Code No: RR220304 **Set No. 1**

II B.Tech II Semester Supplimentary Examinations, Aug/Sep 2007
MECHANICS OF SOLIDS
(Common to Mechanical Engineering, Production 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) Derive relation between three elastic moduli [8]
   (b) Draw stress - strain diagram for mild steel. Indicate salient points and define them. [8]

2. 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]

3. A beam of span 10m is simply supported at two points 6m apart with equal overhang on either side. Both the overhanging portions are loaded with a uniformly distributed load of 2 kN/m run and the beam also carries a concentrated load of 10 kN at the midspan. Construct the SF and BM diagrams and locate the points of inflexion, if any. [16]

4. (a) Discuss the assumptions involved in the theory of simple bending. [6]
   (b) The cross section of a simply supported beam is as shown in Figure 4. Find its moment of resistance if permissible tensile stress is 160MPa. Compare it with equivalent section of same area but [10]
      i. Square section
      ii. Rectangular section with twice the width and
      iii. a circular section.

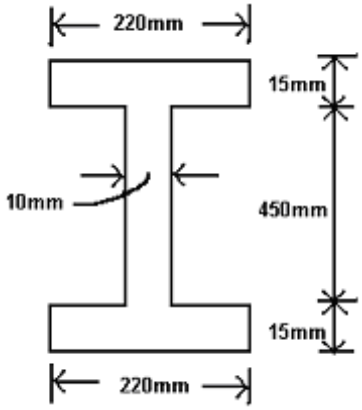

Figure 4

5. (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]

6. The cylindrical shell made of steel is having a diameter of 3 m and the shell is subjected to an internal pressure of 1.5 N/mm^2. Longitudinal joint efficiency of the shell is 85%, ultimate tensile strength of the steel plate is 480 N/mm^2 and the factor of safety is 5. Determine the thickness of the shell plate. [16]

7. Derive an expression for the shear stress produced in a circular shaft which is subjected to torsion. What are the assumptions made in the above derivation ? [16]

8. A propeller shaft, 160mm external diameter, 80mm internal diameter, transmits 450kW at 4/3 Hz. There is, at the same time, a bending moment of 30kN-m and an end thrust of 250kN. Find

   (a) the maximum principal stresses and their planes [6]

   (b) the maximum shear stress and its plane [6]

   (c) the stress, which acting alone, will produce the same maximum strain. Take poisson's ratio = 0.3 [4]

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Code No: RR220304 **Set No. 2**

II B.Tech II Semester Supplimentary Examinations, Aug/Sep 2007
MECHANICS OF SOLIDS
(Common to Mechanical Engineering, Production 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) Define the terms:
   i. Normal stress
   ii. Tangential stress
   iii. Ductility
   iv. Brittleness. [6]
   (b) A flat steel plate is of trapezoidal form of uniform thickness 't'. Its width at one end is 'a' and at the other end is 'b'. If its length is 'L', determine its elongation under an axial pull. [10]

2. (a) Define Factor of safety, Poisson's ratio and strain energy. [6]
   (b) Show that the volumetric strain of a body is the algebraic sum of the linear strains in three mutually perpendicular directions. [10]

3. (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]

4. (a) What is elastic section modulus? [4]
   (b) A beam resting freely on supports 5.8m apart carries a u.d.l of 12 kN/m and also a point load of 15 kN at 2m from the left support. If the permissible stress in timber is 5 MPa, design a suitable section by making the depth equal to 1.8 times the width. [12]

5. (a) A girder of uniform section and constant depth is freely supported over a span of 2.5 meters. Calculate the central deflection and slopes at the ends of the beam under a central load of 25 kN. Given: I $_{XX} = 7.807 \times 10^{-6} m^4$ and E = 200 GN/m^2 . [8]
   (b) A simply supported 6 meters long rolled steel joist carries a uniformly distributed load of 9.5 kN/meter length. Determine slope and deflection at a distance of 3 meters from one end of the beam. [8]

6. Calculate the increase in volume enclosed by a boiler shell 2.5 m long and 1 m in diameter, when it is subjected to an internal pressure of 1.5 N/mm^2. The wall thickness is such that the maximum tensile stress is 22 N/mm^2, under this pressure. Given E = 200 kN/mm^2 and Poisson's ratio = 0.25. [16]

7. Derive an expression for the Euler's crippling load for a long column with following end conditions:
   (a) both ends are hinged
   (b) both ends are fixed. [16]

8. A propeller shaft, 160mm external diameter, 80mm internal diameter, transmits 450kW at 4/3 Hz. There is, at the same time, a bending moment of 30kN-m and an end thrust of 250kN. Find
   (a) the maximum principal stresses and their planes [6]
   (b) the maximum shear stress and its plane [6]
   (c) the stress, which acting alone, will produce the same maximum strain. Take poisson's ratio = 0.3 [4]

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Code No: RR220304 **Set No. 3**

