AE3521 Fall 2001 Homework #1
Due: Tuesday September 4, 2001 at noon (beginning of class) or before

1. Consider the system described by:

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -4 & -1 \\ 3 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

(a) Identify A (system matrix), B (input matrix), and C (output matrix) of the system.
(b) Obtain a differential equation in terms of $y(t)$ and $u(t)$.
(c) Obtain a transfer function for the system and find the poles.
(d) Compare the eigenvalues of the system matrix to the poles.

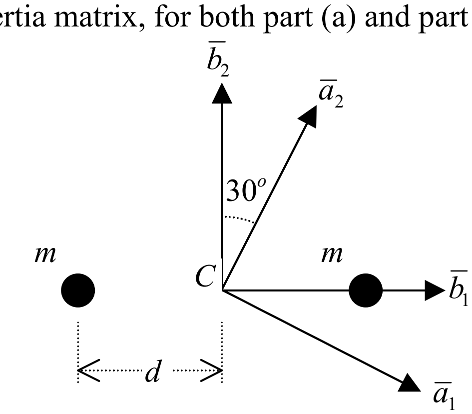
2. The transfer function of a system is:

$$\frac{4}{(s^2-1)(s^2+1)}$$

(a) Obtain a differential equation governing the dynamics of the system.
(b) Represent the system in state space form.
(c) Obtain the eigenvalues and eigenvectors of the system matrix (you may use MATLAB, eig() command)
(d) Compare the eigenvalues of the system matrix with poles of the given transfer function.

3. Consider yourself to be a point mass, sitting "still" working on your homework. *Without* neglecting the rotation of the Earth about it's center:
(a) What is the velocity of your center of mass with respect to the center of the Earth (Give references for the numbers you use, specify units and frame of reference)?
(b) Assuming your pencil or pen has a mass of 1 ounce, what is the angular momentum of that pencil or pen about the center of the Earth?

4. Determine the inertia matrix for the following system composed of two point masses (each with mass *m*, and located distance *d* from the center of mass).
(a) Expressed in the *b*-body-fixed-frame.
(b) Expressed in the *a*-body-fixed-frame.
(c) What are the eigenvalues of the inertia matrix, for both part (a) and part (b)?



$\bar{b}_3, \bar{a}_3$ Out of the page