BRAINWARE UNIVERSITY

Term End Examination 2024-2025
Programme – B.Tech.(ME)-2023
Course Name – Strength of Materials
Course Code - PCC-ME301
(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 correct range of poisson's ratio for steel
a) 0.32 to 0.42 b) 0.47 to 0.50
c) 0.25 to 0.35 d) 0.10 to 0.20

(ii) Identify, the number of independent elastic constants for an isotropic material
a) 2 b) 3
c) 9 d) 1

(iii) A non-hoookean material is _____. (Select from the options given below)
a) steel b) rubber
c) aluminium d) copper

(iv) The slope of the stress-strain curve in the elastic deformation region is
a) Elastic modulus b) Plastic modulus
c) Poisson's ratio d) None of the mentioned

(v) If the material has identical elastic properties in all directions, it is called
a) Elastic b) Isotropic
c) Plastic d) Homogeneous

(vi) A cylinderrical bar having a length of 100 mm and diameter of 10 mm is cut into two pieces by a longitudinal force of 10000 KN applied along the axis of the bar. Calculate the ultimate shear stress of the bar material in KN/mm2.
a) 10 b) 100
c) 1000 d) 10000

(vii) Hogging is _____
a) Negative bending moment b) Positive shear force
c) Positive bending moment d) Negative shear force

(viii) At the point of contraflexure, the value of bending moment is
a) Zero b) Maximum
c) Can not be determined d) Minimum

(ix) The rate of change of shear force is equal to _____

a) Direction of load
b) Change in BMD
c) Maximum bending
d) Intensity of loading

(x) If the section modulus of a beam is increased, the bending stress will

a) increase
b) decrease
c) remain unchanged
d) none of these

(xi) Torsional sectional modulus is also known as _____

a) Polar modulus
b) Sectional modulus
c) Torsion modulus
d) Torsional rigidity

(xii) The critical buckling load for a column is influenced by its _____.

a) Length and material properties
b) Cross-sectional area and temperature
c) Eccentricity and load application
d) Shear forces and bending moments

(xiii) Predict the formula for calculating the the polar moment of inertia of a hollow circular shaft with an outer diameter D and an inner diameter d.

a) $\pi(D^4 - d^4)/32$
b) $\pi(D^2 - d^2)/32$
c) $\pi(D^4 + d^4)/64$
d) $\pi(D^2 + d^2)/64$

(xiv) Select the unit of polar moment of inertia.

a) N/m^2
b) $kg \cdot m^2$
c) m
d) $N \cdot m$

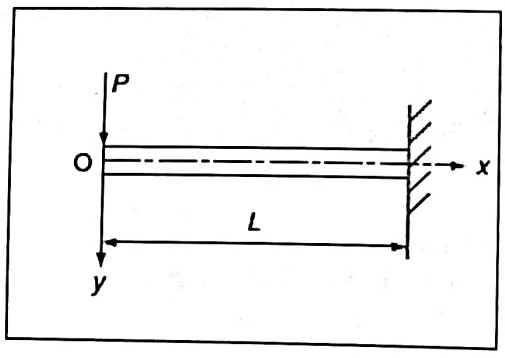
(xv) If a shaft's polar moment of inertia is halved, predict its impact to the torsional stiffness when subjected to the same torque.

a) The stiffness doubles
b) The stiffness remains the same
c) The stiffness is halved
d) The stiffness is reduced by a factor of 4

Group-B

(Short Answer Type Questions) 3 x 5=15

2. The diameter of a thin spherical shell is 1.2 m and its wall thickness is 5 mm. If the allowable tensile stress in the shell material be 100 N/mm2, determine the maximum allowable pressure of the fluid contained in the shell. (3)
3. Write down the bending equation with usual notation. (3)
4. For the cantilever beam as shown in Figure, compute the maximum deflection of the beam due to concentrated load P acting at the free end. Assume constant 'EI'. (3)



5. State Hooke's Law. (3)
6. Illustrate the complementary property of shear stresses. (3)

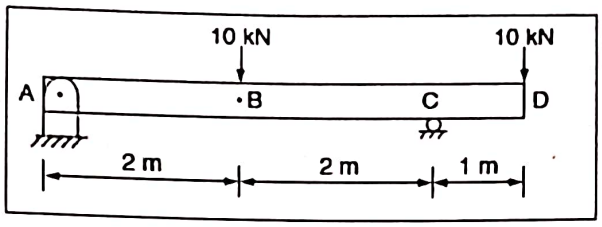
OR

"Steel is more elastic than rubber" -Justify this Statement. (3)

Group-C

(Long Answer Type Questions) 5 x 6=30

7. Define the Plane Stress. Write down the equilibrium equations for plane stress state. (5)
8. A simply supported beam with overhang is subjected to load as shown in figure. Sketch its shear force and bending moment diagrams. Compute the location of point of contraflexure, if any. (5)



9. Develop the expression of force equilibrium equations in 2-D Cartesian Co-ordinates System. (5)

10. State the difference between thin and thick cylinder. (5)

11. The state of stress at a point is given by (5)

$$\sigma_{xx} = x^2y^2 + 30, \qquad \tau_{xy} = 3x^3y^2$$
$$\sigma_{yy} = xz^3 + y^2 + 15, \qquad \tau_{yz} = x^2yz$$
$$\sigma_{zz} = xy^2z + 30, \qquad \tau_{zx} = xz^2$$

Evaluate the body force distribution at the point (2,3,1) so that stresses are in equilibrium. All units of stresses are in MPa.

12. Justify that, "a circular beam is stronger than a square beam when subjected to torsion (twisting)". (5)

OR

Two mutually perpendicular planes of an element are subjected to normal stresses of 10.5 Mpa (Tensile) and 3.5 MPa (compressive) and shear stress of 7 MPa. Estimate the magnitudes and direction of principal stresses. (5)