jω in ten.

Que: 01 The open loop T.F. of unity FB system is given by $G(s) = \frac{1}{S(1+S)(S+2)}$. sketch the polar plot.

$+180^\circ$

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

$S = j\omega \Rightarrow G(j\omega) = \frac{1}{j\omega(j\omega+1)(j\omega+2)}$

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

$\phi = -90^\circ - \tan^{-1}(\omega) - \tan^{-1}\left(\frac{\omega}{2}\right)$

$\omega \to 0$ $\quad \omega \to 0$

Considering:

$\omega = 0$

$\rightarrow M = \infty, \phi = -90^\circ$

$\omega = \infty$

$M = 0, \phi = -270^\circ$ $\quad -90^\circ - 90^\circ - 90^\circ$

$\longrightarrow$ type-1, order-3 System

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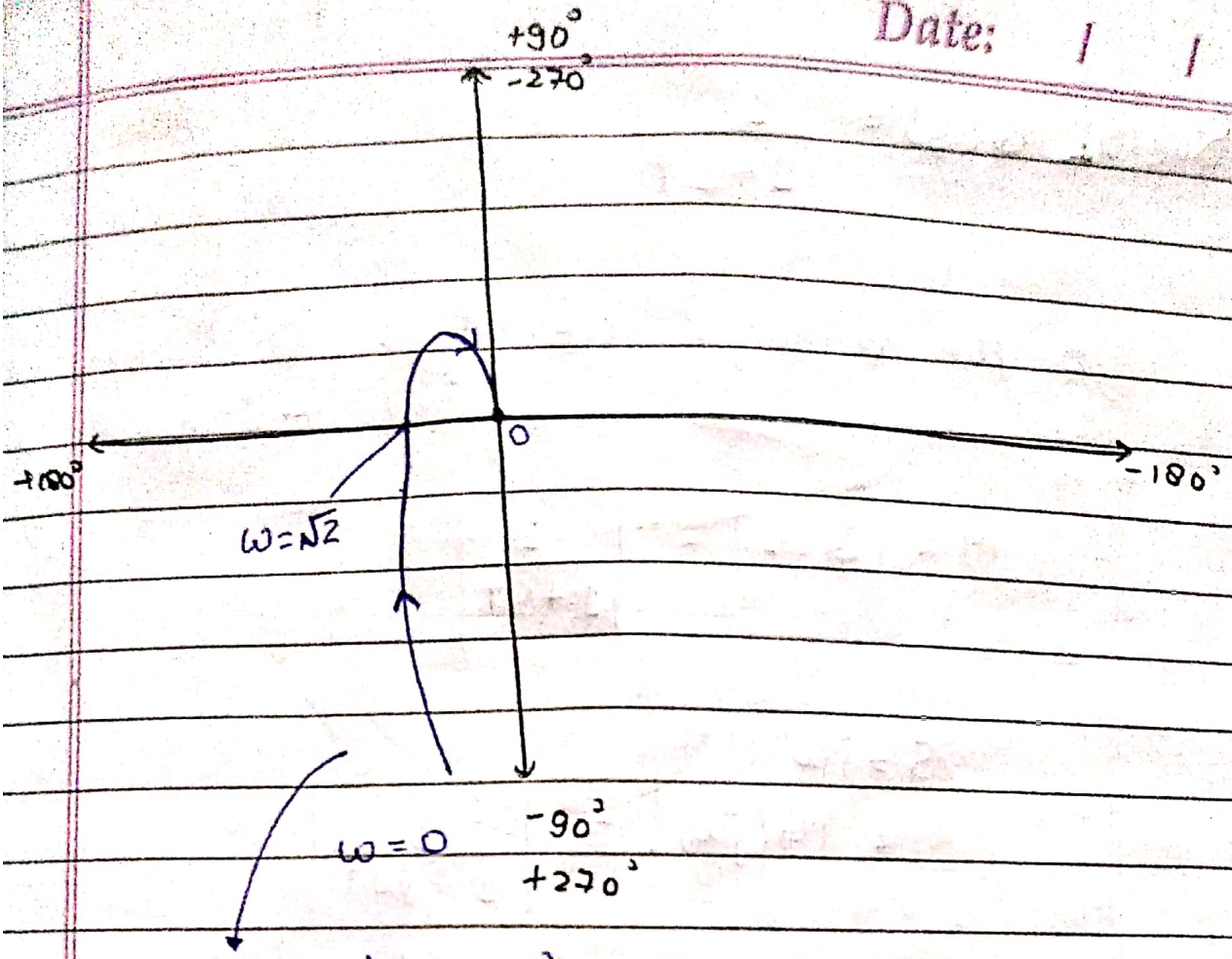
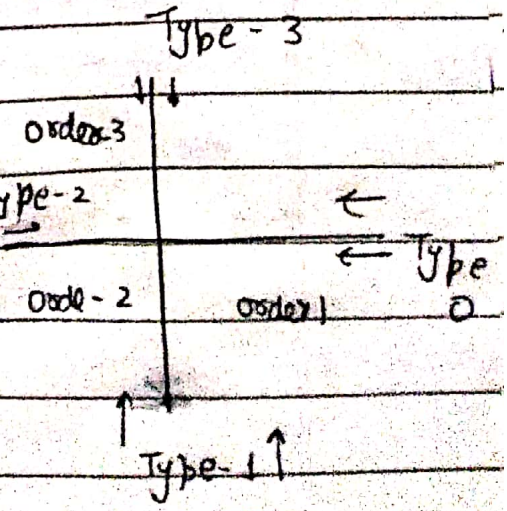


