

Code No: R22012

R10**SET - 1****II B. Tech II Semester, Supplementary Examinations, Dec – 2012****STRENGTH OF MATERIALS**

(Civil Engineering)

Time: 3 hours

Max. Marks: 75

Answer any **FIVE** QuestionsAll Questions carry **Equal** Marks

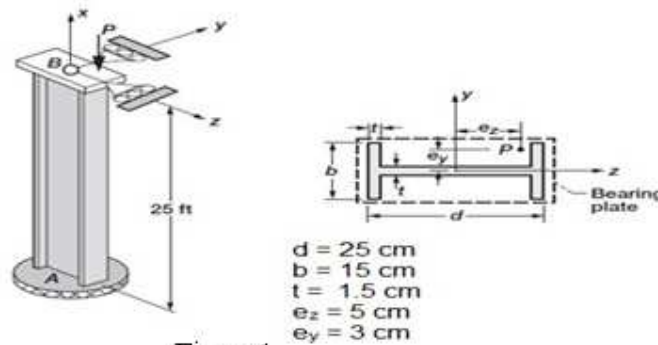
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1. A uniform circular bar of diameter, **d**, and length, **l**, extends an amount, **e**, under tensile pull, **P**, Show that the maximum deflection of the bar when it is used as beam simply supported at its ends and carrying a central load, **W**, is given by  $\delta = \frac{we l^2}{3p d^2}$  Find the ratio of  $\delta/e$  if **l = 75d** and the maximum bending stress due to **W** is equal to the tensile stress under the pull, **P**.
2. Compare the values of maximum and minimum hoop stresses for the cast iron cylindrical shell of 600 mm external diameter and 400 mm internal diameter subjected to a pressure of 30 N/mm<sup>2</sup> applied a) externally and b) internally.
3. a) Derive an expression for the stresses on an oblique section of a rectangular body, when it is subjected to direct stresses in two mutually perpendicular directions.  
b) A piece of material is subjected to a tensile stress of 60 N/mm<sup>2</sup> and 30 N/mm<sup>2</sup> at right angles to each other. Find the stresses on a plane the normal of which makes an angle of 40° with the 60 N/mm<sup>2</sup> stress.
4. A hollow steel shaft 3 m long must transmit a torque of 25 kN-m. the total angle of twist in this length is not to exceed 2.5° and the allowable shearing stress is 90 MPa. Determine the inside and outside diameter of the shaft if G = 85 GPa.
5. a) Derive the equation for Euler buckling load, when one end of the column is fixed and other end is free.  
b) Compare the crippling loads given by Euler's and Rankine's formulae for a tubular steel strut 2.5 m long having outer and inner diameters 4.0 cm and 3.50 cm respectively. Assume pin joints at both ends. Take E = 2.1 x 10<sup>5</sup> N/mm<sup>2</sup>, yield stress = 320 N/mm<sup>2</sup> and Rankine's constant is 1/5000.

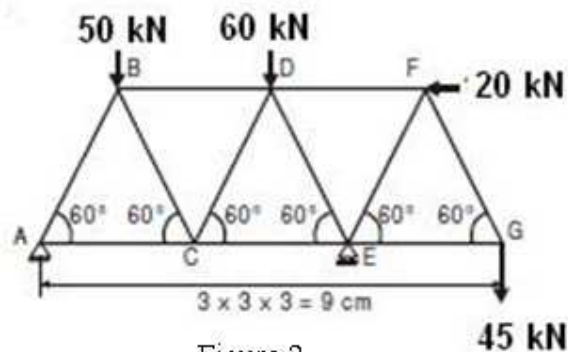
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**R10****SET - 1**

6. The Aluminum column in Fig. 1 fixed at A and hinged at B. Use the concept of effective length to replace the fixed condition. It is made of an I – Section with dimensions as marked. Calculate maximum stress and displacement for load eccentricities marked in Figure1.



7. For a simple supported Curved beam, derive the relation to find Shear force, BM and Tensional moments at a point P, at an angle of  $\phi$  from one support.
8. Determine the forces in all the members of the truss shown in Figure 2 using method of joints and indicate the magnitude and nature of forces on the diagram of the truss. All inclined members are at  $60^\circ$  to horizontal and length of each member is 3 m.



