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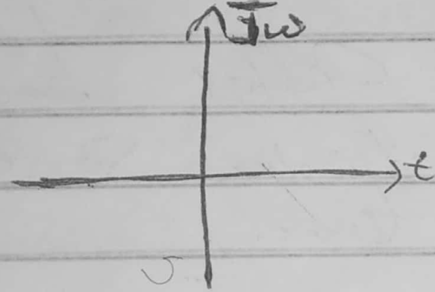
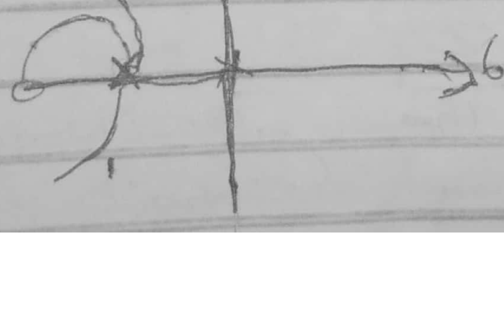
17/ Eg0 04/ 052
EEE 441

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 Symmetrical about the real axis

① e.g.



② The Root locus always starts from the Open-loop Poles & terminates On either finite Open loop Zero & infinity



the point Marked x is the the Poles as Stated in Rule 2, it may terminate at zero a & at infinity]-

3) The number of branches terminates on infinite = $P-Z$

Where $P \rightarrow$ Number of poles

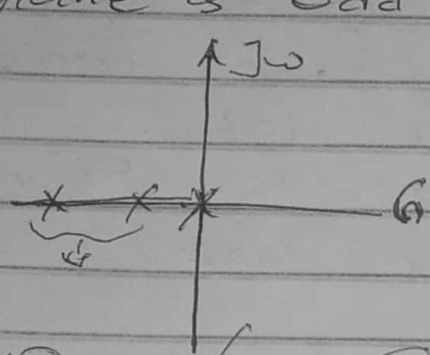
$Z \rightarrow$ Number of zero's

e.g $= \frac{K}{S(S+1)}$ $Z=0$ 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's on the right half of S plane is odd

e.g



That part can't be added because it must be an odd number so its 3 poles that is available there.

(5) The angle of asymptotes

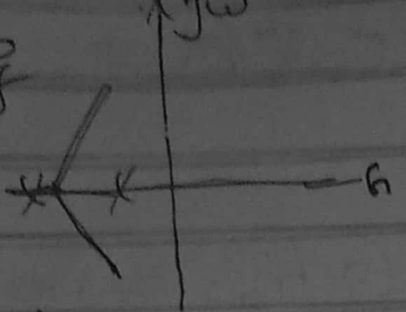
$(P>Z)$ $\phi_A = \frac{(2q+1)180^\circ}{P-Z}$ $q = 0,1,2 \ldots P-Z-1$

$(Z>P)$ $\phi_A = \frac{(2q+1)180}{Z-P}$ $q = 0,1,2, \ldots Z-P-1$

(6) Centroid: The asymptotes meet the real axis at centroid

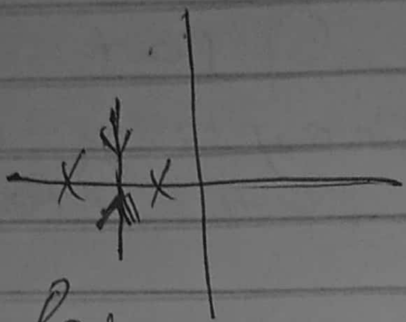
$$\text{Centroid} = \frac{\text{Sum of Real Parts of Poles} - \text{Sum of Real Parts of Zeros}}{\text{No of Poles} - \text{No of Zeros}}$$

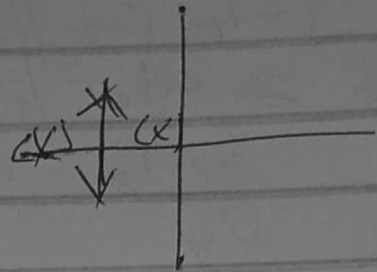
e.g.



