Name ____________________________

EM406

Examination III

November 5, 2004

Problem	Score
1	/30
2	/30
4	/40
Total	/100

Show all work for credit

AND

Stay in your seat until the end of class

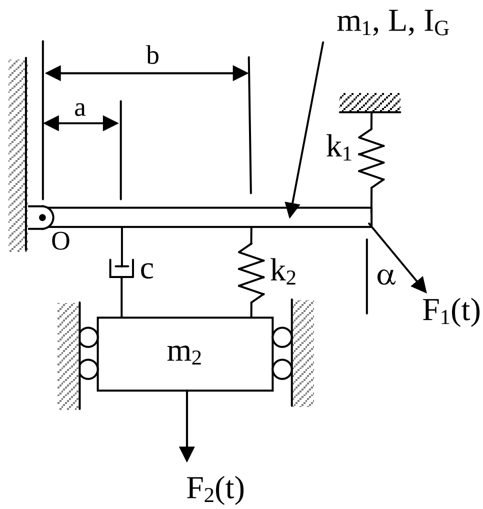
AND

Turn in your signed help sheet

Name ___________________________________ 30 pts

EM406 Examination III **Problem 1** November 5, 2004

A mass is suspended below a uniform slender bar as shown. Using Lagrange's equations determine the equations of motion for the two masses. Assume small angles.



Name ___________________________________ 30 pts

EM406 Examination III **Problem 2** November 5, 2004

If in the previous problem you assume the damping is zero, $F_1 = 0$, and you substitute in numbers for known parameters you find the equations of motion are:

$$\begin{bmatrix} 10 & 0 \\ 0 & 2 \end{bmatrix} \begin{Bmatrix} \ddot{\theta} \\ \ddot{x} \end{Bmatrix} + \begin{bmatrix} 2k_1 + 700 & -700 \\ -700 & 700 \end{bmatrix} \begin{Bmatrix} \theta \\ x \end{Bmatrix} = \begin{Bmatrix} 0 \\ 5\sin\omega t \end{Bmatrix}$$

Determine the value of k_1 such that the steady-state motion of mass, m_2, is zero.

Name ________________________________ 40 pts

EM406 Examination III **Problem 3** November 5, 2004

A 3-DOF system governed by coordinates, x_1, x_2 and x_3 is found to have the eigenvalues and modal matrix (I've rounded horribly to save time writing – assume these are correct.)

$$\omega_1^2 = 1.86 \qquad \omega_2^2 = 6.00 \qquad \omega_3^2 = 9.14$$

$$[\phi] = \begin{bmatrix} 0.48 & -0.26 & 0.13 \\ 0.96 & 0 & -0.21 \\ 0.68 & 0.18 & 0.20 \end{bmatrix}$$

Assume the mass matrix is [M] = 10[I]. Using modal analysis determine the time response of each mass if the system is given the initial conditions

$$x_1(0) = x_2(0) = \dot{x}_2(0) = \dot{x}_3(0) = 0 \quad \text{and} \quad \dot{x}_1(0) = 1 \text{ and } x_3(0) = -2$$

Do not do the algebra associated with the final transformation. Just show me what needs to be done.