

**CE 2111**  
**Mechanics of Materials-I**

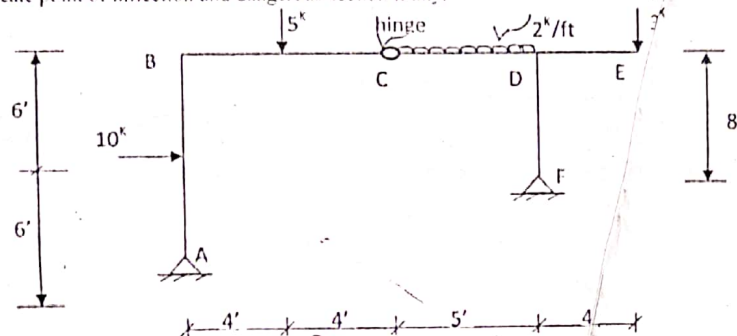
Full Marks: 72

Time: 3 Hours

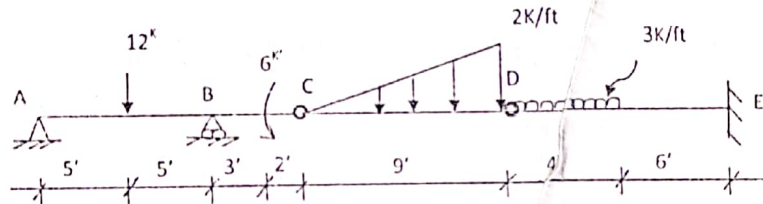
- N.B.:-
- (i) Answer any SIX questions, taking THREE from each section.
  - (ii) Figure in the margin indicate full marks.
  - (iii) Use separate answer script for each section.
  - (iv) Assume reasonable value for any data missing.

**SECTION-A**

- Q.1** Draw shears force and bending moment diagrams for the following frame shown in figure below. 12.0  
 Locate point of inflection and dangerous section if any.

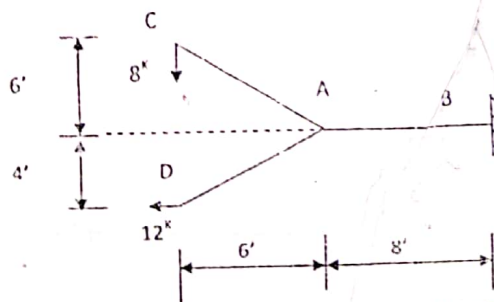


- Q.2** Draw shears force and bending moment diagrams for the following frame shown in figure below. 12.0  
 Locate point of inflection and dangerous section if any.

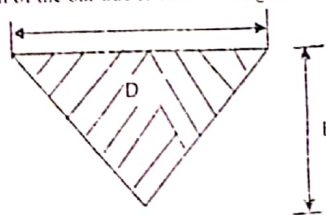


- Q.3(a)** Define point of inflection and dangerous section. 3.00

- (b)** Draw shear force and bending moment diagrams for the shaft shown in figure below. 9.00



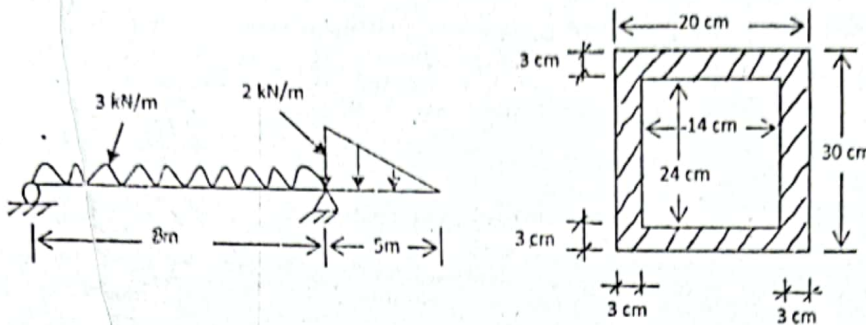
- Q.4 (a)** A solid conical bar of circular x-section is suspended vertically as shown in fig. below. The length of the bar is  $L$ , the diameter of its base  $D$ , the unit weight  $w$  and modulus of elasticity is  $E$ . Determine the elongation of the bar due to its own weight. 7.00



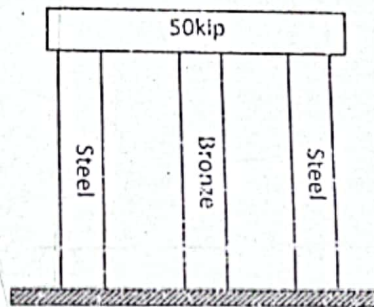
- (b) Prove that "A shearing stress acting on one face of an element is always accompanied by a numerically equal shearing stress acting on a perpendicular force".

