ECEN 3723 Systems I
Fall 2000
Midterm Exam #2

“choose any 2 from Problems 1, 2, and 5, in addition to Problems 3 and 4”

Name: ______________________________

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**Problem 1:**
Consider a filtered circuit that the output response, \( y(t) \), is the time-convolution of the input signal, \( x(t) \), graphically shown below, and the impulse response, \( h(t) \), where \( h(t) = e^{-5t}u(t) \), please find \( y(t) \).
Problem 2:
Show
\[ Z[\text{Im } x(k)] = \frac{1}{2} \left( X(z) - X^*(z^*) \right) \]
where ‘*’ denotes complex conjugate operation.
Problem 3:
Find $X(z)$ for
a) $x(k) = k^3 u(k)$

b) $x(k) = \left(\frac{1}{2}\right)^k u(-k-2)$
**Problem 4:**
Find $x(k)$ for

a) $X(z) = \frac{1}{z^2 + 1}$

b) $X(z) = \ln\left(\frac{z - 1}{2z}\right)$
**Problem 5:**
A linear time-invariant discrete-time system is given by the input-output difference equation
\[ y(k) + y(k-1) - 2y(k-2) = x(k) - 2x(k-1) + x(k-2). \]
Find an input \( x(k) \) with \( x(k) = 0, k < 0 \) that gives the output response \( y(k) = 2u(k) - u(k-2) \) with initial condition \( y[-2] = 2, y[-1] = 1 \).