Draw the polar plot

Q1) $G(s) = \frac{1}{(s)(s+1)(s+2)}$

$s = j\omega \qquad G(j\omega) = \frac{1}{(j\omega)(j\omega+1)(j\omega+2)}$

$M = |G(j\omega)| = \frac{1}{\omega\sqrt{1+\omega^2}\ \sqrt{\omega^2+4}}$

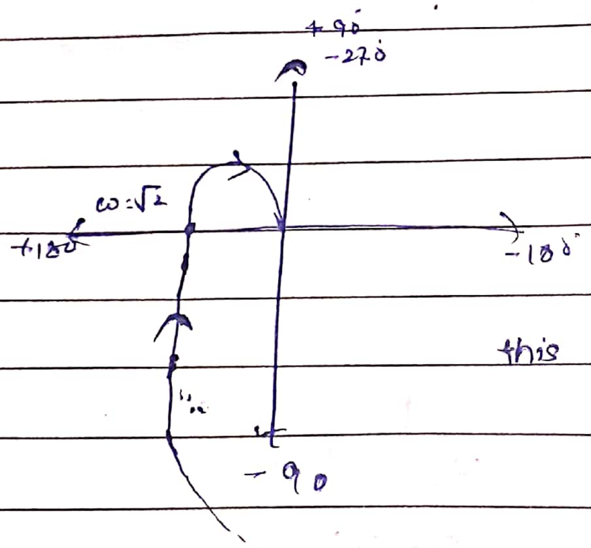
$\phi = -90 - \tan^{-1}(\omega) - \tan^{-1}(\omega/2)$

$\omega = 0$

$M = \infty, \ \phi = -90'$

$\omega = \infty$ → type 1, order 3 system

$M = 0, \ \phi = -270'$

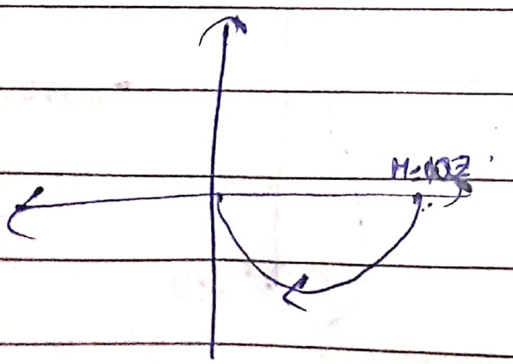


this axis is touching -ve real axis at $\omega = 180^\circ$ in phase by that well get $\omega = \sqrt{2}$.

Q2) $G(s) = \frac{1}{1+sT} \qquad M = |G(s)| = \frac{1}{1+sT}$

$= \frac{1}{\sqrt{1+\omega^2T^2}}$

$\phi = -\tan^{-1}\left(\frac{\omega T}{1}\right)$



consider $\omega = 0$

$M = 1, \ \phi = 0^\circ$

$1\angle 0^\circ$

$\omega = \infty \quad , 0\angle -90^\circ$

Scanned with CamScanner

Type 0, Order 2

Q3)

$$G(s) = \frac{1}{(1+sT_1)(1+sT_2)}$$

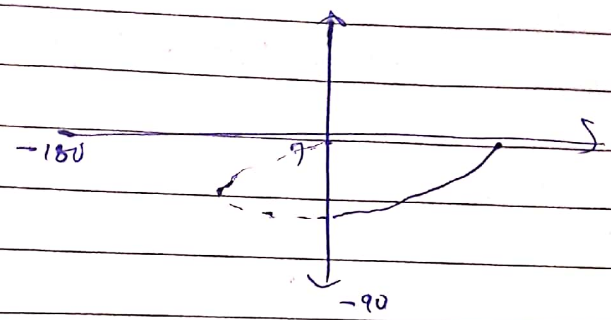
$$G(j\omega) = \frac{1}{(1+j\omega T_1)(1+j\omega T_2)}$$

$$M = \frac{1}{\sqrt{1+\omega^2 T_1^2}\ \sqrt{1+\omega^2 T_2^2}}$$

$$\phi = -\tan^{-1}(\omega T_1) - \tan^{-1}(\omega T_2)$$

$\omega = 0 \rightarrow 1\angle 0^\circ$

$\omega = \infty \Rightarrow 0\angle -180^\circ$)



Type 1, order 2

Q4)

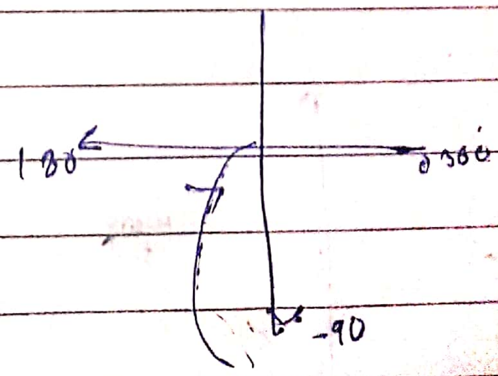
$$G(s) = \frac{1}{(s)(1+sT)}$$

$$G(j\omega) = \frac{1}{j\omega(1+j\omega T)} \quad \frac{1}{\omega\sqrt{1+\omega^2T^2}}$$

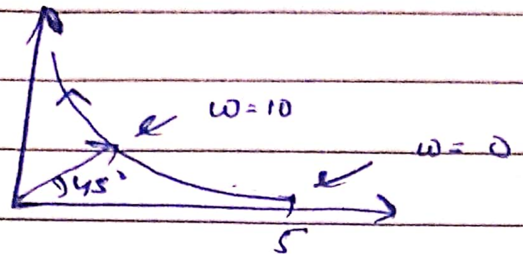
$$\phi = -90^\circ - \tan^{-1}(\omega T/1)$$

$\omega = 0 \Rightarrow \infty\angle -90^\circ$

$\omega = \infty \Rightarrow 0 \angle 180^\circ$



Q5)



ω = 0 $\quad 5\angle 0$

ω = ∞ $\quad \infty \angle 90°$

find out G(s)

$$K = G(j\omega)\big|_{\omega=0} = G(j0) = 5$$

$$G(s) = K(1 + sT)$$

no we need to find out T

$$5(1 + j10T) = 45°$$

$$\tan^{-1}\left(\frac{10T}{1}\right) = 45°$$

$$\boxed{T = \frac{1}{10}}$$

$$G(s) = 5\left(1 + \frac{s}{10}\right)$$

$$G(s) = 5(1 + 0.1s)$$