SECTION-B

- Q.5 An overhanging beam supports the loads as shown in the following figure. Compute the maximum bending and shearing stress and sketch the stress diagram. 12.00



- Q.6 (a) Define the following terms: (i) Yield Strength (ii) Ultimate strength (iii) Necking (iv) Hardness 4.00  
 (b) A 50 Kip weight is supported by three columns as shown in the following figure. Determine the temperature change required to just relieve the bronze column of all stresses. The columns have equal cross-sectional area of 2 sq. inch and are initially same length. 8.00



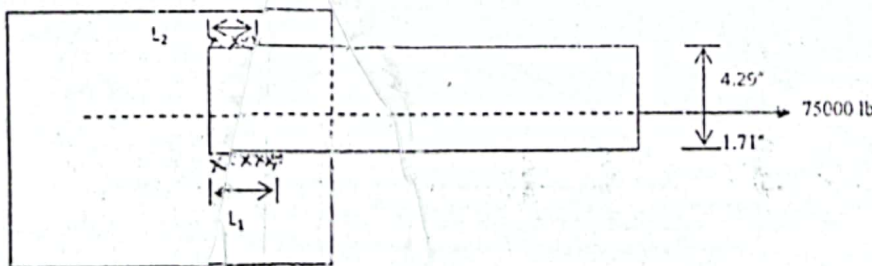
$$\alpha_s = 6.5 \times 10^{-6} \text{ in/in/}^\circ\text{f}$$

$$\alpha_b = 11.2 \times 10^{-6} \text{ in/in/}^\circ\text{f}$$

$$E_s = 30 \times 10^6 \text{ psi}$$

$$E_b = 15 \times 10^6 \text{ psi}$$

- Q.7 (a) Derive illustration for longitudinal and circumferential stress for a thin walled cylinder. 4.00  
 (b) A cylindrical pressure vessel 1 ft in diameter is to be designed to operate at a pressure of 250psi. How thick must the wall be if the tensile stress is not to exceed 15000psi? 5.00  
 (c) Derive the relation between shear stress, shear and moment. 3.00  
 Q.8 (a) Prove that the maximum shearing stress in a rectangular section is 50% greater than the average shear stress. 3.00  
 (b) A 6 x 4 x 1/2 inch angle is to be welded to a gusset plate. The angle carries a load of 75000 lb applied along its centroidal axis. (a) Determine the lengths of the side fillet welds required at the heel and toe of the angle. The welds at the heel and toe are to be the same size as the maximum permissible weld at the toe. (b) Determine the lengths of the side fillet welds if a transverse fillet weld is added at the end of the angle. 9.00



Full marks: 72

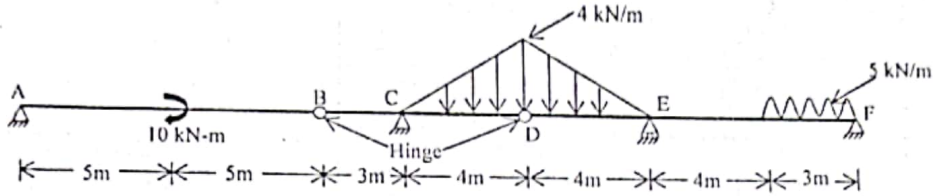
Time: 3 Hours

- N.B:-
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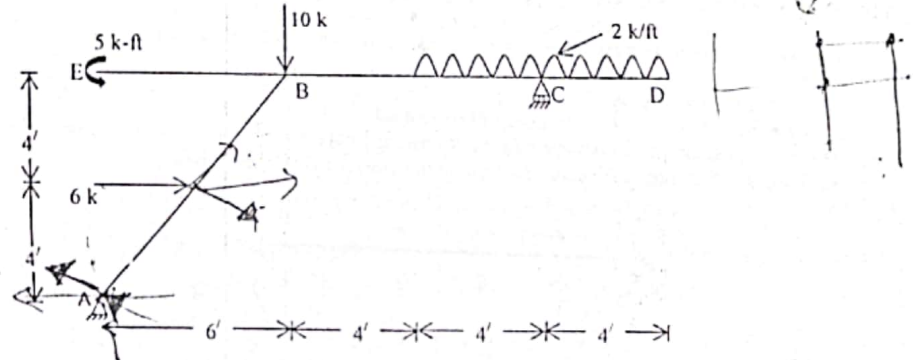
5.9.15  
4.2.15

