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Question Paper Code: U4704

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

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. 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. Thermal Strain is _____. CO1-U
(a) $\alpha T / E$ (b) αT (c) $\alpha T + E$ (d) αTE
3. A continuous beam is one which has CO1-U
(a) Less than two supports (b) Two supports only
(c) More than two supports (d) None of the above
4. In a cantilever, carrying a load whose intensity varies uniformly from zero at the free end to w per unit run at the fixed end, the BM changes following a CO1-U
(a) linear law (b) Parabolic law (c) cubic law (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. Torsional Rigidity is defined as----- CO1-U
(a) T / Θ (b) $C \times \Theta$ (c) $C \times J$ (d) $J \times \Theta$
7. If the slenderness ratio for a column is 100, then it is said to be CO1-U
a _____ column.
(a) Long (b) Short (c) Medium (d) None of the above

8. The slenderness ratio is the ratio of CO1-U
- (a) Length of column to least radius of gyration
 - (b) Moment of inertia to area of cross-section
 - (c) Area of cross-section to moment of inertia
 - (d) Least radius of gyration to length of the column

9. 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

10. In case of a thin walled cylinder the ratio of longitudinal strain to volumetric strain is CO1-U
- _____
- (a) $(3m-2)/(5m-4)$
 - (b) $(m-1)/(5m-1)$
 - (c) $(2m+1)/(m-5)$
 - (d) $(m-1)/(3m-2)$

PART – B (5 x 2= 10Marks)

- 11. Illustrate the elastic constants? CO1 U
- 12. Show the maximum bending moment in a simply supported beam of span 'L' subjected to UDL of 'w' over entire span? CO1-U
- 13. Illustrate the expression for power transmitted by a shaft. CO1-U
- 14. Explain buckling load CO1-U
- 15. Outline the stresses induced in a thin walled cylinder subjected to internal fluid pressure CO1-U

PART – C (5 x 16= 80Marks)

16. (a) A reinforced concrete column 500mm X 500mm in section is reinforced with 4 steel bars of 20mm diameter, one in each corner. The column is carrying a load of 750 KN. Determine the stresses 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. CO1- App (16)

Or

- (b) Three bar made of copper, Zinc and aluminum are equal length and have cross sections 500, 750 and 1000 mm² respectively. They are rigidly connected at their ends. If this compound member is subjected to a longitudinal pull of 250 kN. Estimate the proportional of the load carried on each rod and the induced stress. Take the Young's modulus for copper = 1.3×10^5 N/mm², for zinc = 1×10^5 N/mm² and for aluminum = 0.8×10^5 N/mm². CO1 -App (16)

17. (a) Draw the SF and BM diagram for the simply supported beam of span 7 m which carries point load of 36 kN at a distance of 2 m from the left end and spread UDL of 20 kN/m over a length of 4 m which is at distance of 1 m from the right end. CO3 -App (16)
- Or
- (b) A simply supported beam of span 10 m carries a concentrated load of 10 kN at 2 m from the left support and a UDL of 4 kN/m over the entire length. Sketch the shear force and bending moment diagram for the beam. CO3- App (16)
18. (a) A hollow shaft, having an internal diameter 50% of its external diameter, transmits 600kW at 150 rpm. Determine the external diameter of the shaft if the shear stress is not to exceed 65 N/mm² 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 = 1×10^5 N/mm² CO3 -App (16)
- Or
- (b) A composite shaft consists of copper rod of 25 mm diameter enclosed in a steel tube of external diameter 45 mm and 5 mm thick. The shaft is required to transmit a torque of 1100 N-m and both the shafts have equal lengths, welded to a plate at each end, so that their twists are equal. If the modulus of rigidity for steel is twice that of copper, find: (a) Shear stress developed in copper. (b) Shear stress developed in steel. CO3 -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: CO3 -App (16)
- (a) Rankine's formula, take $\sigma_c = 500$ N/mm², $a = 1/1600$
Euler's formula, take $E = 1.2 \times 10^5$ N/mm². The factor of safety of the column is 3.
- Or
- (b) A 1.5 m long column has a circular cross-section of 5 cm diameter. One of the ends of the column is fixed and the other end is free. Taking factor of safety as 3, calculate the safe load using: CO3-App (16)
- (a) Rankine's formula, take $\sigma_c = 560$ N/mm², $a = 1/1600$
Euler's formula, take $E = 1.2 \times 10^5$ N/mm².

20. (a) A boiler is subjected to an internal steam pressure of 2 N/mm^2 . CO3 -App (16)
The thickness of boiler plate is 2.0 cm and permissible tensile stress is 120 N/mm^2 . Find out the maximum diameter, when the efficiency of longitudinal joint is 90 % and circumference joint is 40 %.

Or

- (b) A thin spherical shell 1.5m in diameter, with its wall of 1.25 cm CO3-App (16)
thickness is filled with the fluid at atmospheric pressure. What intensity of pressure will be developed in it if 160 cm^3 more of fluid is pumped into it? Also calculate the hoop stress at that pressure and increase in diameter.