B.Tech II Year - II Semester Examinations, April-May, 2012
MECHANICS OF SOLIDS
(Mining Engineering)

Time: 3 hours   **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

- - -

1.a)   A specimen of steel 25mm diameter with a gauge length of 200mm is tested to destruction It has an extension of 0.16 mm under a load of 80 KN and the load at elastic limit is 160 KN. The maximum load is 180 KN. The total extension at fracture is 56 mm and diameter at neck is 18 mm. Find
i) The stress at elastic limit
ii) Young's modulus
iii) Percentage elongation
iv) Ultimate tensile stress.
  b)   Explain about the different types of stresses.   [10+5]

2.   A simply supported beam ABC with supports at A and B, 6 meters apart and with an overhang BC 2 meters long carries a uniformly distributed load of 15 kN per meter over the whole length as shown in Figure.1. Draw S.F and B.M. diagrams.
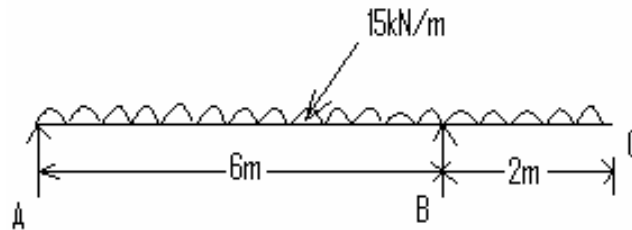   [15]

Figure.1

3.a)   What are the assumptions made in simple theory of bending?
  b)   A Circular pipe of external diameter 70mm and thickness 8mm is used as a simply supported beam over an effective span of2.5m.Find the maximum concentrated load that can be applied at the center of the span if permissible stress in the tube is $150N/mm^2$.   [5+10]

4.   The Un-symmetrical I-section shown in Figure.2 is subjected to a shear force of 30kN. Draw the shear stress variation diagram across the depth.   [15]
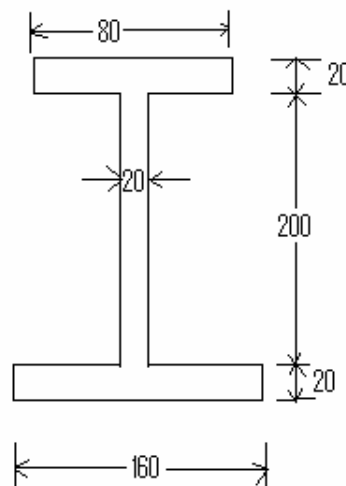
All dimensions are in MM
Figure.2

5. Determine the forces in the various members of the truss shown in Figure.3. [15]
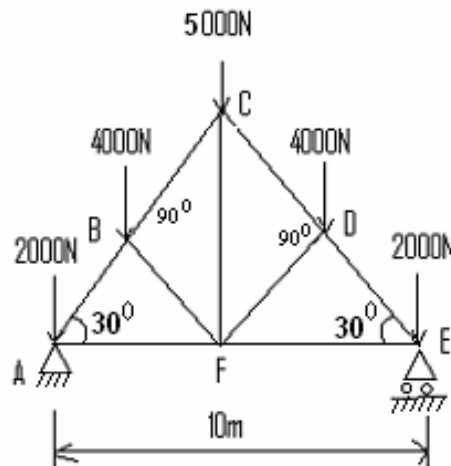

Figure.3

6.a) A Cantilever beam 200mm wide and 400mm deep and 5m long is loaded with a u.d.l of 800N per meter run extending over a length of 3m from the free end. Find the deflection at the free end Take $E = 2 \times 10^5$ N/mm^2. Double integration method.
  b) Using moment area method to derive the expression for maximum slope and deflection of a cantilever loaded with a point load at the free end. [10+5]

7. a) Derive formulas for longitudinal and circumferential stresses for thin cylinders.
  b) A thin cylindrical tube with closed ends has an internal diameter of 50mm and a wall thickness of 2.50 mm. The tube is axially loaded in tension with a load of 10kN and is subjected to an axial torque of 500 N-m under an internal pressure of 6N/mm^2. Determine the principal stresses on the outer surface of the tube and the maximum shear stress. [7+8]