SECTION-A

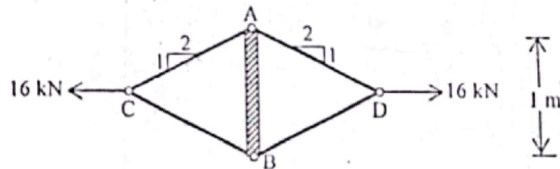
Q.1 Draw shear force and bending moment diagrams for the following beam shown in figure below. Locate the point of inflection and dangerous section if any. 12.00



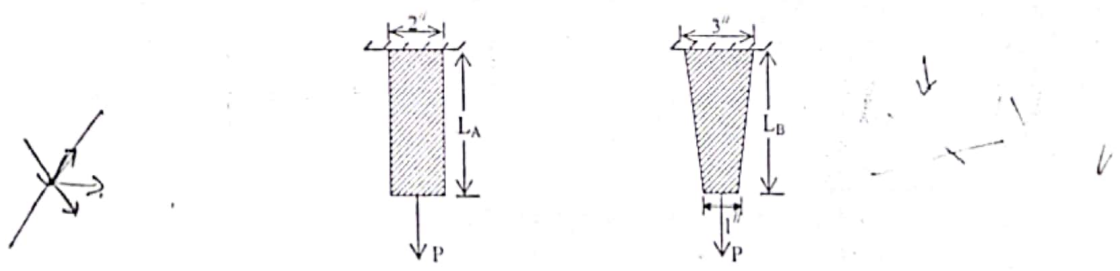
Q.2 Draw shear force and bending moment diagrams for the following frame shown in figure below. 12.00



Q.3(a) Determine the deformation of steel tubular spreader bar AB due to the application of tensile forces at C and D. The cross sectional area of the tube is 100 mm<sup>2</sup>. Let E = 200 GPa. 5.00

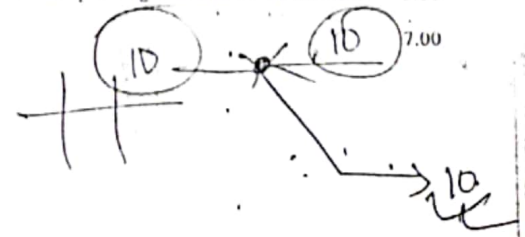
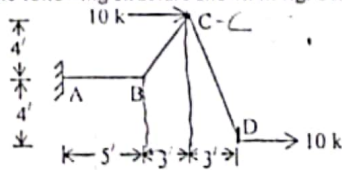


(b) Two bars are to be cut from a 1-in thick metal plate so that both bars have constant thickness of 1 in. Bar A is to have a constant width of 2 in through its entire length. Bar B is to be 3 in wide at the top and 1 in wide at the bottom. Each bar is to be subjected to the same load P. Determine the ratio  $L_A/L_B$  so that both bars will stretch the same amount. Neglect the weight of the bar. 7.00



Q.4(a) Prove that "the intensity of shear force ordinate equals the slope of the corresponding ordinate of the moment diagram." 5.00

(b) Draw SFD and BMD for the following structure shown in fig. below. 7.00



SECTION-B

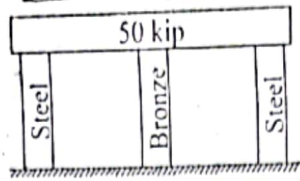
Q.5(a) Define the following terms:

- i) Thermal strain
- ii) Modulus of rigidity
- iii) Poisson's Ratio
- iv) Ductility

4.00

(b) A 50 kip weight is supported by three columns, as shown in the following figure. Determine the temperature change necessary to just relieve the bronze column of all stresses. The columns have equal cross sectional area of 2 sq.-in and are initially the same length.

8.00



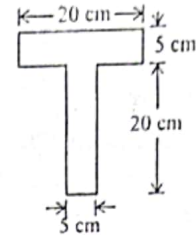
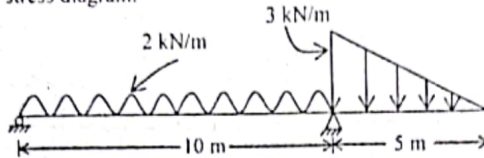
$$\begin{aligned} \alpha_s &= 6.5 \times 10^{-6} \text{ in/in}^\circ\text{F} \\ \alpha_b &= 11.2 \times 10^{-6} \text{ in/in}^\circ\text{F} \\ E_s &= 30 \times 10^6 \text{ Psi} \\ E_b &= 15 \times 10^6 \text{ Psi} \end{aligned}$$

Q.6(a) Derive the formula for horizontal shearing stress.

