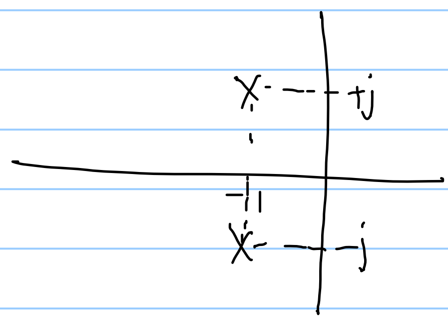
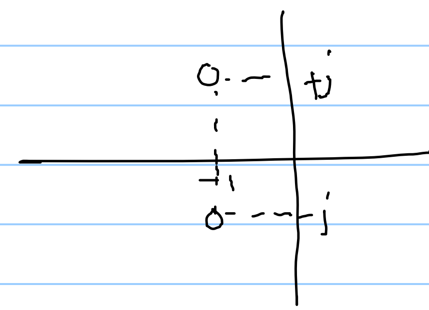
Note Title 12/22/2021

Angle of departure (ϕ_d) : it is calculated at complex conjugate poles

Angle of arrival (ϕ_a) :- it is calculated at complex conjugate zero



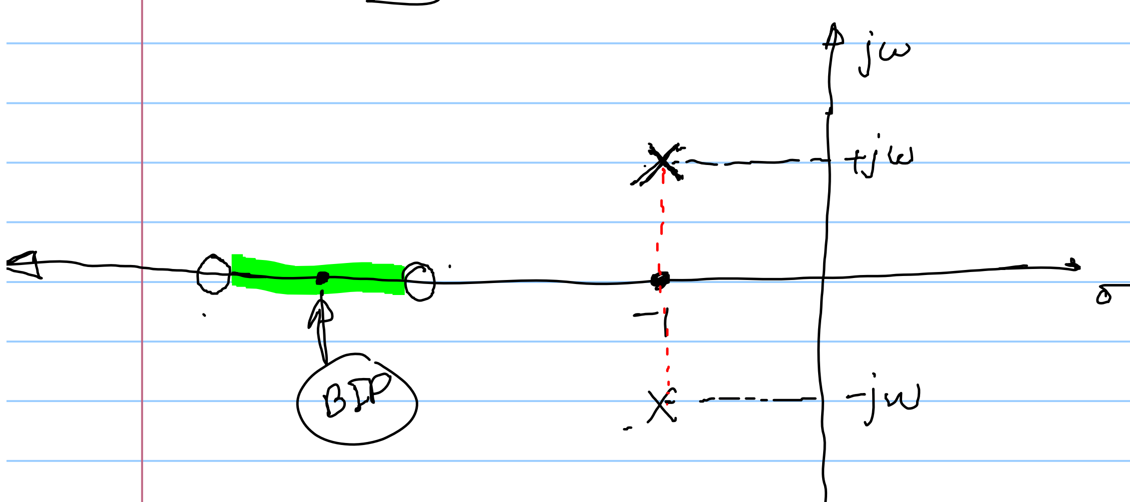
Complex conjugate pole



Complex Conjugate ZERO

Angle of departure (ϕ_d) :

it gives that angle with which pole departs or leaves the initial position



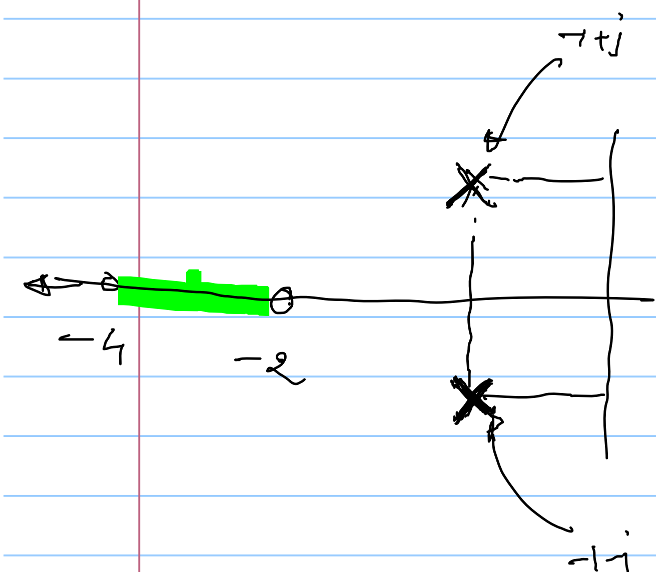
$$\phi_d = 180^\circ + \angle G(s)H(s) \Big|_{\text{at the img complex pole}}$$

$$\boxed{\phi_d = 180^\circ - \phi}$$

i) $G(s)H(s) = \dfrac{K(s+2)(s+4)}{\boxed{(s^2+2s+2)}} \rightarrow s_1 = -1+j \checkmark, \quad s_2 = -1-j \checkmark$

