NAME: ______________________________    Section: ___________

RIN: _______________________________

Wednesday, December 14, 2011

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**N.B.:** You will be graded on 5 problems, 20 points per problem. Problems 1, 2, and 3 are mandatory and will be graded. Before turning in your exam, please make sure you have circled the two problems you want to be graded out of problems 4, 5 and 6.
Problem 1 (20 points)
A plane structure has two members that are connected at C by a pin, which is fixed to BCDE and passes through the smooth slot in member AC. A couple moment \( M = 600 \text{ lb-ft} \) is applied to the member \( AC \). A load 500 lb is applied at \( B \). Neglect the weight of each member.

(a) Draw FBD for \( AC \) \hfill (4 pts.)
(b) Draw FBD for \( BDE \) \hfill (4 pts.)
(c) Determine the horizontal and vertical components of reactions at supports \( A, D, \) and \( E \). \hfill (12 pts.)
Problem 2 (20 points)

Given the system of linear equations:

\[
\begin{align*}
    x + y + 3z &= 6 \\
    2x + 3y - 4z &= -2 \\
    3x - 2y + 5z &= 7
\end{align*}
\]

a. Write the system of equations in a matrix form \(Ax = B\). Identify \(x\), \(A\) and \(B\). (3 pts.)
b. Calculate the \(\det(A)\) using the method of cofactors by expanding the 3rd column. (5 pts.)
c. Calculate the \(\text{Adj}(A)\). (5 pts.)
d. Determine \(A^{-1}\). (3 pts.)
e. Use Cramer’s rule to solve for the value of \(y\). (4 pts.)
Problem 3 (20 points)

The masses of blocks A and B are \( m_A = 40 \text{ kg} \) and \( m_B = 85 \text{ kg} \). The coefficient of friction is 0.25 for both surfaces. Determine the force \( P \) and the tension \( T \) in the horizontal cable, when motion of block B down the inclined surface is impending.

Note: To receive full credit you should draw all necessary FBD’s.
Problem 4 (20 points)

An 1800-N vertical load \( Q \) is applied to the center of pulley C. This frictionless pulley C can roll on the cable ACB. The pulley is held in the position shown by a second cable CAD, which passes over frictionless pulley A and supports a load \( P \).

Determine:

(a) The tension \( T \) in cable ACB (8 pts.)
(b) The magnitude of the load \( P \) (8 pts.)
(c) The horizontal and vertical reaction forces at support A (4 pts.)

To receive credit draw all the Free Body Diagrams FBDs required for solving the problem.
Problem 5 (20 points)

A bulldozer is pulling a heavy concrete block. The block is attached to the bulldozer by a bar AB and three cables (AC, AD and AE) attached to a ring at A, as shown in the figure below. Under static equilibrium conditions, the force in the cable AE has a magnitude of 8 kN.

1. Identify the particle to be analyzed and write the equilibrium equations (14 pts.)
2. Determine the tension in cable AC (2 pts.)
3. Determine the tension in cable AD (2 pts.)
4. Determine the force exerted by the bar AB on the ring A. (2 pts.)

Draw all necessary free body diagrams separately from the figure below.
Problem 6 (20 points)

For the truss shown, determine:

a. the reaction forces at $C$ and $E$.  
   (5 pts.)

b. by using the method of joints, the force in **ALL** the members of the truss shown and state whether the member is in tension or compression.  
   (15 pts.)

(To receive credit draw all the Free Body Diagrams FBDs required for solving the problem)