3.00

(b) A T-beam supports the loads as shown in the figure below. Compute the maximum bending and shearing stress and sketch the stress diagram.

9.00



Q.7(a) Prove that the circumferential stress in a thin wall cylinder is twice the values of the longitudinal stress.

4.00

(b) A spherical vessel with an inside diameter of 50 inch is made of material having an allowable stress in tension of 10000 psi. Determine the thickness of the wall if the vessel is to sustain a pressure of 200 psi.

8.00

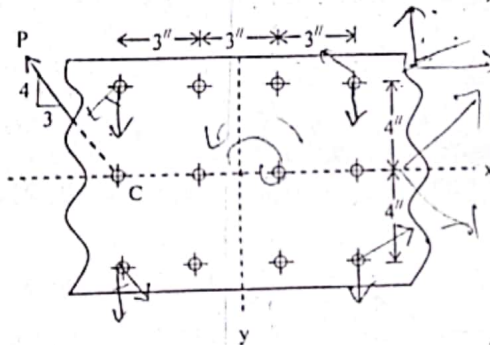
Q.8(a) Define the following terms:

3.00

- i) Lap joint
- ii) Butt joint
- iii) Efficiency of riveted joint.

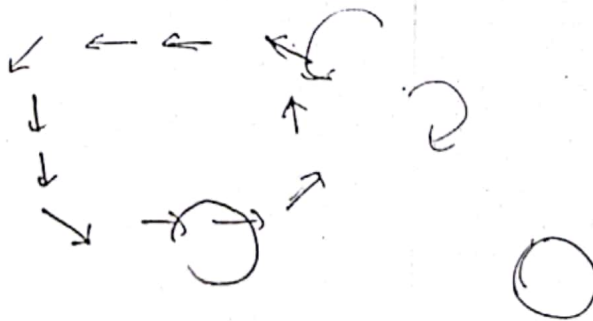
(b) On the connection of rivets shown in the following figure, the load P = 48000 lb passes through the center of the rivet 'C'. Determine the resultant load on the most heavily loaded rivet.

9.00



$$T_{\text{top}} = \frac{P \Delta T \cdot L}{A}$$

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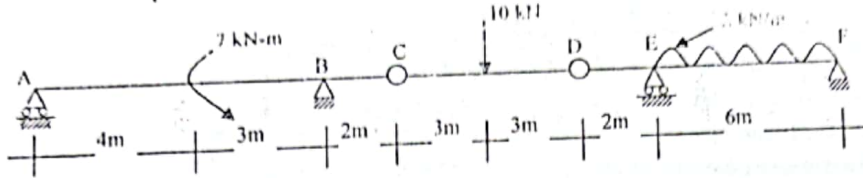
Full marks: 72

Time: 3 Hours

- N.B:- (i) Answer any **SIX** questions, taking **THREE** from each section.  
 (ii) Figures in the margin indicate full marks.  
 (iii) Use separate answer script for each section.  
 (iv) Assume reasonable value for any data missing.

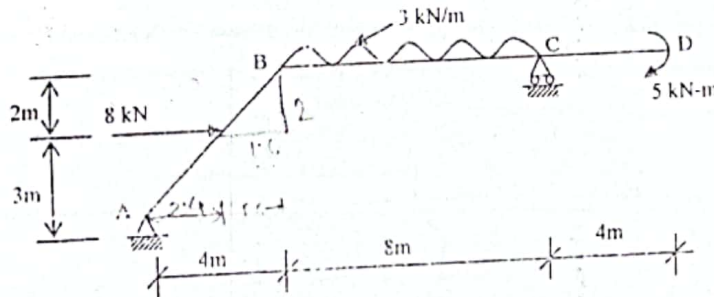
**SECTION-A**

Q.1 Draw SFD & BMD for the following structure. Locate the point of inflection and dangerous section if any. 12

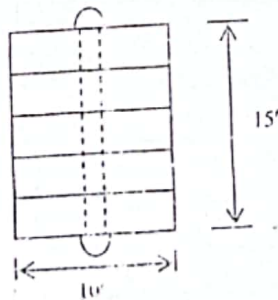


Q.2 Two men are to carry a 4" x 4" wooden bar of 16 ft long. i) If they pick it up at the ends, what will be the maximum bending stress in the bar? ii) If it is assumed that each man takes hold of the bar at the same distance from the end, between what points can this be done in order that the bending stress in the bar would be maximum? (Weight of bar = 20 lb/ft). 12

