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

II B.Tech II Semester Regular Examinations, Apr/May 2006
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. Complementary shear
   ii. Poisson's ratio
   iii. Volumetric strain. [6]
   (b) If the Young's Modulus of elasticity of a material is twice its modulus of rigidity, then compute the Poisson's ratio of material. [10]

2. (a) What are the elastic constants ? Derive the relation between them. [8]
   (b) A load of 2.0 kN is to be raised at the end of a steel wire. If the stress in the wire must not exceed 100 N/mm^2, what is the minimum diameter of the wire? What will be the extension in 5.0 m long wire? Take E = 210 kN/mm^2. [8]

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) 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 1. 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.

5. An overhanging beam ABC 7 m long is supported at A and B such that AB = 4m. It is loaded with point load of 10 KN at the end C. If E = 200 $\times 10^2 kN/m^2$ and I = 12 $\times 10^{-6} m^4$ determine deflection at the point C and maximum deflection between A and B. [16]

6. A 2m diameter cast iron pipe has thickness of 10 mm and is closely wound with a layer of 5 mm diameter steel wire under a tensile stress of 50 N/mm^2. If water under a pressure of 3.2 N/mm^2 is admitted into the pipe, find the stresses induced in the pipe and steel wire. [16]

7. (a) Define slenderness ratio. State the limitations of Euler's formula. [4]

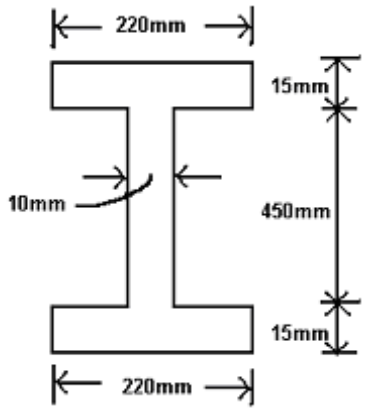

Figure 1:

(b) Derive an expression for the Rankine's crippling load for a column. [8]

(c) How will you justify the Rankine's formula is applicable for all lengths of columns, ranging from short to long columns. [4]

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**

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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. An unknown weight falls 4 cm on to a collar rigidly attached to the lower end of a vertical bar 4m long and 8 cm^2 in section. If the maximum instantaneous extension is found to be 0.42 cm, find the corresponding stress and the value of the unknown weight. E = 200 kN/mm^2. [16]

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 $E_S = 200 kN/mm^2$; $\alpha_S = 11.2 \times 10^{-6} per^0$C
   $E_b = 90 kN/mm^2$; $\alpha_b = 2.1 \times 10^{-5} per^0$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) State the assumptions involved in the theory of simple bending. [6]

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

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) Prove that the tendency to burst length wise is twice as great as a transverse section in a thin cylindrical shell subjected to an internal fluid pressure. [8]

   (b) A thin cylindrical shell 3 m long is of 1 m diameter. Determine the changes in length and diameter, if the shell is subjected to an internal pressure of 20 N/mm.^{2}. Take E = 200 kN/mm^2 and 1/m = 0.28. [8]

7. Derive an expression for the major and minor principal stresses on an oblique plane, when the body is subjected to direct stresses in two mutually perpendicular directions accompanied by a shear stress. [16]

8. (a) Derive an equation for the deflection of an open coiled helical spring. [8]

   (b) Find the maximum permissible axial load for a closely coiled helical spring made out of 10 mm square rod with 16 coils of 12 cm mean diameter if the maximum shear stress is limited to 300 N/mm^2, calculate also the deflection under the load if N=$0.84\times10^5 N/mm^2$. [8]

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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. Prove that Poisson's ratio for the material of a body is 0.5, if its volume does not change when stressed. Prove also that Poisson's ratio is zero when there is no lateral deformation when a member is axially stressed. [16]
3. 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 Figure1. Draw the BMD using the calculated value of 'a'. [16]

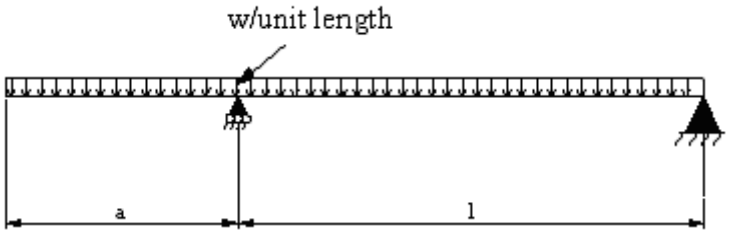

Figure 1:

4. (a) Find the dimensions of the strongest rectangular beam that can be cut out of a log of wood 2.6m diameter. [8]
   (b) A T-beam having flange 160mm × 20mm and web 20mm × 170mm is simply supported over a span of 6.5m. It carries a u.d.l of 6kN/m including self weight over its entire span, together with a point load of 40kN at mid span. Find the maximum tensile and compressive stresses occurring in the beam section and sketch the stresses across the section. [8]
5. (a) A beam of length L is supported at each end with a couple applied at an intermediate point. Deduce an expression for the deflection and hence calculate the deflection at the point of application of the moment. [8]
   (b) A beam of length L carries a uniformly distributed load w/unit length and rests on three supports, two at the ends and one in the middle. Find how much the middle support be lower than the end ones in order that the pressures on the three supports shall be equal. [8]

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. 4**

II B.Tech II Semester Regular Examinations, Apr/May 2006
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) State Hooke's Law. Explain Elastic limit. [6]
   (b) A steel bar 1.6 m long is acted upon by forces as shown in the Figure1. Find the elongation of the bar. Take E = 2.1×10^8 KN/m^2. [10]

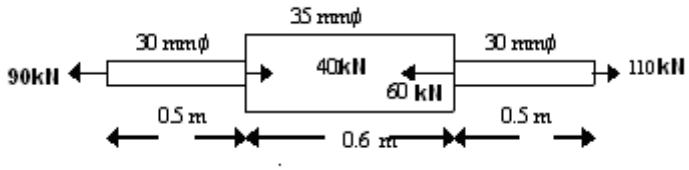

Figure 1:

2. (a) Derive the relationship between the three moduli of elasticity. [8]
   (b) Show that in a prismatic bar, the maximum stress intensity due to a suddenly applied load is twice the stress intensity produced by the same load applied gradually. [8]

3. (a) Device the relations among loading, shear force and bending moment in a beam. [9]
   (b) A cantilever beam AB span 6m is subjected to a uniformly varying load of 8 kN/m intensity at the fixed end A and zero at the free end B. draw SFD and BMD. [7]

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

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 2.4 m internal diameter and 6 m high vertical steam boiler is constructed with 20 mm thick plates for a working pressure of 1.1 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. [8]

Assume the Poisson's ratio as 0.28 and E = 210 kN/mm^2.

7. Direct stresses of 120 N/mm^2 tension and 90 N/mm^2 compression are applied to an elastic material at a certain point, on planes at right angles. The greater principal stress is limited to 150N/mm^2. What shearing stress may be applied to the given planes and what will be the maximum shearing stress at the point ? Work from the first principals. [16]

8. (a) Derive an expression for the angle of twist in the case of a member of circular cross section subjected to torsional moment. [6]

(b) A solid steel shaft has to transmit 75 kW power at 200 r.p.m. taking the allowable shear stress as 70 N/mm^2, find a suitable diameter for the shaft if the maximum torque transmitted in each revolution exceeds the mean by 30%.

[10]

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