ϕ_d

$\rightarrow$ $\phi_d = 180^\circ + \angle(G(s)H(s))\Big|$ at the img cmplex pole



$$\angle G(s)H(s)\Big|_{s=-1+j} = \frac{\overset{0^\circ}{\angle K}\ \overset{45^\circ}{\angle(s+2)}\ \overset{18.43^\circ}{\angle(s+4)}}{\underset{90^\circ}{\angle(s+1+j)}\ \underset{0^\circ}{\angle(s+1-j)}}$$

$=$

$$\angle(s+2)\Big|_{s=-1+j} = \angle(-1+j+2) = \angle 45^\circ$$

$\boxed{-1+j+2}$

$$\angle(s+4)\Big|_{s=-1+j} = \angle(-1+j+4) = \angle 18.43^\circ$$

$\boxed{x+iy}$

$$\angle(s+1+j)\Big|_{s=-1+j} = \angle(\cancel{-1}+j+\cancel{1}+j) = \angle 90^\circ$$

$\boxed{1+i}$

$x+iy$

$$\angle(s+1-j)\Big|_{s=-1+j} = \angle(\cancel{-1}+\cancel{j}+\cancel{1}-\cancel{j}) = 0^\circ$$

$1+i$

$\boxed{3.\ r\angle\theta}$ $\qquad$ $\boxed{\angle 45^\circ}$

$$\angle G(s)H(s)\Big|_{s=-1+j} = \frac{\bar{0}\ \angle 45^\circ \cdot \angle 18.43^\circ}{\angle 90^\circ\ \angle 0^\circ}$$

$$= \frac{\angle 63.43^\circ}{\angle 90^\circ}$$

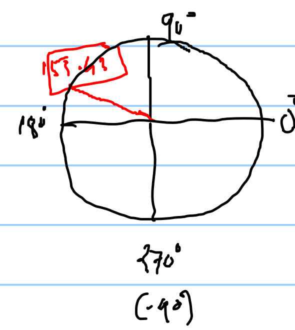
$$= \angle 63.43^\circ - \angle 90^\circ$$

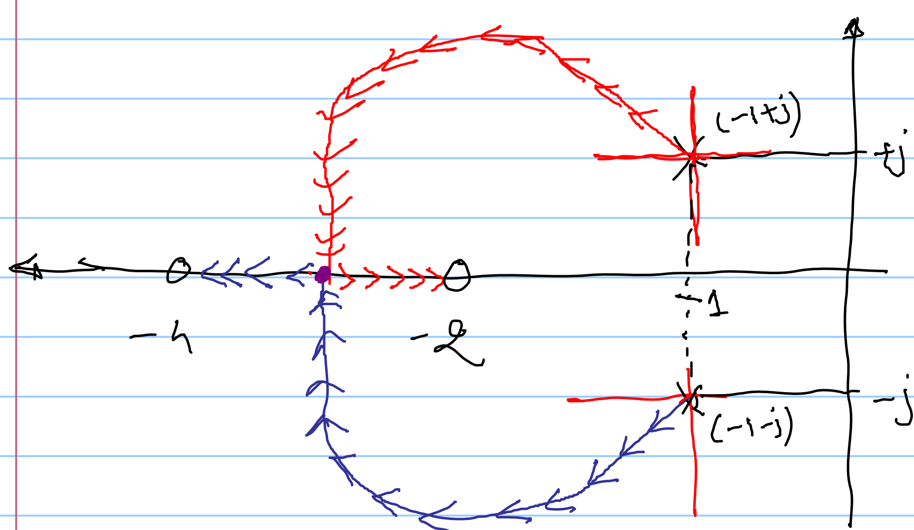
$$\boxed{\angle G(s)H(s)\Big|_{s=-1+j} = -26.57^\circ}$$

