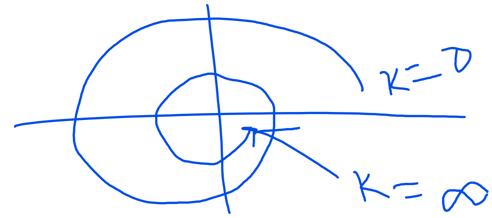
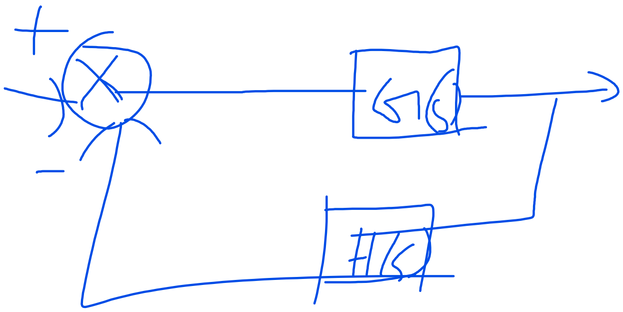
Root Locus.

K

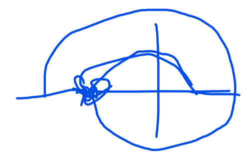
$\boxed{0 - \infty}$

$1 + G(s)H(s) = 0.$





$G(s)\,H(s)$



$1 + G(s)H(s) = 0$

$S = ?$

$|G(s)H(s)| = 1$

$\angle G(s)H(s) = (2k+1)180^\circ$

$k = 0, 1, 2, \ldots$

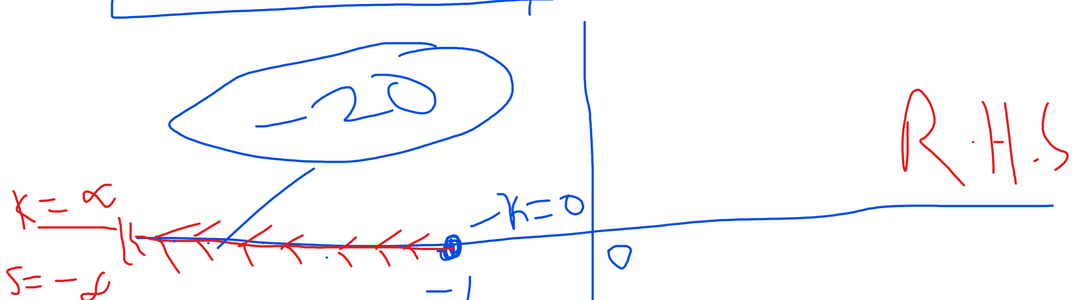
1) $GH = \dfrac{K}{s+1}$

$1 + GH = 1 + \dfrac{K}{s+1} = 0$

$\Rightarrow \; s + 1 + K = 0$

$\Rightarrow \; \boxed{s = -1 - k}$

k:	0	2	6	∞
s =	−1	−3	−7	−∞



1) The system is stable for any k.

2) $P = 1$, $Z = 0$, $N = 1$, $N = P$, $P > Z$

$= Z$, $Z > P$.

3) Locus starts journey from O.L pole

" ends " on O.L zero or infinity

s = complex no.

$(x + iy)$. $\quad |x+iy| = \sqrt{x^2+y^2}$

$\tan^{-1}(y/x)$.

