

Reading Assignment:

FPE, Sections 5.1 - 5.3

Note: *It is in your interest to consult MATLAB only after completing a hand sketch.*

You are encouraged to verify your results using MATLAB, and you will need help from MATLAB to complete Problem 2: `rlocus` and `rltool` are useful and fun!

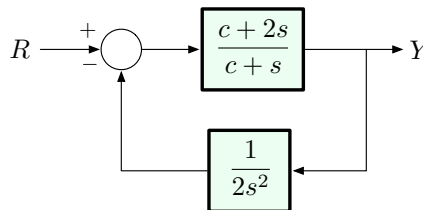
Problems:

1. Sketch the root loci below by hand, applying rules A—F.

$$KL(s) =$$

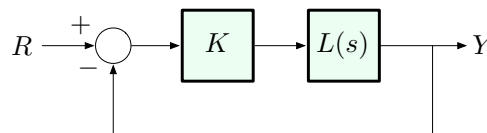
(a) $K \frac{1}{s^2 + 2s + 10}$ (b) $K \frac{s - 2}{s^2 + 2s + 10}$ (c) $K \frac{(s + 1)(s + 2)}{s(s^2 + 4)(s^2 + 5)}$ (d) $K \frac{s + 2}{s^5 + 1}$

2. Consider the feedback system shown below.



Determine the transfer function $Y(s)/R(s)$, and from this the characteristic equation. Sketch the root locus for $c > 0$.

3. Consider the Evans-style feedback configuration



Suppose that $L(s)$ has

- (i) 3 LHP poles and 1 LHP zero;
- (ii) 1 RHP pole, 2 LHP poles, and 3 LHP zeros;
- (iii) 5 LHP poles, 4 LHP zeros, 1 RHP zero.

In each of these three cases, use your knowledge of the effect of open-loop poles and zeros on the root locus to explain whether or not the corresponding closed-loop system can always be stabilized by choosing large enough gain K . Be sure to give detailed justification for your answers.