MECH 467 - Tutorial 5 – Zero-order Hold

1) Obtain the zero-order hold equivalent for the following systems with a sampling period of $T = 0.01$.

A. $$G_p(s) = \frac{K}{s+a} \quad K = 10 \quad a = 3$$

B. $$G_p(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2} \quad \omega_n = 10\ [rad/s] \quad \zeta = 0.8$$

C. $$G_p(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2} \quad \omega_n = 20\ [rad/s] \quad \zeta = 1.25$$

D. $$G_p(s) = K\frac{s + a/10}{s+a} \quad K = 0.81 \quad a = 2$$

2) If the ZOH equivalent of a system is

$$G_p(z) = \frac{z(z+b)}{z^2 + a_1 z + a_2}$$

And the controller has a transfer function of

$$D(z) = K_p + K_I\frac{z}{z-1}$$

What is the closed loop transfer function of the system with unity feedback?

3) What is the DC gain and delay of the following system?

$$G(z) = \frac{y(k)}{u(k)} = \frac{b_0 z^2 + b_1 z + b_2}{z^3(z^2 + a_1 z + a_2)}$$

Express $y(k)$ in terms of past/present inputs and outputs.

What is the steady-state error of the system to the following input (step function)?

$$u(t) = 2$$