8. A compound tube is composed of a tube 250mm internal diameter and 25mm thick shrunk on a tube of 250mm external diameter and 25mm thick. The radial pressure at the junction is 8N/mm^2. The compound tube is subjected to an internal fluid pressure of 84.5 N/mm^2. Find the variation of the hoop stress over the wall of the compound tube. [15]

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1.   A rectangular bar of cross section 30 mm × 60 mm and length 200 mm is restrained from expansion along its 30 mm × 200 mm sides by surrounding material. Find the change in dimension and volume when a compressive force of 180 KN acts in axial direction. Take $E = 2 \times 10^5$ N/mm^2 and $\mu = 0.3$.
        What are the changes if surrounding material can restrain only 50% of expansion on 30 mm × 200 mm side?   [15]

2.a)   Draw the B.M. and S.F. for a simply supported beam of span 'l' carrying a concentrated load "W" at mid span.
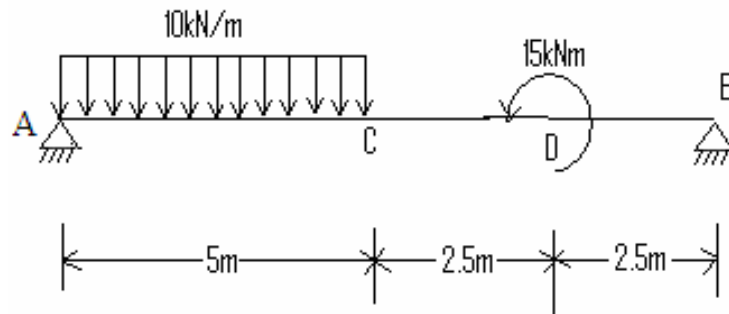   b)   Draw the B.M and S.F. diagrams for the beam as shown in Figure.1.   [5+10]

Figure.1

3.a)   What are the design criteria according to the bending and relation between the bending moment and section modulus?
   b)   Compare the flexural strength of the following two beams of equal weight
        i) I-section 20cm×15cm, having 2cm as flange thickness and 1cm as web thickness.
        ii) Rectangular section having depth equal to 1.75width.   [5+10]

4.   The Un-symmetrical I-section shown in Figure.2. is subjected to a shear force of 40kN. Draw the shear stress variation diagram across the depth.   [15]
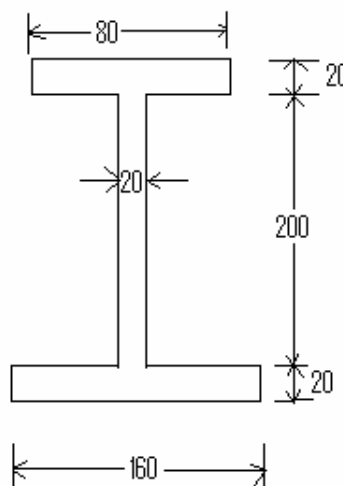
All dimensions are in MM
Figure.2

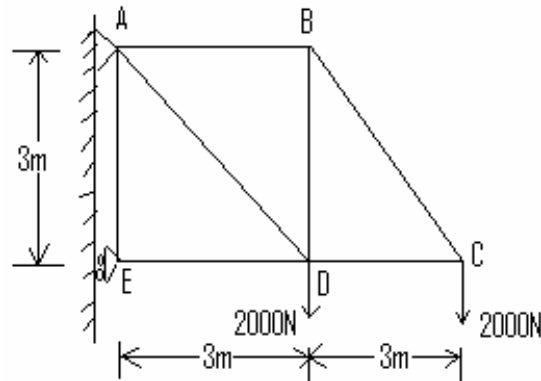5.　　Determine the forces in all the members of the truss shown in Figure.3.　　[15]

Figure.3

6.a)　Determine slope and deflection of a cantilever loaded with a point load at the free end using Moment Area method.

