O K L A H O M A S T A T E U N I V E R S I T Y

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

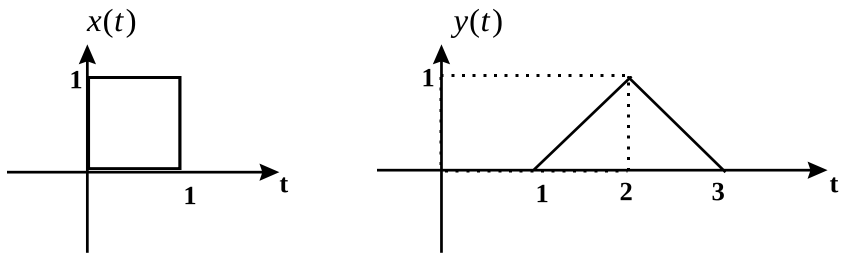
ECEN/MAE 5713 Linear Systems
Spring 2011
Midterm Exam #1

Name : ______________________________

E-Mail Address:_______________________________________

<u>Problem 1</u>:

A system is found to have zero-state response, $y(t)$ as shown below on the right, when the input, $x(t)$ as show below on the left, is applied. Is this system a) causal, b) time-varying, c) zero-memory, and/or d) zero-state linear ? Justify your answer. (Hint: find the relationship between input and output, $y(t) = f(x(t))$)



<u>Problem 2</u>:

Find the *observable* canonical form realization (in minimal order) from continuous-time system

$$\frac{d^4 y(t)}{dt^4} + 3t\frac{d^3 y(t)}{dt^3} + 4\frac{d^2 y(t)}{dt^2} + 2\frac{dy(t)}{dt} + \alpha(t)y(t) = \frac{d^2 u(t)}{dt^2} + e^{-t}\frac{du(t)}{dt} + u(t)\,.$$

Notice that gain blocks may be *time* dependent. Show the simulation diagram and its corresponding state space representation.

Problem 3:

Find a minimal *observable* canonical form realization (i.e., its simulation diagram and state space representation) for the following 2-input, 1-output system described by

$$H(s) = \begin{bmatrix} \dfrac{2s+3}{s^3+4s^2+5s+2} & \dfrac{s^2+2s+2}{s^4+3s^3+3s^2+s} \end{bmatrix}.$$

<u>Problem 4</u>:

Let

$$H(z) = \begin{bmatrix} \dfrac{z+2}{z^2+z} & \dfrac{z}{z^2+z} \\ \dfrac{1}{z^2+2z} & \dfrac{z+1}{z^2+2z} \end{bmatrix}$$

be a transfer function matrix. Find a minimal realization (i.e., simulation diagram and state space representation) for the discrete-time system represented by $H(z)$.