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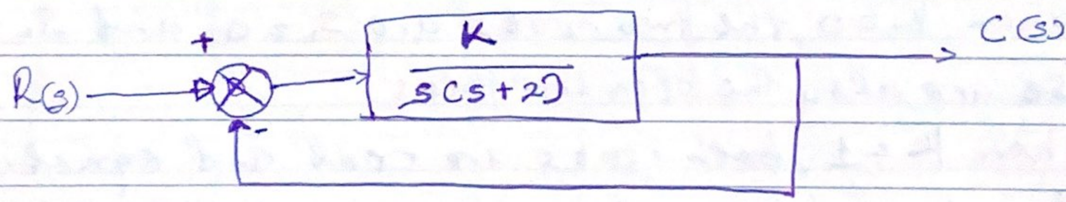
17/Eng04/014

EEE 471 Assignment.

• Briefly Explain the Root Locus Technique.

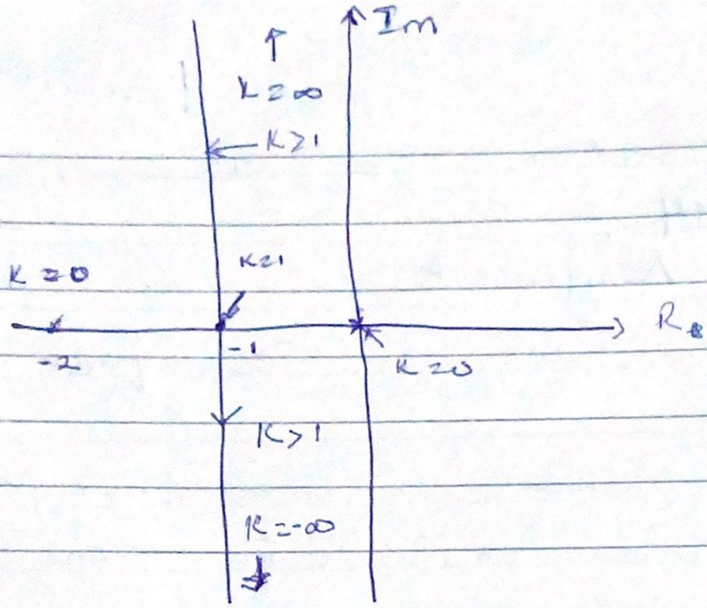
Root Locus is a graphical method in which roots of the characteristics equation are plotted in S-Plane for the different values of Parameter.

The locus of the root of the characteristics equation when gain is varied from zero to infinity is called root Locus



$$G(s) = \frac{K}{s(s+2)}, \quad H(s) = 1$$

$$1 + \frac{K}{s(s+2)} \cdot 1 = 0 \quad \text{or} \quad s^2 + 2s + K = 0$$



As K is varied, the two roots give the Locii in S-Plane. For various value of K, the location of the roots are

① When $0 < K < 1$, the roots are real and distinct

② when $K = 0$, the two roots are $S_1 = 0$ and $S_2 = -2$ these are also the open Loop Poles

③ When $K = 1$, both roots are real and equal.

④ When $K > 1$, the roots are complex Conjugate With real Part $= -1$

When "K" is varying the root locus is shown in the ~~Fig~~ Figure above.

ⓐ When $K = 0$, two branches of root Locus starts from $S = 0$ and $S = -2$

ⓑ When $K = 1$, both roots meet at $S = -1$

ⓒ When $K > 1$, the roots breakaway from the real axis and become complex conjugate having negative real part equal to (-1).

2 (a) Describe the use of Routh Hurwitz to find the stability of a closed loop system when:

(i) Entire row is zero on the Routh table.

$$T(s) = \frac{10}{s^5 + 7s^4 + 6s^3 + 42s^2 + 8s + 56}$$

s^5	1	6	8
s^4	$\cancel{7} \to 1$	$\cancel{42} \to 6$	$\cancel{56} \to 8$
s^3	$0 \to$	$0 \to$	$0 \to$
s^2			
s^1			
s^0			

- They are zeros in third row

(1) Form a new polynomial using the entries in the row above zeros. The polynomial will start with power of s in that row, and continue by skipping every other power of s i.e

$$P(s) = s^4 + 6s^2 + 8 \quad \text{-- (i)}$$

(2) Then we differentiate the polynomial with respect to s and obtain

$$\frac{dP(s)}{ds} = 4s^3 + 12s + 0 \quad \text{-- (ii)}$$

③ Finally the row with all zeros in the Routh table is replaced with the co-efficient in Eqn (ii)

s^5	1	6	8
s^4	$\cancel{7} \to 1$	$\cancel{42} \to 6$	$\cancel{56} - 8$
s^3	$\cancel{0} \to 4 \to 1$	$\cancel{0} \to \cancel{12} \to 3$	$\cancel{0} \to 0$
s^2	3	8	0
s^1	1/3	0	0
s^0	8	0	0

⇒ Why does an entire row of zero occur?

When a purely odd or even polynomial is a factor of the original polynomial ($s^4 + 6s^2 + 8$ is an even polynomial as it only has even power of s.).