

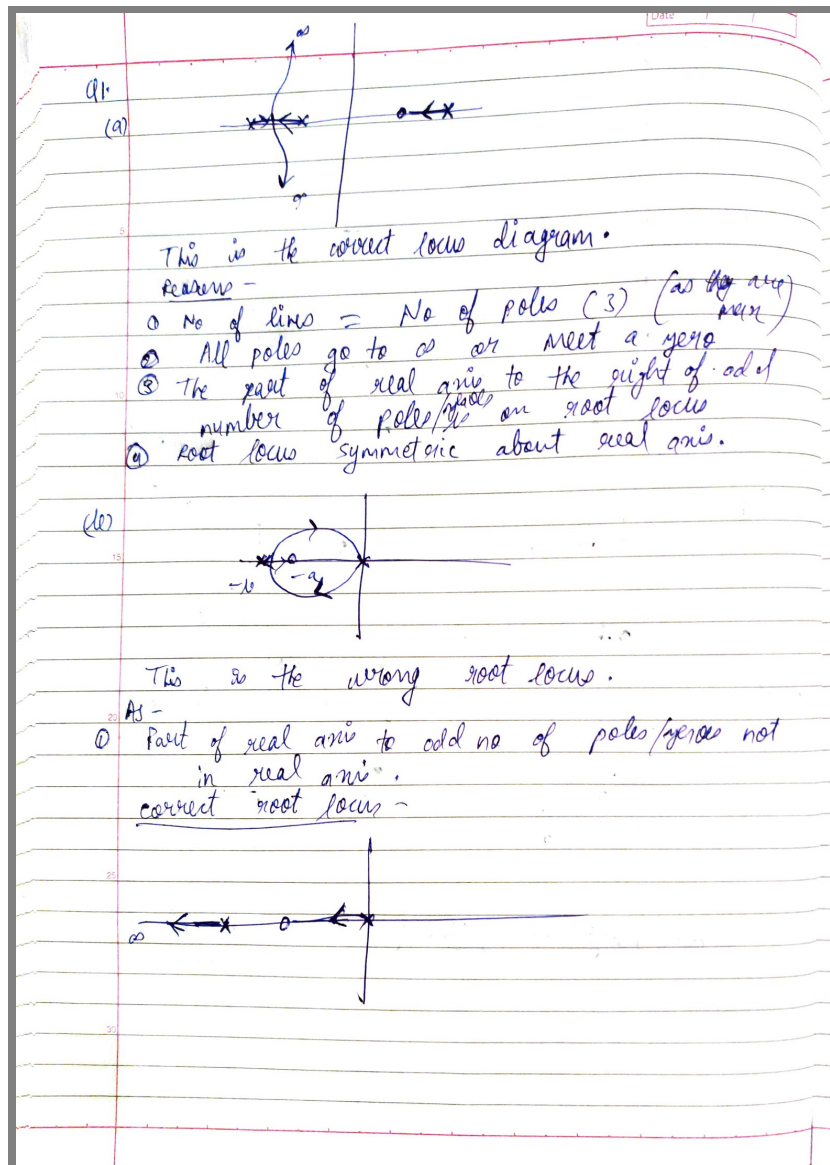
Lab9-Report

RollNo-190020021

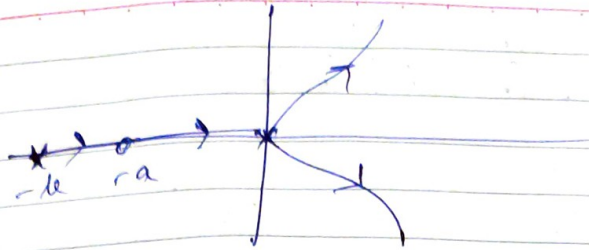
Kushagra Khatwani

Answers-

Q1-

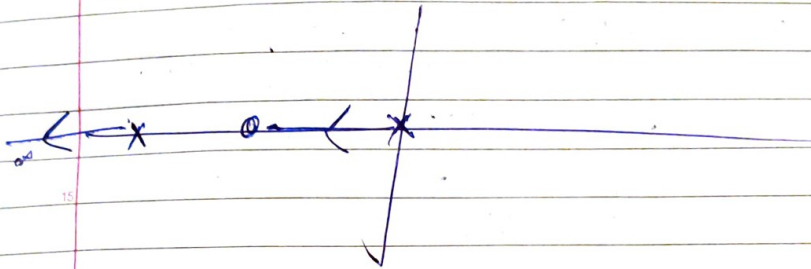


(K)