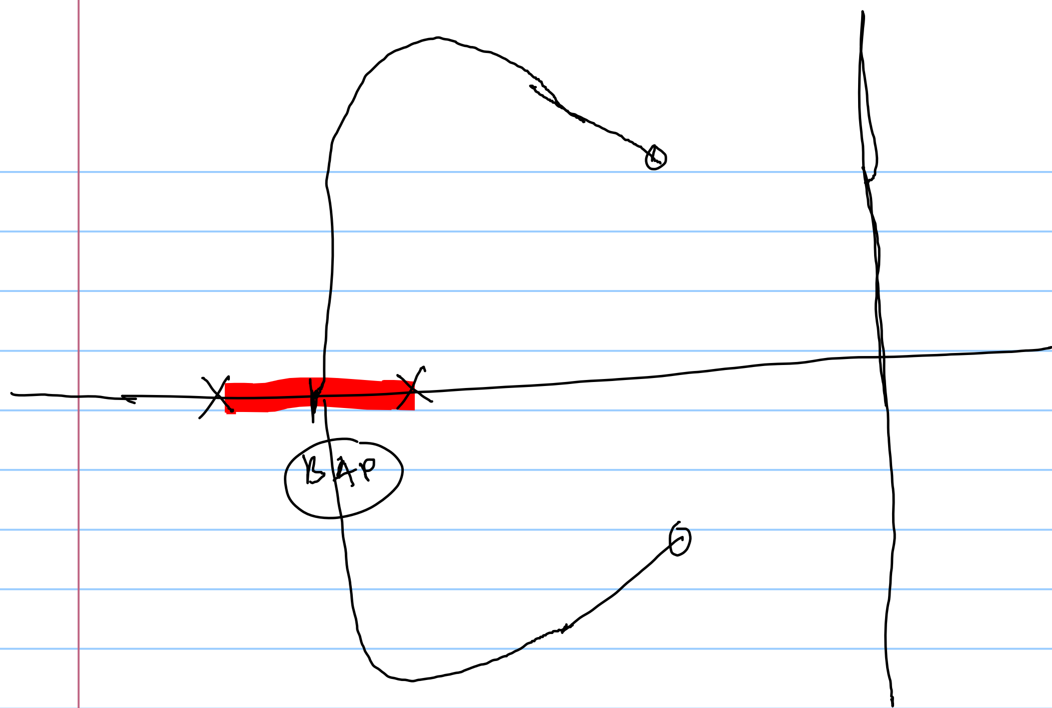
$$\phi_d = 180^\circ + \angle G(s)H(s)$$

$$= 180^\circ + (-26.57^\circ)$$

$$\boxed{\phi_d = \pm 153.43^\circ}$$







Problems on RLD :-

(1) Draw the R.L.D. of $G(s)H(s) = \dfrac{K}{s(s+2)}$

Solⁿ: 1. Identify real axis R.L Branches / poles. & break points.
2. find the No. of assymptotes & their angle
3. find the centroid if assymptotes are there.