Q.3 Draw shear force and bending moment diagrams for the following structure shown below. 12

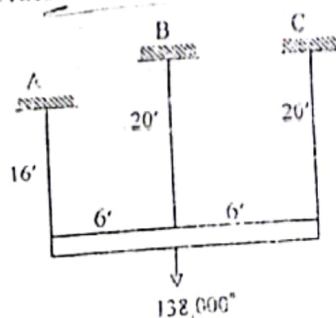


Q.4(a) Prove that for a beam of solid circular X-section the maximum shearing unit stress on any cross-section is 4/3 times the average shearing stress. 3  
 (b) Five planks 3" x 10" arranged as shown in figure below and secured by bolts spaced at 2 ft apart, are used to support a concentrated load 'P' at the center of a simple supported span of 16 ft long. If P causes a maximum flexural stress of 2000 psi, determine the maximum shearing force on the bolt and maximum shearing stress in the plank. 9

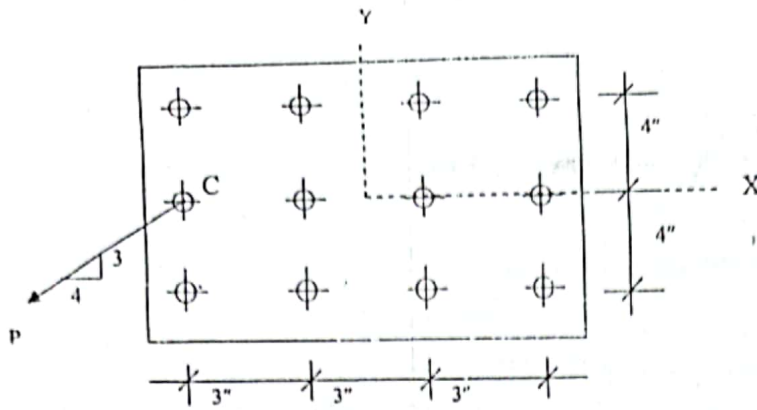


**SECTION-B**

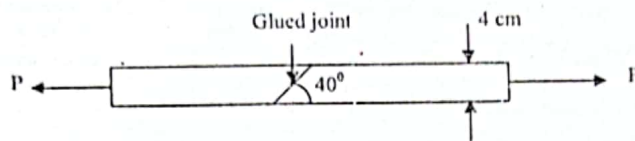
Q.5(a) Define the following terms: (i) Hoop Stress (ii) Longitudinal Stress (iii) Hook's Law. 3  
 (b) A rigid floor is suspended by three rods as shown in the following figure. The total uniform floor load is of 138,000 lb. Area and material properties of three rods are same. Compute the load on each rod. 9



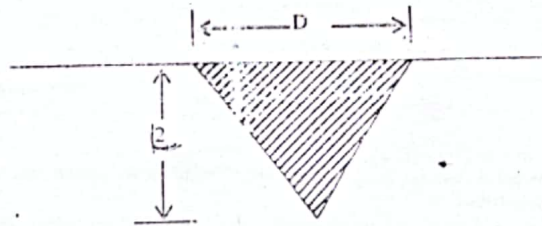
- Q.6 On the connection of 12 rivets in the following figure, the load  $P = 43,000$  lb passes through the center of the rivet 'c' and has a slope of 4 to 3, Determine the resultant load on the most heavily loaded rivet.



- Q.7(a) Two blocks of wood 4 cm wide and 1 cm thick, are glued together as shown in figure below. Determine the shearing load and shearing stress on the glued joint if  $P = 60$  kN.

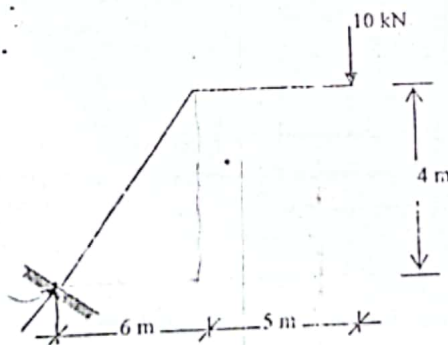


- (b) A solid conical bar of circular x-section is suspended vertically as shown in figure below. The length of the bar is  $L$ , The diameter of its base  $D$ , the modulus of elasticity  $E$ , and the weight density  $\gamma$ . Determine the elongation of the bar due to its own weight.



