EXAM I  EE-295 Feedback & Optimal Control

Thu. March 20, 2014

NAME ________________________________

Closed Book.

Please write clearly and underline or box your answer.

1. ________

2. ________

3. ________

4. ________

5. ________
1. (15%) (Laplace Transforms)

Assume all signals are causal (zero for $t < 0$). Do the following:

(a) for $x(t) = \delta(t)$, give the response $w(t)$. (You may just write it down).

(b) Now find $y(t)$ using Laplace transforms. That is, find the inverse Laplace transforms of

$$Y(s) = \frac{s}{s + 2}$$

(c) Recalling that,

$$\frac{d}{dt} \leftrightarrow s$$

find $y(t)$ by differentiating $w(t)$.

(c) Were the second block to be $\frac{1}{s}$, find $y(t)$. 
2. (10%) (Laplace Transform)

(a) Signal $e^{2t} u(t)$ does not have a Fourier transform. Explain why.

(b) Write the Laplace Transform of $e^{2t} u(t)$ and give the ROC.

(c) Determine the Laplace Transform of $e^{j\omega t} u(t)$ and give the ROC.
3. (15%) (Bode Plots)

(a) Plot magnitude and phase of $H(s) = \frac{1}{s}$.
$\theta(\omega)$
4. (15%)  
(Bode Plots)  

(a) Plot magnitude and phase of $H(s) = \frac{1}{s+1}$.
5. (15%) (State Equation)

(a) For the state equation \( \dot{x} = Ax \),

\[
\begin{bmatrix}
\dot{x}_1 \\
\dot{x}_2 \\
\end{bmatrix}
= \begin{bmatrix}
-1 & 0 \\
0 & -1 \\
\end{bmatrix}
\begin{bmatrix}
x_1 \\
x_2 \\
\end{bmatrix}
\]

find the eigen values of \( A \) and the state-transition matrix \( \Phi(t) \).

(b) What modes are present?

(c) For the state equation \( \dot{x} = Ax \),

\[
\begin{bmatrix}
\dot{x}_1 \\
\dot{x}_2 \\
\end{bmatrix}
= \begin{bmatrix}
-1 & 1 \\
0 & -1 \\
\end{bmatrix}
\begin{bmatrix}
x_1 \\
x_2 \\
\end{bmatrix}
\]

find the eigen values of \( A \) and the state-transition matrix \( \Phi(t) \).

(d) What modes are present?