OKLAHOMA STATE UNIVERSITY

SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING
SCHOOL OF MECHANICAL AND AEROSPACE ENGINEERING

ECEN 4413/MAE 4053
Automatic Control Systems
Spring 2012

Midterm Exam #2

DO ALL FOUR

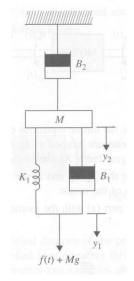Name : _____

E-Mail Address:_____

Problem 1:

Draw the state diagram for the state space system given by

$$\dot{x} = Ax + Bu = \begin{bmatrix} -3 & 2 & 0 \\ -1 & 0 & 1 \\ -2 & -3 & -4 \end{bmatrix} x + \begin{bmatrix} 0 & 1 \\ 1 & 0 \\ 1 & 0 \end{bmatrix} u.$$
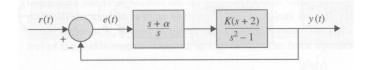
Problem 2:

Write the equation of motion for the linear translational system shown below. Draw the state diagram using a minimum number of integrators. Write the state equation from the state diagram. Find the transfer functions $Y_1(s)/F(s)$ and $Y_2(s)/F(s)$. Set $Mg = 0$ for the transfer function.

Problem 3:

The block diagram of a control system is shown below. Find the region in the K vs. α plane for the system to be stable. (Use K as the vertical and α as the horizontal axis.)

$r(t) \xrightarrow{\quad} \bigoplus \xrightarrow{e(t)} \boxed{\dfrac{s+\alpha}{s}} \xrightarrow{\quad} \boxed{\dfrac{K(s+2)}{s^2-1}} \xrightarrow{y(t)}$

Problem 4:
Consider the closed-loop control system described by

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ -b_3 & 0 & 1 \\ 0 & -b_2 & -b_1 \end{bmatrix} x + \begin{bmatrix} 1 \\ b_1 \\ b_3 \end{bmatrix} r.$$

$$y = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix} x$$

Determine its stability criteria.