Code No: R22012 **R10** SET - 1

II B. Tech II Semester Regular Examinations April/May – 2013
STRENGTH OF MATERIALS
(Civil Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) Using the moment-area method, determine the deflection at the free end of a cantilever beam of span *l* subjected to a load *P* at a distance *a* from the fixed end. *EI* is constant.
   b) Derive the differential equation of the elastic curve for a beam subjected to bending in a plane of symmetry. (5M+10M)

2. a) Derive expression for volumetric change in thin cylinder subjected to an internal pressure *p*.
   b) A thick cylindrical pipe of outside diameter 300 mm and internal diameter 200 mm is subjected to an internal fluid pressure of 14 MPa. Determine the maximum hoop stress in the section. Draw the variation of the hoop stress across the thickness of the pipe. (7M+8M)

3. A square element of a thin plate subjected to a compressive stress of 5 MPa in x-direction, a tensile stress of 15 MPa in y-direction and a shear stress of 10 MPa (clockwise). Determine the principal stresses and their directions by using analytical method. Also find the normal stress and shear stress on the diagonal plane of the square element. (15M)

4. A closed coil helical spring is made of 12 mm diameter wire and is having mean diameter of 150 mm and 10 complete turns. The modulus of rigidity of the material of spring is 80 MPa. When a load of 500 N is applied, determine the maximum shear stress, strain energy stored, deflection produced and stiffness of the spring. (15M)

5. A built-up I section has the following dimensions.
   Overall depth : 400 mm
   Flanges : 300 mm x 50 mm
   Web thickness : 30 mm.
   When it is used as a simply supported beam, it deflects by 10 mm when subjected to a load of 40 kN/m over its entire length. Find the safe load, if the same section is used as a column with both ends hinged. Use Euler's formula. Assume a factor of safety 1.75 and take E = 2 x 10^5 MPa. (15M)
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Code No: R22012 **R10** SET - 1

6. The cross-section of a masonry pier is a hollow rectangle, the dimensions of external and internal rectangles being 1200 mm x 800 mm and 900 mm x 500 mm respectively. A load of 300 kN in the vertical plane bisecting the 1200 mm width of pier is transmitted at an eccentricity of '*e*'. Calculate the maximum value of '*e*' so that no tension is induced in the section. (15M)

7. Determine the maximum positive bending moment and maximum twisting moment in a semi-circular beam simply supported on three equally spaced supports. Take radius of the centre line of the beam as 'R' and load per unit length of the beam as 'w'. (15M)

8. Determine the forces in all the members of the truss as shown in the Figure 1. (15M)

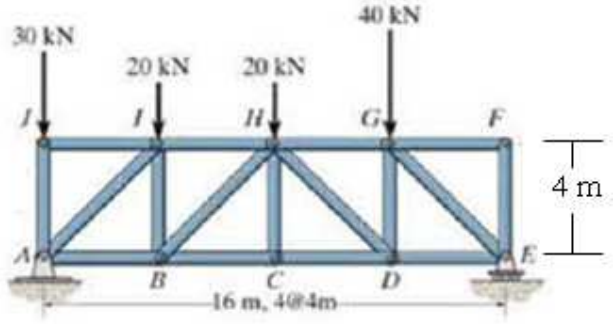

Figure 1

Code No: R22012 **R10** SET - 2

II B. Tech II Semester Regular Examinations April/May – 2013
STRENGTH OF MATERIALS
(Civil Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. A simply supported beam of span 6 m is subjected to a concentrated load of 18 kN at 4 m from left support. E= 200GPa and I= 15 x 10^6 mm^4. Calculate:
   a) The position and value of the maximum deflection
   b) Slope at mid-span
   c) Deflection under load. (7M+4M+4M)

2. a) Calculate the minimum thickness of the shell of a thin cylinder of 1 m diameter, if it is to withstand an internal pressure of 2 MPa and the longitudinal stress is not to exceed 30 MPa and the hoop stress is not to exceed 40 MPa.
   b) Derive the Lame's equations for a thick cylinder using normal conventions. (7M+8M)

3. A square element of a thin plate subjected to a compressive stress of 6 MPa in x-direction, a tensile stress of 12 MPa in y-direction and a shear stress of 10 MPa (clockwise). Determine the principal stresses and their directions by constructing Mohr's circle. Also find the normal stress and shear stress on the diagonal plane of the square element. (15M)

