

B.E. DEGREE EXAMINATIONS: APRIL / MAY 2010

Fourth Semester

MECHANICAL ENGINEERING

U07ME401: Strength of Materials

Time: Three Hours

Maximum Marks: 100

Answer ALL the Questions:-

PART A (10 x 1 = 10 Marks)

1. If a force acts on a body, it sets up some resistance to the deformation. This resistance is known as
A. Stress B. Strain C. Elasticity D. Modulus of elasticity
2. A composite section, contains 4 different materials. The stresses in all the different materials will be
A. Zero B. equal C. different D. in the ratio of their areas.
3. The bending moment at the free end of a cantilever beam carrying any type of load is
A. Zero B. minimum C. maximum D. equal to the load
4. In the theory of simple bending, the bending stress in the beam section varies
A. linearly B. parabolically C. elliptically D. Zig-Zag
5. A cantilever beam of span "l" carries a UDL of "w" per unit length over its entire span. If its span is halved, then its slope will become
A. Half B. one - fourth C. one – eighth D. one - sixteenth
6. The slenderness ratio of a long column is
A. 10 – 20 B. 20 – 30 C. 50 – 60 D. above 80.
7. When a body is subjected to a direct tensile stress(σ) in one plane, then the tangential stress on an oblique section of the body inclined at an angle (θ) to normal of the section is equal to
A. $P \sin^2 \theta$ B. $P \cos^2 \theta$ C. $P/2 \sin^2 \theta$ D. $P/2 \cos^2 \theta$
8. In a thin shell, the ratio of longitudinal stress to the circumferential stress is
A. 1/2 B. 3/4 C. 1 D. 2
9. When a solid shaft is subjected to torsion, the shear stress induced in the shaft at its center is
A. Zero B. Minimum C. Maximum D. Average
10. When a closely coiled spring is subjected to an axial load, it is said to be under
A. bending B. shear C. torsion D. Shear and torsion

PART B (10 x 2 = 20 Marks)

11. Define shear stress and state the principle of shear stress.
12. Define strain energy is stored in a body.

13. Classify the beams, depending upon type of supports.
14. Define the terms shear force and bending moment.
15. What do you understand by the term “column”? Distinguish clearly between long and short column.
16. What are the uses of moment area method in finding out slope and deflection of beams?
17. Define principal planes and principal stresses.
18. Distinguish between cylindrical shell and spherical shell.
19. Write the assumptions for finding out the shear stress in a circular shaft, subjected to torsion.
20. What are helical springs? Classify it.

PART C (5 x 14 = 70 Marks)

21. a) A circular steel rod ABCD of different cross – section is loaded as shown in fig.1. Find the maximum stress induced in the rod and its deformation. Take $E= 200\text{GPa}$.

[OR]

- b) A composite bar made up of aluminum and steel, is held between two supports as shown in fig.2. The bars are stress-free at a temperature of 38°C . What will be the stresses in the two bars, when the temperature is 21°C , if (a) the supports are underlying, (b) the supports come nearer to each other by 0.1mm ? It can be assumed that the change of temperature is uniform all along the length of the bar. Take E for steel as 200GPa ; E for aluminum as 75GPa and coefficient of expansion for steel as 11.7×10^{-6} per $^\circ\text{C}$ and coefficient of expansion for aluminum as 23.4×10^{-6} per $^\circ\text{C}$.

22. a) A simply supported beam 5m long is loaded with a uniformly distributed load of 10kN/m over a length of 2m as shown in fig.3. Draw shear force and bending moment diagrams for the beam indicating the value of maximum bending moment.

[OR]

- b) A T – shaped cross – section of a beam shown in fig.4 is subjected to a vertical shear force of 100kN . Calculate the shear stress at important points and draw shear stress distribution diagram. Moment of inertia about the horizontal neutral axis is mm^4

23. a) By double integration method, derive the expression $Y_c = 5Wl^4 / 384EI$ for a simply supported beam with a uniform distributed load.

