Code No: R1621013 **R16** SET - 1

II B. Tech I Semester Regular/Supplementary Examinations, Oct / Nov - 2019
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 **FOUR** Questions from **Part-B**

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PART –A

1. a) Define (i) Poisson's ratio and (ii) Volumetric strain (2M)
b) Deduce the relation between Shear force and intensity of loading. (3M)
c) Find the section modulus for a section, if breadth is equal to half of its depth. (2M)
d) Write the shear stress equation and explain the terms. (2M)
e) Find the slope, of a simply supported beam of span, L carrying a central point load, P. (3M)
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'. (2M)

PART -B

2. a) Deduce the expression for Strain Energy due to gradual and sudden applied loads. (7M)
b) A rectangular plate made of steel is 4 m long and 20 mm thick and is subjected to an axial tensile load of 60 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. (7M)

3. a) Deduce the relation between Shear force and bending moment. (4M)
b) An overhanging beam is shown in figure 1. Draw the S.F and B.M diagrams (10M)

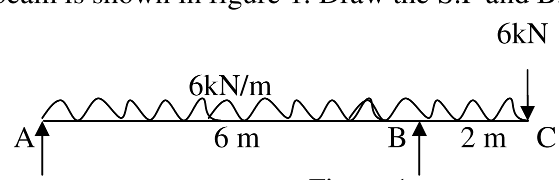

Figure 1

4. a) Derive the bending equation from fundamentals using standard notation (7M)
b) A beam is simply supported and carries a uniformly distributed load of 50 kN/m for 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 130 N/mm^2 and moment of inertia of the section is $7x10^8$ mm^4, find the span of the beam. (7M)

5. A 12 cm x 5 cm I- section is subjected to a shearing force of 14 kN. Calculate the shear stress at the neutral axis and at the top of the web. What percentage of shearing force is carried by the web? Given I = $220x10^4$ mm^4, Area = $9.4x10^3$ mm^2, web thickness = 3.5 mm and flange thickness = 5.5 mm. (14M)
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6. A simply supported beam of span 5 m, carrying a point load of 8 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= $2x10^5$ N/mm^2 and I = 2 $x10^8$ mm^4. Use double integration method. (14M)

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 9 N/mm^2. Find the final stresses sent up across the section, when the compound cylinder is subjected an internal fluid pressure of 86 N/mm^2. (14M)

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2. Answer **ALL** the question in **Part-A**
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PART –A

1.	a)	Find the elongation of the bar due its self-weight.	(2M)
	b)	Deduce the relation between S.F and B.M.	(2M)
	c)	Write the assumptions made in the theory of simple bending	(2M)
	d)	Find the ratio of maximum shear stress to average shear stress in case of a circular section.	(3M)
	e)	Find the maximum deflection in case a cantilever beam of span L, loaded with a UDL of intensity, w kN/m for the whole span.	(3M)
	f)	Deduce the circumferential stress equation for a thin spherical shell subjected to an internal pressure of intensity 'p' with a thickness't' and diameter 'd'.	(2M)

PART -B

2.	a)	Deduce the relation between the Modulus of Elasticity and Modulus of Rigidity.	(6M)
	b)	A load of 120 N falls through a height of 20 mm on to a collar rigidly attached to the lower end of a vertical bar 1.2 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 $E=2x10^5$ N/mm^2	(8M)
3.		A horizontal beam, 26 m long, carries a uniformly distributed load of 12 kN/m over the whole length and concentrated load of 32 kN at 1 m from the right end. Draw the diagrams of S.F and B.M inserting the principal values.	(14M)
4.	a)	Derive the bending equation from fundamentals using standard notations.	(7M)
	b)	Calculate the maximum flexural stress induced in a cast iron (C.I) pipe of external diameter 40 mm, internal diameter 20 mm and of length 4 m, when the pipe is simply supported at its ends and carries a point load of 80 N at its centre.	(7M)
5.	a)	From the fundamentals obtain the expression for shearing stress at a section of a loaded beam?	(6M)
	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 = $220x10^4$ mm^4, Area = $9.4x10^2$ mm^2, web thickness = 3.5 mm and flange thickness = 5.5 mm	(8M)
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6. A simply supported beam of span 6 m loaded point load of 14 kN at its centre, in addition to the UDL of 6 kN/m for the whole span. Find slopes at the supports and maximum deflection. Use double integration method. (14M)

7. a) 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 (6M)

   b) A spherical shell of internal diameter 750 mm and of thickness 9 mm is subjected to an internal pressure of 1.8 N/mm^2. Determine the increase in diameter and increase in Volume. Take E= $2x10^5$ N/mm^2, 1/m =0.33 (8M)

