AMERICAN UNIVERSITY OF BEIRUT
CIVE 210 STATICS

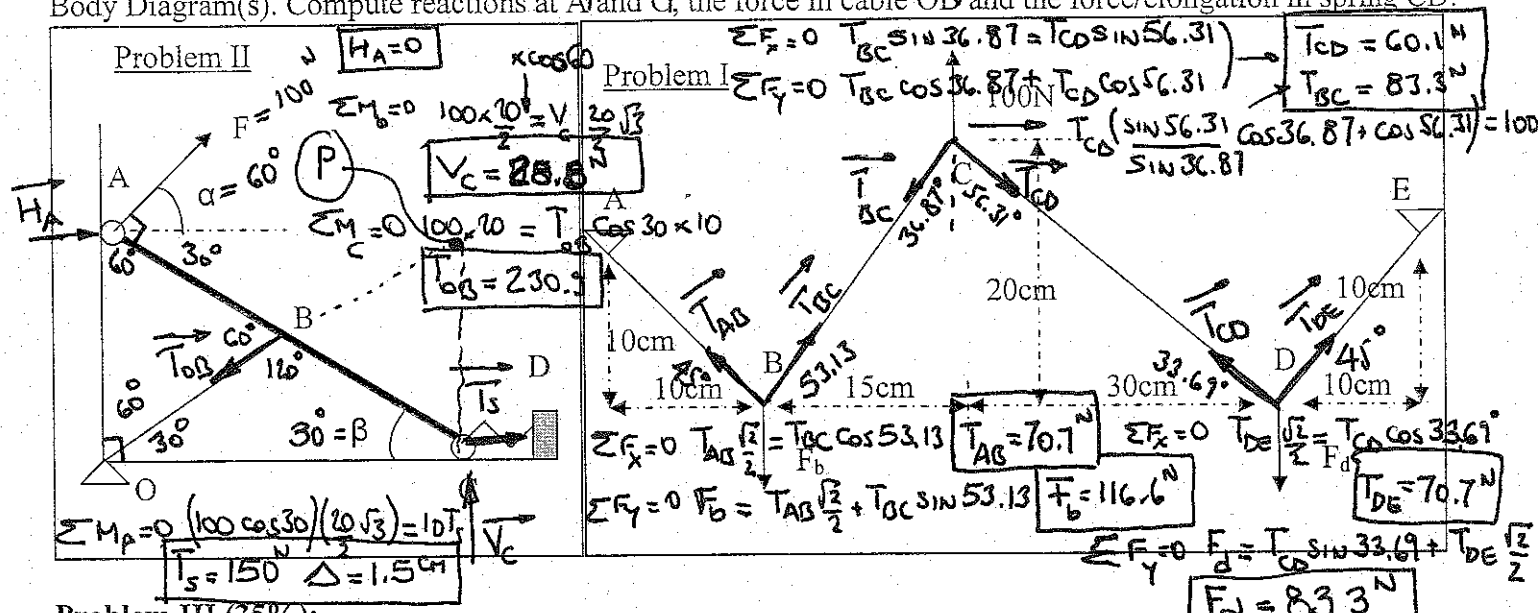
EXAM I: 8:00 – 9:30 AM — Mar 29, 2008
Spring 2007-2008 — Professor: FOUAD KASTI
Student Name: — Student ID:

Problem I (30%):

A single weightless piecewise cable ABCDE is hinge supported at A and E as shown. The cable is loaded with vertical concentrated forces F_b (down) at B, 100N (up) at C and F_d (down) at D as shown. Assuming geometry as shown, draw Free Body Diagram(s), and compute the tension forces in cable segments AB, BC, CD and DE as well as the applied forces F_b and F_d required for equilibrium.

Problem II (35%):

A rigid, homogeneous, weightless and uniform bar ABC is roller supported at A against a vertical wall, roller supported at C against a horizontal surface, connected to a rigid weightless cable OB and to a spring CD of spring stiffness K=100N/cm. Assume a 100N force F is applied at point A oriented at an angle α to the horizontal direction. Assume roller support at A is barely touching the vertical wall, cable OB is hinged at O, frictionless and dimensionless roller supports, α = 60° and β = 30°. Assume AB = BC = OB = 10cm, draw Free Body Diagram(s). Compute reactions at A and C, the force in cable OB and the force/elongation in spring CD.



Problem III (35%):

For the three dimensional system shown, draw Free Body Diagram(s) and compute the tension forces in cables AB and AC as well as the compression force in bar AO. Assume F is a vertical force of magnitude 150N. Assume weightless system. Use Cartesian Formulation.

$\Sigma \vec{F} = 0 \quad \vec{T}_{AB} + \vec{T}_{AC} + \vec{T}_{AO} + \vec{F} = 0$

(1) $T_{AB}\frac{-3}{3.25} + T_{AC}\frac{-3}{3.5} + T_{AO}(+1) = 0$ ← $\Sigma F_x = 0$

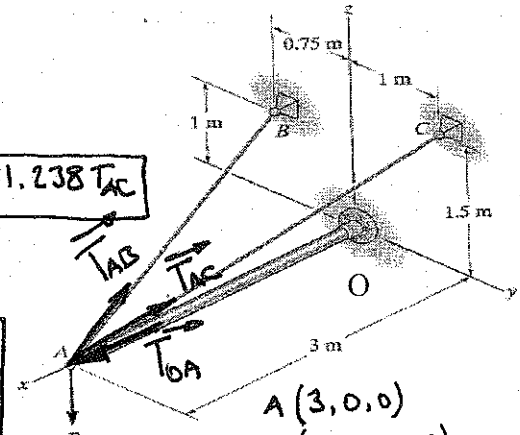
(2) $T_{AO}\frac{-0.75}{3.25} + T_{AC}\frac{1}{3.5} + 0 = 0$ ← $\Sigma F_y = 0$ → $T_{AB} = 1.238\,T_{AC}$

(3) $T_{AB}\frac{1}{3.25} + T_{AC}\frac{1.5}{3.5} + 0 - 150 = 0$ ← $\Sigma F_z = 0$

(3) + (2) → $T_{AC} = 185.3$ N

(2) → $T_{AB} = 229.4$ N

(1) → $T_{AO} = 370.6$ N



A (3, 0, 0)
B (0, −0.75, 1)
C (0, 1, 1.5)

$\vec{AB} = (-3, -0.75, 1) \quad \vec{u}_{AB} = \frac{-3}{3.25}\vec{i} + \frac{-0.75}{3.25}\vec{j} + \frac{1}{3.25}\vec{k}$

$\vec{u}_{AC} = \frac{-3}{3.5}\vec{i} + \frac{1}{3.5}\vec{j} + \frac{1.5}{3.5}\vec{k} \qquad \vec{u}_{OA} = +\vec{i}$