Code No: R2021012 **R20** SET - 1

II B. Tech I Semester Regular/Supplementary Examinations, December, 2023
STRENGTH OF MATERIALS- I
(Civil Engineering)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
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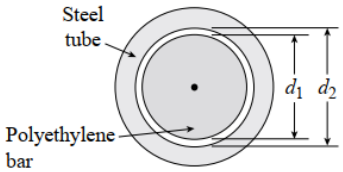
UNIT-I

1 a) A polyethylene bar having diameter d_1=4.0 in. is placed inside a steel tube having inner diameter d_2=4.02 in. (see figure). The polyethylene bar is then compressed by an axial force P. At what value of the force P will the space between the nylon bar and the steeltube be closed? (For nylon, assume E =400 ksi and v=0.4.) [7M]



b) The cross-sectional area of bar ABCD is 600 mm^2(Figure 1). Determine the maximum normal stress in the bar. [7M]

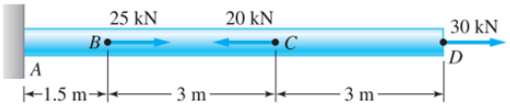


Figure 1

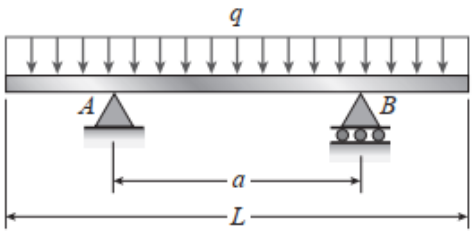


Figure 2

OR [7M]

2 a) A circular rod made of material Ahas a sleeve made of material B shrunk onto it so that the two parts are securely bonded. For all three cases listed below,derive expression for the total elongation and stress inducedin the circular rod when the assembly is subjected to a temperature change of ΔT. Case 1: $\alpha_1>\alpha_2$; Case 2: $\alpha_1=\alpha_2$;Case 3: $\alpha_1<\alpha_2$ (Geometric and Material properties are as follows. **Rod:** diameter d_1, length L_1, Youngs modulus E_1, Coefficient of thermal expansion α_1 **Sleve:** outer diameter d_2, length L_1,Youngs modulus E_2, Coefficient of thermal expansion α_2) [7M]

b) Establish the relationship between Poisson's ratio, Elastic moduli and bulk modulus. [7M]

UNIT-II

3 A beam of length L is being designed to support a uniform load of intensity q (see figure 2). If the supports of the beam are placed at the ends, creating a simple beam, the maximum bending moment in the beam is $ql^2/8$. However, if the supports of the beam are moved symmetrically toward the middle of the beam (as pictured), the maximum bending moment is reduced. Determine the distance a between the supports so that the maximum bending moment in the beam has the smallest possible numerical value. Draw the shear-force and bending-moment diagrams for this condition. [14M]

OR

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4 a) For the beam shown in Figure 3, draw the shear force and bending moment diagrams. [7M]

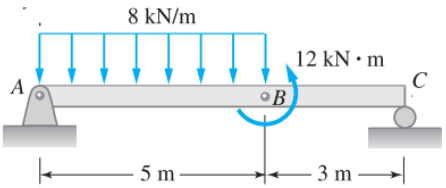


Figure 3

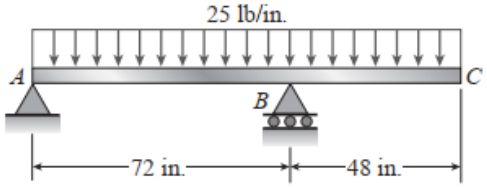
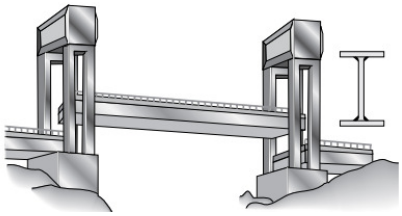


Figure 4

b) Find the point of contra flexure for the beam shown in Figure 4 [7M]

UNIT-III

5 a) Each girder of the lift bridge (see figure) is 180 ft long and simply supported at the ends. The design load for each girder is a uniform load of intensity 1.6 k/ft. The girders are fabricated by welding tree steel plates so as to form an I-shaped cross section (see figure) having section modulus S =3600 in.3 What is the maximum bending stress in a girder dueto the uniform load? [7M]



b) What are the assumptions of Theory of simple bending? [7M]

OR

6 a) An I – section has the following dimensions: [7M]
Flanges : 150 mm x 20 mm
Web : 30 mm x 10 mm
The maximum shear stress developed in the beam is 16.8 N/mm^2. Find the shear force to which the beam is subjected.

