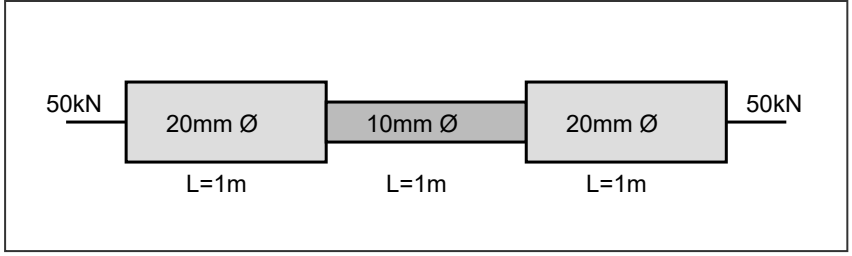
(vii) The energy stored in a body within the elastic limit is called:

(a) Resilience (b) Proof Resilience
(c) Toughness (d) Hardness

SECTION B (Long Answer Type)

Q.2. (a) [Theory] Draw the **Stress-Strain Diagram for Mild Steel** under tension. Explain all significant points (Proportional Limit, Yield Point, Ultimate Stress, Breaking Point). **[7]**

Q.2. (b) [Numerical] Find the total elongation of the **Stepped Bar** shown below. Take E = 200 GPa. **[7]**

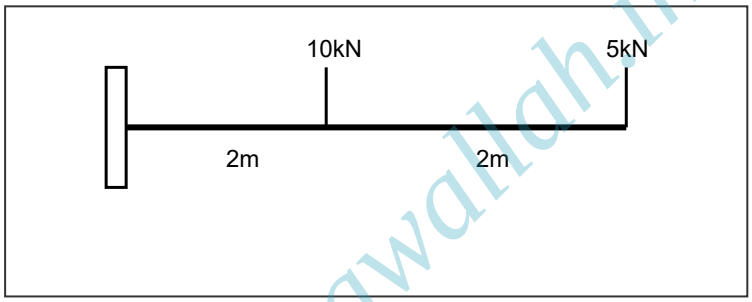


Q.3. (a) [Theory] Derive the relationship between **Modulus of Elasticity (E)** and **Modulus of Rigidity (G)**:
$E = 2G(1 + \mu)$. **[7]**

Q.3. (b) [Numerical] A steel rod of 20 mm diameter and 2 meters length is subjected to an axial pull of 50 kN. Find the **Stress**, **Strain**, and **Elongation**. Take E = 2×10^5 N/mm². **[7]**

Q.4. (a) [Theory] State the assumptions in the **Theory of Simple Bending**. Derive the Bending Equation: **M/I = σ/y = E/R**. **[7]**

Q.4. (b) [Numerical] Draw the **SFD and BMD** for the Cantilever Beam shown below. **[7]**



Q.5. (a) [Theory] Derive the **Torsion Equation** for a circular shaft: **T/J = τ/R = Gθ/L**. State the assumptions made. **[7]**

Q.5. (b) [Numerical] Compare the strength of a **Solid Shaft** and a **Hollow Shaft** of the same material and same weight. Show that the hollow shaft is stronger. **[7]**

Q.6. (a) [Theory] What are the assumptions made in **Euler's Column Theory**? Discuss the limitations of Euler's formula for short columns. **[7]**

Q.6. (b) [Theory/Diagram] Define **Shear Stress**. Sketch the Shear Stress Distribution diagram for a (i) Rectangular Section, (ii) Circular Section, and (iii) I-Section. **[7]**

Q.7. Write Short Notes on (Any FOUR): [3.5 × 4 = 14]

a. Point of Contraflexure

b. Section Modulus (Z)

c. Factor of Safety

d. Hooke's Law

e. Slenderness Ratio