A   **Reg. No. :**

Question Paper Code: 94704

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2023

Fourth Semester

Mechanical Engineering

19UME404 - Mechanics of Materials

(Regulations 2019)

Duration: Three hours   Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The ratio of tensile stress to the tensile Strain is known as ___   CO1- U

    (a) Young's Modulus   (b) Poisson's ratio   (c) Stress   (d) Strain

2. A material which recovers fully after unloading is known as   CO1- U

    (a) Plastic   (b) Elastic   (c) In Elastic   (d) partially elastic

3. In a cantilever, carrying a load whose intensity   CO1- U
    varies uniformly from zero at the free end to weight
    per unit run at the fixed end, the BM changesfollowing a

    (a) linear law   (b) Parabolic law   (c) cubic law   (d) none of the above

4. BM at supports in case of simply supported beams is always   CO1- U

    (a) Less than   (b) More than   (c) Zero   (d) none of the
    unity   unity   above

5. In the torsion equation T/J= τ/R=Cθ/L, the term J/R is called _   CO1- U

    (a) Shear   (b) Section modulus   (c) Polar modulus   (d) None of these
    Modulus

6. The polar moment of inertia of a hollow shaft of outer   CO1- U
    diameter (D) and inner diameter (d) is

    (a) π/16(D3-d3)   (b) π/16(D4-d4)   (c) π/32(D4-d4)   (d) π/64(D4-d4)

7. The column which has highest equivalent length has ___   CO1- U

    (a) one end fixed otherpin joined   (b) both ends fixed

    (c) both ends hinged   (d) one   end   fixed other end free

8. All short columns fails by ------------------   CO1- U

    (a) Crushing   (b) Elongation   (c) Bending   (d) twisting

9. A thin cylindrical shell of diameter (d), length (l) is   CO1- U
    subjected to an internal pressure (p). The circumferential
    stress of the shell is ___

    (a) bulk removal   (b) minimum removal

    (c) surface finishing   (d) none of the above

10. Which of the following are usually considered as thin cylinders?   CO1- U

    (a) Boilers   (b) Tanks   (c) Steam pipes   (d) Water pipes

PART – B (5 x 2= 10 Marks)

11. Explain what is stress?   CO1- U

12. Explain what is cantilever beam?   CO1- U

13. Define polar modulus.   CO1- U

14. State the limitation of Euler's formula.   CO1- U

15. Define Hoop stress and longitudinal stress.   CO1- U

PART – C (5 x 16= 80 Marks)

16. (a) A mild steel rod of 20 mm diameter and 300 mm long is   CO2- App   (16)
        enclosed centrally inside a hollow upper tube of external
        diameter 30 mm and internal diameter of 25 mm. The ends of
        the tube and rods are brazed together and the composite bar is
        subjected to an axial pull of 40 kN. If E for steel and copper is
        200 GN/m^2 and 100 GN/m^2 respectively, find the stresses
        developed in the rod and tube. Also, find the extension
        of the rod.

                                          Or

    (b) A reinforced concrete column 500mm X 500mm in section is   CO1- U   (16)
        reinforced with 4 steel bars of 20mm diameter, one in each
        corner. The column is carrying a load of 750kN. Determine the
        stress in concrete and steel bars. Take E for steel as 210
        GPa and for concrete as 14 GPa. Also calculate load carried by
        steel and concrete.

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17. (a) A Cantilever 3.6 m long carries load of 30 KN, 70 KN, 40   CO2- App   (16)
    KN and 60 KN at distance of 0, 0.6, 1.5 and 2.4 m
    respectively from the free end. Draw the SF and
    BM diagrams for the cantilever

<div align="center">Or</div>

  (b) Draw the SF and BM diagram for a simply supported beam of   CO2- App   (16)
    span 9 m. The beam carries a UDL of 10 KN/m for a distance of
    6 m from the left support. Find the maximum value and their
    position. Give the values at important points in the
    diagram

18. (a) Find the diameter of a solid circular shaft to transmit 150 KW   CO2- App   (16)
    of power at 300 rpm. If the allowable shear stress is 90 MPa
    and twist is 1° over 2 m length of the shaft.
    Take rigidity modulus as 90 GPa.

<div align="center">Or</div>

  (b) A solid shaft is to transmit 300 KW at 100rpm if the shear   CO2- App   (16)
    stress is not to exceed 80N/mm2. Find the diameter of the
    shaft. If this shaft is to be replaced by hollow shaft of same
    material and length with an internal diameter of 0.6 times the
    external diameter, what percentage saving in weight is
    possible?

19. (a) A steel 8 m long and 80mm in diameter is used a column   CO2- App   (16)
    determine the crippling load by using Euler's formula when
    the column is used in any three end conditions.
    $E = 2.1 \times 10\ 5\ N/mm\ 2$.

<div align="center">Or</div>

  (b) A hollow cast iron column whose outside diameter is 200 mm   CO2- App   (16)
    has a thickness of 20 mm. The length of the column is 4.5 m
    with both of its fixed. Calculate the safe load for the column
    using Rankine's formula. Also calculate the ratio of Euler's
    crippling load to that of Rankine's critical load. Take factor of
    safety as 4. $f_c = 550\ N/mm^2$, $\alpha = 1/1600$ and $E = 94\ kN/mm^2$.

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20. (a) A cylinder has internal diameter of 230 mm, wall thickness 5   CO2- App   (16)
          mm and is 1 m long. It is found to change in internal volume by
          12 X 10-6 m3 when filled with a liquid at a pressure 'p'. Taking
          E = 200 GPa and poisson's ratio = 0.25, determine the stresses
          in the cylinder, the changes in its length and internal diameter.

                                        Or

     (b) A cylindrical shell 1 m internal diameter and 15 mm wall   CO2- App   (16)
          thickness is 3 m long. Calculate the maximum intensity of shear
          stress induced and also the changes in the dimensions of the
          shell if it is subjected to an internal pressure of 1.5 N/mm2.
          Take E = 2.04 X 105 N/mm2 and 1/m = 0.3.