Prelab 7

Greg and Ian

Find the transfer function of the differential feedback block:

$$\frac{{}^{a}\!/_{s(s+\tau)}}{1+\ {}^{\alpha K_d s}\!/_{s(s+\tau)}}$$

We then found the open loop for the whole transfer function.

$$\frac{\alpha(K_i + sK_p)}{s^2(s+(\tau+\alpha K_d)}$$

The close loop is:

$$\frac{\alpha(K_i + sK_p)}{s^3 + (\tau + \alpha K_d)s^2 + \alpha K_p s + \ \alpha K_i}$$

This results in:

$$z = -\frac{K_i}{K_p}$$

When we expand the expected function with the s+p term we get:

$$\frac{N(s)}{s^3 + (2\zeta\omega_n + p)s^2 + (\omega_n{}^2 + 2\zeta\omega_n p)s + \omega_n{}^2 p}$$

We can then match up terms and we end up with:

$$K_d = \frac{2\zeta\omega_n + p - \tau}{\alpha}$$

$$K_p = \frac{\omega_n{}^2 + 2\zeta\omega_n p}{\alpha}$$

$$K_i = \frac{\omega_n{}^2 p}{\alpha}$$

Perform the substitution on p:

$$p = \frac{K_i}{K_p} \Rightarrow K_i = \frac{{\omega_n}^2 \frac{K_i}{K_p}}{\alpha} \Rightarrow K_p = \frac{{\omega_n}^2}{\alpha}$$

But:

$$K_p = \frac{{\omega_n}^2 + 2\zeta\omega_n p}{\alpha}$$

Therefore

$$\zeta = 0$$

This is not a good controller so it is infesable.