4. A solid shaft transmits 250 kW at 100 rpm. If the shear stress is not to exceed 75 MPa, what should be the diameter of the shaft? If this shaft is to be replaced by a hollow one whose internal diameter is 0.6 times the outer diameter, determine the size and the percentage saving in weight, the maximum shear stress being the same. (15M)

5. A solid steel column and a hollow steel column, both having same length and cross-sectional area, are fixed at the ends. If the internal diameter of hollow column is 2/3 of its external diameter, find the ratio of buckling strengths of solid column to hollow column. (15M)
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Code No: R22012 **R10** SET - 2

6. A concrete wall of rectangular cross-section is 1 m thick and 2.5 m high. It has to retain water up to a height of 2.25 m. determine the stress intensities at the base, if the concrete weighs 25 kN/m^3. (15M)

7. A curved beam, rectangular in cross-section is subjected to pure bending with couple of 400 N-m. The beam has a width of 20 mm and depth of 40 mm and is curved in a plane parallel to the depth. The mean radius of curvature is 50 mm. Find the position of the neutral axis and the ratio of the maximum stress to the minimum stress. Also plot the variation of the bending stress across the section. (15M)

8. Determine the forces in all the members of the truss as shown in the Figure 1. P_1=40 kN and P_2=20 kN (15M)

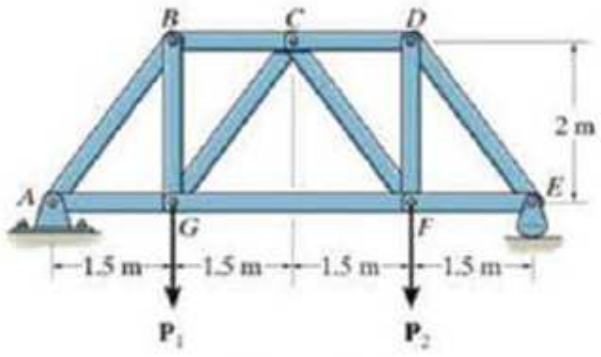

Figure 1

Code No: R22012 **R10** SET - 3

II B. Tech II Semester Regular Examinations April/May – 2013
STRENGTH OF MATERIALS
(Civil Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) State and prove Moment-Area Theorems.
   b) Using the moment-area method, determine the deflection at the free end of a cantilever beam of span '*l*' subjected to a load '*P*' at the fixed end. 'EI' is constant. (11M+4M)

2. a) Derive expression for volumetric change in a thin spherical shell subjected to an internal pressure *p*.
   b) A thick cylindrical pipe of outside diameter 300 mm and internal diameter 200 mm is subjected to an internal fluid pressure of 15 MPa. Determine the maximum hoop stress in the section. Draw the variation of the hoop stress across the thickness of the pipe. (7M+8M)

3. A square element of a thin plate subjected to a tensile stress of 5 MPa in x-direction, a tensile stress of 15 MPa in y-direction and a shear stress of 10 MPa (clockwise). Determine the principal stresses and their directions by using analytical method. Also find the normal stress and shear stress on the diagonal plane of the square element. (15M)

4. Compare the weight of solid with that of a hollow one having the same material and of same lengths are to transmit same power at a given speed, if the first shaft is of a solid circular section and the second shaft is of hollow circular section, whose internal diameter is 0.6 times the outside diameter. (15M)

5. A round vertical bar is clamped at the lower end and is free at the other. The effective length is 2 m. A horizontal force of 30 N at the top produces a horizontal deflection of 15 mm. What is the buckling load for the bar in the given conditions? (15M)

6. An unsymmetrical I-section with the following dimensions is subjected to a bending moment of 15 kN-m, the top flange being in compression. Draw the bending stress distribution across the depth marking the salient points and compute the total moment resisted by the top flange.
   Top flange : 240 mm x 10 mm
   Bottom flange : 180 mm x 10 mm
   Web : 300 mm x 10 mm
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Code No: R22012 **R10** SET - 3

7. A curved beam, rectangular in cross-section is subjected to pure bending with couple of 300 N-m. The beam has a width of 20 mm and depth of 40 mm and is curved in a plane parallel to the depth. The mean radius of curvature is 50 mm. Find the position of the neutral axis and the ratio of the maximum stress to the minimum stress. Also plot the variation of the bending stress across the section. (15M)

