CE371 - Section 02 - Structural Analysis **Varma**

Exam No. 1

Student Name: AMIT VARMA

Student ID: _____

Points scored:

Question 1 = _____

Question 2 = _____

Question 3 = _____

Question 4 = _____

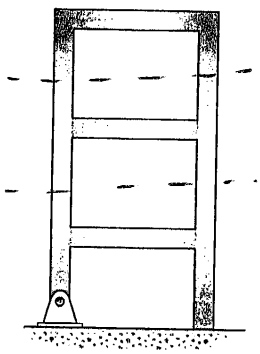
Question 5 = _____

Total = _____

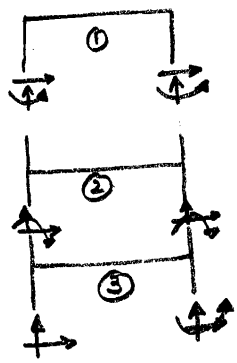
P.S. The exam is closed book and closed notes. You will not need to reference anything. Please do not exchange information or answers with any student. Any form of cheating or copying will result in expulsion from the exam hall.

Question 1. (10 points)

Classify each of the structures as statically determinate, indeterminate, or unstable. State your reasoning clearly. If indeterminate, specify the degree of indeterminacy.



(a)



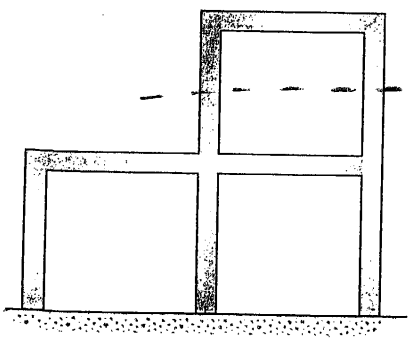
$r = 17$

$n = 3$

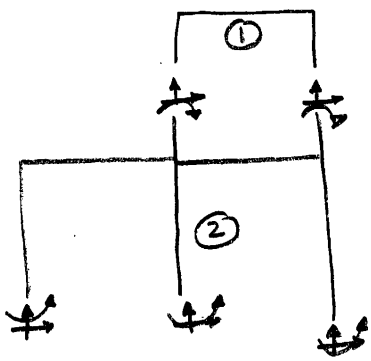
$r > 3n$

$\therefore r - 3n = 8$

INDETERMINATE TO 8°



(b)



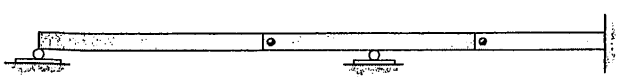
$r = 15$

$n = 2$

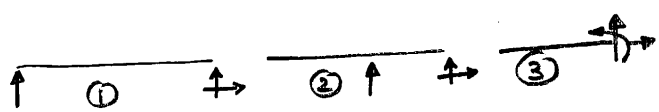
$r > 3n$

$r - 3n = 9$

INDETERMINATE TO 9°

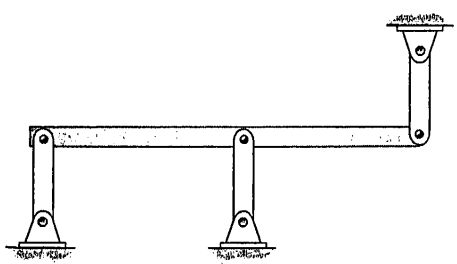


(a)

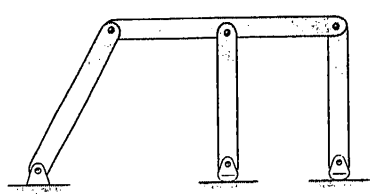


$r = 9$ $n = 3$ $\therefore r = 3n$

DETERMINATE & STABLE



(b)



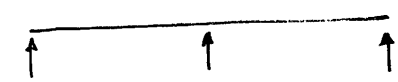
$r = 6$

$n = 4$

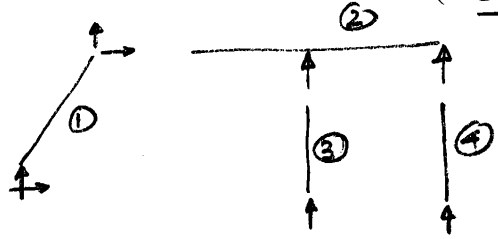
$r = 3n$

(c)

