# Homework #9:  ECE 461/661

## z-Transforms

1) Determine the difference equation that relates X and Y

$$Y = \left( \frac{0.005z}{(z-0.95)(z-0.9)(z-0.5)} \right) X$$

2) Determine y(k) assuming

$$Y = \left( \frac{0.005z}{(z-0.95)(z-0.9)(z-0.5)} \right) X \qquad x(k) = u(k)$$

3) Determine y(t) assuming

$$Y = \left( \frac{0.005z}{(z^2-1.6z+0.68)(z-0.5)} \right) X \qquad x(k) = u(k)$$

## s to z conversion

3) Determine the discrete-time equivalent of G(s).  Assume T = 0.5 second

4) Determine the discrete-time equivalent of G(s).  Assume T = 0.1 second

$$G(s) = \left( \frac{1.4427}{(s+0.1617)(s+1.04)(s+2.719)(s+5.05)} \right)$$

## Root Locus in the z-Domain

Assume T = 0.5 seconds.

$$G(s) = \left( \frac{1.4427}{(s+0.1617)(s+1.04)(s+2.719)(s+5.05)} \right)$$

5) Draw the root locus for G(z)

6) Find k for no overshoot in the step response
   - Simulate the closed-loop system's step response

7) Find k for 20% overshoot for a step response (damping ratio = 0.4559)
   - Simulate the closed-loop system's step response

8) Find k for a damping ratio of 0.00
   - Simulate the closed-loop system's step response