8. Determine the forces in all the members of the truss as shown in the Figure 1. (15M)

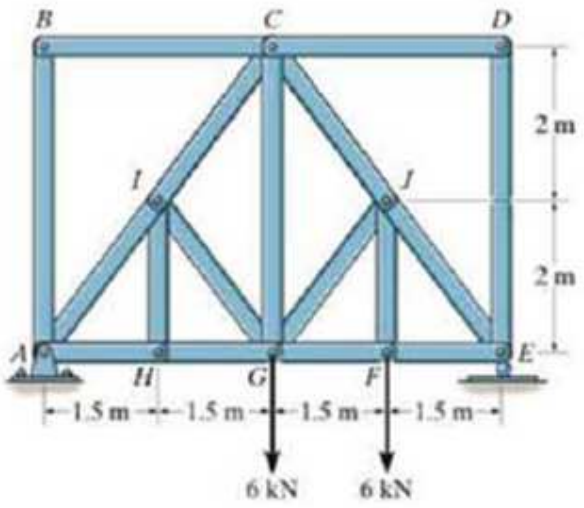

Figure 1

Code No: R22012 **R10** SET - 4

II B. Tech II Semester Regular Examinations April/May – 2013
STRENGTH OF MATERIALS
(Civil Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. A simply supported beam of span '*l*' is subjected to two equal loads of 'W/2' each at third points. Determine the deflection at mid-span and under loads. 'EI' is constant. (15M)

2. a) Derive expression for volumetric change in a thin cylinder subjected to an internal pressure *p*.
   b) A thick cylindrical pipe of outside diameter 300 mm and internal diameter 200 mm is subjected to an internal fluid pressure of 12 MPa. What minimum external pressure can be applied so that the tensile stress in the metal shall not exceed 16 MPa? (7M+8M)

3. A square element of a thin plate subjected to a tensile stress of 5 MPa in x-direction, a tensile stress of 15 MPa in y-direction and a shear stress of 10 MPa (clockwise). Determine the principal stresses and their directions by constructing Mohr's circle. Also find the normal stress and shear stress on the diagonal plane of the square element. (15M)

4. a) Determine the maximum shear stress and angle of twist produced in a solid shaft of 100 mm diameter and 10 m long transmitting 112.5 kW power at 150 rpm. G=82000 MPa.
   b) Derive the torsion equation mentioning the assumptions made. (5M+10M)

5. Determine the maximum uniformly distributed lateral load, applied in the plane of symmetry parallel to the longer side of the section, which can be carried by a 160 mm x 80 mm timber struct 4 m long which is already subjected to an axial thrust of 20 kN so that the maximum fibre stress does not exceed 14 MPa. Take E = 10 kN/mm^2 and assume pinned ends. (15M)

6. a) What are the assumptions made in the derivation of flexure equation?
   b) A simply supported beam having a span of 3.6 m is to carry a uniformly distributed load of 16 kN/m. The cross-section is to be rectangle with depth being equal to twice its width. If the allowable bending stress in tension or compression is 8.4 MPa, determine the cross-section of the beam. (7M+8M)
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Code No: R22012 **R10** SET - 4

7. A curved beam, rectangular in cross-section is subjected to pure bending with couple of 500 N-m. The beam has a width of 20 mm and depth of 40 mm and is curved in a plane parallel to the depth. The mean radius of curvature is 50 mm. Find the position of the neutral axis and the ratio of the maximum stress to the minimum stress. Also plot the variation of the bending stress across the section. (15M)

8. Determine the forces in all the members of the truss as shown in the Figure 1. (15M)

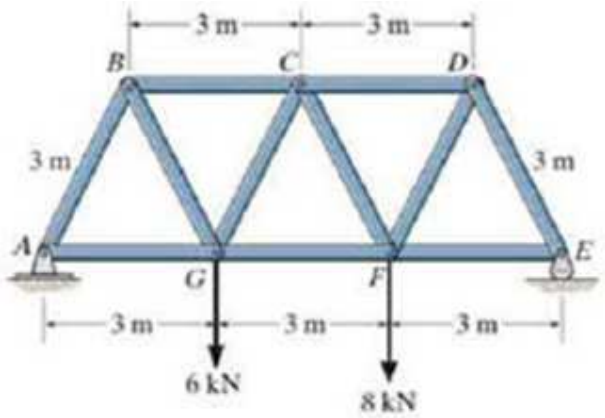

Figure 1