Code No: R059210303 **Set No. 1**

II B.Tech I Semester Supplimentary Examinations, February 2008
MECHANICS OF SOLIDS
(Common to Mechanical Engineering, Mechatronics, Metallurgy & Material Technology, Production Engineering, Aeronautical Engineering and Automobile Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. A rigid bar is supported by three rods, the outer one of steel and the central one of copper. The cross sectional area of each steel rod is 300 mm^2 and of the copper rod is 1000 mm^2. The three rods are equally spaced and the loads of 50 kN are each applied midway between the rods. Determine the forces in each of the vertical bars if the rigid bar remains horizontal after the loads have been applied. Neglect the weight of the rigid bar. Take Es = 205 kN/mm^2 and Ec = 110 kN/mm^2. [16]

2. A horizontal beam of 10m long is carrying a uniformly distributed load of 1 kN/m over the entire length. The beam is simply supported on two supports 6m apart. Find the position of the supports, so that the BM on the beam is as small as possible. Also draw the SF and BM diagrams. [16]

3. (a) State the assumptions involved in the theory of simple bending. [6]
   (b) Derive the Bending equation from fist principle. [10]

4. (a) Sketch the variation of shear stress across the depth of the beam of the following cross sections.
      i. T - section and [3]
      ii. Sequence section with diagonal vertical. [3]
      iii. Circular section. [3]
   (b) An I section is having overall depth as 550mm and overall width as 200mm. The thickness of the flanges is 25mm where as the thickness of the web is 20mm. If the section carries a shear force of 45kN, calculate the shear stress values at salient points and draw the sketch showing variation of shear stress. [7]

5. (a) What is degree of in determinancy in trusses? Explain with examples?
   (b) Explain method of tension coefficients, and explain why it is preferred to analyse the trusses ? [8+8]

6. A simply supported beam A B of span 6 meters and of flexural rigidity EI = 8 $\times 10^4 kN - m^2$ is subjected to a clockwise couple of 60 kN-m at a distance of 4 m from the left end.

   Find the deflection at the point of application of the couple and the maximum deflection and slope. [16]

7. A vertical steam boiler is of 2 m internal diameter and 5 m high. It is constructed with 20 mm thick plates for a working pressure of 1 N/mm^2. The end plates are flat and are not stayed. Calculate

   (a) the stress in the circumferential plates due to resisting the bursting effect and the stress in the circumferential plate due to the pressure on the end plates. [8]

   (b) the increase in length, diameter and volume. Assume the Poisson's ratio as 0.3 and E = 200 GN/m^2. [8]

8. Compare the values of max. and minimum hoop stresses for a cast steel cylindrical shell of 600 mm external dia. And 400 mm internal dia. Subjected to a pressure of $30N/mm^2$ applied

   (a) Internally and

   (b) Externally. [8+8]

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Code No: R059210303 **Set No. 2**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. A steel rod 28 mm diameter is fixed concentrically in a brass tube of 42 mm outer diameter and 30 mm inner diameter. Both the rod and tube are 450 mm long. The compound rod is held between two stops which are exactly 450 mm apart and the temperature of the bar is raised by 70^0C.

   (a) Find the stresses in the rod and tube if the distance between the stops is increased by 0.30 mm.

   (b) Find the increase in the distance between the stops if the force exerted between them is 90 kN

   Take $E_S = 200kN/mm^2$; $\alpha_S = 11.2 \times 10^{-6} per^0$C
   $E_b = 90kN/mm^2$; $\alpha_b = 2.1 \times 10^{-5} per^0$C [16]

2. Calculate the value of 'a' so that the maximum positive bending moment is equal to the maximum bending moment for the beam as shown in the Figure2. Draw the BMD using the calculated value of 'a'. [16]

