ME22B106

Assignment 1:-

2) a) We can see that for the Bode plot of the oltf, there is a dip in the phase of the oltf as compared to G. Thus, the lag controller here ~~achieves~~ induces a phase delay in G in between approximately 0.00477 rad/s and 1.31 rad/s.

We can also see an increase in the steady state error of oltf as compared to G.

We can also see that the magnitude at resonance (at 2.74 rad/s) has increased in the oltf for a value of 9.31 dB as compared to 9.17 dB for G, which indicates ~~higher level of~~ lower level of damping via lower ξ.
The graphs are unaffected beyond resonance in both cases as the dominant poles take over.

b) In the gain response of cltf, we see that the region before resonance is (i.e at lower frequencies) is nearly at constant decibel value. This indicates a large range of controllable frequencies on one side before the system tends to instability. The amount of lag in the phase plot is also noticeably reduced.

c) Since the value of dB $\log_{10}|G(i\omega)|$ is very close to $\log(1)=0$, there is a significant decrease in steady state error of the cltf as compared to the oltf (Note that this is for frequencies before resonance)

1) c)

sin response (not dB)

0.25 rad/s → 0.065 dB → 1.007 units

2.85 rad/s → 8.319 dB → 2.606 units

25 rad/s → -37.81 dB → 0.013 units.

~~Act~~ Actual response

~~0.25~~ 0.25 rad/s → 1.007

2.5 rad/s → 2.621

25 rad/s → ~~0.027~~ 0.0129

The values are very close to each other.

a) assymptotes for gain:-

Let us have $(s-a-ib)$

$s=i\omega$

$\Rightarrow |s-a-ib|_{s=i\omega} = |-a-i(b-\omega)|$

$= \sqrt{a^2+(\omega-b)^2} = a\sqrt{1+\left(\frac{\omega-b}{a}\right)^2}$

For very small values of ω,

$$|G(i\omega)| = a\sqrt{1+\left(\frac{\cancel{\omega}^{0}-b}{a}\right)^2} = \sqrt{a^2+b^2}$$

large values of ω,

$$|G(i\omega)| = \sqrt{a^2+\omega^2\left(1-\frac{b}{\omega}^{\,0}\right)^2} = \sqrt{a^2+\omega^2}$$

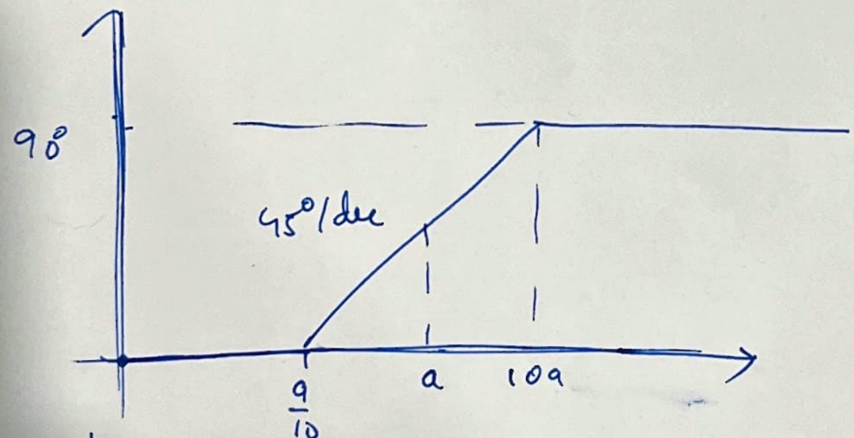
$$\approx \omega$$

$\therefore$ The assymptotes are :-

$$\cancel{|G(i\omega)|}\ y = \begin{cases} 20\log_{10}\sqrt{a^2+b^2}, & \omega \le \sqrt{a^2+b^2} \\ 20\log_{10}\omega, & \omega > \sqrt{a^2+b^2} \end{cases}$$

Phase :-

1st order (say $(s+a)$)



2nd order (underdamped)