JHARKHAND UNIVERSITY OF TECHNOLOGY

Diploma 3rd Semester Sample Paper (DIPLOMA WALLAH)

MECHANICS OF MATERIALS (MEC 301)

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

INSTRUCTIONS:

1. Question No. 1 is Compulsory.
2. Answer any **FOUR** questions from the remaining (Q.2 to Q.7).
3. Use the provided figures for numerical problems.

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

(i) The point of contraflexure occurs where:

(a) Shear force is zero (b) Bending moment changes sign
(c) Bending moment is maximum (d) Deflection is maximum

(ii) The Hoop Stress in a thin cylindrical shell subjected to internal pressure 'p' is:

(a) pd/2t (b) pd/4t
(c) pd/t (d) pd/8t

(iii) The variation of shear stress in a circular beam section is:

(a) Linear (b) Parabolic
(c) Hyperbolic (d) Uniform

(iv) Rankine's formula is applicable for:

(a) Long columns only (b) Short columns only
(c) Both long and short columns (d) None of these

(v) If a material has identical properties in all directions, it is said to be:

(a) Homogeneous (b) Isotropic
(c) Elastic (d) Plastic

(vi) Thermal stress depends on:

(a) Change in temperature (b) Coefficient of expansion (α)
(c) Modulus of Elasticity (E) (d) All of the above

(vii) The value of Poisson's ratio for steel varies between:

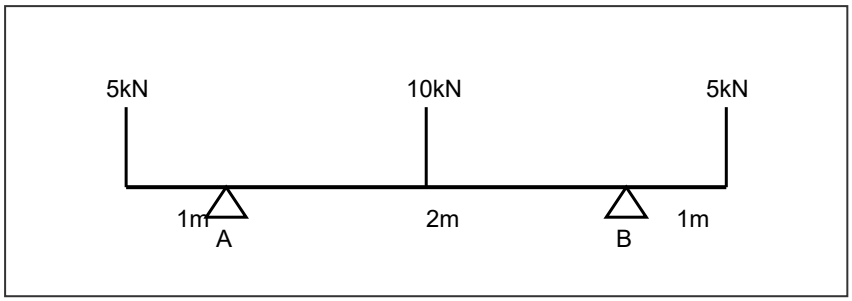
(a) 0.25 to 0.33 (b) 0.4 to 0.5
(c) 0.0 to 0.1 (d) 1.0 to 2.0

SECTION B (Long Answer Type)

Q.2. (a) [Theory] Derive the relationship among **Young's Modulus (E)**, **Modulus of Rigidity (G)**, and **Bulk Modulus (K)**:
$E = 9KG / (3K+G)$. [7]

Q.2. (b) [Theory] Explain **Resilience**, **Proof Resilience**, and **Modulus of Resilience**. Illustrate the concept using the area under the stress-strain curve. **[7]**

Q.3. (a) [Numerical] A beam is simply supported at A and B with overhangs on both sides. Draw the **SFD and BMD** for the loading shown below. **[7]**



Q.3. (b) [Theory] State and explain the **Theorem of Parallel Axes** and **Theorem of Perpendicular Axes** for Moment of Inertia. **[7]**

Q.4. (a) [Numerical] A rectangular beam is to support a UDL of 10 kN/m over a span of 4 m. If the depth is twice the width (d=2b) and bending stress is not to exceed 8 MPa, find the **Dimensions of the cross-section**. **[7]**

Q.4. (b) [Theory] Explain the distribution of Bending Stress across the depth of a beam. Prove that the **Neutral Axis coincides with the Centroid** of the cross-section. **[7]**

Q.5. (a) [Numerical] A solid shaft is required to transmit a torque of 20 kNm. Find the necessary **diameter of the shaft** if the allowable shear stress is 60 MPa and the allowable twist is 1° for every 20 diameters length of the shaft. (Take G = 80 GPa). **[7]**

Q.5. (b) [Theory] Explain **Rankine's Formula** for columns. How does it differ from Euler's formula? Define Crushing Load. **[7]**

Q.6. (a) [Theory] Derive the expression for **Circumferential (Hoop) Stress** and **Longitudinal Stress** in a thin cylindrical shell subjected to internal fluid pressure. **[7]**

Q.6. (b) [Numerical] A thin cylindrical shell of 1m internal diameter and 10 mm thickness is subjected to an internal pressure of 2 N/mm². Calculate the **Hoop Stress** and **Longitudinal Stress**. **[7]**

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

a. Strain Energy due to Torsion

b. Equivalent Length of Column

c. Torsional Rigidity

d. Principal Planes (Brief Concept)

e. Ductility vs Brittleness