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**R10****SET - 2**

**II B. Tech II Semester, Supplementary Examinations, Dec – 2012**  
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1. A girder rests on two supports 5 m apart, and carries a distributed load of 60 kN, 2 m from one support. Find the ratio of maximum deflection to deflection under load.
2. A tube whose external diameter and internal diameters are 360 mm and 240 mm respectively has another tube 60 mm thick shrunk on to it. The bore of outer tube is machined to 0.8 mm less than the external diameter of the tube on to which it subsequently shrunk. If the tubes are made of steel for which the value of $E = 200 \text{ kN/m}^2$, Determine expressions for the radial and hoop stresses developed in the inner tube.
3. a) Derive the expression for the stresses on an oblique plane of a rectangular body, when the body is subjected to simple shear stress.
b) A body is subjected to direct stresses in two mutually perpendicular directions accompanied by a simple shear stress. Draw the Mohr's circle of stresses and explain how you will obtain the principal stresses and principal planes.
4. A steel propeller shaft is to transmit 4.5 MW at 3 Hz without exceeding a shearing stress of 50 MPa or twisting through more than 1° in a length of 26 diameters. Compute the proper diameter if $G = 83 \text{ GPa}$.
5. a) Derive the expression for Euler's crippling load for long column with both ends hinged.
b) A hollow cylindrical steel strut has to be designed for the following conditions. Length 2m, axial load 100 kN, ratio of internal to external diameter 0.8, and factor of safety 3. Determine the necessary external diameter of the strut and the thickness of the metal, if the ends of the strut are hinged. Use Rankine's formula. Take $E = 2.1 \times 10^5 \text{ N/mm}^2$, yield stress = 320 N/mm^2 and Rankine's constant is $1/7500$.
6. A compressive load of $P = 100 \text{ kN}$ is applied through Z –axis with an eccentricities of 70 mm and 30 mm along the X – and Y – axis respectively from the centroid of a column. The column dimensions are along x – axis 300 mm and along Y –axis 150 mm. Compute the stress at each corner and the location of neutral axis. Illustrate your answers with a sketch. What additional load applied at the centroid is necessary so that no tensile stress exists anywhere on the cross section.

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R10**SET - 2**

7. For a semicircular beam simply supported on three supports equally spaced. Compute the maximum Twisting moment and location at which this maximum twisting moment occurs for a uniformly distributed load of intensity w , acting on the entire beam.
8. Find the forces in members of truss shown in Figure 1 and tabulate the values.

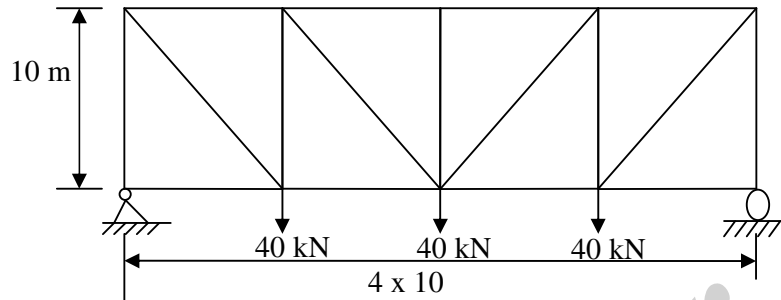


Figure 1

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R10**SET - 3****II B. Tech II Semester, Supplementary Examinations, Dec – 2012****STRENGTH OF MATERIALS**

(Civil Engineering)

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1. A cantilever rectangular in cross section has constant width, ' b ' and depth varying uniformly from ' d ' at free end to ' $2d$ ' at fixed end. Find the deflection of the free end of the cantilever due to load ' w ' placed there in terms of $\frac{12wL^3}{Ebd^2}$
 2. 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/mm². The wall thickness is such that the maximum tensile stress in the shell is 25 N/mm² under pressure. Take $\mu = 0.3$.
 3. a) Derive the criteria of the failure according to maximum strain energy theory.
b) If the principal stress at a point in an elastic material are $2P$ - tensile, P - tensile and $\frac{P}{2}$ - compressive. Calculate the value of ' P ' according to:
i) Principal strain theory
ii) Maximum strain energy theory
iii) Maximum shear strain energy theory
The elastic limit in simple tension is 250 N/mm² and Poisson's ratio is 0.3.
 4. A solid circular shaft of diameter d has the same weight as a hollow circular shaft of mean diameter, d . Assuming the same maximum shear stress in both the cases, determine the ratio of torques transmitted by the two shafts. Also compare the angles of twist per unit length in these two shafts.
 5. a) Develop secant formula and discuss with its importance.
b) Compare the crippling loads given by Euler's and Rankine's formulas for the tubular steel strut 2.5 m long having outer and inner diameters of 4 cm and 3.5 cm respectively. Assume the pin joints at both ends. Permissible stress, $\sigma_s = 320$ N/mm².
 6. a) What do you mean by eccentricity of loading? What are its effects on a column section?
b) A hollow rectangular column is 120cm deep, 80cm wide and 15cm thick. An eccentric load of 200kN acts on the centroidal axis bisecting 120cm long side, the eccentricity being 10cm. Determine the maximum and minimum stress in the column.