b) Establish a relationship between maximum and average shear stress for a given rectangular section of width b and depth d. [7M]

UNIT-IV

7 a) A simply supported beam of span 7.5 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]

OR

8 a) Determine Maximum deflection for simply supported beam under uniformly distributed load. [7M]

b) Discuss briefly about moment area method. [7M]

UNIT-V

9 a) A cylindrical pipe of diameter 1.5 m and thickness 1.0 cm is subjected to an internal fluid pressure of 1.2 N/mm^2. Determine longitudinal stress developed in the pipe, and circumferential stress developed in the pipe. [7M]

b) Derive an expression for longitudinal stress for thin cylinders. [7M]

OR

10 a) Differentiate between thin cylinder and thick cylinder and mention any four application of thin and thick cylinders. [7M]

b) A water main 80 cm diameter contains water at a pressure head of 100 m. If the weight density of water is 9810 N/mm^2, find the thickness of the metal required for the water main. Given the permissible stress as 20 N/mm^2. [7M]

Code No: R2021012 **R20** SET - 2

II B. Tech I Semester Regular/Supplementary Examinations, December, 2023
STRENGTH OF MATERIALS- I
(Civil Engineering)

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UNIT-I

1 a) Define Hook's law. Differentiate between brittle, ductile materials with the help of stress strain diagram. [7M]

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^2cross-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=2x10^5N/mm^2 [7M]

OR

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 [7M]

b) A circular steel rod AB (diameter d_1= 1.0 in., length L_1= 3.0 ft) has a bronze sleeve (outer diameter d_2= 1.25 in., length L_2= 1.0 ft) shrunk onto it so that the two parts are securely bonded (see Figure). [7M]
Calculate the total elongation of the steel bar due to a temperature riseT= 500°F. (Material properties are as follows: for steel, E_s= 30x 106 psi and α_s=6.5x10^6/°F; for bronze, E_b= 15 x 10^6 psi and α_b=11x10^6/°F.)

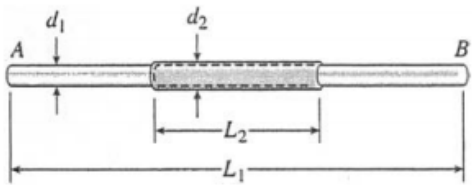

Figure 1

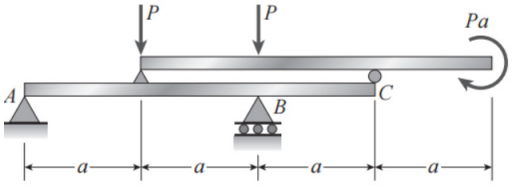

Figure 2

UNIT-II

3 a) A simply supported beam of span 9 m loaded with a varying load of intensity 2 kN/m at the left hand side and 4.5 kN/m at the right side. Draw the S.F and B.M diagrams. [7M]

b) Define point of contra flexure? Explain with the help of an example. [7M]

OR

4 A beam ABC is simply supported at A and B and has an overhang BC (see Figure 2). The beam is loaded by two forces P and a clockwise couple of moment Pa that act through the arrangement shown. Draw the shear-force and bending-moment diagrams for beam ABC. [14M]

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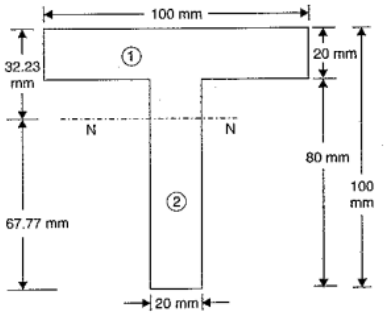
UNIT-III

5 a) A water main 600 mm diameter contains water at a pressure head of 100 m. If the density of water is 9810 N/m3, find the thickness of the metal required for the water main. Given the permissible stress as 22 N/mm2. [7M]

b) Find the ratio of depth to width of the strongest beam that can be cut from a circular log of diameter, d [7M]

OR

6 A cast iron beam is of T-section as shown in Figure. The beam is simply supported on a span of 8 m. The beam carries a uniformly distributed load of 1.5 kN/m length on the entire span. Determine the maximum tensile and maximum compressive stresses. Draw the shear stress distribution across the cross section. [14M]



UNIT-IV

7 a) 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 moment area method. [7M]

b) Explain moment area methods with example. [7M]

OR

8 a) Derive the deflection expression for deflection at the free end of a cantilever beam of length L, having a constant EI throughout the section and a load *P* is applied at the center of the beam. [7M]

b) Explain Macaulay's method with example. [7M]

