RENSSELAER POLYTECHNIC INSTITUTE
TROY, NY

EXAM NO. 3 INTRODUCTION TO ENGINEERING ANALYSIS

(ENGR-1100) – Spring 11

NAME: ____________________________  Section: ________

RIN: ____________________________

Wednesday, April 20, 2011
8:00 – 9:50

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

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<th>Problem</th>
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Problem #1 (10 %)

Given the following information about the system:

\[ \mathbf{r}_{A/o} = OA = \hat{i} + \hat{j} + 6 \hat{k} \]
\[ F_A = 900 \hat{k} \]
\[ \mathbf{r}_{B/o} = OB = 3 \hat{i} + 4 \hat{j} - 7 \hat{k} \]
\[ F_A = 900 \hat{i} + 900 \hat{j} \]

Write, using MATLAB syntax, the code needed to generate to determine the moment \( M_o \) about point \( O \).
Problem #2 (25 %)

Given:

\[
\begin{align*}
3x + 7y + 6z &= 1 \\
2x + 4y + 3z &= 1 \\
y + 2z &= -1
\end{align*}
\]

a) Write the above system of equations in the form \( AX = B \). Identify each of the matrices \( A \), \( X \) and \( B \) respectively (4 points)

b) Find the inverse \( A^{-1} \) of matrix \( A \) (10 points)

c) Solve the system of equations by the matrix inversion method (i.e., using matrix \( A^{-1} \)) (7 points)

d) Find the Cofactor of the member \( a_{32} \) of matrix \( A \) (4 points)
Problem #3 (20%)

A 25kg door is made self-closing by hanging a 15kg counterweight from a cable attached at C, passing by a frictionless pulley at pin E. The door is held open (in equilibrium) by a force $\vec{P}$ applied to the knob at D, in a direction perpendicular to the door. When $\theta = 90^\circ$, and assuming that the hinge at A does not exert an axial thrust (NO force in the y-direction) determine:

a) The magnitude of $P$ (8)

b) The components of the reactions at A (6)

c) The components of the reactions at B (6)

Note: You have to draw any required FBD and show all work to receive full credit
Problem #4 (25 %)

The truss shown is supported at F by a smooth pin and at E by a smooth roller.

a) Using the method of joints, determine the force in members AB, BC and AC, and state whether the members are in tension or compression (10 points)
b) Using the method of sections, determine the force in members BD, CD and CE, and state whether the members are in tension or compression (13 points)
c) Determine any zero-force member you can find (2 points)

Note: You have to draw all needed FBD you are using in a) and b) to get full credit.
Problem #5 (20%)

The movement of the backhoe bucket shown is controlled by the three hydraulic cylinders shown (AB, CD and EF). Determine the force exerted by each cylinder to support the 3000lb load as shown.

a) The force exerted by cylinder AB
b) The force exerted by cylinder CD
c) The force exerted by cylinder EF
d) State for each of the three cylinders whether they are in tension or compression

Note: You have to draw any required FBD and show all work to receive full credit.