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# BRAINWARE UNIVERSITY



**Term End Examination 2025-2026**
**Programme – Dip.ME-2024**
**Course Name – Strength of Materials**
**Course Code - DME30104**
**( Semester III )**

**Full Marks : 60** **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

## Group-A

(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) Identify the mateial which has identical properties in all direction.

a) Homogeneous b) Isotropic.
c) Elastic. d) None of these.

(ii) Identify the correct mechanical properties which is developed due to resistance of a body during deformation.

a) Stress. b) Strain.
c) Pressure. d) Modulas of rigidity.

(iii) The modulus of elasticity in terms of bulk modulus and modulus of rigidity can be defined as ________.

a) 9KG/(3K+G) b) 9KG/(K+3G)
c) (K+3G)/9KG d) (3K+G)/9KG

(iv) Identify the bulk modulus of a material having E = 200 GPa and G = 80 GPa.

a) 233.3 GPa. b) 133.3 GPa.
c) 250 GPa. d) 130 GPa.

(v) Identify where the point of contraflexure lies.

a) Shear Force changing sign. b) Bending moment is zero or changing sign.
c) Shear force is zero. d) Bending moment is maximum.

(vi) The variation of the bending moment due to a uniformly distributed load is identified by ________.

a) Cubic law. b) Parabolic law.
c) Linear law. d) Uniform law.

(vii) Interpret the following statements about diagrams and identify the false one: I. Slope of BMD = shear. II. Slope of SFD = load intensity. III. Slope of curvature = flexural rotation. IV. Second derivative of deflection = curvature.

a) I only
b) II only
c) III only
d) IV only

(viii) A cantilever beam OP is connected via pin at P to PQ. A 10 kN load is applied at midpoint of PQ. Analyze and compute bending moment at fixed end O.

a) 2.5 kN-m.
b) 5 kN-m.
c) 10 kN-m.
d) 25 kN-m.

(ix) Interpret the shape of the bending moment diagram for a uniform cantilever beam loaded by a single concentrated load at the free end.

a) Rectangle.
b) Triangle.
c) Trapezium.
d) Parabola.

(x) Apply the bending equation to calculate the radius of curvature of a beam subjected to a known moment.

a) $\sigma / Y$
b) $R = E / \sigma$
c) $R = M / E$
d) $R = Y / \sigma$

(xi) Determine the deflection at the free end of a cantilever beam subjected to a point load.

a) $PL / EI$
b) $PL^3 / 3EI$
c) $PL^2 / 2EI$
d) $2PL / EI$

(xii) Identify the symbol used for polar moment of inertia.

a) M
b) J
c) I
d) A

(xiii) Describe the term "safe load" in spring design.

a) Load under yield point
b) Maximum permissible load
c) Buckling load
d) Minimum working load

(xiv) Recall the governing equation for thin cylindrical shells.

a) $\sigma_h = pd/2t$
b) $\sigma_l = pd/2t$
c) $\sigma = E\varepsilon$
d) $\sigma = M/I$

(xv) Determine total elongation in length of cylindrical shell due to pressure.

a) $\Delta L = \varepsilon \times L$
b) $\Delta L = \sigma \times L$
c) $\Delta L = \sigma/E$
d) $\Delta L = p \times L$



## Group-B

(Short Answer Type Questions) 3 x 5=15

2. Define the term 'Stress' and describe why Stress is a Tensor quantity. (3)
3. Express the relation between shear force and bending moment of a beam. (3)
4. Describe an expression for the strain energy of a shaft acted upon by bending and torsional stresses. (3)
5. Define hoop stress and longitudinal stress in a thin cylindrical shell subjected to internal pressure. (3)
6. Derive a relation for the shear stress across sections of a square with a triangular side base. (3)

**OR**

Prove the relation for simple bending. $\sigma/y = M/I = E/R$. (3)

## Group-C

(Long Answer Type Questions) 5 x 6=30

7. Describe Elasticity with suitable examples. Also state Hooke law. (5)
8. Explain the Sagging Bending Moment and Hogging Bending Moment with a neat sketch. (5)
9. Define the following terms as used in the theory of bending: a) Neutral Axis. b) Modulus of Section. c) Moment of Resistance. d) Radius of Curvature. e) Bending Stress. (5)
10. A shaft transmits a power of 280 kW. Evaluate: (5)

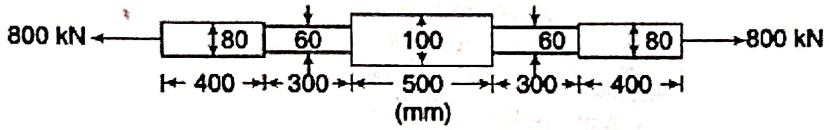
(i) The diameter of the solid shaft to transmit the required power.

(ii) The inner and outer diameter of the hollow shaft if the ratio of the inner and outer diameter is 2/3.

(iii) The percentage of saving material using hollow shaft compare to solid shaft.

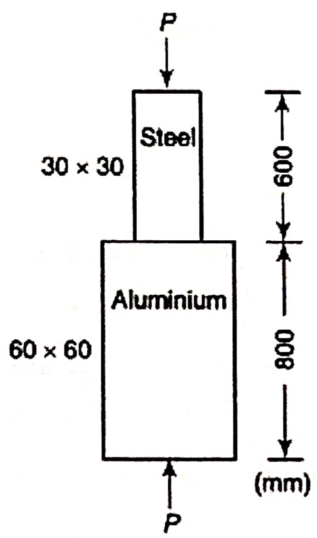
11. A closed end-cupper tube of 72 mm internal diameter, 800 mm long and 2 mm thick is filled with water under pressure. Calculate the change in pressure if additional 4000 $mm^3$ of water is pumped into the tube. Neglect any distortion of the end plates. Take E = 102 GPa, K = 2200 MPa and Poisson's ratio of 0.3. (5)

12. A circular bar of various cross-section is subjected to a pull of 800 kN as shown in the figure. Measure the percentage of extension of the bar if the Young's modulus of the bar is 204 GPa. (5)




OR

A bar made up with two equal cross-section of different metals, one is steel and another one is aluminium as shown in the figure. The bar is acted is acted upon a compressive load P. Deduce the value of P if the total decrease in length of the bar is 0.3 mm. Take $E_{al}$ = 75 GPa and $E_s$ = 205 GPa. (5)



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