UNIT-V

9 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]

OR

10 a) 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 [7M]

b) Derive an expression for hoop stress and longitudinal stresses and establish a relationship between them. [7M]

Code No: R2021012 **R20** SET - 3

II B. Tech I Semester Regular/Supplementary Examinations, December, 2023
STRENGTH OF MATERIALS- I
(Civil Engineering)

Time: 3 hours Max. Marks: 70

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UNIT-I

1 a) Deduce the expression for Strain Energy due to gradual and sudden applied loads. [7M]

b) An T – section has the following dimensions: [7M]
Flanges : 150 mm x 20 mm
Web : 30 mm x 10 mm
The maximum shear stress developed in the beam is 16.8 N/mm^2. Find the shear force to which the beam is subjected.

OR

2 a) The rails of a railroad track are welded together at their ends (to form continuous rails and thus eliminatethe clacking sound of the wheels) when the temperature is 60°F.
What compressive stress is produced in the rails when they are heated by the sun to 120°F if the coefficient of thermalexpansion $\alpha = 6.5 \times 10^{6}$/°F and the modulus of elasticity $E = 30 \times 10^{6}$ psi? [7M]

b) Draw the stress strain curve for mild steel and explain critical stresses and points. [7M]

UNIT-II

3 Draw the shear force and bending moment for the given beam AC (see figure) [14M]

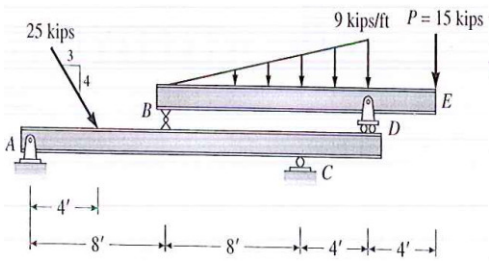

Figure 1

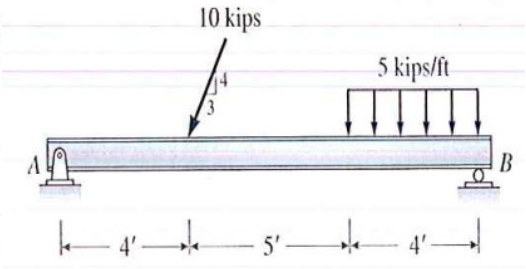

Figure 2

OR

4 a) Determine the reactions for the given figure1 and figure2 beams. [7M]

b) What are the different types of beams? Explain the support conditions and draw free body diagrams. [7M]

UNIT-III

5 a) Derive the shear stress formula from fundamentals. [7M]

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b) A T – section has the following dimensions: [7M]
Flanges : 150 mm x 20 mm
Web : 30 mm x 10 mm
The maximum shear stress developed in the beam is 16.8 N/mm^2. Find the shear force to which the beam is subjected.

OR

6 a) 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. [7M]

b) Establish a relationship between maximum and average shear stress of a isosceles triangle. [7M]

UNIT-IV

7 a) Calculate the deflection and slope at point B for the given beam (Figure 3). [7M]

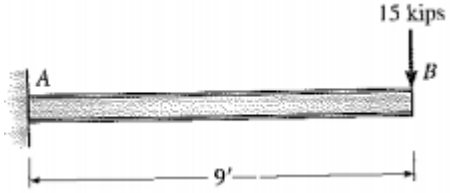

Figure 3

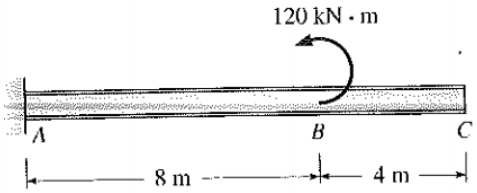

Figure 4

b) Explain double integration method. [7M]

OR

8 a) Calculate the deflection and slope at point C for the given beam (Figure 4). [7M]

b) Explain Mohr's theorem. [7M]

UNIT-V

9 a) A cylindrical tank subjected to internal pressure p is simultaneously compressed by an axial force F=72 kN (see figure). The cylinder has diameter d 100 mm and wall thickness t=4 mm. Calculate the maximum allowable internal pressure p_{max} based upon an allowable shear stress in the wall of the tank of 60 MPa. [7M]

b) Derive an expression for circumferential stress for thin cylinders. [7M]

