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

Question Paper Code : 11410

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2011

Fourth Semester

Mechanical Engineering

ME 2254 — STRENGTH OF MATERIALS

(Common to Automobile Engineering and Production Engineering)

(Regulation 2008)

(Common to PTME 2254 Strength of Materials for B.E. (Part-Time) Third Semester Mechanical Engineering-Regulation 2009)

Time : Three hours **Maximum : 100 marks**

Answer ALL questions

PART A — (10 × 2 = 20 marks)

1. A rod of diameter 30 mm and length 400 mm was found to elongate 0.35 mm when it was subjected to a load of 65 kN. Compute the modulus of elasticity of the material of this rod.
2. What is strain energy and write its unit in S.I. system?
3. Mention and sketch any two types of supports and cording for the beams.
4. Sketch the bending stress as well as shear stress distribution for a beam of rectangular cross section.
5. Write down the simple torsion formula with the meaning of each symbol for circular cross section.
6. Define stiffness of spring and mention its unit in SI system.
7. List any four methods of determining slope and deflection of loaded beam.
8. The actual length of a column is 10 m. Determine its effective length if both the ends of the column are rigidity fixed.
9. What are assumptions involved in the analysis of thin cylindrical shells.
10. Define principle planes.

PART B — (5 × 16 = 80 marks)

11. (a) Two vertical rods one of steel and other of copper are each rigidly fixed at the top and 600 mm apart. Diameters and lengths of the rods are 25 mm and 5 m respectively. A cross bar fixed to the rods at the lower end carries a load of 7 kN such that the cross bar remains horizontal even after loading. Find the steps in each rod and the position of the load on the cross bar. Assume the modulus of elasticity for steel and copper as 200 kN/mm^2 and 100 kN/mm^2 respectively.

Or

(b) A cast iron flat 300 mm long and 30 mm (thickness) × 60 mm (width) uniform cross section, is acted upon by the following forces :

30 kN tensile in the direction of the length

360 kN compression in the direction of the width

240 kN tensile in the direction of the thickness.

Calculate the direct strain, net strain in each direction and change in volume of the flat. Assume the modulus of elasticity and Poisson's ratio for cast iron as 140 kN/mm^2 and 0.25 respectively.

12. (a) Draw the shear force and bending moment diagrams for the beam shown in Fig. Q 12(a). Also determine the maximum bending moment and location of point of contra flexure.

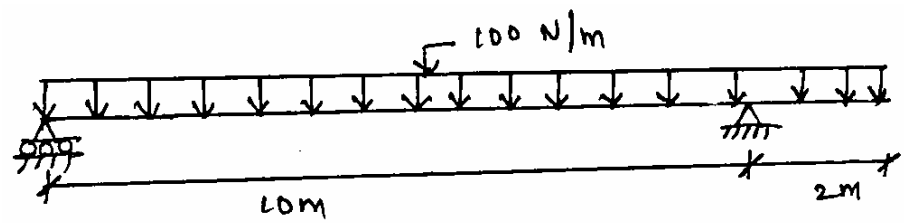

Fig. Q. 12(a)

Or

(b) A cast iron pipe 300 mm internal diameter, metal thickness 15 mm, is supported at two points 6 m apart. Find the maximum bending stress in the metal of the pipe when it is running full of water. Assume the specific weight of cast iron and water as 72 kN/m^3 and 10 kN/m^3 respectively.

13. (a) A steel shaft is required to transmit 75 kW power at 100 r.p.m. and the maximum twisting moment is 30% greater than the mean. Find the diameter of the steel shaft if the maximum stress is 70 N/mm^2. Also determine the angle of twist in a length of 3 m of the shaft. Assume the modulus of rigidity for steel as 90 kN/mm^2.

Or

(b) A helical spring, in which the mean diameter of the coils is 12 times the wire diameter, is to be designed to absorb 300 J energy with an extension of 150 mm. The maximum shear stress is not to exceed 140 N/mm^2. Determine the mean diameter of the spring, diameter of the wire which forms the spring and the number of turns. Assume the modulus of rigidity of the material of the spring as 80 kN/mm^2.