1. poles (P) = 2 poles at $s=0$, $s=-2$

2. $N = P - Z$

$\boxed{N = 2 - 0 = 2}$

3. 1^{st} Angle for $q=0$ = $\dfrac{180 \times (2q+1)}{P-Z} = 90^\circ$

2^{nd} Angle for $q=1$ = $\dfrac{180(2q+1)}{P-Z} = 270^\circ$

4. Break pts = $s(s+2) = 0$

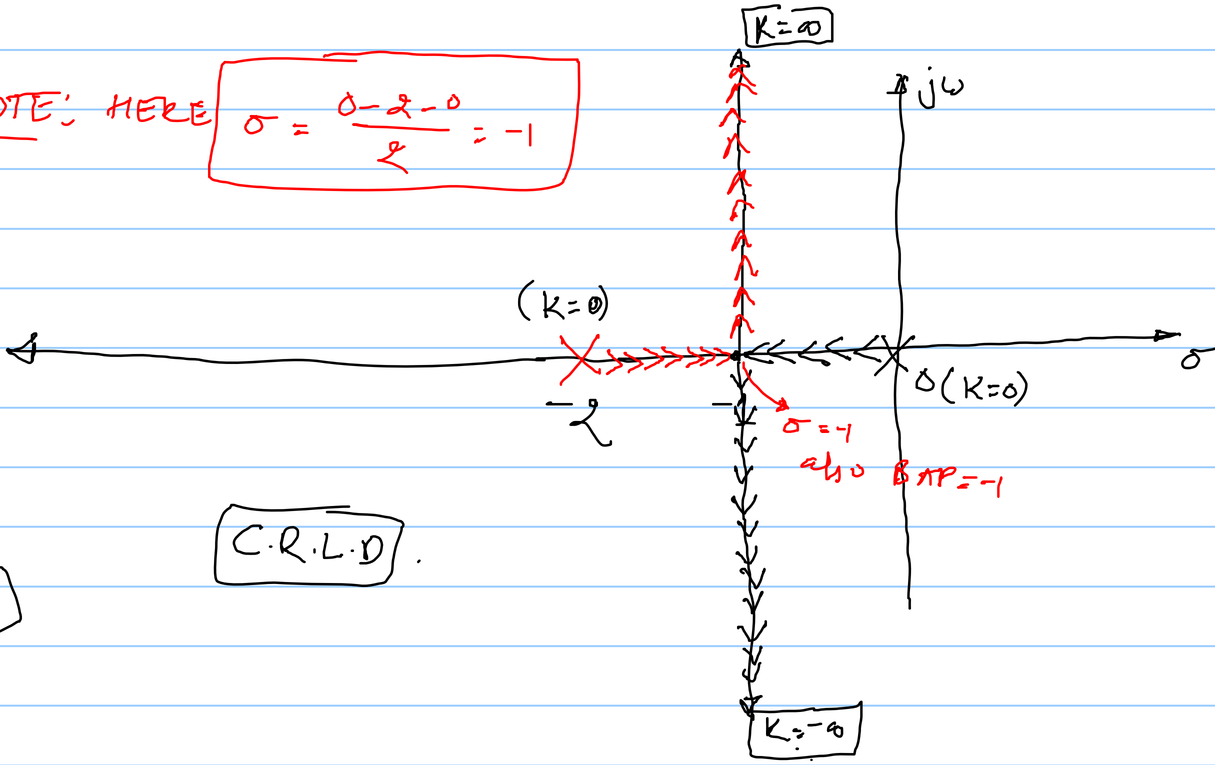
$s^2 + 2s = 0$

diff: $2s + 2 = 0$

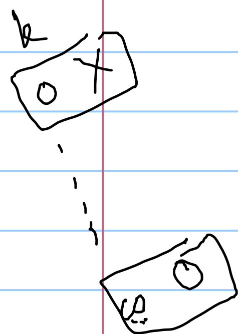
$2s = -2$

$\boxed{s = -1}$ → only break pt

NOTE: HERE $\boxed{\sigma = \frac{0-2-0}{2} = -1}$



$\boxed{\text{C.R.L.D}}$.



② $G(s)H(s) = \dfrac{K}{s(s+4)(s+7)}$

Sol^n:

1. No. of poles = 03 at $s=0$, $s=-4$, $s=-7$

2. $N = P - Z$

$= 03 - 0$

$\boxed{N = 3}$

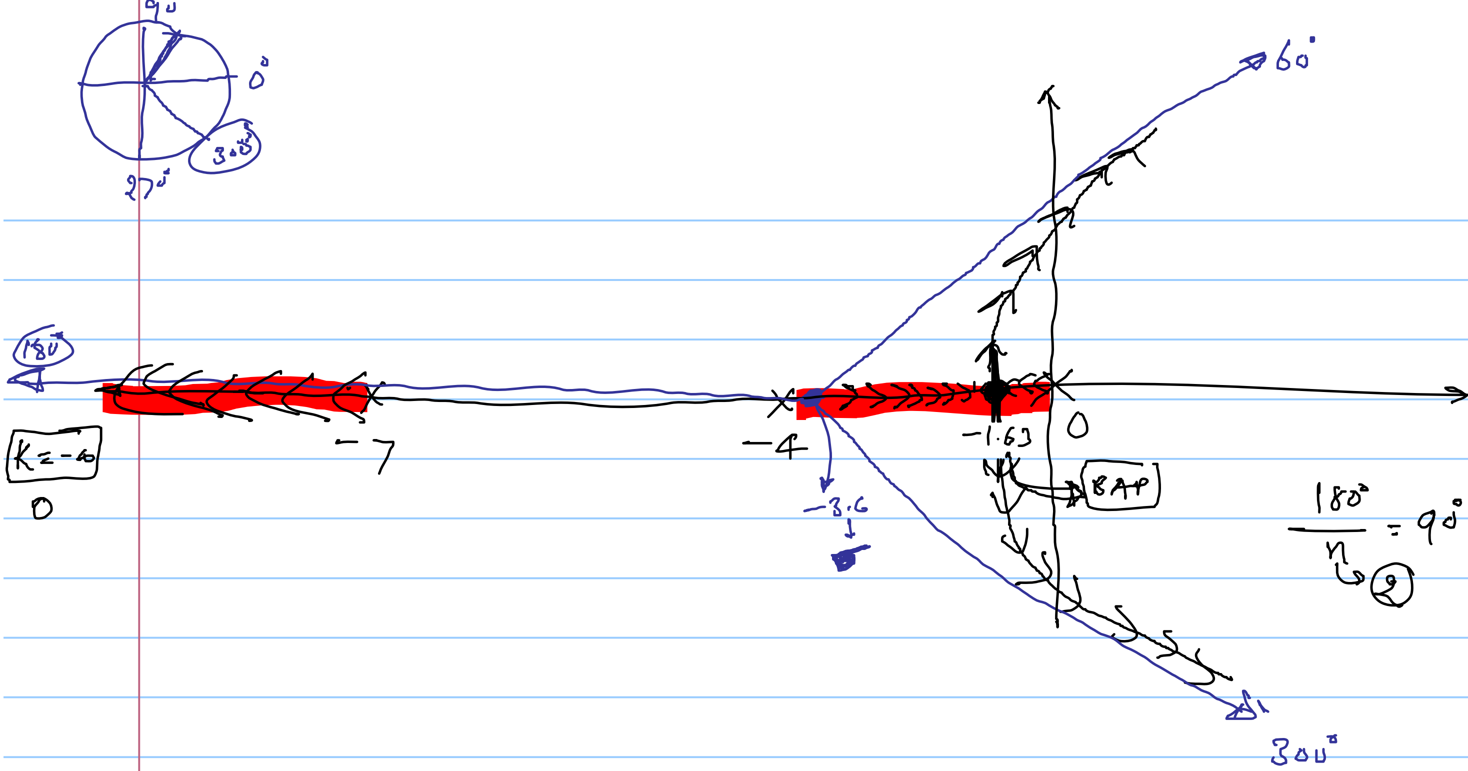
3. 1st Angle of assymptote $(q=0) = \dfrac{(2q+1)\times 180^\circ}{3} = 60^\circ$