Ans This is wrong root locus diagram.
As -

① Poles go to zeros not vice versa.
Correct root locus diagram -



$$Q2. \quad G(s)H(s) = \frac{K(s-2+i)(s-2-i)}{(s+1)(s+4+2i)(s+4-2i)}$$

$$(i) \quad s = -3 + 2.2i$$

If $\angle GH = (2t+1)\pi$, $|GH| = 1$
then it lies on
root locus

$$GH(s) = \frac{K(-5+3.2i)(-5-3.2i)}{(2+2.2i)(1+4.2i)(1+0.2i)}$$

$$\begin{aligned} \angle GH &= 0 + \angle -5+3.2i + \angle -5-3.2i - \angle 2+2.2i - \angle 1+4.2i - \angle 1+0.2i \\ &= -32.62 + 32.62 + 47.72 - 76.60 - 11.31 \\ &\neq (2t+1)\pi \end{aligned}$$

so $s = -3 + 2.2i$ does not lie
on root locus.

$$(b) \quad s = -1 + 1.5i$$

If $\angle GH = (2t+1)\pi$, $|GH| = 1$
then it lies on root locus.

$$GH(s) = \frac{K(-3+2.5i)(-3-2.5i)}{(1.5i)(3+3.5i)(3-0.49i)}$$

$$\begin{aligned} \angle GH &= 0 - 39.92 - 9.65 - 90 + 49.48 \\ &\quad + 9.28 \approx -180 \\ &= (2t+1)\pi \end{aligned}$$

so $s = -1 + 1.5i$ ~~does not~~ lie
on root locus.

(10) so value of K \rightarrow

$$|G_H| = 1$$

$$K \frac{|-3+2.51i| |-3+0.51i|}{|1.51i| |3+3.51i| |3-0.49i|} = 1$$

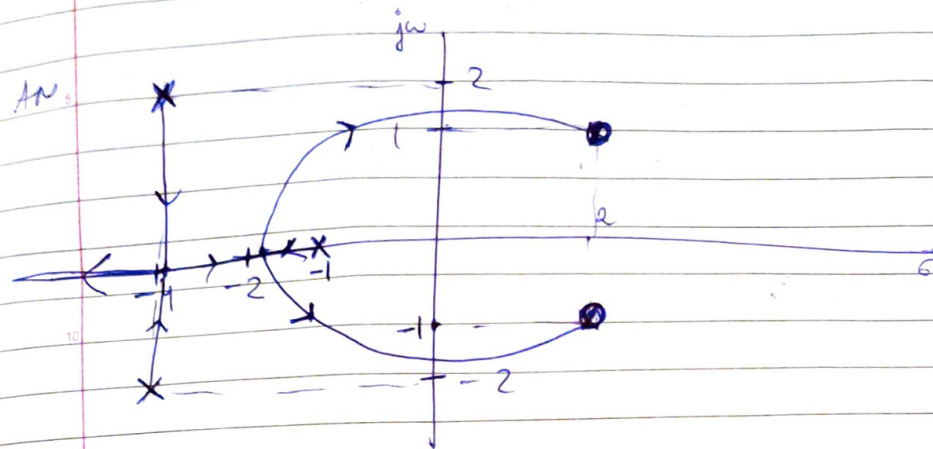
~~$$K = \frac{1.51 \times 4.62 \times 3.04}{4.62 \times 3.91 \times 3.04}$$~~

