LCS ASSIGNMENT 1

*1. $G(s).H(s) = \frac{Ke^{-0.2s}}{s(s+2)(s+8)}$

(a) G.M = 2db ; (b) P.M = 45°

*Sol. let $k = 1 \Rightarrow G(s).H(s) = \frac{e^{-0.2s}}{s(s+2)(s+8)}$

$\Rightarrow G(s) = \frac{e^{-0.2s}}{16s(1+0.5s)(1+0.125s)} = \frac{0.0625e^{-0.2s}}{s(1+0.5s)(1+0.125s)}$

$\Rightarrow G(j\omega) = \frac{0.0625e^{-0.2j\omega}}{j\omega(1+j0.5\omega)(1+j0.125\omega)}$

$|0.0625e^{-0.2j\omega}| = 0.0625 \quad \angle 0.0625e^{-0.2j\omega} = -0.2\omega$ rad

*Magnitude :-

* $\omega_{c_1} = 2$ r/s ; $\omega_{c_2} = 8$ r/s

* Term	* Corner frequency	* Slope in dB/decade
$\frac{0.0625}{j\omega}$	-	-20
$\frac{1}{1+0.5j\omega}$	2 r/s	-40
$\frac{1}{1+j0.125\omega}$	8 r/s	-60.

$M = 20\log(0.0625) - 20\log(\omega) - 20\log(0.5\omega) - 20\log(0.125\omega)$

$0 < \omega \leq 2$

$M = 20\log(0.0625) - 20\log(\omega)$; at $\omega = 0.5 \Rightarrow M = -18$ db

at $\omega = 2 \Rightarrow M = -30$db

$2 < \omega \leq 8$

$M = 20\log(0.0625) - 20\log(\omega) - 20\log(0.5\omega)$ at $\omega = 8 \Rightarrow M = -54$dB

$\omega > 8$

$M = 20\log(0.0625) - 20\log(\omega) - 20\log(0.5\omega) - 20\log(0.125\omega)$

at $\omega = 50 \Rightarrow M = -102$ db.

*Phase :-

$$\phi = -0.2\omega - \tan^{-1}(0.5\omega) - 90 - \tan^{-1}(0.125\omega)$$

$\times \frac{180}{\pi}$

*ω	*ϕ
0.01	-90
0.1	-94
0.5	-114
1	-134
2	-172
3	-202
4	-226.

*Calculate of K :-

G.M = 2db.

* When K=1 ; G.M = -32 db. but required G.M = 2db.

$\Rightarrow$ 30db should be added to each & every part.

$\Rightarrow$ $20\log K = 30db$

$K = 31.62$.

$\because P.M = 180^\circ + \phi_{gc}$.

