EE128  Homework #1

Due on Friday 9/22/06 at 10AM.

(1) Consider the following feedback system where \( u \) is the input and \( y \) is the output.

(a) Let \( A=1 \). Sketch the \( y \) vs. \( u \) graph and the \( y \) vs. \( d \) graph. The y-axis in your graph must cover the interval \([0 2]\) and you must specify the coordinate of any ‘break point’ of the graph. (Hint: you can write \( y=g(e) \) as a piecewise-linear function).

(b) Repeat (1) with \( A=20 \).

(c) Base on the graphs from (a) and (b), comment on the effect of the feedback gain \( A \).

(2) Problem 3.13, parts a, b and c. (Hint: \( i_a \) is the input and \( r_a \omega_a = \dot{x}_1 \))

(3) Consider the nonlinear state equation. A state \( X_o \) is an equilibrium state of the system for a given \( u_o \) if

\[
0 = F(X_o, u_o).
\]

Note that the state vector \( X(t) \) stays constant if it is at an equilibrium state (i.e., \( X(t)=X_o \) for all \( t \)) since the rate of change of \( X \) is zero at this state.

(a) Find all the equilibrium states of the following system for \( u=0 \).

\[
\begin{align*}
\dot{x}_1 &= x_1(x_2 - 1) \\
\dot{x}_2 &= x_2(2 - x_1) + u^2
\end{align*}
\]

(b) Linearize the system about all the equilibrium states found above.

(4) Problem 3.20 for the systems shown in diagram (a), (b), and (c) on page 154. No need to use Mason’s rule.

(5) Problem 3.28