14. (a) **A beam of length 6 m is simply supported at the ends and carries two point loads of 48 kN and 40 kN at a distance of 1 m and 3 m respectively from the left support. Compute the slope and deflection under each load. Assume EI = 17000 kN–m^2.**

Or

(b) **A hollow cast iron strut 150 mm outer and 100 mm in diameter and 8 m long, one end pin jointed and other end is fixed, is subjected to an axial compressive load. Taking factor of safety as 5 and Rankine's constants 550 N/mm^2 and 1/1600, calculate the safe load.**

15. (a) **A cylindrical shell 800 mm in diameter, 3 m long is having 10 mm metal thickness. If the shell is subjected to an internal pressure of 2.5 N/mm^2,**

(i) **the change in diameter**

(ii) **the change in length and**

(iii) **the change in volume.**

Assume the modulus of elasticity and Poisson's ratio of the material of the shell as 200 kN/mm^2 and 0.25 respectively.

Or

(b) **The state of stress (in N/mm^2) acting at a certain point of the strained material is shown in Fig. Q 15(b). Compute**

(i) **The magnitude and nature of principal stresses and**

(ii) **The orientation of principal planes.**

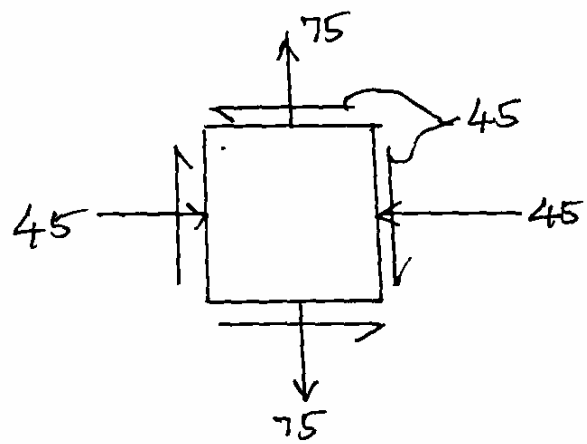

Fig. Q. 15(b)

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Question Paper Code : 53201

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2010

Fourth Semester

Mechanical Engineering

ME 2254 — STRENGTH OF MATERIALS

(Common to Automobile Engineering and Production Engineering)

(Regulation 2008)

(Also common to PTME 2254 Strength of Materials for Third Semester Mechanical Engineering B.E. Part – Time Regulation 2009)

Time : Three hours Maximum : 100 Marks

(Assume 1 ton = 1000 kg and 1 kg = 10 N)

Answer ALL questions

PART A — (10 × 2 = 20 Marks)

1. State the principle of superposition.

2. Define "Shear Stress".

3. Write down any four types of beams.

4. Write the expression for section modulus.

5. What is meant by stiffness of spring?

6. What is a laminated spring?

7. Mention any two methods of finding the slope and deflection of beams.

8. Write down the equations for maximum deflection of a simply Supported beam loaded with a central point load.

9. Define "Thin Shell".

10. Mention the types of stresses produced in thin cylindrical shells.

PART B — (5 × 16 = 80 Marks)

11. (a) A Mild steel rod of 20 mm diameter and 300 mm long is enclosed centrally inside a hollow copper tube of external diameter 30 mm and internal diameter 25 mm. The ends of the rod and tube 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 the tube also find the extension of the rod.

Or

(b) 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 moduli.

12. (a) A Cantilever 1.5 m long carries a load of 2 tons at its free end, and another load 1 ton at a distance of 0.5 m from the free end. Draw shear force and bending moment diagrams for the cantilever.

Or

(b) A beam of triangular cross section having base width of 100 mm and height of 150 mm is subjected to a shear force of 15 KN. Find the value of maximum shear stress, and sketch the shear stress distribution along the depth of beam.

13. (a) A bar of magnesium alloy 28 mm in diameter was tested on a gauge length of 25 cm in tension and in torsion. A tensile load of 5 tonnes produced an extension of 0.4 mm and a torque of 1250 kg-cm produced a twist of 1.51 degrees. Determine the (i) Young's modulus (ii) Modulus of rigidity (iii) Bulk modulus (iv) Poisson's ratio for the material under test.

Or

(b) An open coil helical spring made of 10 mm diameter wire and of mean diameter 10 cm has 12 coils, angle of helix being 15 degrees. Determine the axial deflection and the intensities of bending and shear stress under axial load of 50 kg. Take C as 0.8×10^6 kg/cm^2 and E as 0.2×10^6 kg/cm^2.