　b)　Using Moment Area method, find the mid span deflection of the beam shown in Figure.4. Take E = 200 GPa and I = 200×10^{-4} m^4.　　[7+8]
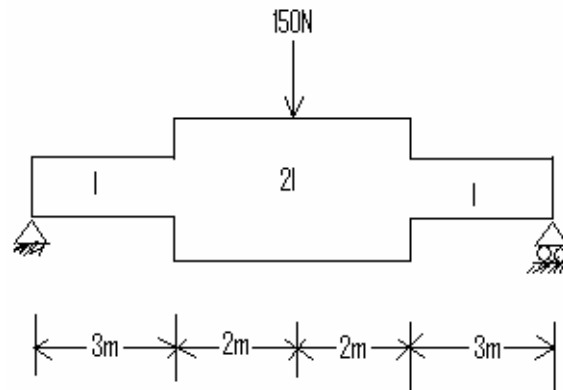

Figure.4

7.　　A boiler is subjected to an internal steam pressure of 2N/mm^2. The thickness of boiler plate is 2.6cm and permissible tensile stress is 120N/mm^2. Find out the maximum diameter, when efficiency of longitudinal joint is 90% and that of circumferential joint is 40%.　　[15]

8.　　A steel tube of 200mm external diameter is to be shrunk on to another steel tube of 60mm internal diameter. After shrinking the diameter at the junction is 120mm. Before shrinking on the difference of diameter at the junction is 0.08mm. Find the hoop stresses developed in the two tubes after shrinking on, and the radial pressure at the junction. Take E = 2×10^5 N/mm^2.　　[15]

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1. A flat bar of aluminum alloy 24 mm wide and 6 mm thick is placed between two steel bars each 24 mm wide and 9 mm thick to form a composite bar 24 mm × 24 mm as shown in Figure.1. The three bars are fastened together at their ends when the temperature is 10 degrees centigrade. Find the stress in each of the material when the temperature of the whole assembly is raised to 50^0C. If at the new temperature a compressive load of 20kN is applied to the composite bar what are the final stress in steel and aluminum? Take $E_s = 2 \times 10^5$ N/mm^2, $E_a = 2/3 \times 10^5$ N/mm^2, $\alpha_s = 1.2 \times 10^{-5}$ per ^{0}C and $\alpha_a = 2.3 \times 10^{-5}$ per ^{0}C. [15]
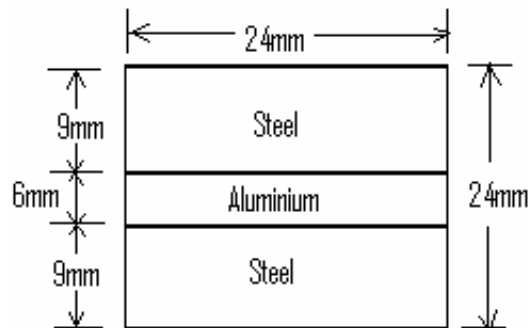

Figure.1

2. A horizontal beam 10m long carries a u.d.l of 180N/m over its entire span and in addition a concentrated load of 200N at the left end. The beam is supported at two points 7m apart, so chosen that each support carries half the total load. Draw S.F.D and B.M.D. [15]

3.a) Figure.2. shows the section of a beam. Find the ratio of its moment of resistance to bending in the plane YY to that for bending in the plane XX if the maximum stress due to the bending is the same in both cases. For a semi-circle of radius r, the centroid is at a distance of 4r/3Π from the centre.
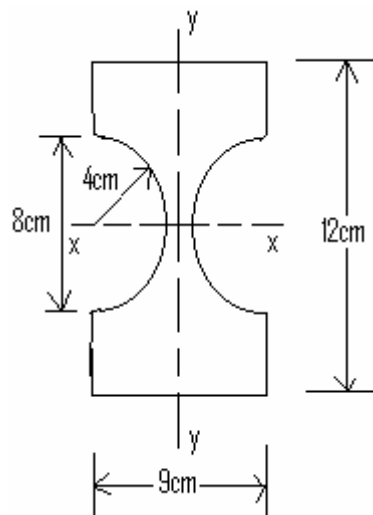

Figure.2

   b) Calculate the sectional modulus for Solid & Hollow rectangular section. [10+5]