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PART –A

1. a) Define and explain strain energy. (2M)
   b) Draw the B.M.D of a cantilever beam of L, subjected to a couple M at the free end. (2M)
   c) Write the simple bending equation and explain the terms in detail. (2M)
   d) Show that the ratio of maximum shear stress to average shear stress is 3/2 in case of a rectangular section, bxd. (3M)
   e) Find the slope for a cantilever beam of span L, loaded with a UDL of w kN/m for the whole span. (2M)
   f) Deduce the circumferential stress equation for a thin spherical shell subjected to an internal pressure of intensity ‘p’ with a thickness‘t’ and diameter ‘d’. (3M)

PART -B

2. 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. (6M)
   b) The Modulus of rigidity for a material is 0.51×10^5 N/mm^2. A 10 mm diameter rod of the material was subjected to an axial pull of 12 kN and the change in diameter was observed to be 3×10^{-3} mm. Calculate Poisson’s ratio and the module of elasticity. (8M)

3. a) Deduce the relation between Shear force and bending moment. (4M)
   b) A simply supported beam of span 10 m carries point loads 6 kN each at distance of 3 m and 5 m from left support and also a uniformly distributed load of 3 kN/m between the two point loads. Draw the S.F and B.M diagrams for the beam. (10M)

4. a) Find the ratio of depth to width of the strongest beam that can be cut from a circular log of diameter, d (6M)
   b) A simply supported beam carries a uniformly distributed load of 40 kN/m for 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 of inertia of the section is 7×10^8 mm^4, find the span of the beam. (8M)

5. a) From the fundamentals, obtain the expression for shearing stress at a section of a loaded beam? (6M)
   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 50 kN. (8M)
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6. a) Write and explain moment area theorems in detail. (4M)

   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. (10M)

7. a) Show that the sum of radial and hoop stresses in a thick cylinder is constant. (6M)

   b) Find the thickness of metal necessary for a cylindrical shell of internal diameter 160 mm to withstand an internal pressure of 10 N/mm^2. The maximum hoop stress in the section is not to exceed 38 N/mm^2. (8M)

Code No: R1621013 **R16** SET - 4

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(Civil Engineering)

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2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1. a) Find the elongation of the bar of length ‘L’ m, if it is subjected to a Pull of ‘P’ kN. (2M)
   b) Find the SF at left support, if a simply supported beam of span 6 m is subjected an eccentric point load of 12 kN at distance of 2 m from the left support. (3M)
   c) Deduce the section modulus for a hollow circular section of external diameter, D and internal diameter, d, If internal diameter is 3/4 of its external diameter. (3M)
   d) Write the shear stress equations and explain the terms. (2M)
   e) State the moment area theorems. (2M)
   f) Deduce the longitudinal stress for a thin spherical subjected to an internal pressure of intensity ‘p’ with a thickness‘t’ and diameter‘d’. (2M)

PART -B

2. 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. (4M)
   b) A steel rod of 30mm diameter and 5 m long is connected to two grips and the rod is maintained at a temperature of 95^0 C. Determine the stress and pull, when the temperature falls to 30^oC, if (i) the ends do not yield and (ii) the ends yield by 1.2 mm. $E=2x10^5 N/mm^2$ and $\alpha = 12x10^{-6}/ ^oC$. (10M)

3. a) Deduce the relation between Shear force and bending moment. (6M)
   b) A simply supported beam of span 9 m loaded with a varying load of intensity zero at the left hand side and 4.5 kN/m at the right side. Draw the S.F and B.M diagrams. (8M)

4. a) Write the assumptions made in the theory of simple bending. (4M)
   b) A water main 800 mm diameter contains water at a pressure head of 100 m. If the density of water is 9810 N/m^3, find the thickness of the metal required for the water main. Given the permissible stress as 22 N/mm^2. (10M)

5. a) Derive the shear stress formula from fundamentals. (6M)
   b) A 120 mm x 50 mm I-Section is subjected to a shearing force of 15kN. Calculate the shear stress at the neutral axis and at the top of the web. Given I = $220x10^4$ mm^4, Area = $9.4x10^2$ mm^2, web thickness = 3.5 mm and flange thickness = 5.5 mm. (8M)
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6. a) State and prove the moment area theorems. (6M)

   b) A simply supported beam of span L, carrying a point load P at 0.3L from left support. Determine the mid-span displacement and slopes at the supports, using the method of integration. (8M)

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. (14M)