Control Systems Assignment # 1

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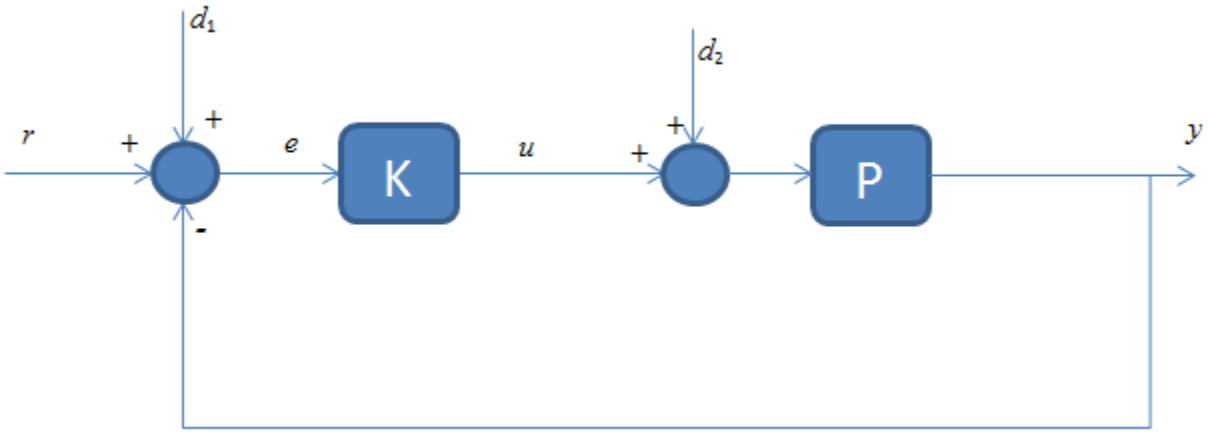
Problem 1

Consider the following system



a) Calculate the expression for y in terms of d_1, d_2, and r.
b) Can you achieve the goal of the control system $y = r$ in the given system? Provide reason for your answer!
c) Suppose that $P = 5, d_1 = 0, d_2 = 3, and\ r = 10$. Determine the value of K for which y is 99% of r. Also determine the value of K for which y is 95% of r.

Problem 2

Convert the following differential equations into transfer functions under the assumption of zero initial conditions.

a) $\ddot{y} = 3u$
b) $2\ddot{y} = 5\dot{u} + 9u$
c) $\dot{y} = u + 1$

Problem 3

Calculate and plot the impulse response of the systems with following transfer functions

a) $G(s) = \frac{1}{(s+1)^2}$
b) $G(s) = \frac{s+1}{s^2+3s+1}$
c) $G(s) = \frac{1}{s^2+3s-1}$

Problem 4

Calculate the state space representation of the systems with following transfer functions

a) $G(s) = \frac{5}{s^3+3s^2+2s+1}$

b) $G(s) = \frac{\omega^2}{s^2+2\zeta\omega s+\omega^2}$

c) $G(s) = \frac{s+1}{s^2+3s+2}$

Problem 5

Convert the following state space model into transfer functions

$$\begin{bmatrix} \dot{x_1} \\ \dot{x_2} \\ \dot{x_3} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 5 \\ 2 & 1 & 0 \\ 4 & 3 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 3 \\ 0 \\ 3 \end{bmatrix} u$$

$$y = \begin{bmatrix} 0 & 0 & 7 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + 9u$$