4.a) A Simply supported beam carries a uniformly distributed load of intensity 30N/mm over the entire span of 1.0 meter. The cross section of the beam is a T-section having the dimension as shown in Figure.3. Calculate the maximum shear stress for the section of beam.
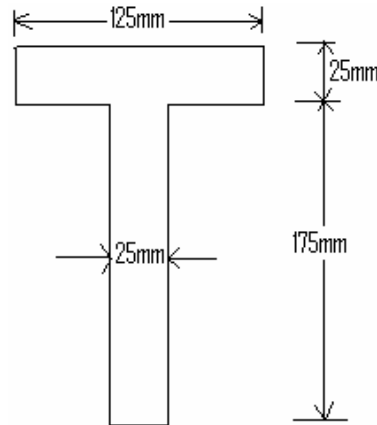

Figure.3

b) A laminated wooden beam 100mm wide and 150mm deep is made of three 100mm × 50mm planks glued together to resist longitudinal shear. The beam is simply supported over a span of 2 m. If the allowable shearing stress in the glued joints is 0.40 N/mm^2. Find the safe concentrated load that the beam may carry at its centre. [10+5]

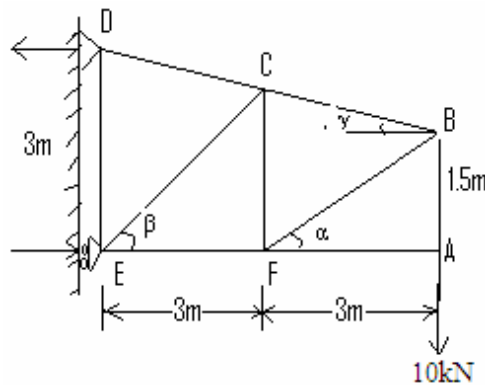5. Find the forces in the members of the loaded truss as shown in Figure.4. [15]

Figure.4

6.a) Derive EI d^{2}y/dx^2= -M.
  b) A Simply supported beam AB of length 4m carries a concentrated load of 50 KN at its centre 'C'. Find the slope at 'A' and deflection at 'C'.
  Take EI=1.0 × 10^4 kN.m^2. [7+8]

7.a) Derive the equations for the circumferential and longitudinal stresses induced in the thin spherical shells.
  b) A Vessel in the shape of spherical shell 800mm in diameter, 10mm shell thickness is completely filled with a fluid at atmospheric pressure. Additional fluid is then pumped in till the water pressure increases by 5N/mm^2. Find the volume of this additional fluid given that μ = 0.25 and E = 2 × 10^5 N/mm^2 for the shell material. [7+8]

8.a) A pipe of 400mm internal diameter and 100mm thickness contains a fluid at a pressure of 8 N/mm^2. Find the maximum and minimum hoop stress across the section. Also, sketch the radial pressure distribution and hoop stress distribution across the section.

  b) A thick spherical shell of 150mm internal diameter is subjected to an internal fluid pressure of 20N/mm^2. If the permissible tensile stress is 100N/mm^2, find the thickness of the shell.   [10+5]

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1.a)   A bar of 20 mm diameter is tested in tension. It is observed that when a load of 37.7 KN is applied, the extension measured over a gauge length of 200 mm is 0.12 mm and contraction in diameter is 0.0036 mm. Find Poisson's ratio and elastic constants E, G & K.

  b)   Explain the stress-strain relationship for mild steel in direct tension.   [10+5]

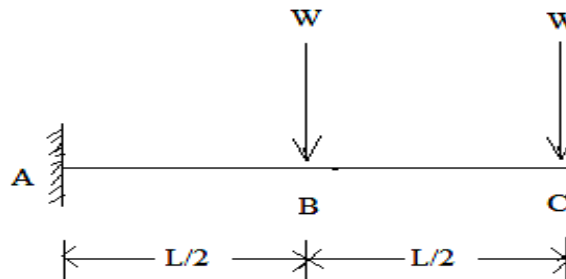2.a)   Draw the S.F.D & B.M.D of the cantilever beam as shown in Figure.1.

