II B. Tech I Semester Regular Examinations, Jan - 2015
STRENGTH OF MATERIALS - I
(Civil Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART-A

1. a) Explain the Strain Energy and deduce the expression due to gradual loading.
   b) Show that the ratio of maximum shear stress to average shear stress is 1.5 in case of a rectangular section (bxd).
   c) Derive an expression for circumferential stress for a thin spherical shell of internal diameter d, wall thickness t, is subjected to an internal pressure p.
   d) Deduce the relation between shear force and bending moment
   e) Explain moment area theorems.
   f) Write the assumptions made in the theory of simple bending. (4M+4M+4M+4M+4M+2M)

PART-B

2. a) Deduce the relation between the Modulus of Elasticity and Modulus of Rigidity from fundamentals.
   b) The Modulus of rigidity for a material is $0.51x10^5$ N/mm^2. A 10 mm diameter rod of the material was subjected to an axial pull of 10 kN and the change in diameter was observed to be $3x10^{-3}$ mm. Calculate Poisson's ratio and the modulus of elasticity. (6M+10M)

3. a) Deduce the relation between Shear force and intensity of loading.
   b) An overhanging beam is shown in Figure 1. Draw the S.F and B.M diagrams. (4M+12M)

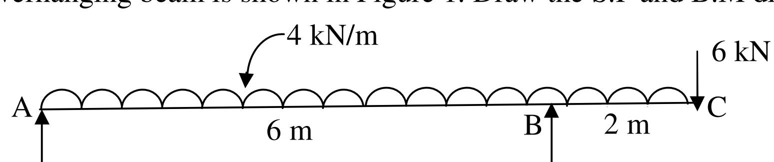

Figure 1

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4. a) Derive the bending equation from fundamentals $M/I = f/y = E/R$
   b) A 120 mm x 50 mm I- section is subjected to a shearing force of 10 kN. Calculate the shear stress at the neutral axis and at the top of the web. Given I = 220×10^4 mm^4, Area = 9.4×10^2 mm^2, web thickness = 3.5 mm and flange thickness = 5.5 mm (8M+8M)

5. a) Obtain the expression for shearing stress at a section of a loaded beam?
   b) A T – section beam with 100 mm x 15 mm flange and 150 mm x 15 mm web is subjected to a shear force of 12 kN at a section. Draw the variation of shear stress across the depth of the beam and obtain the value of maximum shear stress of the section. (6M+10M)

6. A simply supported beam of span 5 m, carrying a point load of 5 kN at a distance of 3 m from the left end. Find (i) slope at the left support, (ii) deflection under the load and (iii) maximum deflection. Take E= 2×10^5 N/mm^2 and I = 1×10^8 mm^4. Use double integration method. (16M)

7. A compound cylinder is made by shrinking a cylinder of external diameter 200 mm and an internal diameter 160 mm over another cylinder of external diameter 160 mm and internal diameter 120 mm. The radial pressure at the junction after shrinking is 8 N/mm^2. Find the final stress set up across the section, when the compound cylinder is subjected to an internal fluid pressure of 60 N/mm^2. (16M)

Code No: RT21013 **R13** SET - 2

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PART-A

1. a) Define (i) Poisson’s ratio and (ii) Volumetric strain
   b) A cantilever beam of span 2 m is loaded with a point load of 30 kN at its free end. Find the deflection at the fee end, if EI = 8×10^{12} N-mm^4.
   c) Show that the ratio of maximum shear stress to average shear stress is 4/3 in case of a circular section of diameter d.
   d) Deduce the circumferential stress equation for a thin cylindrical shell subjected to an internal pressure of intensity ‘p’ with a thickness ‘t’ and diameter ‘d’.
   e) Deduce the section modulus for a hollow circular section of internal diameter, d and external diameter, D.
   f) Deduce the relation between Shear force and intensity of loading

(3M+4M+4M+4M+4M+3M)