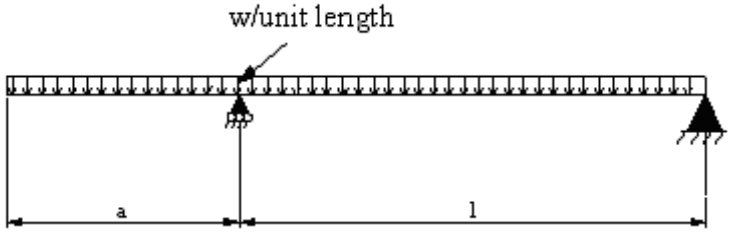

Figure 2

3. (a) State the assumptions involved in the theory of simple bending. [6]

   (b) Derive the Bending equation from fist principle. [10]

4. (a) What do you mean by shear stress in beams? [4]

   (b) From first principles derive the expression for shear stress at any point in any cross section of a beam which is subjected to a shear force F. [6]

   (c) A circular beam of 120mm diameter is subjected to a shear force of 7kN. Calculate:

      i. Average shear stress. [3]

      ii. Maximum shear stress. [3]

Also sketch the variation of the shear stress along the depth of the beam.

5. Analyse the frame shown in Figure 5. [16]

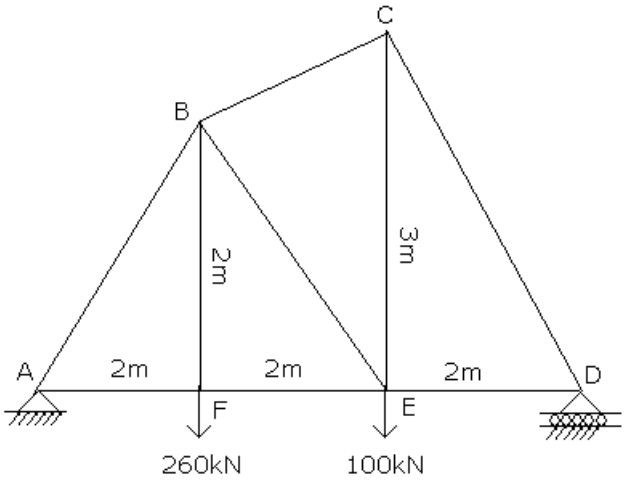

Figure 5

6. (a) What is Macaulay's method for finding out the slope and deflection? of a beam? Discuss the cases, where it is of a particular use. [6]

   (b) A 3 meters long cantilever is loaded with a point load of 450 N at the free end. If the section is rectangular 80 mm (wide) × 160 mm (deep), and E = 10 GN/m^2, calculate slope and deflection. [10]

   i. at the free end of the cantilever,

   ii. at a distance of 0.55 m from the free end.

7. (a) Derive an expression for the proportional increase in capacity of a thin cylindrical shell when it is subjected to an internal pressure. [8]

   (b) A vertical gas storage tank is made of 25 mm thick mild steel plate and has to withstand maximum internal pressure of 1.5 MN/m^2. Determine the diameter of the tank if stress is 240 MN/m^2, factor of safety is 4 and joint efficiency is 80%. [8]

8. Compare the values of max. and minimum hoop stresses for a cast steel cylindrical shell of 600 mm external dia. And 400 mm internal dia. Subjected to a pressure of $30N/mm^2$ applied

   (a) Internally and

   (b) Externally. [8+8]

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Code No: R059210303 **Set No. 3**

II B.Tech I Semester Supplimentary Examinations, February 2008
MECHANICS OF SOLIDS
(Common to Mechanical Engineering, Mechatronics, Metallurgy & Material Technology, Production Engineering, Aeronautical Engineering and Automobile Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) How do you find temperature stresses in case of a compound bar subjected to temperature rise ? [6]
   (b) A bar of brass 25 mm diameter is enclosed in a steel tube of 50 mm external diameter and 25 mm internal diameter. The bar and the tube are both initially 1m long and are rigidly fastened at both ends. Find the stresses in two materials when the temperature rises from 15^0C to 95^0C. If the composite bar is then subjected to an axial load of 60 kN, find the resulting stresses.
   E steel = 200×10^3 Mpa $\alpha\ steel = 11.6 \times 10^{-6}/^0$C
   E brass = 100×10^3 Mpa $\alpha\ brass = 18.7 \times 10^{-6}/^0$C [10]