$\therefore$ DETERMINATE & STABLE

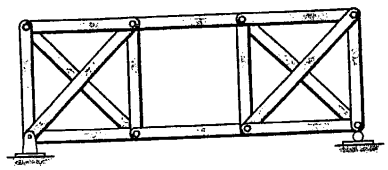


UNSTABLE reactions are parallel



Question 2 (10 points)

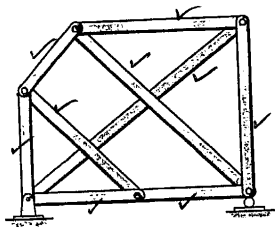
Classify the truss as simple, compound, or complex. Determine if it is determinate, indeterminate, or stable. If it is indeterminate, state external or internal indeterminacy and to what degree.



(a)

UNSTABLE

TRIANGULATION INCOMPLETE

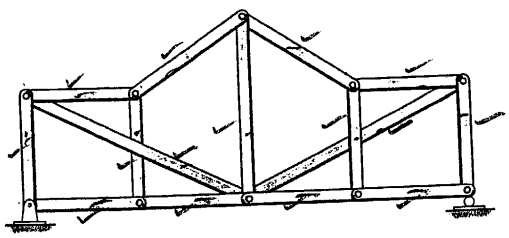


(b)

$b = 9$, $r = 3$, $j = 6$ } $b + r = 2j$

determinate

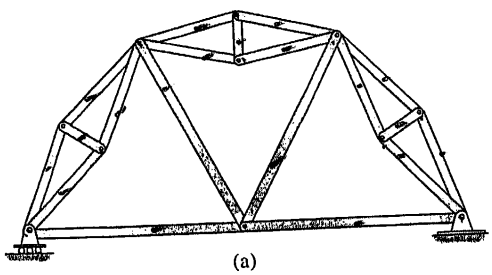
COMPLEX



(c)

$b = 15$, $r = 3$, $j = 10$ } $b + r < 2j$

UNSTABLE



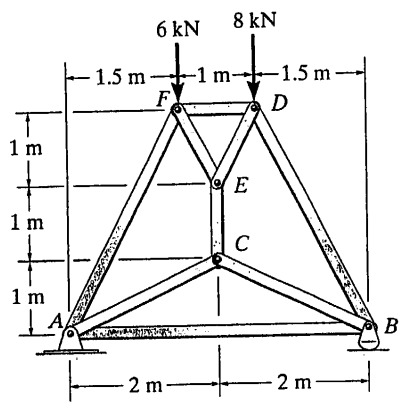
(a)

