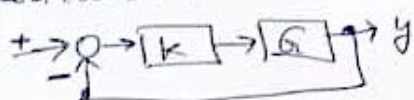


Practice Problems EE 302 Rootlocus: 14th Feb 2021.

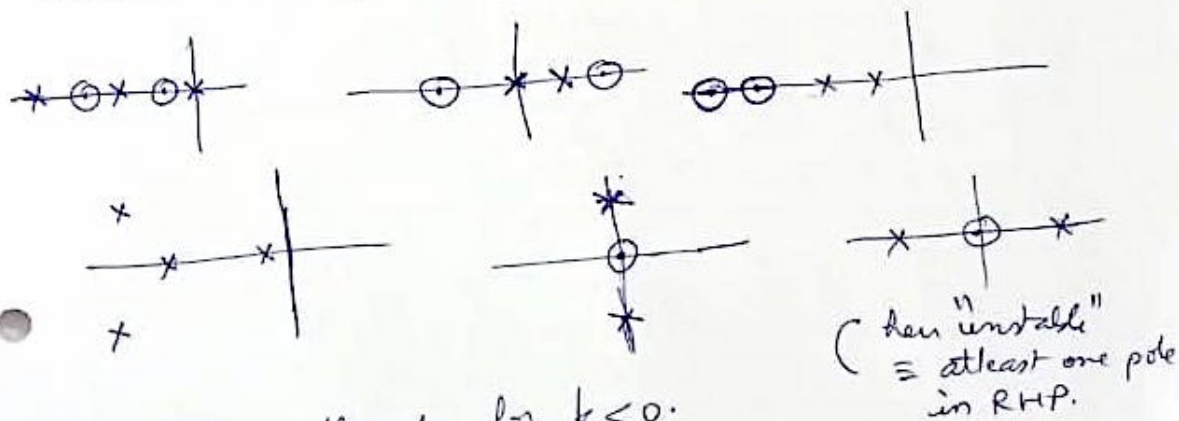
1. Consider feedback configuration 

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) # <u>breakaway</u> points |
| (c) # <u>break in</u> points | (d) whether <u>unstable</u> 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 $j\omega$ 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.



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

3. Consider the 2^3 possibilities (related, but not same, as figure in Q-1. $2^3 = 8 = 2 \times 2 \times 2$ ← $G(s)$ leading coefficient of n, d same sign or n, d opposite sign.

+ve feedback or -ve feedback
 $k > 0$ or $k < 0$

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

Q7 Consider the two plants whose transfer functions are

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

- Sketch the root loci for these systems (by hand) without much refinement.
- Now, repeat the same using the 'rlocus' command on MATLAB.
- 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?
- 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?

Q8 Consider the system whose transfer function is given by $G(s) = \frac{1}{s(s+2)(s^2+2s+5)}$. 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 $\frac{dk}{ds} = 0$ break-in/breakaway points? Justify your answer.