II B.Tech II Semester Supplimentary Examinations, Aug/Sep 2007
MECHANICS OF SOLIDS
(Common to Mechanical Engineering, Production 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) The piston of a steam engine is 40 cm in diameter while the piston rod is 6 cm in diameter. The pressure of the steam acting is 1.05 N/mm^2. Find the stress in the piston rod and its elongation, if the piston rod is 75 cm long. E = 205 kN/mm^2 when the piston is on in the instroke. [8]

   (b) A reinforced concrete column 50 cm in diameter has four 30 mm diameter steel rods embedded, and carries an axial load of 850 kN. Calculate the stresses in each of the two materials. E for steel = $2.04\times10^5 N/mm^2$ and E for concrete = $0.136\times10^5 N/mm^2$. What is the adhesive force between steel and concrete. [8]

2. 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 $E_S = 200kN/mm^2$; $\alpha_S = 11.2\times10^{-6} per^0$C
   $E_b = 90kN/mm^2$; $\alpha_b = 2.1\times10^{-5} per^0$C [16]

3. (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]

4. (a) A beam of square section is used as beam with one diagonal horizontal. Obtain the magnitude and location of maximum shear stress in the beam. Draw the variation of shear stress across the section. [8]

   (b) A beam is of T-section, flange 145mm × 15mm, web 18mm × 120mm. If it is subjected to a shear force of 30kN, find the maximum intensity of shear stress and sketch the distribution of shear stress across the section. [8]

5. (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]

6. 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]

7. Derive an expression for the shear stress produced in a circular shaft which is subjected to torsion. What are the assumptions made in the above derivation ? [16]

8. A propeller shaft, 160mm external diameter, 80mm internal diameter, transmits 450kW at 4/3 Hz. There is, at the same time, a bending moment of 30kN-m and an end thrust of 250kN. Find

   (a) the maximum principal stresses and their planes [6]

   (b) the maximum shear stress and its plane [6]

   (c) the stress, which acting alone, will produce the same maximum strain. Take poisson's ratio = 0.3 [4]

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Code No: RR220304 **Set No. 4**

II B.Tech II Semester Supplimentary Examinations, Aug/Sep 2007
MECHANICS OF SOLIDS
(Common to Mechanical Engineering, Production 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) Define and explain the terms:
   i. Modulus of Elasticity
   ii. Modulus of Rigidity
   iii. Poisson's ratio
   iv. Bulk Modulus. [6]
   (b) Two vertical rods one of steel and the other of copper are each rigidly fixed at the top and 600 mm apart. The diameter and length of each rod are 30 mm and 375 mm respectively. A cross bar fixed to the rods at the lower ends carries a load of 5 kN such that the cross bar remains horizontal even after loading. Find the stress in each rod and the position of the load on the bar. E_S = 200 Gpa and E_C = 100 Gpa. [10]

2. (a) Define Factor of safety, Poisson's ratio and strain energy. [6]
   (b) Show that the volumetric strain of a body is the algebraic sum of the linear strains in three mutually perpendicular directions. [10]

3. (a) Define shear force and bending moment. [4]
   (b) A horizontal beam AB of length 4m in hinged at A and supported on rollers at B. the beam carries inclined loads of 100N, 200N and 300N incised towards the roller support at $60^0, 45^0$ and 30^0 Respectively to the horizontal, at 1m, 2m and 3m respectively from A. draw the SF and BM diagrams. [12]

4. (a) A simply supported beam of span 6 m has a cross section 180 mm × 300 mm. If the permissible stress is 9 MPa, find the maximum concentrated load that can be applied at 2m from left end. [8]
   (b) A rolled steel joist of I section has top and bottom flanges 185 mm × 25 mm and web of size 300 mm × 15 mm. It is used as a simply supported beam over a span 5m to carry an uniformly distributed load of 75 kN/m over its entire span. Draw bending stress across a section at $(\frac{1}{5})$th the span. [8]

5. (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]

6. Derive the formula for the thickness of the thin cylindrical shell and solve the following problem. A thin cylindrical shell of 1 m diameter is subjected to an internal pressure of 1 N/mm^2. Calculate the suitable thickness of the shell, if the tensile strength of the plate is 400 N/mm^2 and factor of safety is 4. [16]

7. At a point in material under stress, the intensity of resultant stress on a certain plane is 60 N/mm^2 (tensile) inclined 30^0 to normal of that plane. The stress on a plane at right angles to this has a normal tensile component of intensity 40 N/mm^2. Find fully

   (a) The resultant stress on the second plane

   (b) The principal planes and stresses

   (c) The plane of maximum shear and its intensity. [16]

8. A propeller shaft, 160mm external diameter, 80mm internal diameter, transmits 450kW at 4/3 Hz. There is, at the same time, a bending moment of 30kN-m and an end thrust of 250kN. Find

   (a) the maximum principal stresses and their planes [6]

   (b) the maximum shear stress and its plane [6]

   (c) the stress, which acting alone, will produce the same maximum strain. Take poisson's ratio = 0.3 [4]

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