A **Reg. No. :** | | | | | | | | | | | | |

Question Paper Code: U4704

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2024

Fourth Semester

Mechanical Engineering

21UME404 - MECHANICS Of MATERIALS

(Regulations 2021)

Duration: Three hours Maximum: 100 Marks

Answer All Questions

PART A - (10 x 1 = 10 Marks)

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

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

2. The equation of deflection (dl) equal to_____. CO1-U

   (a) AL / PE (b) PL / AE (c) PL / E (d) PA / E

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

   (a) Less than unity (c) Zero

   (b) More than unity (d) none of the above

4. The point of contraflexture is also called CO1-U

   (a) The point of inflexion (c) Either of the above

   (b) A virtual hinge (d) None of the above

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

   (a) $\pi/16(D^3-d^3)$ (b) $\pi/16(D^4-d^4)$ (c)$\pi/32(D^4-d^4)$ (d) $\pi/64(D^4-d^4)$

6. The Torque transmitted by a solid circular shaft is given by CO1-U

   a) $T= \pi/16\ \tau\ D^3$ b) $T= \pi/32\ \tau\ D^3$ c) $\pi/64\ \tau\ D^3$ d) $\pi/16\ \tau\ D^4$

7. If the slenderness ratio for a column is 100, then it is said to be a _____ column. CO1-U

   (a) Long (c) Medium

   (b) Short (d) None of the above

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 subjected to an internal pressure (p). The circumferential stress of the shell is _____ CO1-U

(a) pd/2t (b)pd/4t (c)pd/6t (d) pd/8t

10. In a thin shell, the ratio of longitudinal stress to the hoop stress is _____ CO1-U

(a) 1/2 (b) 3/4 (c) 1 (d) 2

PART – B (5 x 2= 10Marks)

11. Define Bulk Modulus. CO1-U

12. Classify shear force and bending moment? CO1-U

13. Explain torsional rigidity CO1-U

14. Show the limitations of Euler's formula. CO1-U

15. Show how could a thin cylindrical shell fail? CO1-U

PART – C (5 x 16= 80Marks)

16. (a) A reinforced concrete column 500 mm x 500 mm in section is reinforced with 4 steel bars of 25 mm diameter; one in each corner, the column is carrying a load of 1000 KN. Find the stresses in the concrete and steel bars. Take E for steel =210 x 10^3 N/mm^2 and E for concrete = 14 x10^3 N/mm^2. CO2-App (16)

Or

(b) A steel rod of 3cm diameter is enclosed centrally in a hollow copper tube of external diameter 5cm and internal diameter of 4 cm. The composite bar is then subjected to an axial pull of 45,000 N. If the length of each bar is equal to 15 cm, determine:
(i) The stresses in the rod and tube, and (ii) Load carried by each bar.
Take E for steel = 2.1 x 10^5 N/mm^2 and for copper = 1.1 x 10^5 N/mm^2 CO2-App (16)

17. (a) A Cantilever 3.6 m long carries load of 30 KN, 70 KN, 40 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 beam. CO2-App (16)

Or

(b) A simply supported beam 9 m long is loaded with a UDL of 1800 N/m over a length of 4 m from the left end. Draw the SF and BM diagram for the beam and calculate the magnitude and position of the maximum BM. CO2-App (16)

18. (a) A hollow shaft, having an internal diameter 50% of its external diameter, transmits 600 KW at 150 rpm. Determine the external diameter of the shaft if the shear stress is not to exceed 65 N/mm^2 and the twist in a length of 3m should not exceed 1.4 degrees. Assume maximum torque 1.2 times the mean torque and modulus of rigidity = $1x10^5$ N/mm^2 CO3 App (16)

Or

(b) A solid circular shaft transmits 75 KW power at 200 rpm. Calculate the shaft diameter, if the twist in the shaft is not to exceed 1degree in 2 m length of the shaft, and shear stress is limited to 50 N/mm^2. Take C = 1 $x10^5$ N/mm^2. CO2-App (16)

19. (a) A cast iron column has circular c/s of 60 mm diameter and 2 m long. If one of the ends of the column is fixed position and other end is free, calculate the safe load by using:
    (a) Rankine's formula, take σ_c = 500 N/mm^2, a = 1/1600
    (b) Euler's formula, take E= 1.2 X 10^5 N/ mm^2. The factor of safety of the column is 3. CO3-App (16)

Or

(b) A hollow cast iron column 250 mm outside diameter and 200 mm inside diameter, 6 m long has both ends fixed, It is subjected to an axial compressive load. Taking factor of safety as 5, σ_c = 500 N/mm^2, a = 1/1600. Determine the safe Rankine load. CO3-App (16)

20. (a) A cylindrical shell 1 m diameter and 3 m length is subjected to an internal pressure of 2 MPa. Calculate the minimum thickness if the stress should not exceed 50 MPa. Find the changes in diameter and volume of the shell. Take μ = 0.3 and E = 200 KN/mm^2. CO3- App (16)

Or

(b) A cylindrical shell 90 cm long 20 cm internal diameter having thickness of metal as 8 mm is filled with fluid at atmospheric pressure. If an additional 20 cm^3 of fluid is pumped into the cylinder, find (i) the pressure exerted by the fluid on the cylinder and (ii) the hoop stress induced. Take E= 2 x 10^5 N/mm^2 and μ = 0.3. CO3- App (16)