COMPOUND TYPE 3

$b = 19$, $r = 3$, $j = 11$ } $b + r = 2j$

determinate

STABLE



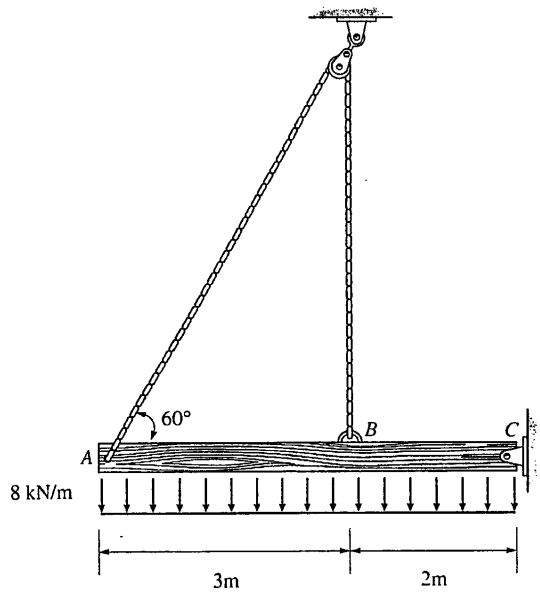
COMPOUND TYPE 2

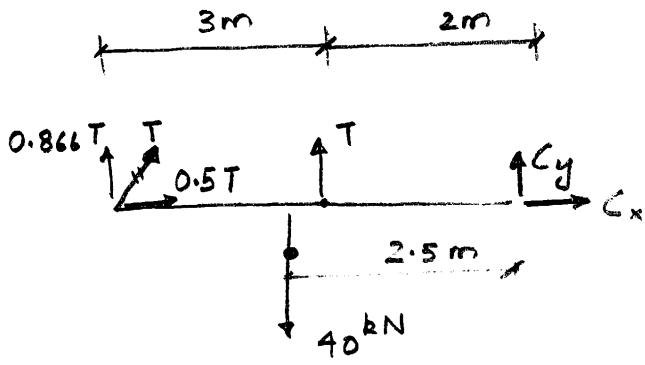
UNSTABLE

Question 3.

(20 points)

For the structure shown below, determine the tension in the cable and the horizontal and vertical reactions at C. Note that the tension in a cable is always constant (on either side of a frictionless pulley).





$\rightarrow \Sigma F_x = 0 \quad \therefore \quad 0.5T + C_x = 0$

$+\uparrow \Sigma F_y = 0 \quad \therefore \quad 0.866T + T + C_y - 40 = 0$

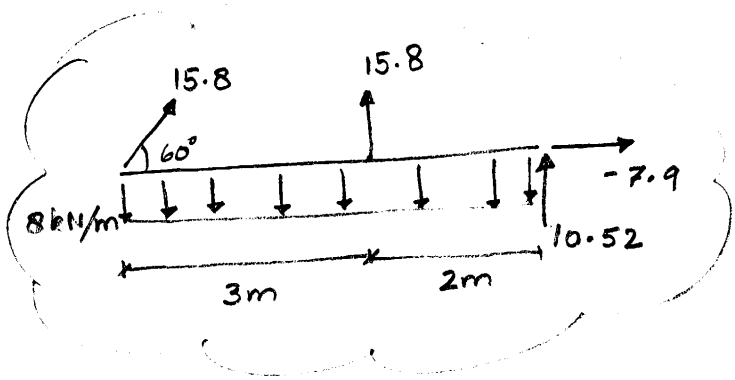
$(+ \Sigma M_c = 0 \quad \therefore \quad -2T - 5(0.866T) + 40 \times 2.5 = 0$

$\therefore T = \frac{100}{6.33} = 15.8 \text{ kN}$

$\therefore C_x = -7.9 \text{ kN}$

$C_y = 40 - 1.866T$

$C_y = 10.5172 \text{ kN}$



5 Points FBD

3 x 3 Point Equations

2 x 3 Final Answers

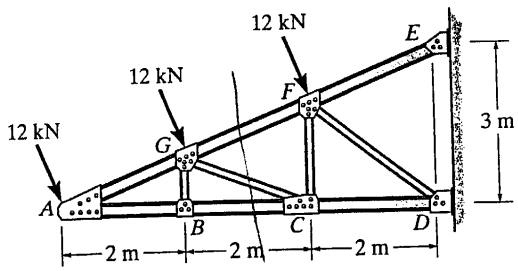
20

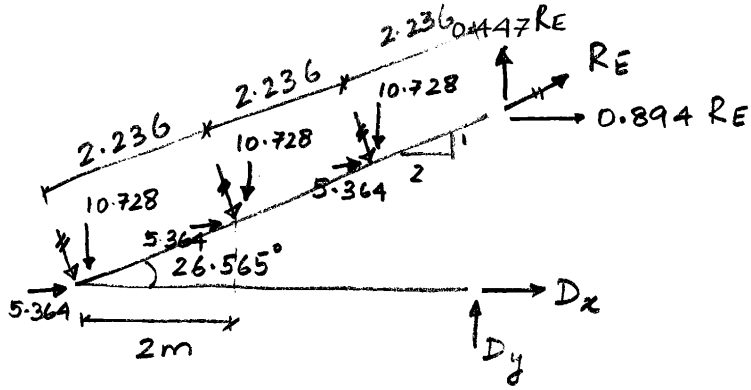
5 Points 1st FBD
2 x 3 Points Equations
1 x 3 Reactions
2 FEF
16 points

