NAME: ______________________________    Section: ___________

RIN: _______________________________

Wednesday, November 12, 2014
8:00 – 9:50

Please state clearly all assumptions made in order for full credit to be given.

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A grand piano lid is supported by two hinges at $A$ and $B$ as well as a prop stick $CD$. The lid weighs $50$ lb and the center-of-weight is at $G$. The two hinges are properly aligned therefore exert only force reactions on the lid. Only the hinge at $A$ reacts to axial forces, if any. $L = 40$ in, $l = 26$ in, $a = 22$ in, $b = 17$ in, $c = 11$ in, and $\alpha = 50^\circ$.

a) Complete the free-body-diagram for the lid in the given picture on the right.

b) Express each force labeled in Part a) in Cartesian vector form.

c) Express the moment of all forces in part b) about $A$ in Cartesian vector form.

d) Write scalar equations of equilibrium for the lid.

e) Solve magnitude of reaction by prop stick $CD$ and reaction components at $A$ and $B$. 

\[\text{Lengths: } AB = L \]
\[\text{CD} = l\]
Problem #2 (25)

The I-beam shown is subjected to a distributed load as well as a concentrated load.

a) Determine the magnitude of a concentrated load equivalent to the triangular distributed load. (8)

b) Determine the location of the concentrated load found in part (a) measured from the left end of the beam (12)

c) Use your results to calculate the reactions at both supports. The support A is a smooth pin, and the support at B is a smooth roller. (5)

Note: Neglect the weight of the I-beam and draw the FBD for part c.
Problem #3 (25)

The truss shown in the figure is supported by a smooth pin at $A$ and a roller at $F$.

a) Identify zero-force members, if any. (2)

b) Use method-of-joint to determine forces in $AB$, $AG$, $CD$, and $DE$. (13)

c) Use method-of-section to determine forces in $BC$, $CF$, and $EF$. (10)

In b) and c), you must show FBDs, indicate if the force is tension (T) or compression (C), and use the specified method to get the credit.
Problem #4 (25)

For the shown matrix:

a) Using the method of cofactor expansion calculate the determinant of matrix $A$ (10)

b) Let matrix B be the intersection of rows ‘1 through 3’ and columns ‘2 through 4’ (shaded area). Show how to obtain the inverse of matrix B by using elementary row operations. To receive full credit, all elementary row operations shall be identified and each result shown. You may combine up to two elementary row operations in a single step as long as you clearly identify both operations. (15)

$$A = \begin{bmatrix}
0 & -1 & 2 & 0 & 5 \\
2 & 1 & -3 & 0 & -1 \\
-3 & 5 & 4 & 3 & 2 \\
0 & 2 & -3 & 0 & 6 \\
0 & -2 & 3 & 0 & -5
\end{bmatrix}$$