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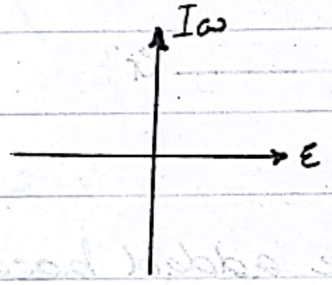
Elect/Elect:
Course: EEE441

1) Root locus is a graphical presentation of the closed loop poles as a system parametre is varied. The root locus gives a graphic presentation of a system's stability.

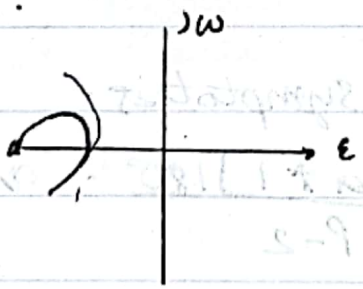
Under the root locus there are various rules to be taken.

① The root locus is always symmetric as about the real axis

E.g



2) The root locus always start from the open-loop poles & terminal on either finite open loop zeros & Infinity.

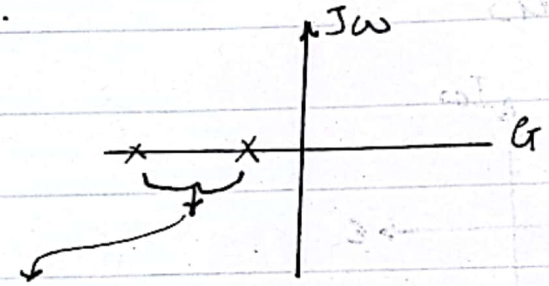


3) The number of branches terminals on Infinites: P-Z
where P → number of poles.
Z → Number of Zeros

E.g $= \frac{K}{S[S+3]}$. Z=0 No of branches = 2-0=2
P=2

4) A point on the real axis lies on the locus if the number of open loop poles + Zero on the right half of S plane is odd.

E.g.



That part must be added because its must be an odd number so its 3poles that are available there.

5) The angle of a symptotes.

If P>Z $\theta_A = \frac{[2q+1]180°}{P-Z}$. $q=0,1,2\cdots P-Z-1$

If Z>P $\theta_A = \frac{(2q+1)180°}{Z-P}$ $q=0,1,2\cdots Z-P-1$

b) Centroid + The asymptotes meet the real axis at Centroid.

Centroid = Sum of real parts of poles - Sum of real parts of Zero's

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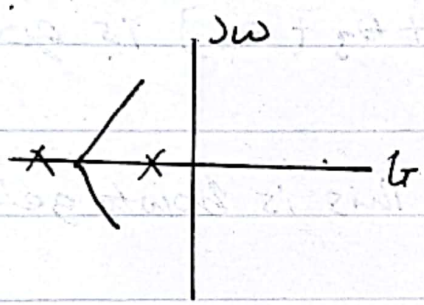
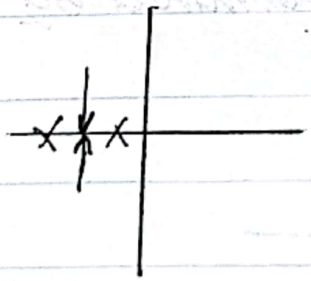
no of poles - no of Zero's

Eg.

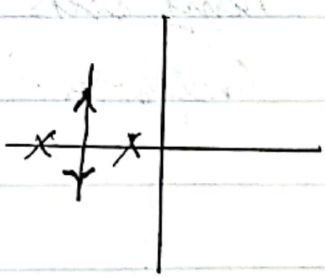


7) Break away & Break in point is calculated by solving $\frac{dk}{ds} = 0$

Eg.



Breaking point



Breaking away

8) The angle of departure from an open loop is poles give by $\phi_p = \pm 180°[2q+1] + \phi$ $q = 0, 1, 2 \ldots$

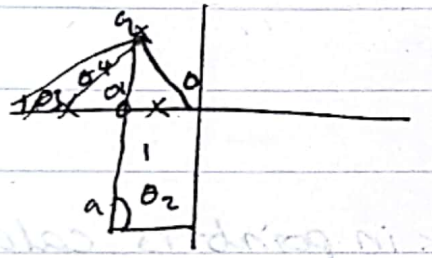
This means when you have Imaiginary poles.

Where $\phi = \phi_2 - [\theta_1 + \theta_3 + \theta_4)$

9) The angle of arrival from an open loop zero is given by $\theta_2 = \pm 180°[2q+1] - \phi$; $q = 0, 1, 2, 3 \ldots$

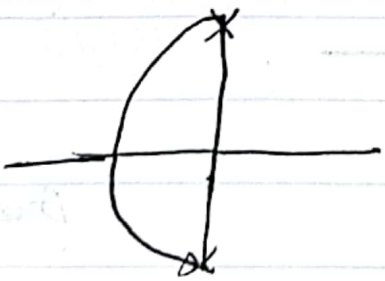
When you have Imaginary Zeros.

The $\phi = \theta_2 - [\theta_1 + \theta_3 + \theta_4]$ is gotten from.



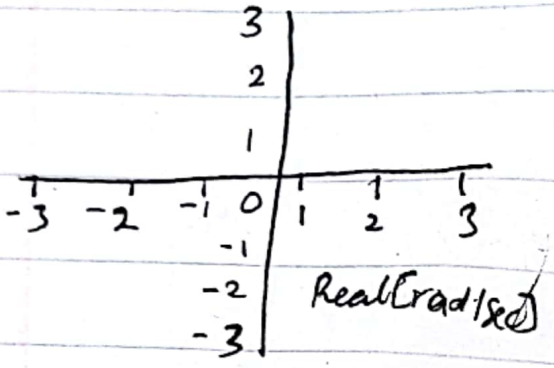
This is how to get $Ph(\phi)$

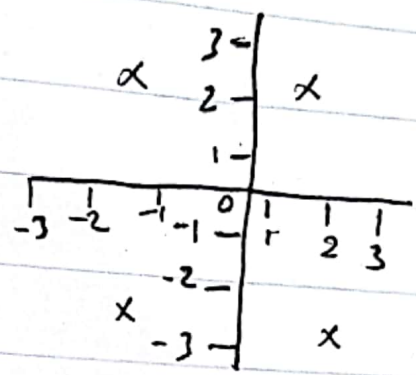
b) The Intersection of root locus branches → the Imaginary axis can be determined by use of routh criteria.



The Intersection points of the root locus on the real axis is called CENTROID but the Intersection point of the root locus on the Imaginary axis is called the Intersection points.

2) A whole row of zeros indicates the presence of pairs of poles that are mirrored about the imaginary axis.





→ AG best the system is marginary stable

→ use a Routh table to determine if it is Unstable

→ If an entire row of zero's appears in a Routh table.

1) Create an auxiliary polynomios from, the row above the row of zero, skipping other power of s.

2) Differentiate the auxilary polynomios

3) Replace the zero row's with the co-efficients of the resulting polynomial.

4) Complete the Routh table as usual.

5) Evaluate the sign of the first column entries.

b) To determine the poles on the jω axis.

∴ Determine the system poles for the unforced damped system the poles are:

$= \sigma \pm j\omega$