$\boxed{G(s)H(s)}$

$1+G(s)H(s)=0$

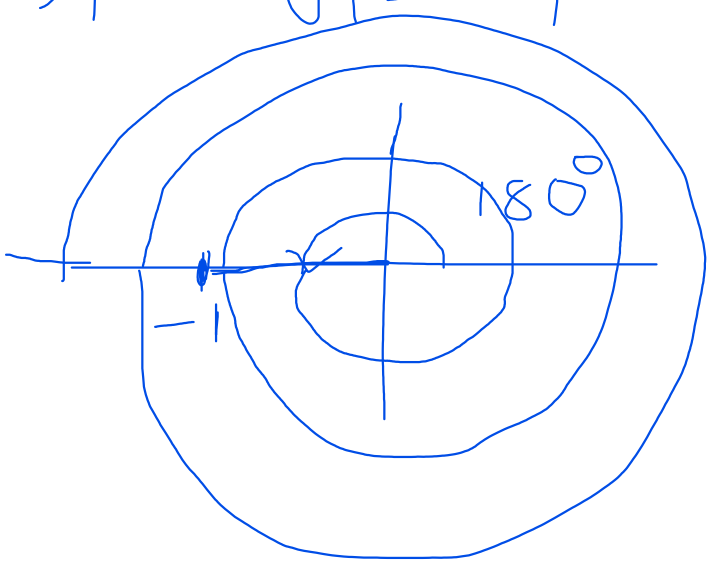
$\Rightarrow G(s)H(s) = -1$

$\Rightarrow |x+iy| = -1$

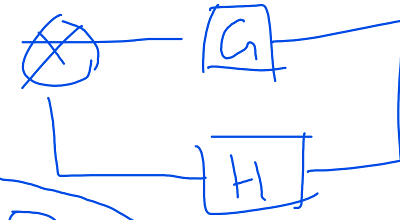
$|G(s)H(s)| = 1$

$\angle GH = \tan^{-1}(-1)$

$= (2k+1)\,180^\circ$



2) $GH = \dfrac{K}{s(s+4)}$



$1 + GH = 1 + \dfrac{K}{s(s+4)} = 0$

$\dfrac{GH}{1+GH}$

$\rightarrow \quad s^2 + 4s + K = 0$

GH

$1 + GH = 0$

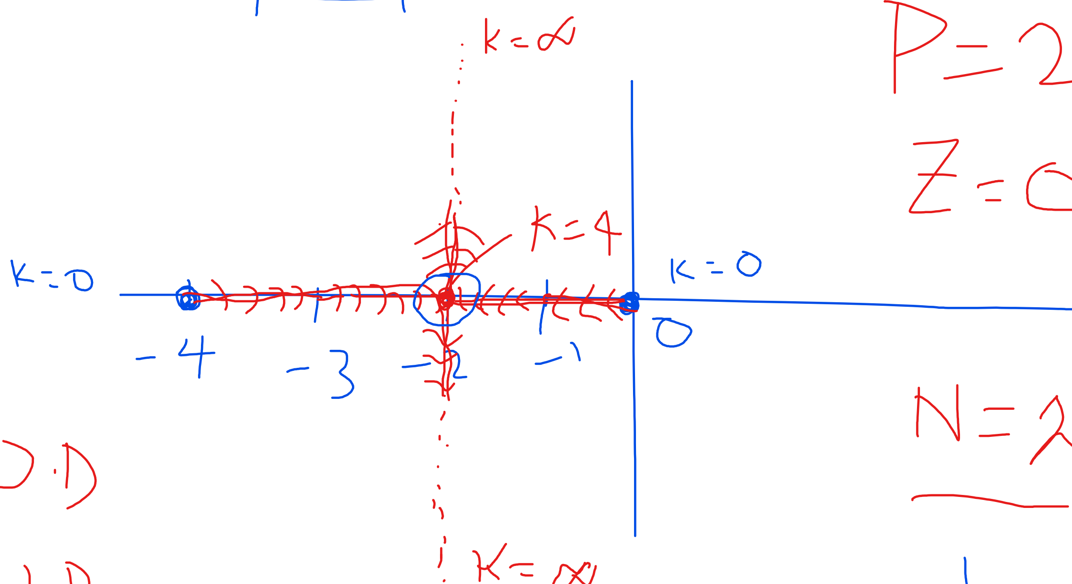
$s = \dfrac{-4 \pm \sqrt{16 - 4K}}{2}$

$= -2 \pm \sqrt{4 - K}$

$-2 \pm \sqrt{2}$

K	0	2	4	6	∞
s_1	0	−1	−2	$-2+j\sqrt{2}$	$-2+j\infty$
s_2	−4	−3	−2	$-2-j\sqrt{2}$	$-2-j\infty$

Real axis



P=2

Z=0

N=2

4) $0 < K < 4$ O.D

$K > 4 \rightarrow$ U.D.

Inherently stable.