this plot is touching the -ve real axis at 180° that means we can substitute $\omega = 180°$ in phase. by that we'll get $\omega = \sqrt{2}$.

put this value in magnitude we'll get

$M = 0.165$

$(0.165, 180)$



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Que:02 $G(s) = \frac{1}{1+sT}$

0 pole at origin i.e. Type - 0 System
order - 1 System

$$M = |G(s)| = \left|\frac{1}{1+sT}\right|$$

$s = j\omega$

$$= |G(j\omega)| = \left|\frac{1}{1+j\omega T}\right|$$

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

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

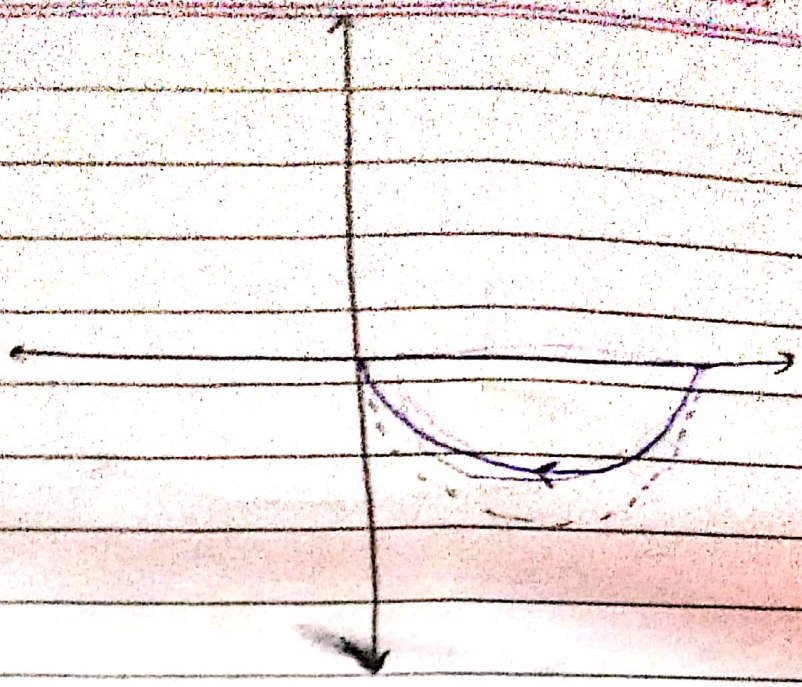
$$= -\tan^{-1}(\omega T)$$

Consider $\omega = 0$

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

$1\angle 0^\circ$

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



Type 0, Order-2

Ques 03

$$G(S) = \frac{1}{(1+ST_1)(1+ST_2)} \qquad S = -\frac{1}{T_1}, -\frac{1}{T_2}$$

no poles at origin, i.e. type 0 system.
order 2 system.

