Electrical Engineering 141, Homework 6

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Problem 1

The open loop transfer function is the following.

$$\frac{K}{(s+1)^3}$$

This crosses the real axis when $1 + j\omega$ has a phase of $\pm\frac{\pi}{3}$ or 0. This occurs at $\omega = 0, \pm\sqrt{3}$. The magnitude of the open loop transfer function at these points are K and $-\frac{K}{8}$, respectively. The open loop transfer function has no poles in the right half plane, so we should have no encirclements around -1 in order to have a stable system. Since we know that the value of the transfer function goes to zero as ω goes to ∞, we know that we will have an encirclement if $-\frac{K}{8} < -1$. On the positive side we also know we will have an encirclement if $K < -1$. Thus we want the following inequality to hold in order to have a stable system.

$$-1 < K < 8$$

Problem 2

a)

b)

c)

d)

Problem 3

a)

b)

c)

d)

e)

Problem 4

a)

b)

c)

d)

Problem 5

a)

b)

c)

d)

e)

f)

g)