Given $P.M = 45^\circ$

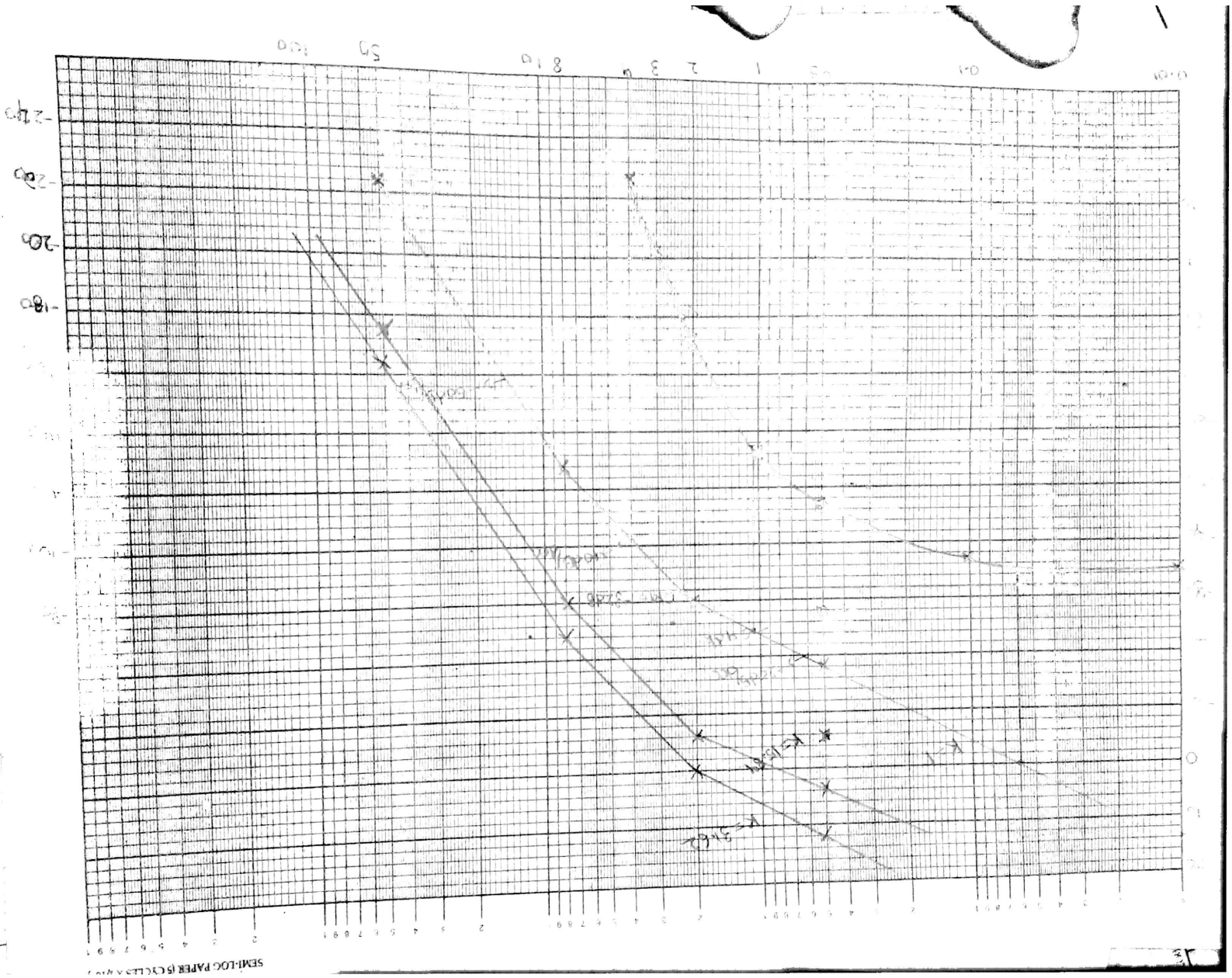
$\Rightarrow \phi_{gc} = 45 - 180^\circ = -135^\circ$.

at $\phi = -135^\circ$; Gain $= -24$ dB

But at $\phi = -135^\circ$; gain $= 7$ dB. {should be}.

$\Rightarrow 20\log K = 24$

$\Rightarrow K = 15.84$.