[OR]

- b) Find the Euler’s crippling load for a hollow cylindrical steel column of 38mm external diameter and 2.5mm thick. Take length of the column as 2.3m and hinged

at its both ends. Take $E=205\text{GPa}$. Also determine crippling load by Rankine's formula using constants as 335MPa and $1/7500$.

24. a) A plane element in a boiler is subjected to tensile stresses of 400MPa on one plane and 150MPa on the other at right angles to the former. Each of the above stresses is accompanied by a shear stress of 100MPa such that when associated with the minor tensile stress tends to rotate the element in anticlockwise direction. Find
- (i) Principal stresses and their directions.
 - (ii) Maximum shearing stresses and the directions of the plane on which they act.

[OR]

- b) (i) A spherical shell of 2m diameter is made up of 10mm thick plates. Calculate the change in diameter and volume of the shell, when it is subjected to an internal pressure of 1.6MPa . Take $E= 200\text{GPa}$ and $1/m = 0.3$.
- (ii) A cylindrical shell of 1.3m diameter is made up of 18mm thick plates. Find the circumferential and tangential stress in the plates, if the boiler is subjected to an internal pressure of 2.4MPa . Take efficiency of joints as 70% .
25. a) A hollow steel shaft of 300mm external diameter and 200mm internal diameter has to be replaced by a solid alloy shaft. Assuming the same values of polar modulus for both, calculate the diameter of the latter and work out the ratio of their torsional rigidities. Take C for steel as $2.4C$ for alloy.

[OR]

- b) An open coil helical spring made up of 10mm diameter wire and of mean diameter of 100mm has 12 coils, angle of helix being 15° . Determine the axial deflection and the intensities of bending and shear stresses under an axial load of 500N . Take C as 80GPa and E as 200GPa .

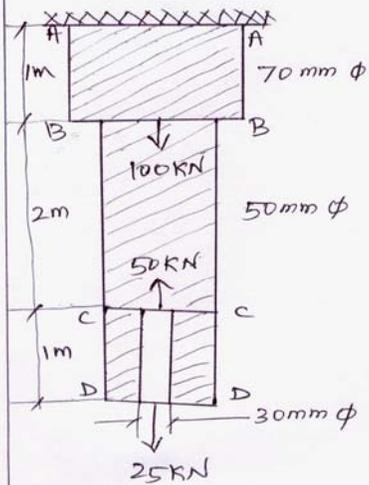


Fig. 1.

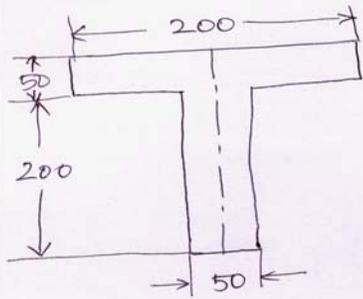


Fig. 4.

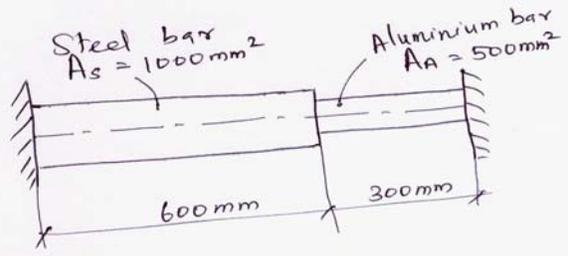


Fig. 2

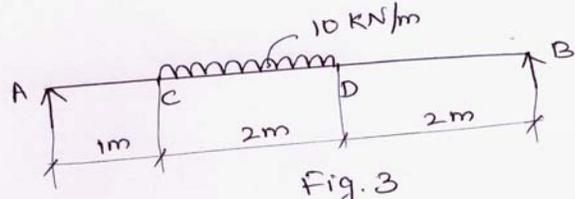


Fig. 3
