Sheet 6

1. Find the damping ratio and the undamped natural frequency of the sampled data systems whose characteristic equations are given below

(a) $z^2 - z + 2 = 0$

(b) $z^2 + 1 = 0$

(c) $z^2 - z + 1 = 0$

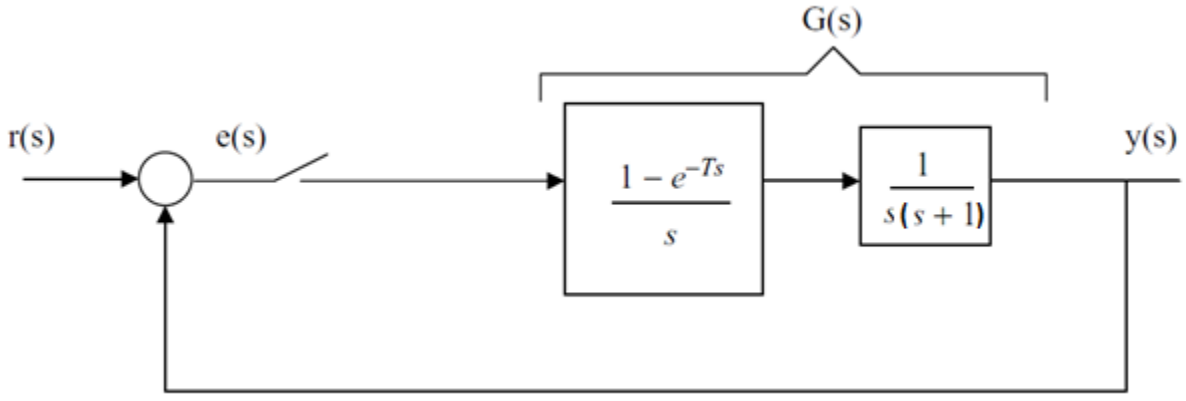
(d) $z^2 + 0.81 = 0$

2. Consider the closed-loop system of Figure below. Assume that $T = 1$ s.

(a) Calculate the transfer function of the system.

(b) Calculate and plot the unit step response at the sampling instants.

(c) Calculate the damping factor and the undamped natural frequency of the system.



3. A unit step input is applied to the system in previous Figure Calculate:

(a) The percentage overshoot.

(b) The peak time.

(c) The rise time.

(d) Settling time to 5 %.

4. The closed-loop transfer functions of four sampled data systems are given below. Calculate the percentage overshoots and peak times.

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

$$\text{(b)}\ G(z) = \frac{1}{z^2 + 2z + 1}$$

$$\text{(c)}\ G(z) = \frac{1}{z^2 - z + 1}$$

$$\text{(d)}\ G(z) = \frac{2}{z^2 + z + 4}$$

5. The *s*-plane poles of a continuous-time system are at $s = -1$ and $s = -2$. Assuming $T = 1$s, calculate the pole locations in the *z*-plane.

6. The *s*-plane poles of a continuous-time system are at $s_{1,2} = -0.5 \pm j0.9$. Assuming $T = 1$s, calculate the pole locations in the *z*-plane. Calculate the damping ratio and the undamped-natural frequency of the system.