14. (a) A horizontal girder of steel having uniform section is 14 meters long and is simply supported at its ends. It caries concentrated loads of 12 tonnes and 8 tonnes at two points 3 metres and 4.5 metres from the two ends respectively. I for the section of the girder is 160×10^3 cm^4 and $E = 2.1 \times 10^6$ kg/cm^2 calculate the deflection of the girder at points under the two loads.

Or

(b) Find the Euler's crippling load for a hollow cylindrical steel column of 38 mm external diameter and 2.5 mm thick. Take length of the column as 2.3 m and hinged at its both ends. Take E = 205 kN/mm^2. Also determine the crippling load by Rankine's formula using f_c = 335N/mm^2 and a = 1/7500.

15. (a) A Cylindrical shell 3 meters long has 1 metre internal diameter and 15 mm metal thickness. Calculate the circumferential and longitudinal stresses induced and also changes in the dimensions of the shell, if it is subjected to an internal pressure of 15 kg/cm^2.

Take E = 2.0×10^6 kg/cm^2 and Poisson's ratio = 0.3.

Or

(b) At a point in a strained material the principal stresses are 100 N/mm^2 (tensile) and 60 N/mm^2 (compressive). Determine normal stress, shear stress, resultant stress on a plane inclined at 50 degrees to the axis of the major principal stress. Also determine the maximum shear stress at the point.

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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?

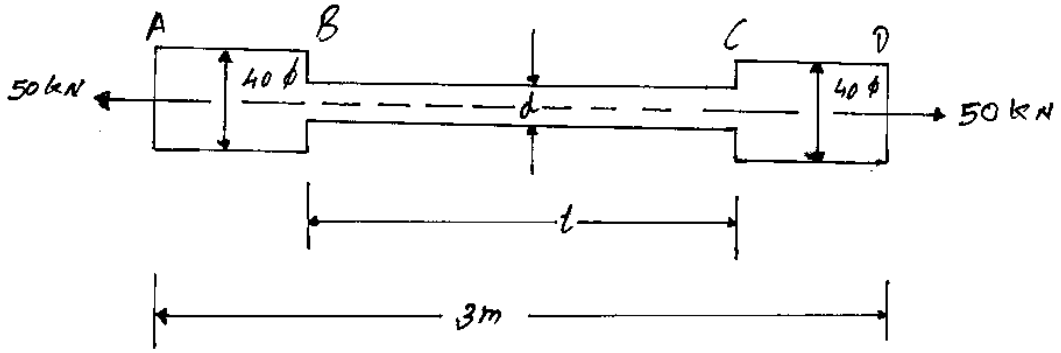
8. What are the assumptions made in Euler's column theory?

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)



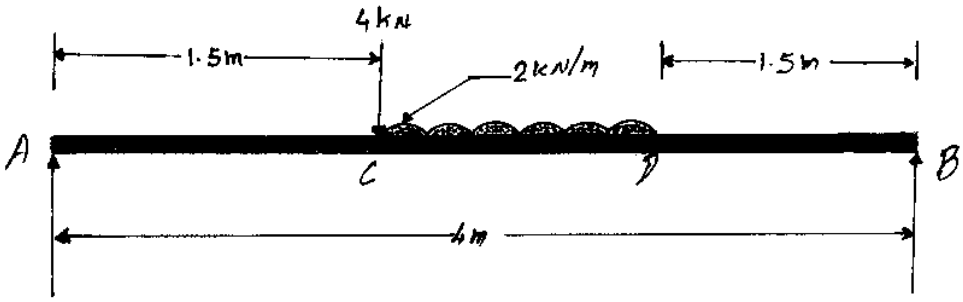
(ii) A circular bar rigidly fixed at its both ends uniformly tapers from 75 mm at one end to 50 mm at the other end. If its temperature is raised through 26 K, what will be the maximum stress developed in the bar. Take E as 200 GPa and α as $12 \times 10^{-6}/K$ for the bar material. (4)

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 = $150 \times 10^6 \text{ mm}^4$.

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 $24 \times 10^6 \text{ mm}^4$ over the left half of the span and $48 \times 10^6 \text{ mm}^4$ 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)

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