7) Break away & Break in Point (CS) calculated by Solving $\frac{dk}{ds} = 0$

e.g.





Breaking Point (Going into the Poles) — Break Away (Going away)

Whenever you are having two Poles you have Break away but whenever you have two Zeros you have Breaking Point

8) The angle of departure from an open loop CS Poles given by
$\phi_p = \pm 180^\circ (2q+1) + \phi \quad q = 0, 1, 2 \ldots$

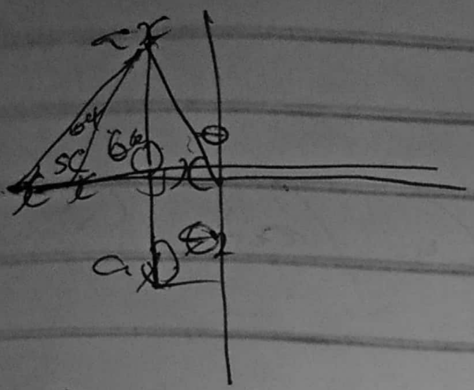
This means when you have imaginary poles

where $\phi = \theta_2 - (\theta_1 + \theta_3 + \theta_4)$

9) The angle of arrival from an open loop zero is given by $\phi_z = \pm 180^\circ (2q+1) - \phi, \quad q = 0, 1, 2, 3$

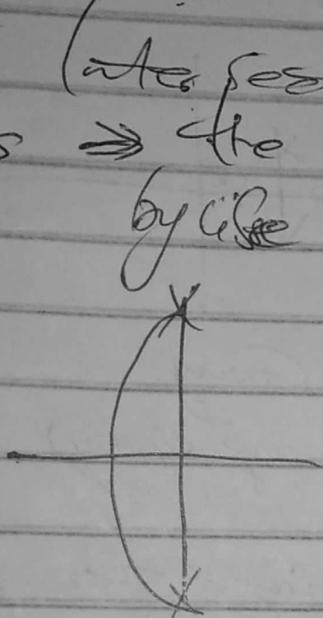
when you have imaginary zeros

The co-o φ = θ - (θ1 + θ3 + θ4) is gotten



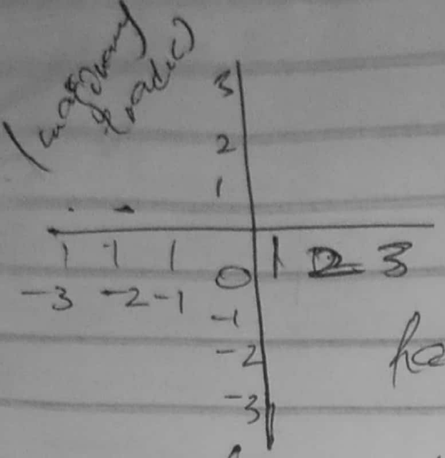
→ This is how to get phi (φ)

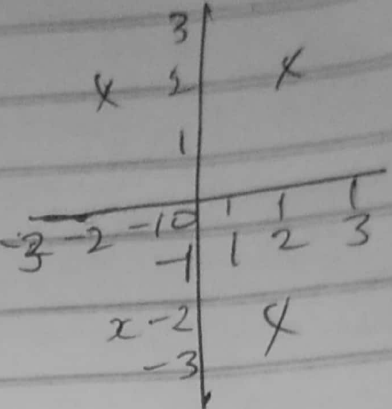
(D) The intersection of root locus branches with the imaginary axis can be determined by use of Routh Criteria



The intersection point 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 point.

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





→ At best the system is marginally stable

→ Use a Routh table to determine if it's unstable

→ If an entire row of zeros appears in a Routh table

i) Create an auxiliary polynomial from the row above the row of zero, skipping other powers of s.

ii) Differentiate the auxiliary polynomial w.r.t. s

iii) Replace the zero row with the co-efficients of the resulting polynomial.

iv) Complete the Routh table as usual.

v) Interpret the sign of the first column entries

(b) To determine the poles on the jω axis.

Determine the system poles of the uncompensated system the poles are

= ± jω