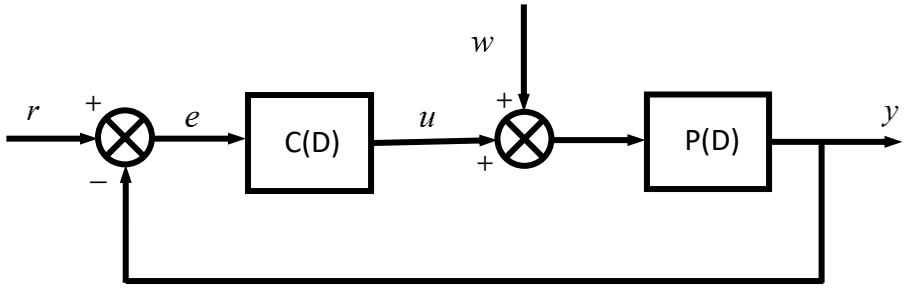
ENME 585 – Quiz 2

Closed book and closed notes. Schulich calculators allowed. Please show your work.



1. In the above feedback loop, proportional control $C(D) = k$ is applied to the plant $P(D) = \frac{D}{D^2-2D+1}$.

   a) Sketch the loci of the closed-loop poles as $k > 0$ varies.

   b) Find the values of any imaginary axis crossings in the root locus and the range of k for closed-loop stability.

   c) What value of k gives repeated real stable poles, and what is the value of the poles?

2. Suppose instead that the simple lag control $C(D) = \frac{k}{D+4}$ is applied to the plant of Question 1.

   a) Sketch the loci of the closed-loop poles as $k > 0$ varies.

   b) Find the values of any imaginary axis crossings in the root locus and the range of k for closed-loop stability.

3. In the above feedback loop, integral control $C(D) = \frac{k}{D}$ is applied to the plant $P(D) = \frac{1}{D+2}$.

   a) Find $T_{re}(D)$.

   b) Find (in terms of k) the steady-state error e_{ss} if $r = [1]$ and $w = 0$.

   c) Find e_{ss} if $r = [t]$ and $w = 0$.

   d) Find $T_{ry}(D)$.

   e) Find y_{ss} if $r = [1]$ and $w = 0$.

   f) Find y_{ss} if $r = 0$ and $w = [1]$.

   g) What value of k makes the closed-loop system critically damped?

   h) If $k = 2$, $r = [1]$, and $w = 0$, find the peak value of $y(t)$ and the time at which it occurs.