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R10**SET - 3**

7. a) Write down the detailed procedure to compute the maximum stresses of beam in unsymmetrical bending.

b) A beam of rectangular section, 80 mm wide and 120 mm deep as shown in Figure 1, is subjected to a bending moment of 10 kNm. The trace of the plane of the loading is at 45° to the axis of the section. Locate the neutral axis of the section, and calculate the maximum bending stress induced in section.

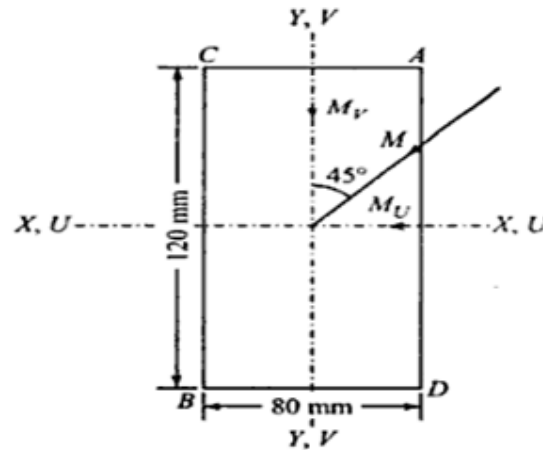


Figure 1

8. Find the forces in all the members of the truss shown in Figure 2 using method of joints.

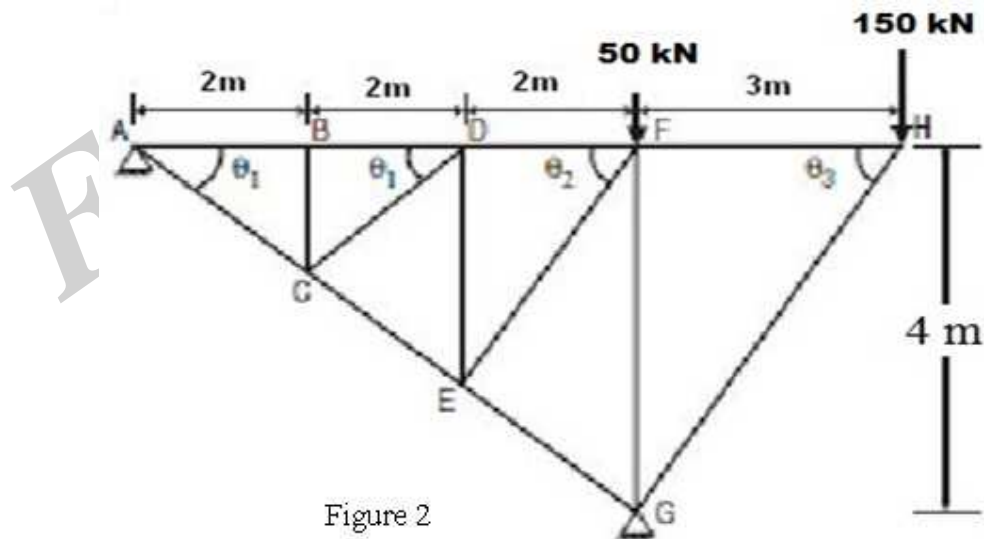


Figure 2

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R10**SET - 4****II B. Tech II Semester, Supplementary Examinations, Dec – 2012****STRENGTH OF MATERIALS**

