

**MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL**

Paper Code : PC-ROB 402/PC-AUE 401/PC-ME403 Strength of Materials

UPID : 004432

Time Allotted : 3 Hours

Full Marks : 70

The Figures in the margin indicate full marks

Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer any ten of the following :

[1 x 10 = 10]

- (i) Young's modulus is defined as the ratio of _____.
- (ii) Tensile strength of a material is obtained by dividing the maximum load during the test by the _____.
- (iii) A simply supported beam with a gradually varying load from zero at 'B' and 'w' per unit length at 'A' is shown in the below figure. The shear force at 'B' is equal to _____.



- (iv) The assumption made in Euler's column theory is that _____.
- (v) Percentage reduction in area performing tensile test on cast iron may be of the order of _____.
- (vi) When a body is subjected to a direct tensile stress (σ_x) in one plane accompanied by a simple shear stress (τ_{xy}), the minimum normal stress is _____.
- (vii) The torque transmitted by a hollow shaft of outer diameter (d_1) and inner diameter (d_2) is _____ (where, τ = Maximum allowable shear stress).
- (viii) If the slenderness ratio for a column is 100, then it is said to be a _____ column.
- (ix) The energy stored in a body when strained within elastic limit is known as _____.
- (x) The intensity of stress which causes unit strain is called _____.
- (xi) Modular ratio of two materials is the ratio of _____.
- (xii) The bending moment at a point on a beam is the algebraic _____ of all the moments on either side of the point.

Group-B (Short Answer Type Question)

Answer any three of the following :

[5 x 3 = 15]

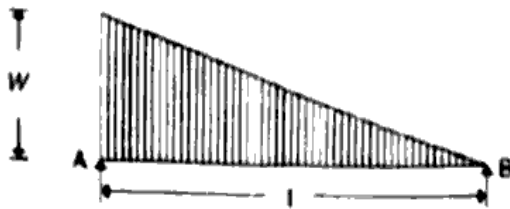
1. Why the bending stress in a beam is inversely proportional to section modulus? [5]
2. If the radius of wire stretched by a load is doubled, then what happens to its Young's modulus and why? [5]
3. What is Resilience and what is its effect? [5]
4. What is Impact strength of a material and what is its use? [5]
5. A composite shaft consisting of two stepped portions having spring constants K_1 and K_2 is held between two rigid supports at the ends. What is its equivalent spring constant? [5]

Group-C (Long Answer Type Question)

Answer any three of the following :

[15 x 3 = 45]

1. For the beam shown in the below figure, draw the SF&BM between A and B [15]



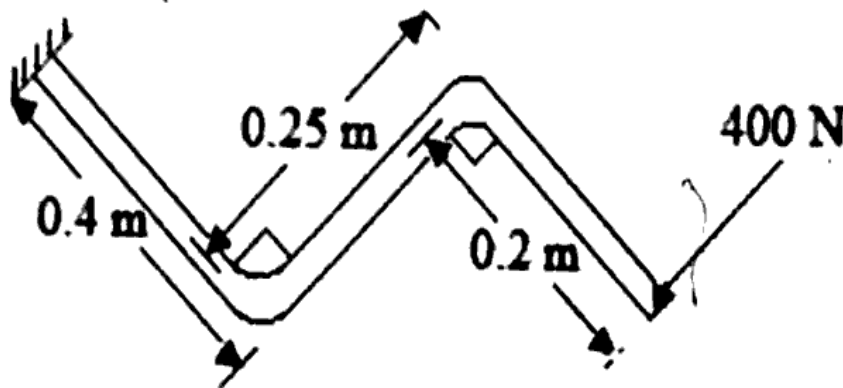
When a body is subjected to a direct tensile stress (σ_x) in one plane accompanied by a simple shear stress (τ_{xy}), find the maximum normal stress?

8. A load perpendicular to the plane of the handle is applied at the free end as shown in the given figure. The values of Shear Forces (S.F.), Bending Moment (B.M.) and torque at the fixed end of the handle have been determined respectively as 400 N, 340 Nm and 100 by a student.

[15]

Among these values, those of

- S.F., B.M. and torque are correct
- S.F. and B.M. are correct
- B.M. and torque are correct
- S.F. and torque are correct



9. A boiler shell 200 cm diameter and plate thickness 1.5 cm is subjected to internal pressure of 1.5 MN/m, what will be the hoop stress? Also define hoop stress.

[15]

10. A 10 mm diameter tensile specimen has a 50 mm gauge length. The load corresponding to the 0.2% offset is 55 kN and the maximum load is 70 kN. Fracture occurs at 60 kN. The diameter after fracture is 8 mm and the gauge length at fracture is 65 mm.

[15]

Calculate the following properties of the material from the tension test.

- % Elongation
- Reduction of Area (RA) %
- Tensile strength or ultimate tensile strength (UTS)
- Yield strength
- Fracture strength
- If $E = 200 \text{ GPa}$, the elastic recoverable strain at maximum load
- If the elongation at maximum load (the uniform elongation) is 20%, what is the plastic strain at maximum load?

11. Find the relation between equivalent length (L) and actual length (l) of a column for both ends fixed.

[15]

When a closely-coiled helical spring of mean diameter (D) is subjected to an axial load (W), what is the deflection of the spring (δ)? (Where d = Diameter of spring wire, n = No. of turns of the spring, and C = Modulus of rigidity for the spring material).

*** END OF PAPER ***