2nd — " — " — " = 180°

3rd Angle of — " — " — = $\dfrac{(2\times 2+1)\times 180^\circ}{3} = 300^\circ$

4. $\sigma = \dfrac{\Sigma \text{ R.P. of poles} - \Sigma \text{ R.P. zeros}}{N} = \dfrac{0-4-7-0}{3}$

$= \dfrac{-11}{3} = \boxed{-3.6}$



Break pts: $s(s+4)(s+7)=0$

$(s^2+4s)(s+7)=0$

$s^3+7s^2+4s^2+28s=0$

diff $3s^2+14s+8s+28=0$

$\boxed{3s^2+22s+28=0}$

$\boxed{s_1=-1.63}$ — Valid BAP ✓

HW

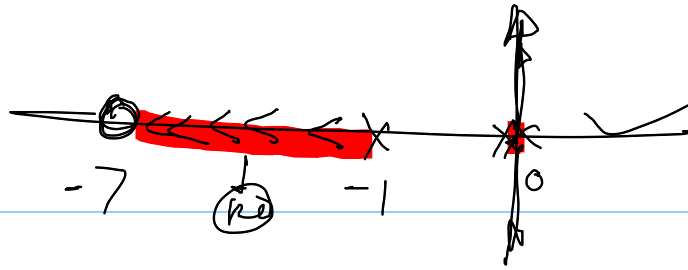
1) $G(s)H(s) = \dfrac{K(s+4)}{s(s+2)(s+3)}$

3) $G(s)H(s) = \dfrac{K(s+1)}{s^2(s+2)(s+3)}$

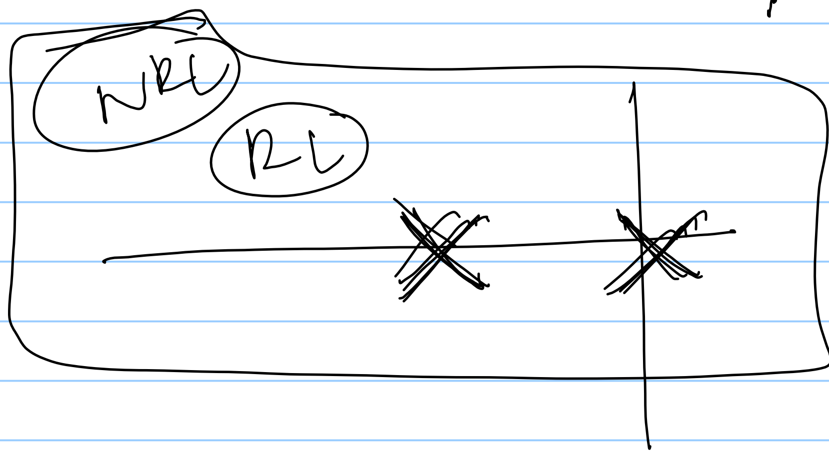
2) $G(s)H(s) = \dfrac{K(s+7) - 1}{s^2(s+1)_3}$

$N=2$ = 90°

270°



RLNP



Bodeplot