- Q.8 (a) Define the following terms: (i) Pitch (ii) Shear Center (iii) Side fillet (iv) Stiffness.

- (b) Draw SFD and BMD for the following structure shown in the figure below.



- (c) Prove that "A shear stress acting on one face of an element is always accompanied by a numerically equal shearing stress acting on a perpendicular face"

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**CE 2111**  
**Mechanics of Materials-I**

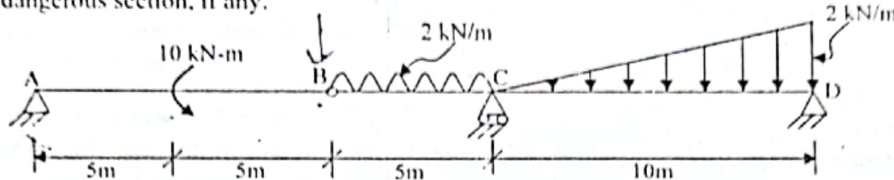
Full Marks: 72

Time: 3 Hours

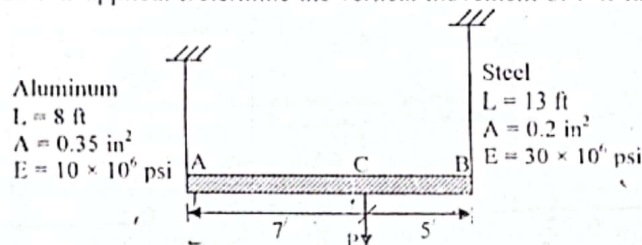
- N.B.:-
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  - (iv) Assume reasonable value for any data not given.

**SECTION-A**

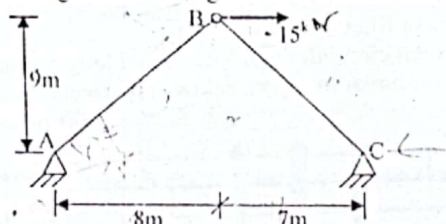
- Q.1 Draw the SFD and BMD for the following structure. Locate the point of inflection and dangerous section, if any. 12.00



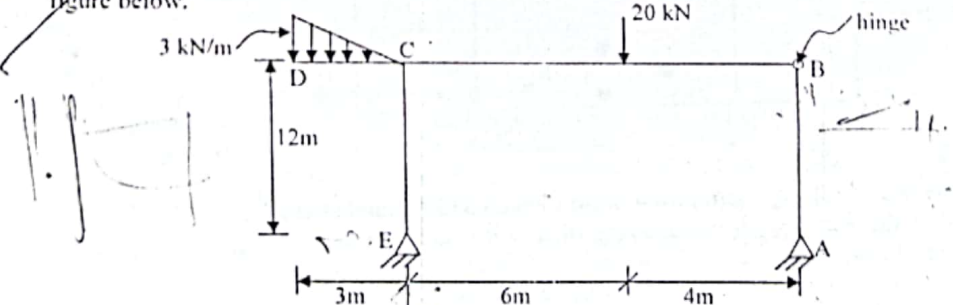
- Q.2(a) The rigid bar AB, attached to two vertical rods as shown in figure below, is horizontal before the load P is applied. Determine the vertical movement of P if its magnitude is 50 kips. 6.00



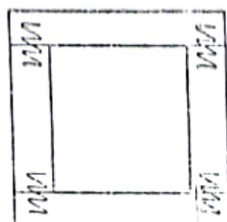
- Q.3 Draw shear force and bending moment diagrams for the following structure shown in figure below. 6.00



- Q.4 Draw shear force and bending moment diagrams for the following structure shown in figure below. 12.00

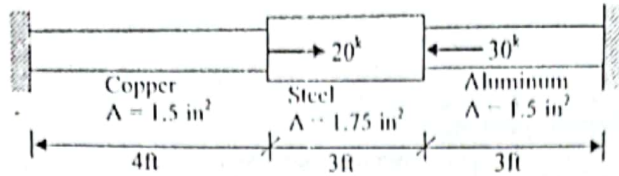


- Q.4 A concentrated load P is carried at mid span of a simply supported beam of 14 ft span. The beam is made of 2 in. by 8 in. pieces screwed together, as shown in figure below. If the maximum flexural stress developed is 1600 psi, find the maximum shearing stress and the pitch of the screws, if each screw can resist 200 lb. 12.00



SECTION - B

Q.5(a) A composite bar is shown in figure below is firmly attached to unyielding supports. Two axial forces are applied. Find the stress in each bar. Assume  $E_{st} = 10 \times 10^6$  psi,  $E_{cu} = 17 \times 10^6$  psi and  $E_{al} = 30 \times 10^6$  psi.

