

**O K L A H O M A   S T A T E   U N I V E R S I T Y**  
**S C H O O L   O F   E L E C T R I C A L   A N D   C O M P U T E R   E N G I N E E R I N G**



**ECEN 3413 Controls I**  
**Spring 1998**  
**Midterm Exam #2**



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**Problem 1:** (*z-transform*)

Given

a)  $x(k) = (k - 1)u(k) - ku(k - 3)$ , (15%)

b)  $x(k) = e^{-bk} (\sin^2 \omega k)u(k)$ , (10%)

find  $X(z)$ .

**Problem 2:** (inverse z-transform)

Given

a)  $X(z) = \frac{z}{z^2 + 1}$ , (15%)

b)  $X(z) = \ln\left(\frac{2z-1}{2z}\right)$ , (10%)

find  $x(k)$ .

**Problem 3:** (*transfer function*) (25%)

The input  $x(k) = u(k) - 2u(k - 2) + u(k - 4)$  is applied to a linear time-invariant discrete-time system. The resulting response with no initial energy is  $y(k) = ku(k) - ku(k - 4)$ . Compute the transfer function  $H(z)$ .

**Problem 4:** (*ordinary difference equation*) (25%)

A linear time-invariant discrete-time system is given by the input/output difference equation

$$y(k) + y(k - 1) - 2y(k - 2) = 2x(k) - x(k - 1).$$

Find an input  $x(k)$  with  $x(k) = 0, k < 0$  that gives the output

response  $y(k) = 2(u(k) - u(k - 3))$  with initial conditions  $y[-2] = 2, y[-1] = 0$ .