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16.413 Problem Set 5

1. Given the unity feedback system

$$G(s) = \frac{K(s+1)}{s^2} \quad H(s) = 1$$

- Obtain the unit impulse response for  $K = 1$ .
- The unit-step response for  $K = 1$ .
- Plot the root loci as a function of  $K$  for the closed-loop system.

2. Determine the range of  $K$  for stability of a unity-feedback control system whose open-loop transfer function is

$$G(s) = \frac{K}{s(s+1)(s+2)}$$

3. Given the unity feedback system

$$G(s) = \frac{2K(s+1)}{s^2(s+5)(s+2)} \quad H(s) = 1$$

- Plot the root locus
- Determine the range of  $K$  where the closed-loop system is stable.

4. Given the unity feedback system

$$G(s) = K \frac{(T_1s+1)}{s(T_2+1)(s+1)} \quad H(s) = 1$$

- Determine the values of  $K$ ,  $T_1$  and  $T_2$  such that the dominant closed-loop poles have a damping ratio  $\zeta = 0.5$  and undamped natural frequency  $\omega_n = 3 \text{ rad/sec}$ .