$$K = \frac{1.51 \times 4.62 \times 3.04}{4.62 \times 3.91 \times 3.04}$$

$$K \approx 1.784$$

for pt to lie on root locus

(ii) $G(s)H(s) = \frac{K(s-2+i)(s-2-i)}{(s+1)(s+4+2i)(s+4-2i)}$



Breakaway and Break in pts -

$$|K| = \max_s \frac{1}{|G(s)H(s)|}$$

$$s = \arg \max_s \frac{1}{|G(s)H(s)|}$$

~~$$K = \frac{(s+1)(s-2+i)(s-2-i)}{(s+4+2i)(s+4-2i)}$$~~

$$K = \frac{(s+1)(s+4+2i)(s+4-2i)}{(s-2+i)(s-2-i)}$$

$$K = \frac{s^3 + 9s^2 + 28s + 20}{s^2 - 4s + 5}$$

$$\frac{dK}{ds} = 0 \quad \text{and we find } s.$$

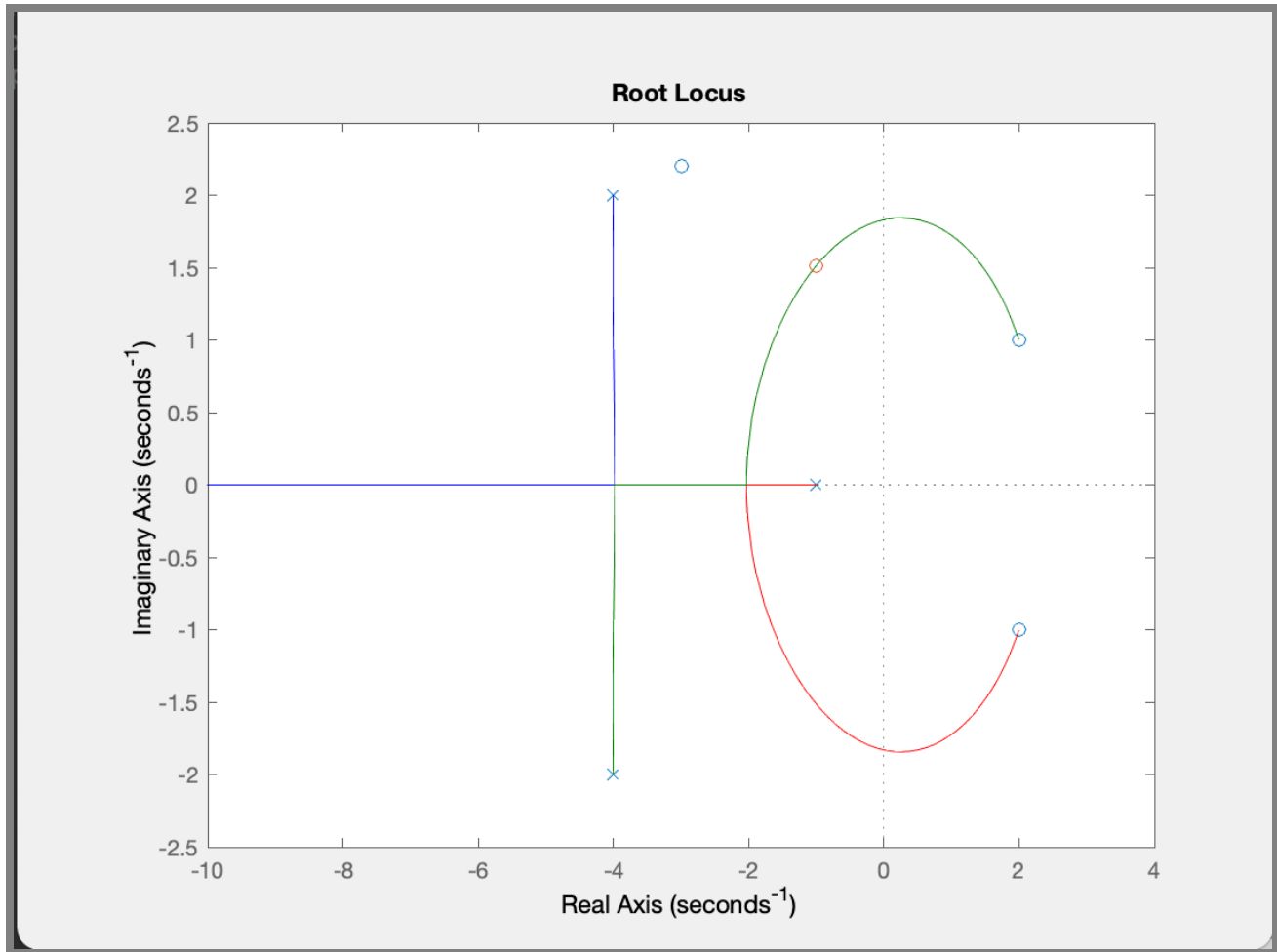
Code Fragment for MATLAB-

```
%transfer function decalration
```

```

sys = tf([1,-4,5],[1 9 28 20]);
%plotting root locus
hold on;
5 rlocus(sys);
scatter(-3,2.2);           %Plotting -3+2.2i
scatter(-1,1.51);         %Plotting -1+1.51i

```



We can see from root locus that

$$-1 + 1.51i$$

lie on the root locus diagram and

$$-3 + 2.2i$$

doesn't lie on root locus.