2. Sketch the shear force and bending moment diagrams showing the salient values for the loaded beam shown in the figure 2 below. [16]

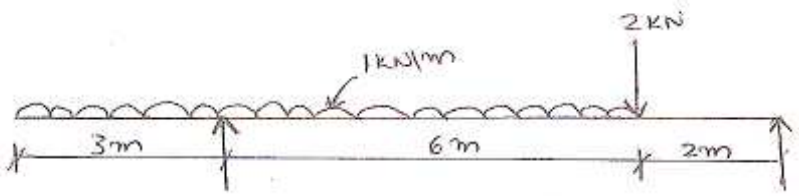

Figure 2

3. (a) State the assumptions involved in the theory of simple bending. [6]
   (b) Derive the Bending equation from fist principle. [10]

4. (a) Sketch the variation of shear stress across the depth of the beam of the following cross sections.
      i. T - section and [3]
      ii. Sequence section with diagonal vertical. [3]
      iii. Circular section. [3]
   (b) An I section is having overall depth as 550mm and overall width as 200mm. The thickness of the flanges is 25mm where as the thickness of the web is 20mm. If the section carries a shear force of 45kN, calculate the shear stress values at salient points and draw the sketch showing variation of shear stress. [7]

5. Analyse the frame shown in Figure 5. [16]

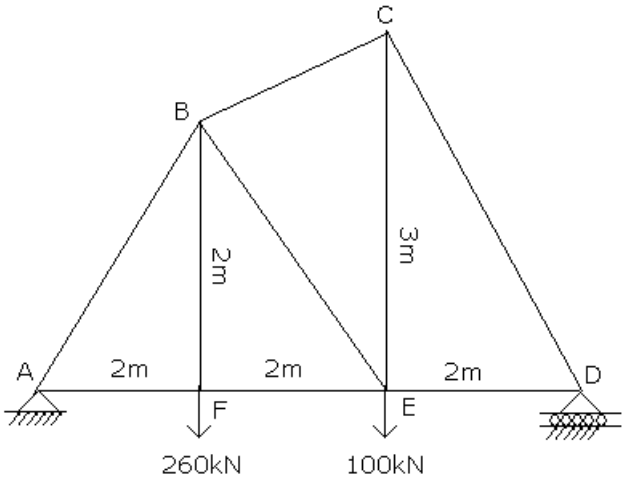

Figure 5

6. (a) What is moment area method? Explain the two Mohr's theorems, as applicable to the slope and deflection of a beam. [6]

   (b) A cantilever of uniform cross-section of length l carries two point loads, W at the free end and 2W at a distance a from the free end. Find the maximum deflection due to this loading. [10]

7. (a) Derive the relation for the change of diameter and length of a thin cylindrical shell subjected to an internal pressure. [10]

   (b) A thin cylinder steel shell of diameter 200 mm and wall thickness 4 mm has spherical ends. Determine the thickness of hemispherical ends if there is no distortion of the junction under pressure. [6]

8. A compound cylinder is formed by shrinking one tube on to another, the final dimensions being, internal diameter 120 mm, external diameter 240 mm, diameter at junction 180 mm. if after shrinking on, the radial pressure at the common surface is $8N/mm^2$, calculate the initial hoop stresses across the sections of the inner and outer tubes. If a fluid under a pressure of $60N/mm^2$, is admitted inside the compound cylinder, calculate the final stresses set up in the sections of the pipes. [16]

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Code No: R059210303 **Set No. 4**