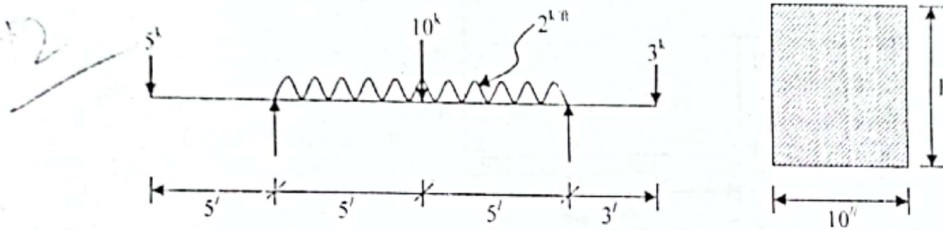


(b) A steel bar 10 ft long with a cross-sectional area of 4 in<sup>2</sup> is placed between two rigid walls as shown in figure below. At a temperature  $-25^\circ\text{C}$ , the gap  $\Delta = 0.1$  in. Find the temperature at which the compressive stress in the bar will be 1800 psi. 6.00



Q.6(a) The strength of the longitudinal joint of a cylindrical tank is 40 kips/ft, whereas for the circumferential joint, it is 19.5 kips/ft. Calculate the maximum diameter of the tank if the internal pressure is 250 psi. 4.00

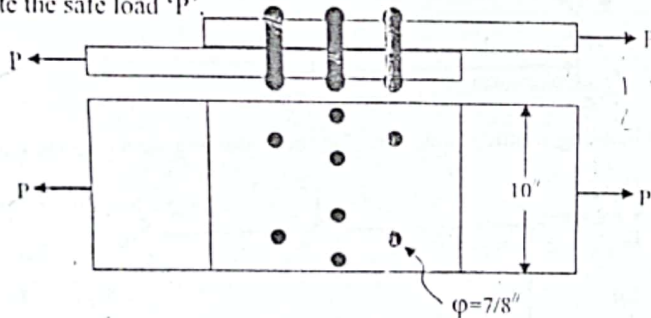
(b) Determine the value of 'h' of the following loaded beam which satisfies the following governing criteria:  $S_t = 4$  ksi and  $S_c = 10$  ksi. 8.00



Q.7(a) Define the following terms: (i) Side fillet (ii) Transverse fillet (iii) Butt fillet 3.00

(b) Illustrate the relation between circumferential stress and longitudinal stress. 3.00

(c) A triple riveted lap joint is shown in figure below. The rivets are 7/8 inch in diameter and the allowable stresses are  $S_s = 15,000$  psi,  $S_b = 32,000$  psi and  $S_t = 20,000$  psi. Calculate the safe load 'P'. 6.00



Q.8(a) Derive an analytical expression for a beam subjected to flexural stress. 3.00

(b) Prove that the average shearing stress of a solid rectangular section is 2/3 of the maximum shearing stress on a given cross-section of a beam. 3.00

(c) A beam of rectangular cross-section is to be cut from a circular log of diameter 'D'. What should be the ratio of depth of the beam to its width for maximum strength in pure bending? 6.00

The End

**CE 211**  
**Mechanics of Materials - I**

Full Marks: 70

Time: 3 Hours

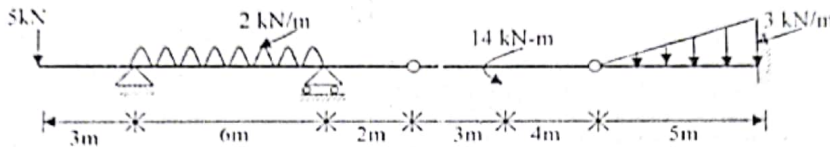
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BABLA  
 CE 212

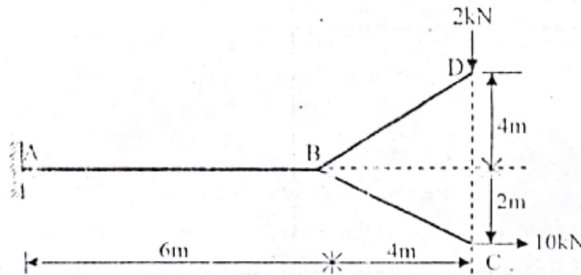
**SECTION-A**

- Q.1 Draw shear force and bending moment diagrams for the following structure as shown in figure 11.67 below. Locate point of inflection and dangerous section if any.



