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Q1 Consider the two plants whose transfer functions are

$$G_1(s) = \frac{1}{s^3+6s^2+45s} \quad \text{and} \quad G_2(s) = \frac{0.075s^2+s+1}{s^3+3s^2+5s}.$$

(a) Sketch the root loci for these systems (by hand) without much refinement.

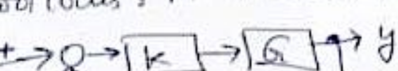
(b) Now, repeat the same using the 'rlocus' command on MATLAB.

(c) From the MATLAB plot, what can you deduce about the closed loop poles of the two ~~plants~~ systems when the proportional gain $K=40$ in either case?

(d) Considering the closed loop transfer fns above (with $k=40$), generate the step responses on MATLAB using the command step. Qualitatively, what can you comment about the two responses?

Q2 Consider the system whose transfer function is given by $G(s) = \dfrac{1}{s(s+2)[s^2+2s+5]}$. Using any of the formulae for computing the breakaway/break-in points, calculate the same [use your calculator only, not MATLAB!]. Are all the solutions of $\dfrac{dk}{ds}=0$ break-in/breakaway points? Justify your answer.

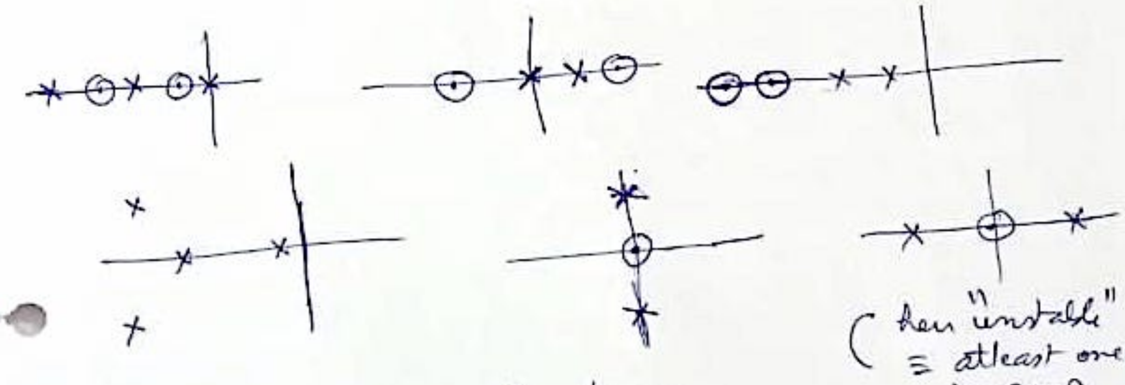
Practice Problems EE 302 Rootlocus: 14th Feb 2021.

1. Consider feedback configuration 

with $G(s) = \frac{n(s)}{d(s)}$, n, d polynomials, and both n, d: monic.
Suppose $k > 0$. Without too much calculation (perhaps none), answer the following

(a) Number of branches
(b) # breakaway points
(c) # break in points
(d) whether unstable for $|k|$ large.
(e) whether unstable for $|k|$ small (near zero)
(f) whether closed loop poles are ever complex? If so, for $|k|$ large or $|k|$ small?
(g) If $j\mathbb{R}$ crossings happen, whether this happens for $s=0$ or through $\pm j\omega$, $\omega \neq 0$, $\omega \in \mathbb{R}$.

Answer (a) — (g) for each of pole/zero pattern below.



(here "unstable" = atleast one pole in RHP.)

2. Solve problem 1 for $k<0$.

3. Consider the 2^3 possibilities (related, but not same, as figure in Q-1. $2^3 = 8 = 2 \times 2 \times 2$

+ve feedback or −ve feedback; $k>0$ or $k<0$; $G(s)$ leading coefficient of n, d same sign … n, d opposite sign.

group these 8 possibilities into just 2 cases. (A) problem 1. (B) problem 2.