3) $\dfrac{K}{s(s+1)(s+3)}$

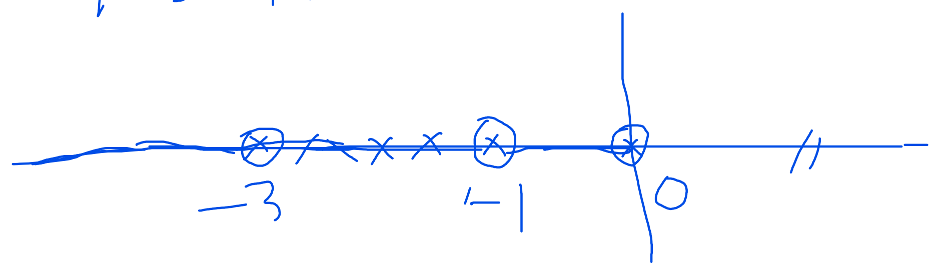
$P = 3$

$Z = 0$

$\boxed{N = 3}$

$s^3 + 4s^2 + 3s + K = 0$

How to test?



3- odd $\Sigma = 1$ odd

2- Even

1) Find O.L poles.

2) Existance of R.L on real axis

3) Determine asymptotes:-

angle of asymptotes $= \dfrac{180^\circ(2k+1)}{P-Z}$

$= \dfrac{180^\circ(2K+1)}{3}$

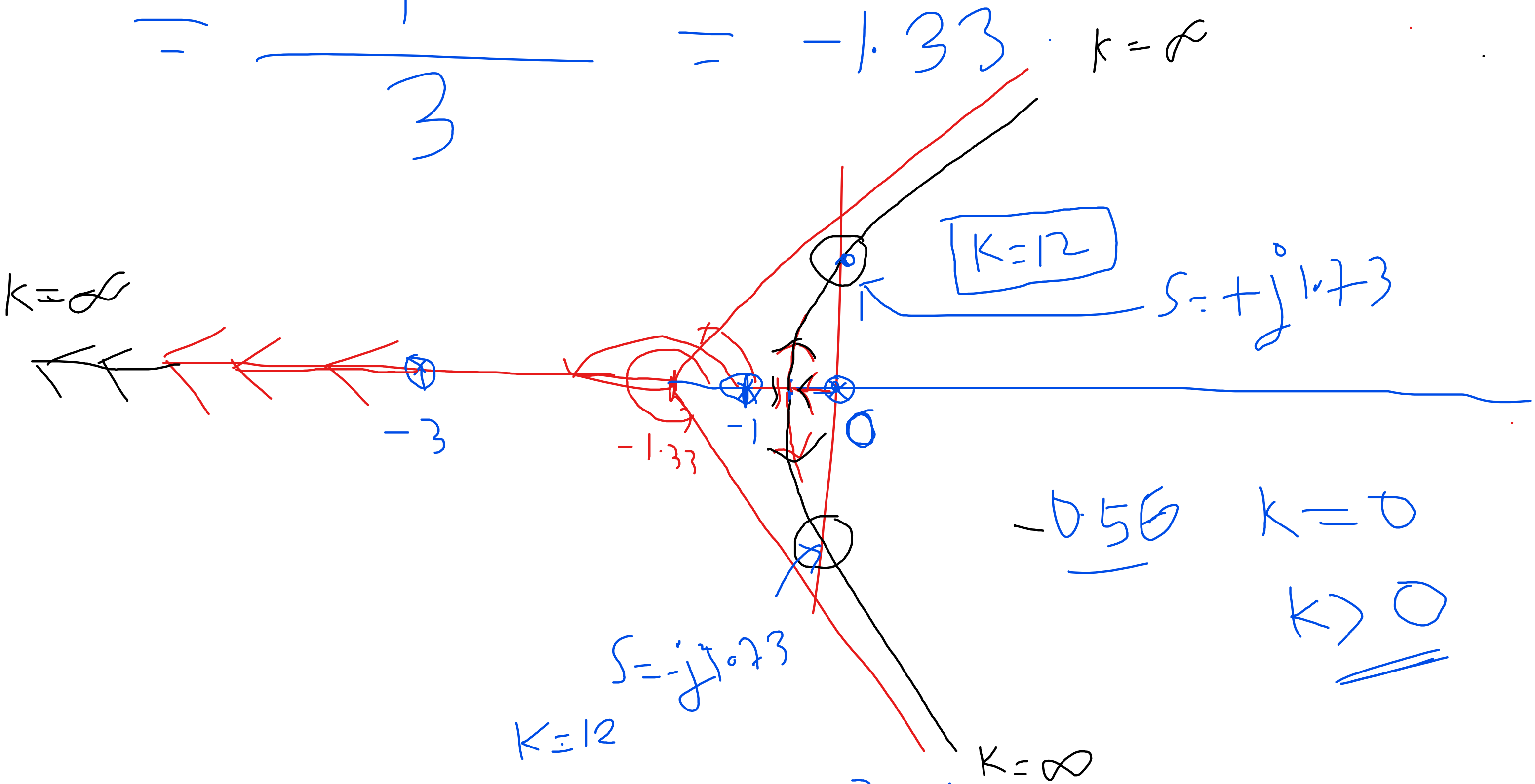
$= 60^\circ, 180^\circ, 300^\circ$

$\left[K = 0, 1, 2 \ldots P-Z-1\right]$

$K = 0, 1, 2$

$$\text{centroid} = \frac{\sum \text{Real part of OL poles} - \sum \text{Real part of OLZ}}{P-Z}$$

$$= \frac{-4}{3} = -1.33$$



