Reg. No. : | | | | | | | | | | | |

Question Paper Code: E3136

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2010

Fourth Semester

Mechanical Engineering

ME2254 — STRENGTH OF MATERIALS

(Regulation 2008)

(Common to Automobile Engineering, Production Engineering)

Time: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A — (10 · 2 = 20 Marks)

1. State Hooke's Law

2. Define bulk modulus.

3. What do you understand by the term 'Point of contraflexure'?

4. What is the value of bending moment corresponding to a point having a zero shear force?

5. Write the assumption for finding out the shear stress of a circular shaft, subjected to torsion.

6. Define the term stiffness of a spring.

7. What is the relation between slope, deflection and radius of curvature of a beam?

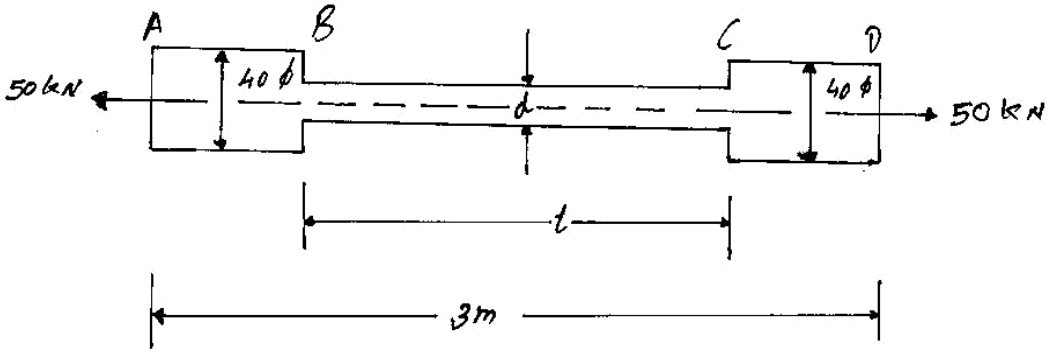
8. What are the assumptions made in Euler's column theory?

9. List out the modes of failure in thin cylindrical shell due to an internal pressure.

10. What do you mean by principal plane?

PART B — (5 · 16 = 80 Marks)

11. (a) (i) An alloy circular bar ABCD 3 m long is subjected to a tensile force of 50 kN as shown in figure. If the stress in the middle portion BC is not to exceed 150 MPa, then what should be its diameter? Also find the length of the middle portion, if the total extension of the bar should not exceed by 3 mm. Take E = 100 GPa. (12)



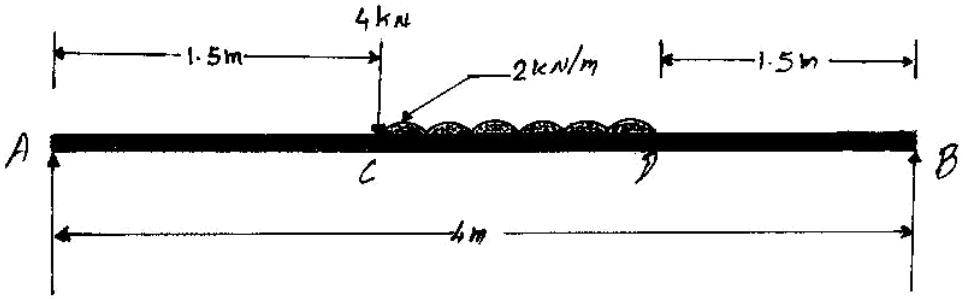
(ii) A circular bar rigidly fixed at its both ends uniformly tapers from 75 mm at one end to 50 mm at the other end. If its temperature is raised through 26 K, what will be the maximum stress developed in the bar. Take E as 200 GPa and α as $12 \cdot 10^{-6}$ /K for the bar material. (4)

Or

(b) (i) In an experiment, a bar of 30 mm diameter is subjected to a pull of 60 kN. The measured extension on gauge length of 200 mm is 0.09 mm and the change in diameter is 0.0039 mm. Calculate the Poisson's ratio and the values of the three modulii. (12)

(ii) An alloy specimen has modulus of elasticity of 120 GPa and modulus of rigidity of 45 GPa. Determine the Poisson's ratio of the material. (4)

12. (a) A simply supported beam of 4 m span is carrying loads as shown in figure. Draw the shear force and bending moment diagrams for the beam.



Or

(b) A horizontal beam 10 m long is carrying a uniformly distributed load of 1 kN/m. The beam is supported on two supports 6 m apart. Find the position of the supports, so that bending moment on the beam is as small as possible. Also draw the shear force and bending moment diagrams.

13. (a) (i) Obtain a relation for the torque and power, a solid shaft can transmit. (8)

(ii) A solid steel shaft has to transmit 100 kW at 160 r.p.m. Taking allowable shear stress as 70 MPa, find the suitable diameter of the shaft. The maximum torque transmitted in each revolution exceeds the mean by 20%. (8)

Or

(b) (i) Derive an equation for deflection of an open coiled helical spring. (8)

(ii) A closely coiled helical spring is made up of 10 mm diameter steel wire having 10 coils with 80 mm mean diameter. If the spring is subjected to an axial twist of 10 kN-mm, determine the bending stress and increase in the number of turns. Take E as 200 GPa. (8)

14. (a) A cantilever AB, 2 m long, is carrying a load of 20 kN at free end and 30 kN at a distance 1 m from the free end. Find the slope and deflection at the free end. Take E = 200 GPa and I = $150 \cdot 10^6$ mm^4 .

Or

(b) A simply supported beam AB of span 4 m, carrying a load of 100 kN at its mid span C has cross sectional moment of inertia $24 \cdot 10^6$ mm^4 over the left half of the span and $48 \cdot 10^6$ mm^4 over the right half. Find the slope at two supports and the deflection under the load. Take E = 200 GPa.

15. (a) (i) A cylindrical vessel 2 m long and 500 mm in diameter with 10 mm thick plates is subjected to an internal pressure of 3 MPa. Calculate the change in volume of the vessel. Take E = 200 GPa and Poisson's ratio = 0.3 for the vessel material. (8)

(ii) A spherical shell of 2 m diameter is made up of 10 mm thick plates. Calculate the change in diameter and volume of the shell, when it is subjected to an internal pressure of 1.6 MPa. Take E = 200 GPa and 1/m = 0.3. (8)

Or

(b) (i) A point in a strained material is subjected to two mutually perpendicular tensile stress of 200 MPa and 100 MPa. Determine the intensities of normal, shear and resultant stresses on a plane inclined at 30° with the axis of the minor tensile stress. (8)

(ii) A point is subjected to a tensile stress of 250 MPa in the horizontal direction and another tensile stress of 100 MPa in the vertical direction. The point is also subjected to a simple shear stress of 25 MPa, such that when it is associated with the major tensile stress, it tends to rotate the element in the clockwise direction. What is the magnitude of the normal and shear stresses on a section inclined at an angle of 20° with the major tensile stress? (8)