5 points 2nd FBD
2 x 3 point equation
1 x 3 points Forces
14 points

Question 4 (30 points)

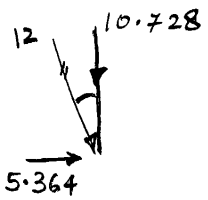
Calcuate the reactions at D and E for the truss. Using the method of joints, calculate the force in member EF. Using the method of sections calculate the force in members GF, GC, and BC





$(+\sum M_E = 0 \quad \therefore \quad +12 \times 2.236 + 12 \times 2 \times 2.236 + 12 \times 3 \times 2.236 + 3D_x = 0$

$\therefore D_x = -53.665 \text{ kN}$

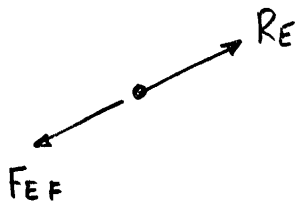


$\rightarrow \sum F_x = 0 \quad \therefore \quad (5.364 \times 3) + D_x + 0.894\, R_E = 0$

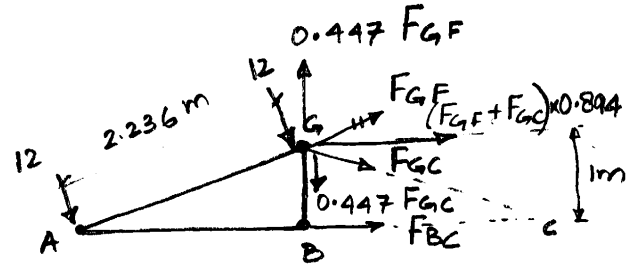
$\therefore R_E = 42.028 \text{ kN}$

$+\uparrow \sum F_y = 0 \quad \therefore \quad -10.728 \times 3 + 0.447 \times 42.028 + D_y = 0$

$\therefore D_y = 13.4 \text{ kN}$



$\therefore F_{EF} = R_E = 42.028 \text{ kN (T)}$



$(+\sum M_G = 0$

$\therefore 12 \times 2.236 + F_{BC} \times 1\text{m} = 0$

$\therefore F_{BC} = -26.832 \text{ kN}$

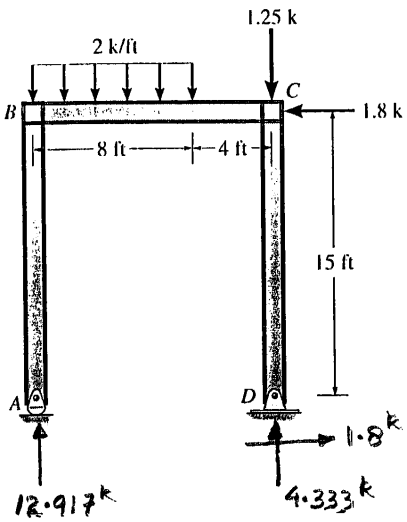
$\rightarrow \sum F_x = 0 \quad 5.364 \times 2 + 0.894\,(F_{GF} + F_{GC}) + F_{BC} = 0$

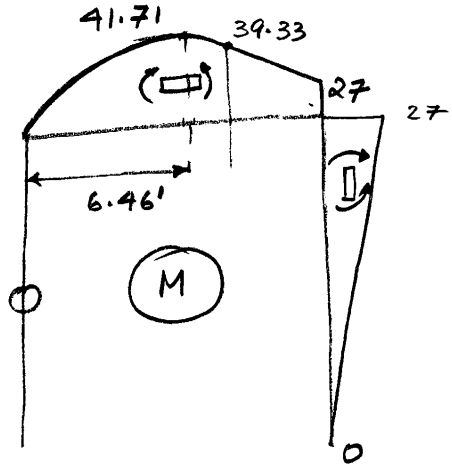
$+\uparrow \sum F_y = 0 \quad -10.728 - 10.728 + 0.447\,(F_{GF} - F_{GC}) = 0$