PART-B

2. a) Deduce the expression for Strain Energy due to gradual and sudden applied loads.
   b) A load of 100 N falls through a height of 20 mm on to a collar rigidly attached to the lower end of a vertical bar 1.5 m long and of 1.5 cm^2 cross-sectional area. The upper end of the vertical bar is fixed. Determine: i) Maximum instantaneous stress induced in the bar, and ii) Maximum instantaneous elongation. Take E=2×10^5 N/mm^2 (6M+10M)

3. A horizontal beam, 30 m long, carries a uniformly distributed load of 10 kN/m over the whole length and concentrated load of 30 kN at the right end. If the beam is simply supported at the left end, find the position of the second support so that the bending moment on the beam should be as small as possible. Draw the diagrams of shearing force and bending moment and insert the principal values. (16M)
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4. a) Write and explain the assumptions made in the theory of simple bending.
   b) Find the section modulus for a hollow circular section of internal diameter d and external diameter D.
   c) Prove that the ratio of depth to width of the strongest beams that can be cut from a circular log of diameter, d is 1.414. (4M+4M+8M)

5. a) Find the ratio of maximum shear stress to average shear stress is 1.5 in case of a rectangular section.
   b) A beam is simply supported and carries a U.D.L of 40 kN/m run over the whole span. The section of the beam is rectangular having depth as 500 mm. If the maximum stress in the material of the beam is 120 N/mm^2 and moment in inertia of the section is $7x10^8$ mm^4. Find the span of the beam. (6M+10M)

6. a) Write and Explain moment area theorems.
   b) Find the slope and deflection of simply supported beam of span L, carrying i) a point load P at the centre, ii) a U.D.L of w kN/m over the entire span using the moment area method. (4M+12M)

7. A steel cylinder (thick) of 300 mm external diameter is to be shrunk to another steel cylinder of 150 mm internal diameter. After shrinking the diameter at the junction is 250 mm and radial pressure at the common junction is 28 N/mm^2. Find the original difference in radii at the junction. Take E = $2x10^5$ N/mm^2. (16M)

Code No: RT21013 **R13** SET - 3

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PART-A

1. a) Deduce the total extension of a uniformly tapering rod of diameters d and D over a length of L, when the rod is subjected to an axial load P.
   b) Deduce the section modulus for a hollow rectangular section of internal dimensions (bxh) and external dimension (BxH).
   c) Find ratio of maximum shear stress to average shear stress, in case of a rectangular section.
   d) A simply supported beam of span 2 m is loaded with a point load of 20 kN at its mid point. Find the maximum slope of the beam, if EI = $500 x 10^9$ N-mm^4.
   e) Deduce the longitudinal stress for a thin cylindrical shell subjected to an internal pressure of intensity 'p' with a thickness 't' and diameter 'd'.
   f) Deduce the relation between shear force and bending moment

(3M+4M+4M+4M+4M+3M)

PART-B

2. a) Deduce the Strain Energy expression for impact loading, in terms of Length, L and height of fall h.
   b) A steel rod of 3 cm diameter and 5 m long is connected to two grips and the rod is maintained at a temperature of 90^0 C. Determine the stress and pull exerted when the temperature falls to 30^oC, if (i) the ends do not yield and (ii) the ends yield by 0.13 cm. Take E = $2.1x10^5$ N/mm^2 and α = $12x10^{-6}$/ ^{o}C. (6M+10M)

3. a) Deduce the relation between S.F and intensity of loading.
   b) A simply supported beam of span 9 m loaded with a varying load of intensity zero at the left hand side and 3 kN/m at the right side. Draw the S.F and B.M diagrams. (4M+12M)
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4. a) Derive the bending equation from fundamentals $M/I = f/y = E/R$
   b) A timber beam of rectangular section is to support a load of 20 k N uniformly distributed over a span of 3.6 m when beam is simply supported. If the depth of section is to be twice the breadth, and the stress in the timber is not to exceed 7 N/mm^2, find the dimensions of the cross-section. (6M+10M)