120020

- Q.2(a) Define dangerous section and point of inflection.  
 (b) Draw shear force and bending moment diagrams for the following structure.

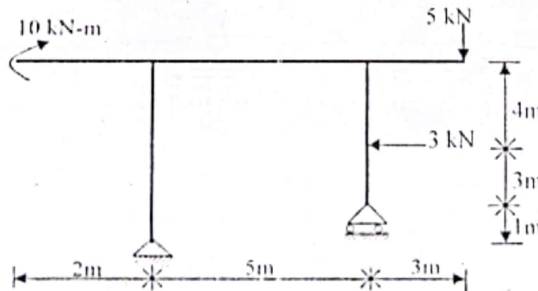


RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY  
 DEPARTMENT OF CIVIL ENGINEERING  
 RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

2.67  
 9.00

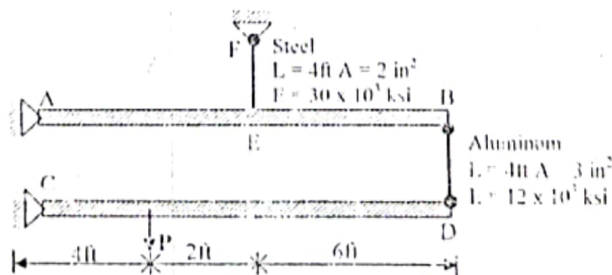
- Q.3 Draw shear force and bending moment diagrams for the frame shown in figure below.

11.67



- Q.4(a) Draw stress-strain diagram of mild steel and explain various point on it.  
 (b) The rigid bars AC and CD are supported by pins at A and B and the two rods BD and BE are shown in figure below. Determine the vertical movement of point D if the value of P is 300 kips.

3.67  
 8.00

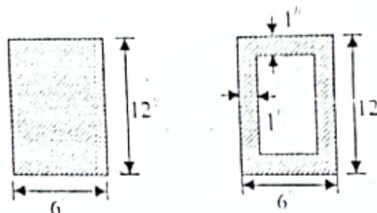


SECTION-B

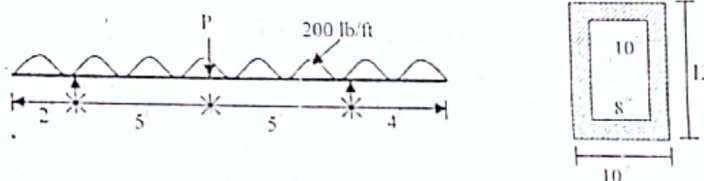
- Q.5(a) Derive the analytical formulation of bursting force on longitudinal and transverse section of a thin walled cylinder. 1.00
- (b) A spherical pressure vessel with an inside diameter of 50 in. is made of material having an allowable stress in tension of 10,000 psi. Determine the thickness of the wall if the vessel is to sustain a pressure of 200 psi. 3.67

$$3 \approx \frac{P \cdot D}{4t} \rightarrow 10000 = \frac{200 \times 50}{4t} \therefore t = \frac{1}{4}''$$

- Q.6(a) What are the assumptions in deriving the relations between bending moment and flexure stresses and between vertical shear and the shearing stresses. 4.00
- (b) Derive the formula for horizontal shearing stress. 4.00
- (c) Compare the strengths of two beams, identical in all respects, except that one is hollow and the other is solid, as shown in the following figure. 4.00



- Q.7(a) Prove that the maximum shearing stress in a rectangular section is 50% greater than the average shearing stress. 2.67
- (b) A box beam carries a distributed load of 200 lb/ft and a concentrated load 'P' as shown in the figure below. Determine the maximum value of P if  $S_x \leq 1000$  psi;  $S_y \leq 1500$  psi and  $S_z \leq 200$  psi. 9.00



- Q.8(a) Define the following terms: (i) Lap joint (ii) Butt joint (iii) Efficiency of a riveted joint. 3.00
- (b) Sketch the major types of weld and write the weld thickness according to different edges. 1.67
- (c) On the connection of 9 rivets shown in the following figure, the load  $P = 40,000$  lb passes through the center of the rivet C and has a slope of 4 to 3. Determine the resultant load on the most heavily loaded rivet. 7.00