Q3. $H(s) = \frac{6(s+5)}{(s+8)(s+1)}$

Ans $|H(j\omega)| = \frac{6(j\omega+5)}{(j\omega+8)(j\omega+1)}$

magnitude

$$20 \log |H(j\omega)| = 20 \log 6 + 20 \log(j\omega+5)$$

$$- 20 \log(j\omega+8) - 20 \log(j\omega+1)$$

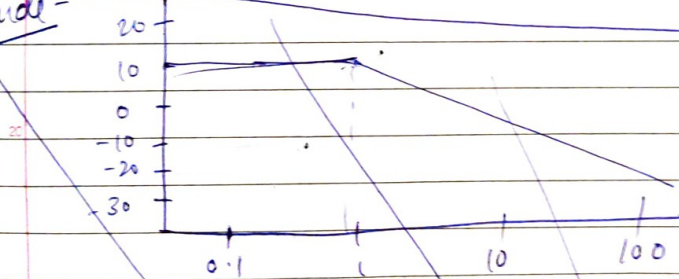
$$20 \log |H(j\omega)| = 20 \log 6 + 20 \log(\sqrt{\omega^2 + 25})$$

$$- 20 \log(\sqrt{\omega^2 + 64}) - 20 \log(\sqrt{\omega^2 + 1})$$

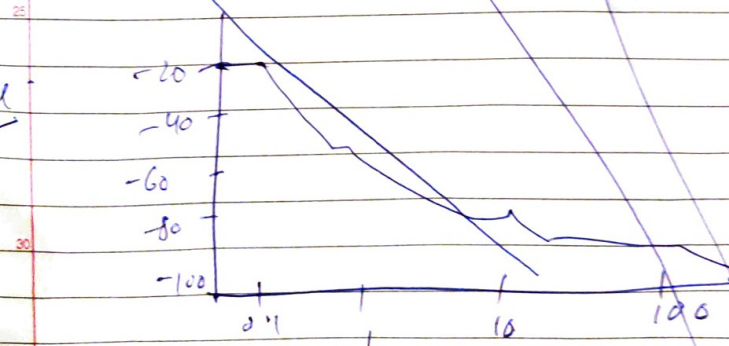
phase

$$\angle H(j\omega) = \tan^{-1}(\omega/5) - \tan^{-1}(\omega/8) - \tan^{-1}(\omega/1)$$

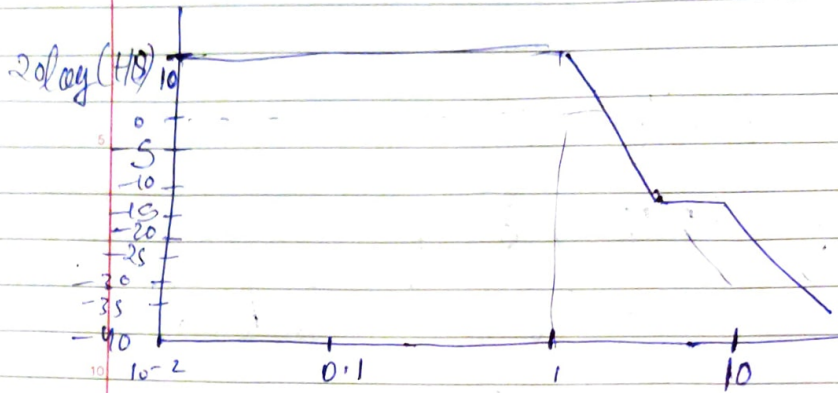
magnitude



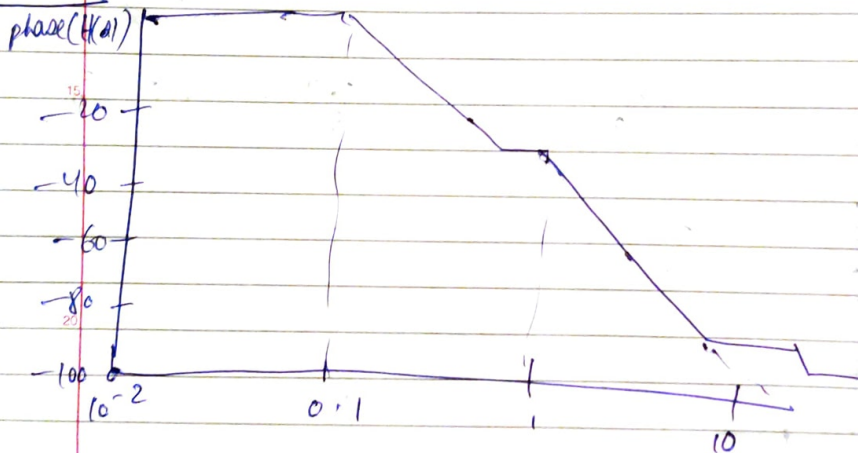
phase



Magnitude -



Phase -



$PM = \infty$

~~$G_M = \infty$~~

$G_M = \infty$

(never crosses 180°)