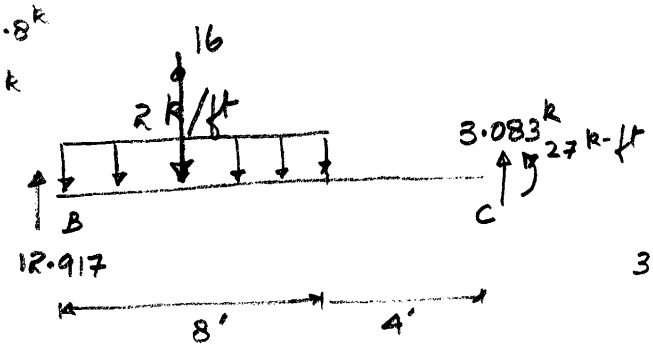
5 FBD x 2 = 10 points
4 = N (2 x 1.5 points)
3 = SFD (4 x 1.5 points)
3 = BMD (4 x 1.5 points).

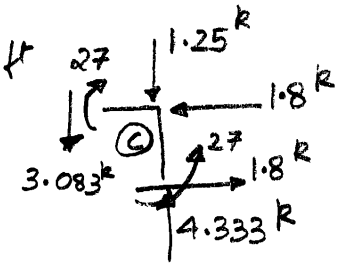
Question 5 (30 points)

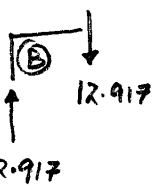
Draw the axial force, shear force, and bending moment diagrams for each member of the frame shown. Assume joints B and C are fixed connected.

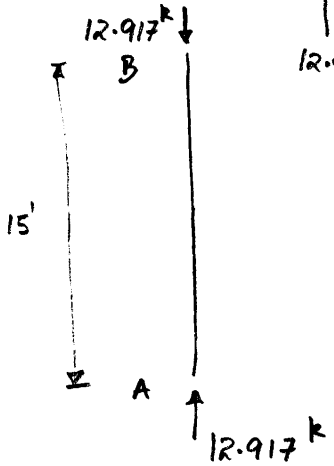


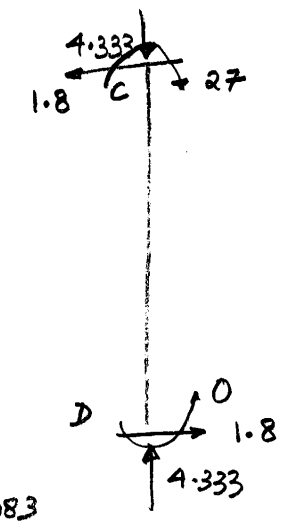


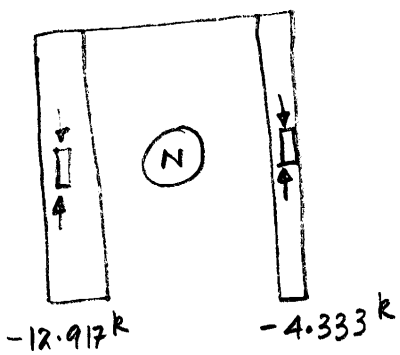


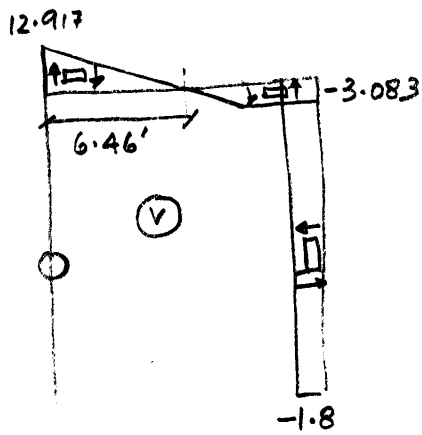












4:22
5:12
50 minutes