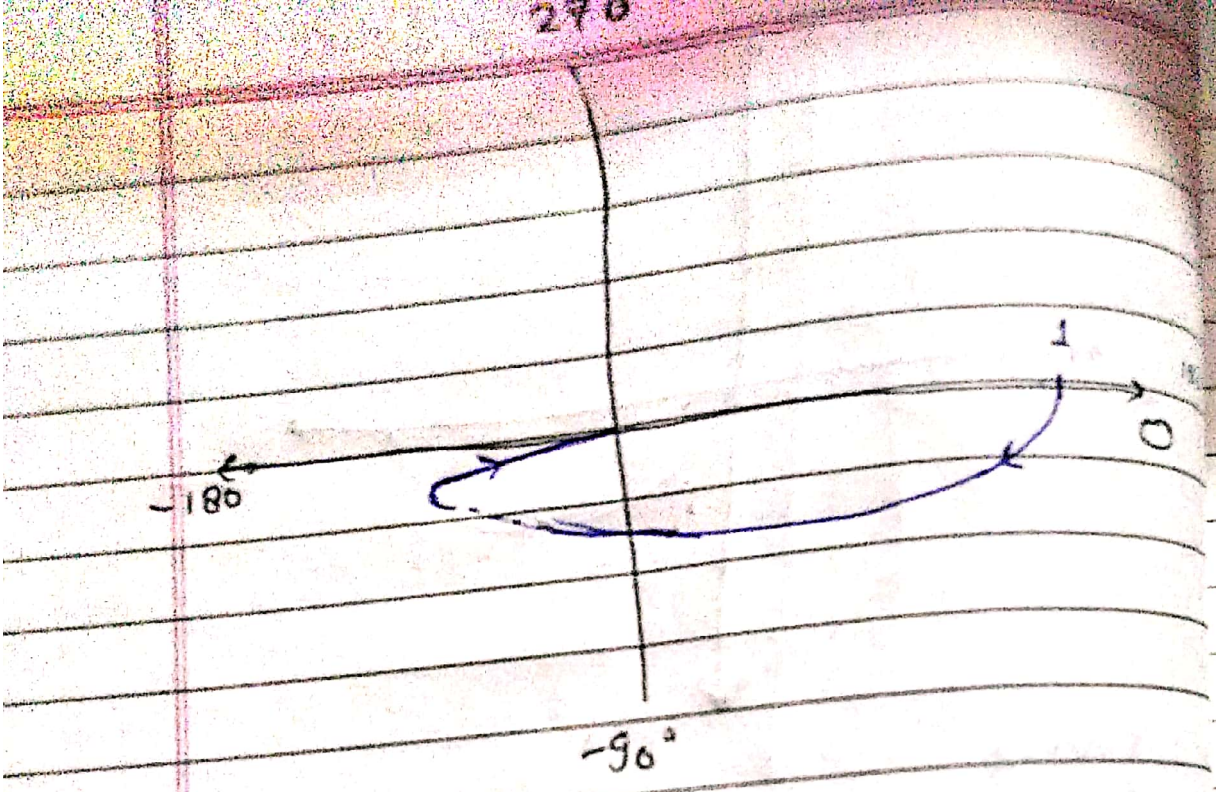
$$G(j\omega) = \frac{1}{(1+j\omega T_1)(1+j\omega T_2)}$$

$$M = \frac{1}{\sqrt{1+\omega_2 T_1^2}\sqrt{1+\omega_2 T_2^2}} = |G(j\omega)| \qquad \frac{1}{m}$$