Figure.1

  b)   Draw the Shear force and bending moment for the simply supported beam shown in Figure.2.   [5+10]
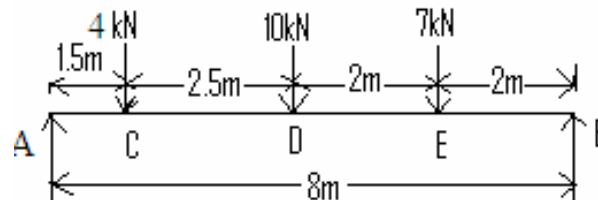

Figure.2

3.a)   A simply supported beam of span 5.0m has a cross-section 150mm×250mm.If the permissible stress is 10N/mm², Find
       i) Maximum intensity of uniformly distributed load it can carry.
       ii) Maximum concentrated load "P' applied at 2.0m from one end it can carry.

  b)   Find the position of the C.G. and calculate the I_{xx}, I_{yy} and sectional modulus(Z) along x-x and y-y axis for a 150mm × 125mm × 12.5mm inverted Tee section as shown in figure3.   [8+7]
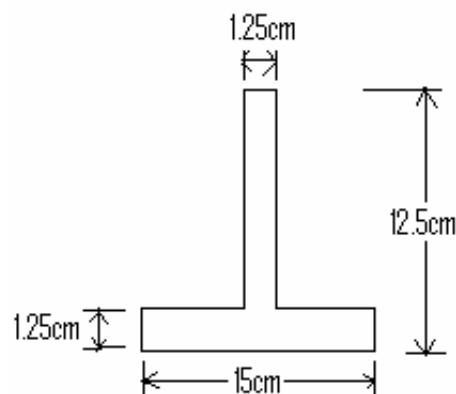

Figure.3

4.   A Steel beam of I-section is 600mm deep. Each flange is 250mm wide and 25mm thick. The web is 15mm thick. The beam section is subjected to a shear force of 500kN. Determine the shear stress distribution for the beam section.
i) When the web is vertical and
ii) When the web is horizontal.   [7+8]

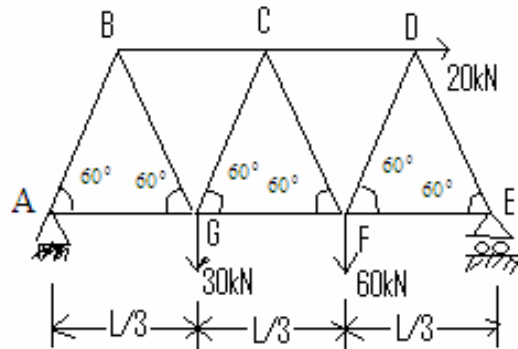5.   Calculate the forces induced in the members of the pin-jointed truss shown in the Figure.4.   [15]

Figure.4

6.a)   Calculate the slope and the deflection at principal locations for the beam shown in Figure.6. Use moment area method. Take EI = 1.0×10^5 kN.m^2.
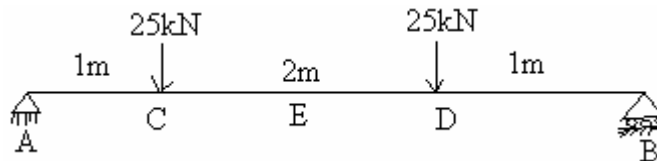

Figure.5

   b)   Find the deflection at the free end of a cantilever of length 'L' subjected to udl of intensity 'w' per unit length over its entire span. Use Double Integration method.
                                                                                   [10+5]

7.   A shell 3.25m long, 1meter in diameter is subjected to an internal pressure of 1N/mm^2. If the thickness of the shell is 10mm, find the circumferential and longitudinal stresses. Find also the maximum shear stress and the changes in the dimensions of the shell. Take E = 2×10^5 N/mm^2 and 1/m=0.3.   [15]

8.a)   Derive Lame's equation.
   b)   A thick spherical shell of 100mm internal diameter is subjected to an internal fluid pressure of 30 N/mm^2. If the permissible tensile stress is 80 N/mm^2, find the thickness of shell.   [8+7]

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