II B.Tech I Semester Supplimentary Examinations, February 2008
MECHANICS OF SOLIDS
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What do you understand by Poisson's ratio ? Derive an expression for volumetric strain. [8]
   (b) Obtain a relation for the stress induced in a body if a load P is applied with an impact. [8]
2. (a) How do you classify loads? Give examples. [4]
   (b) A simply supported beam of length 5m carries a uniformly increasing load of 800 N/m run at one end to 1600 N/m run at the other end. Draw the S.F. and B.M. diagrams for the beam. [12]
3. (a) A cantilever of length 2.8 m fails when a load of 4.7 kN is applied at the free end. If the section of the beam is 65 mm × 105 mm find the stress at failure. [8]
   (b) A T-beam having flange 210 mm × 20 mm is simply supported over a span of 5 m. It carries a u.d.l of 8.8 kN/m over its entire span. Calculate the maximum compressive and tensile stress occurring in the section. What is the magnitude of flexural stress at the junction of flange and web? Draw the variation of stress across the section. [8]
4. (a) Obtain from first principles the expression for shear stress at any point in a circular section of a beam where it is subjected to a shear force F. Sketch the stress variation. [8]
   (b) An I-section has the following dimensions.
   Top and bottom flanges = 165 mm × 20 mm
   Web = 15 mm thick and 200mm deep
   The maximum shear stress developed in the beam is 17MPa.
   Find the shear force to which the beam is subjected. [8]
5. Analyse the cantilever truss shown in Figure 5 by method of sections. [16]

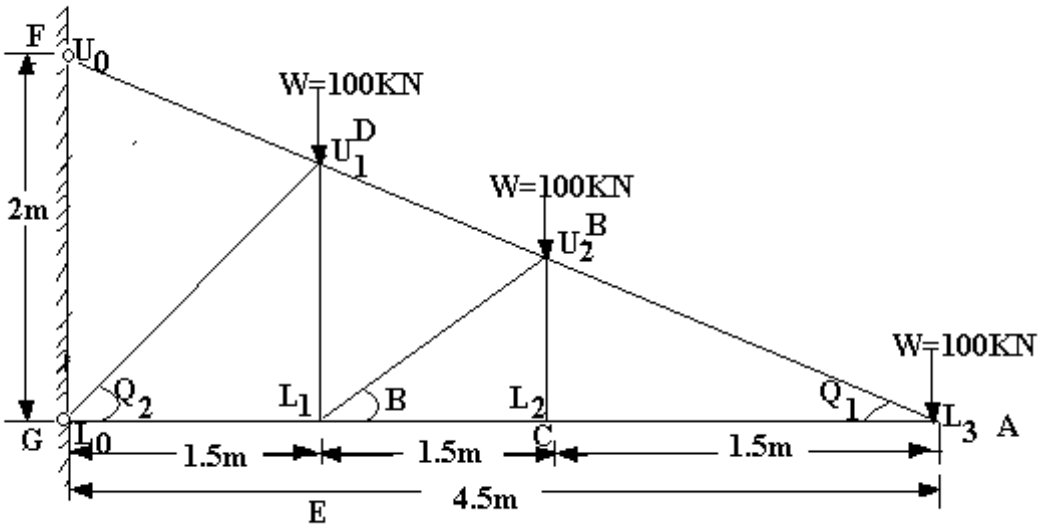

Figure 5

6. (a) What is moment area method? Explain the two Mohr's theorems, as applicable to the slope and deflection of a beam. [6]

   (b) A cantilever of uniform cross-section of length l carries two point loads, W at the free end and 2W at a distance a from the free end. Find the maximum deflection due to this loading. [10]

7. (a) Define pressure vessel and discuss the most important considerations while designing pressure vessel. [6]

   (b) A boiler shell is made of 15 mm thick plate having a limiting tensile stress of 125 N/mm^2. If the longitudinal and circumferential efficiencies are 70% and 60% respectively, determine the maximum diameter of the shell. The allowable maximum pressure is 2.2 N/mm^2. [10]

8. A compound cylinder is formed by shrinking one tube on to another, the final dimensions being, internal diameter 120 mm, external diameter 240 mm, diameter at junction 180 mm. if after shrinking on, the radial pressure at the common surface is $8N/mm^2$, calculate the initial hoop stresses across the sections of the inner and outer tubes. If a fluid under a pressure of $60N/mm^2$, is admitted inside the compound cylinder, calculate the final stresses set up in the sections of the pipes. [16]

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