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

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

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



Type 1, order-2

Que: 04

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

1 pole at origin ; type 1 system
order 2

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

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

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

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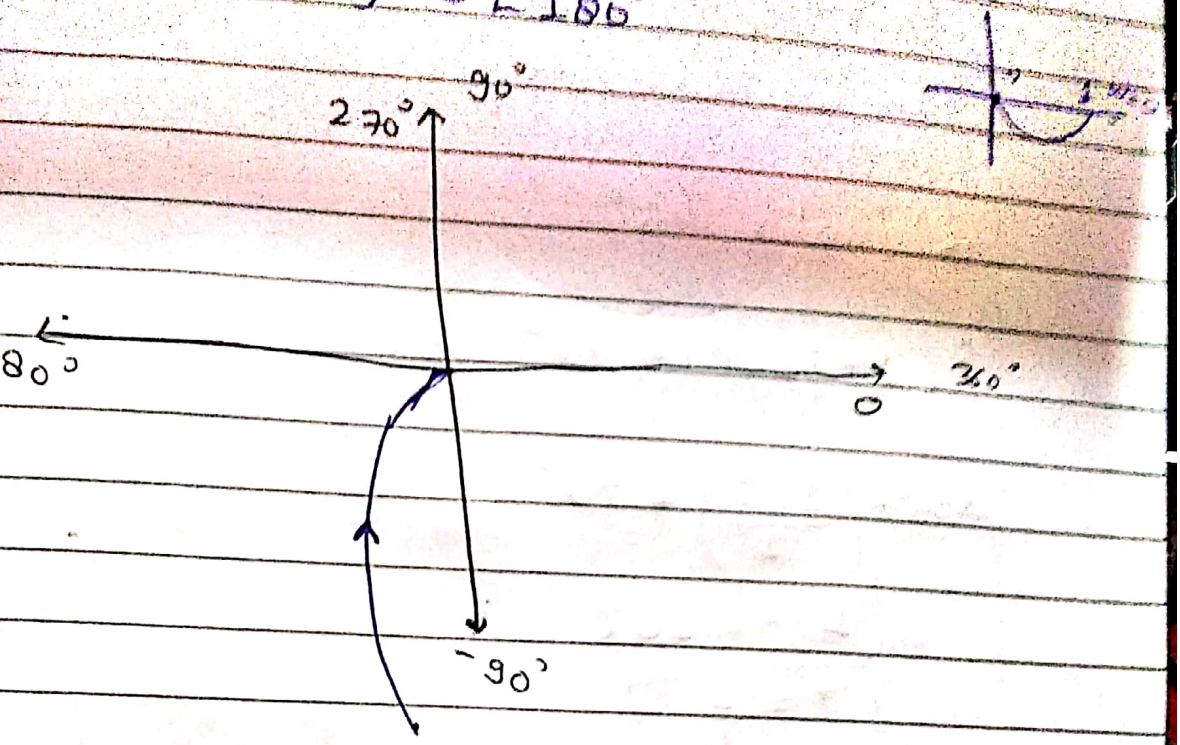
$\omega = 0 \Rightarrow \infty \angle -90^\circ$

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



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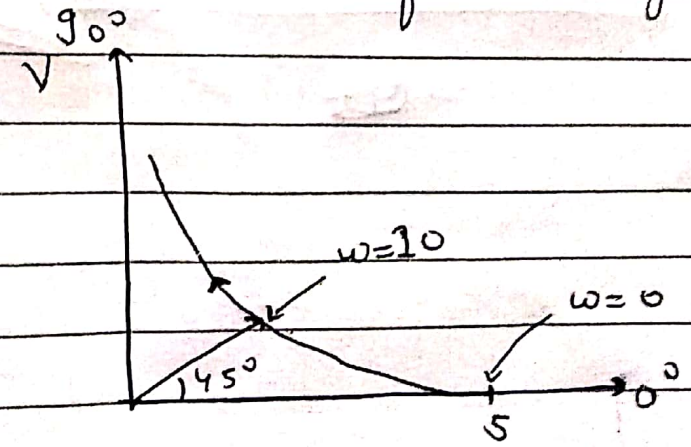
Que 05 Figure shows polar polar of a system. The T.F of the system is?



$\omega = 0 \quad 5\angle 0^\circ$

$\omega = \alpha \quad \infty \angle 90^\circ$

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

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

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$$\boxed{K = 5}$$

Then we need to find out τ

$\omega = 10$ at 45°

$$G(j10) = 45^\circ$$

$$5(1 + j10\tau) = 45^\circ$$

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

$$\tan 45^\circ = 10\tau$$

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

$$\boxed{\tau = 0.1}$$

$$\boxed{G(s) = 5(1 + 0.1s)}$$