4) Break away point :-

$$1 + G(s)H(s) = 0$$

$$\frac{dk}{ds} = 0 \qquad s(s+1)(s+3) + K = 0$$

$$\Rightarrow \frac{dk}{ds} = 0, \quad s = -0.56, -2.1$$

$$1+G(s)H(s)=0$$

$$\Rightarrow s^3+4s^2+3s+K=0$$

s^3	1	3
s^2	4	K
s^1	$\dfrac{12-K}{4}$	0
s^0	K	0

case-1

$$\boxed{K=12}$$

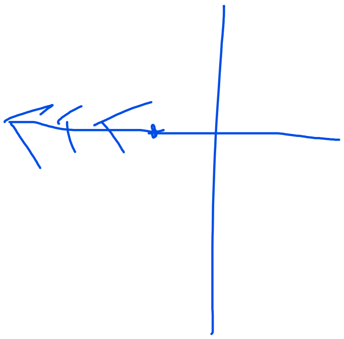
$$4s^2+K=0$$

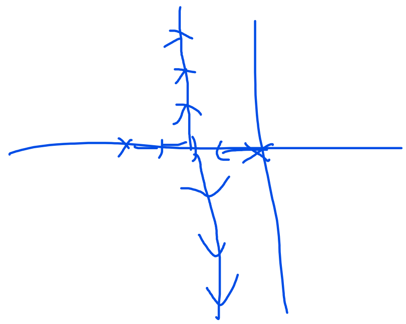
$$\Rightarrow 4s^2+12=0$$

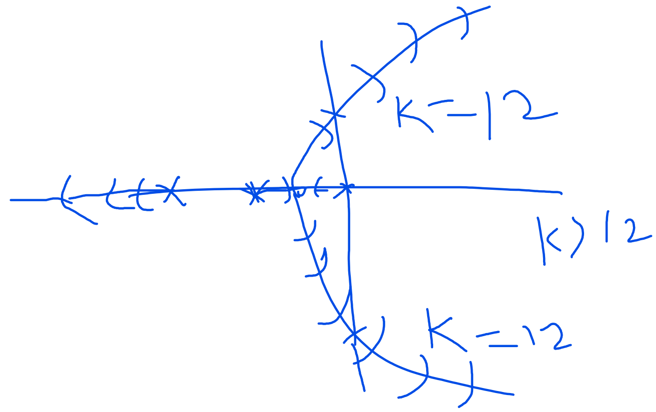
$$\Rightarrow s^2+3=0$$

$$\Rightarrow \boxed{s=\pm j1.73}$$

✓ $\dfrac{K}{s+1}$ ✓ $\dfrac{K}{s(s+1)}$ $\dfrac{K}{s(s+1)(s+3)}$







$\boxed{0 < K < 12}$