The Johns Hopkins University
Department of Electrical and Computer Engineering
520.353 — Control Systems
Fall 2007

Problem Set Number 5

Due: Wednesday, October 31, 2007 in class.

Problems:

1. For the system:
$$k(PCF)(s) = k\frac{s^2+1}{s^3}.$$
   (a) Find the departure/arrival angles at the poles/zeros.
   (b) Plot a clean, clearly labeled root locus diagram for this system.

2. Sketch the root locus with respect to β for the standard feedback system with:
$$P(s) = \frac{4}{10s+\beta}, \qquad C(s) = 5, \qquad F(s) = \frac{5}{s+7}.$$

3. (a) Using all the rules discussed in class, draw the root locus for the system:
$$k(PCF)(s) = k\frac{(s+3)}{s(s^2+2s+26)}.$$
   (b) Find the gain k and the natural frequency ω_n when the system just becomes unstable.
   (c) Using Matlab and the `rlocus` command, obtain a computer printout of the root locus.

4. In the feedback system, take
$$P(s) = \frac{s+1}{s(s+2)}, \qquad C(s) = k, \qquad F(s) = 1.$$
   Sketch the Nyquist plot of P and determine the range of k for which the feedback system is stable.

5. In the feedback system, take
$$P(s) = \frac{(s+2)}{s(s+1)(s-1)}, \qquad C(s) = k, \qquad F(s) = 1.$$
   Sketch the Nyquist plot of P and determine the range of k, if any, for which the feedback system is stable.