*(2) $G(s) = \frac{ke^{-s}}{s(s+2)}$

$e^{-s} = 1 - \frac{s}{1!} + \frac{s^2}{2!} - \dots$

$\Rightarrow G(s) = \frac{k(1-s)}{s(s+2)}$

Zeros (m) = 1 ; poles (n) = 0, -2

$n-m = 1$

*Asymptotes = $\pm \frac{180(2q+1)}{n-m} = \pm 180[2q+1] = \pm 180°$

$q = 0, 1, \dots (n-m-1)$

$\Rightarrow q = 0.$

* $\sigma_A = \frac{0-2-1}{1} = -3.$

*BWP/BIP:→

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

$s^2 + 2s + k - sk = 0.$

$\Rightarrow k = \frac{s^2+2s}{s-1}$

$\Rightarrow \frac{dk}{ds} = 0.$

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

$\Rightarrow s^2 - 2s - 2 = 0.$

$\Rightarrow s_1 = 1+\sqrt{3}\ ;\ s_2 = 1-\sqrt{3}$

at s_1 ; k = 2.72 ; at s_2 ; k = -0.732

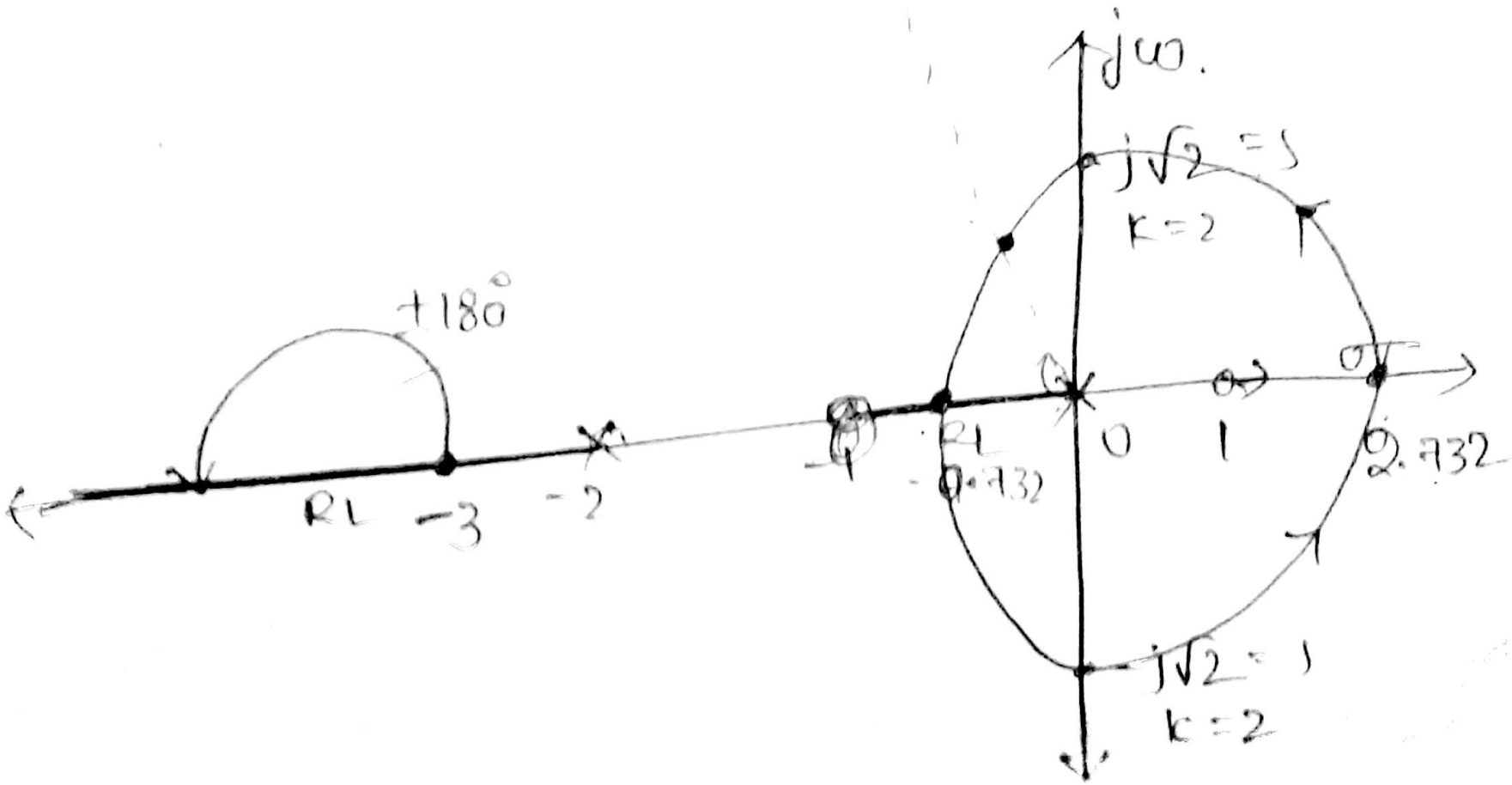
S^2	1	k	0
S^1	$-k+2$	0	0
S^0	k		

* $-k+2=0 \Rightarrow k=2$.

$\Rightarrow s^2+k=0$

$\Rightarrow s = \pm\sqrt{2}j$

* Centroid = $\frac{0-2-1}{2-1} = \frac{-3}{1} = -3$



Root