5. a) Show that the ratio of maximum shear stress to average shear stress is 4/3 in case of a circular section of diameter d.
   b) The cross section of joist is a tee section 150 mm x 100 mm x 13 mm with 150 mm side horizontal. Find the maximum intensity of shear stress and sketch the distribution of stress across the section, if it has to resist a shear force of 80 kN. (6M+10M)

6. a) State and prove the moment area theorems.
   b) A simply supported beam of span L, carrying a point load P at 0.4L from left support. Determine, the (i) mid-span deflection (ii) deflection under the load, and (iii) slopes at the supports. Use the method of integration. Assume constant flexural rigidity for the beam. (6M+10M)

7. A compound cylinder is made by shrinking a cylindrical of external diameter 300 mm and internal diameter of 250 mm over an another cylindrical of external diameter 250 mm and internal diameter 200 mm. The radial pressure at the junction after shrinking is 8 N/mm^2. Find the final stresses sent up across the section, when the compound cylinder is subjected to an internal fluid pressure of 84.5 N/mm^2. (16M)

Code No: RT21013 **R13** SET - 4

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PART-A

1. a) Deduce the expression for Strain Energy due to suddenly applied loads.
   b) Draw the B.M diagram of a cantilever beam of span L, subjected to a couple M at the free end.
   c) Find the section modulus for a hollow circular section of external diameter, D and internal diameter, d, if internal diameter is 60% of external diameter.
   d) Obtain the expression for shearing stress at a section of a loaded beam?
   e) State and prove the moment area theorems.
   f) Deduce the longitudinal stress for a thin spherical shell subjected to an internal pressure of intensity 'p', with a thickness 't' and diameter 'd'. (3M+3M+4M+4M+4M+4M)

PART-B

2. a) Deduce the relation between Modulus of Elasticity and Modulus of Rigidity from fundamentals.
   b) A rectangular plate made of steel is 4 m long and 20 mm thick and is subjected to an axial tensile load of 40 kN. The width of the plate varies from 30 mm at one end to 80 mm at the other end. Find the elongation, if $E = 2x10^5\ N/mm^2$. (6M+10M)

3. Draw the S.F and B.M diagrams of the beam shown in figure 1. (16M)

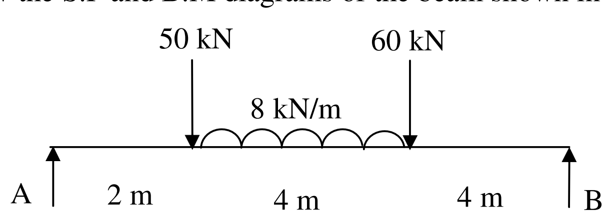

Figure 1
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4. a) Write and Explain moment area theorems.
   b) Find the slope and deflection of simply supported beam of span L, carrying i) a point load P at the centre, ii) a U.D.L of w kN/m over the entire span, using the moment area method. (6M+10M)

5. a) Show that the ratio of maximum shear stress to average shear stress is 3/2 in case of a rectangular section of width, b and depth, d
   b) A 120 mm x 50 mm I- section is subjected to a shearing force of 10 kN. Calculate the shear stress at the neutral axis and at the top of the web. Given I = 220×10^4 mm^4, Area = 9.4×10^2 mm^2, web thickness = 3.5 mm and flange thickness = 5.5 mm (6M+10M)

6. A beam AB, span 8 m, simply supported at the ends is subjected to a point load at C, which is 6m from left support. Using area moment method, compute i) deflection at C, ii) slope at A, iii) slope at B, and iv) slope at C. Take E= 2×10^5 N/mm^2 and I = 6×10^8 mm^4. (16M)

7. Derive the Lames equations from the fundamentals in a thick cylindrical shell for the given radii (r_1 and r_2) and internal fluid pressure, p. (16M)