OR

10 a) A thin cylinder of internal diameter 1.25 m contains a fluid at an internal pressure of 2 N/mm^2. Determine the maximum thickness of the cylinder if: [7M]
i) The longitudinal stress is not to exceed 30 N/mm^2.
ii) The circumferential stress is not to exceed 45 N/mm^2

b) Derive an expression for longitudinal stress for thin cylinders. [7M]

Code No: R2021012 **R20** SET - 4

II B. Tech I Semester Regular/Supplementary Examinations, December, 2023
STRENGTH OF MATERIALS- I
(Civil Engineering)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions each Question from each unit
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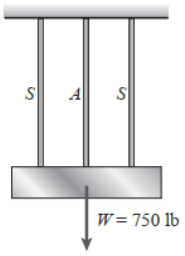
UNIT-I

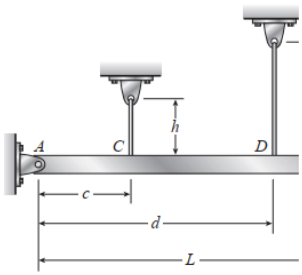
1 a) A rigid bar of weight W =750 lb hangs from three equally spaced wires, two of steel and one of aluminum(see figure). The diameter of the wires is 1/8 in. Before they were loaded, all three wires had the same length. What temperature increase ΔT in all three wires will result in the entire load being carried by the steel wires? (Assume Es=30x10^{6}psi,αs =6.5 x 10^6/°F, and αa = 12x10^6/°F.) [7M]



b) Establish a relation between E, G, and K. [7M]

OR

2 a) A rigid bar AB of length L 66 in. is hinged to a support at A and supported by two vertical wires attached at points C and D(see figure). Both wires have the same cross-sectional area (A =0.0272 in^2) and are made of the same material (modulus E = 30x10^6 psi). The wire at C has length h = 18 in. and the wire at D has length twice that amount. The horizontal distances are c = 20 in. and d =50 in. [7M]
(a) Determine the tensile stresses C and D in the wires due to the load P= 340 lb acting at end B of the bar.
(b) Find the downward displacement B at end B of the bar.



b) Differentiate between elasticity and plasticity. Give some examples with their applications. [7M]

UNIT-II

3 Draw shear force and bending moment diagrams for the given beam (Figure 1) [14M]

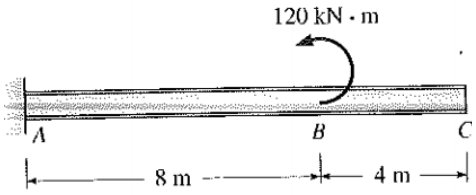


Figure 1

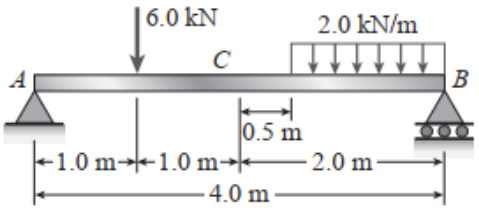


Figure 2

OR

4 Draw the shear force and bending moment diagrams for the given beam (Figure 2) [14M]

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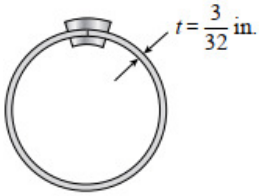
UNIT-III

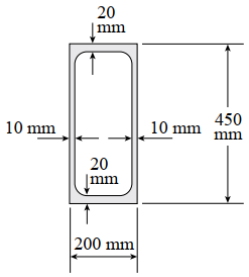
5 What are the assumptions of theory of pure bending and establish the relationship between them. [14M]

OR

6 a) A thin strip of hard copper (E 16,000 ksi) having length L =80 in. and thickness t = 3/32 in. is bent into a circle and held with the ends just touching (see figure). (i) Calculate the maximum bending stressin the strip. (ii) By what percent does the stress increase or decrease if the thickness of the strip is increased by 1/32 in.? [7M]



b) A hollow steel box beam has the rectangular cross section shown in the figure. Determine the maximum allowableshear force that may act on the beam if the allowable shear stress in 36 Mpa [7M]



UNIT-IV

7 a) Differentiate between double integration method and Macaulay's method. Explain their applicability to calculate slope and deflection. [7M]

b) Acantilever beam of span 7.5 m loaded point load of 14 kN at its centre, in addition to the UDL of 6 kN/m for the whole span. Find themaximum deflection. Use double integration method. [7M]

OR

8 a) State moment area theorems. [7M]

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 [7M]

UNIT-V

9 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]

OR

10 a) 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 [7M]

b) Show that the sum of radial and hoop stresses in a thick cylinder is constant. [7M]