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1. A cylindrical pressure vessel 2.5m in diameter and 5m long is made from 15mm thick steel plate having a Young's modulus of  $207 \text{ GN/m}^2$  and a Poisson's ratio of 0.28. If strain gauges are fixed to the cylinder, aligned circumferentially and longitudinally, what strains would they record when the cylinder is subjected to an internal pressure of 3.2 Mpa?
2. At a point within a body subjected to two mutually perpendicular directions, the stresses are  $120 \text{ N/mm}^2$  (tensile) and  $100 \text{ N/mm}^2$  (tensile). Each of the above stresses, is accompanied by a shear stress of  $100 \text{ N/mm}^2$ . Determine the normal, shear and resultant stresses on an oblique plane inclined at an angle of  $45^\circ$  with the axis of minor tensile stress.
3. A thick cylindrical shell of 200 mm internal diameter and has to withstand an internal pressure of  $25 \text{ N/mm}^2$ . Calculate the thickness of the metal necessary for the cylinder on the basis of a) the maximum principal stress, b) the maximum principal strain, c) the maximum shear and d) the maximum strain energy. Neglect the longitudinal direct stress. The permissible tensile stress of the shell is  $125 \text{ N/mm}^2$  and Poisson's ratio is 0.3.
4. A spring loaded safety valve of 50 mm, diameter is to work against a boiler pressure of  $8 \text{ N/mm}^2$ . Determine the lift of the valve when the mean diameter of spring is 160 mm. Number of turns 10 and wire diameter 20 mm. Take  $N = 9 \times 10^4 \text{ N/mm}^2$ .
5. A straight bar of steel 100 cm long and  $20 \times 7.5 \text{ mm}$  in section is mounted in a testing machine and loaded axially in compression till it buckles. Assuming the Euler's formula for pinned ends to apply, estimate the maximum central deflection before material attains its yield stress of  $320 \text{ N/mm}^2$ .  $E = 2.1 \times 10^5 \text{ N/mm}^2$ .
6. A compressive load of  $P = 80 \text{ kN}$  is applied through Z –axis with an eccentricities of 40 mm and 60 mm along the X – and Y – axis respectively from the centroid of a column. The column dimensions are along x – axis 200 mm and along Y –axis 400 mm. Compute the stress at each corner and the location of neutral axis. Illustrate your answers with a sketch. What additional load applied at the centroid is necessary so that no tensile stress exists anywhere on the cross section.

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**R10****SET - 4**

7. a) Define Unsymmetrical bending? What are the two reasons of unsymmetrical Bending?

b) An angle section 9 cm X 6 cm X 1.2 cm is used as a cantilever of one meter length with 6 cm leg as shown in Figure 1. Horizontal. A vertical load of 1000 N is applied at the free end. Determine the position of the neutral axis and the maximum stress set up.  $I_{uu} = 147.5 \text{ cm}^4$ ,  $I_{vv} = 26.8 \text{ cm}^4$ ,  $\tan \alpha = 0.42$ .

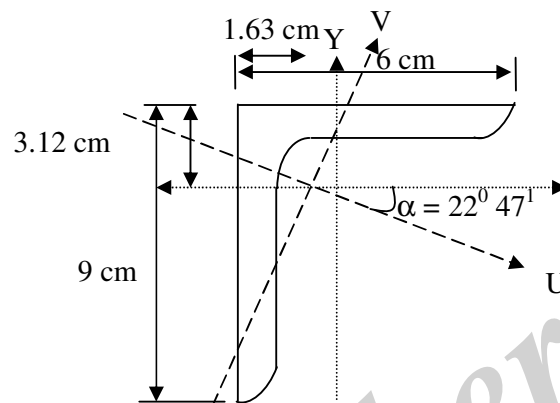


Figure 1

8. Determine the forces in all the members of the truss shown in Figure 2 using method of joints and indicate the magnitude and nature of forces on the diagram of the truss. All inclined members are at  $60^\circ$  to horizontal and length of each member is 2 m.

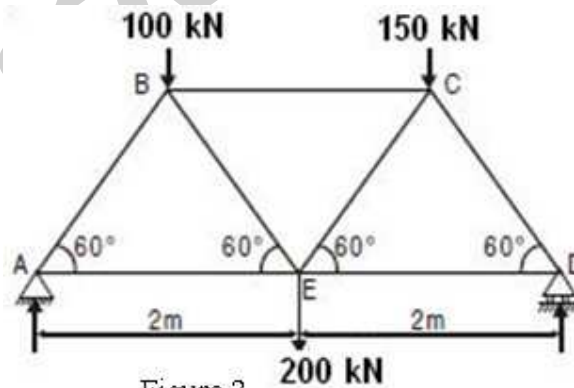


Figure 2