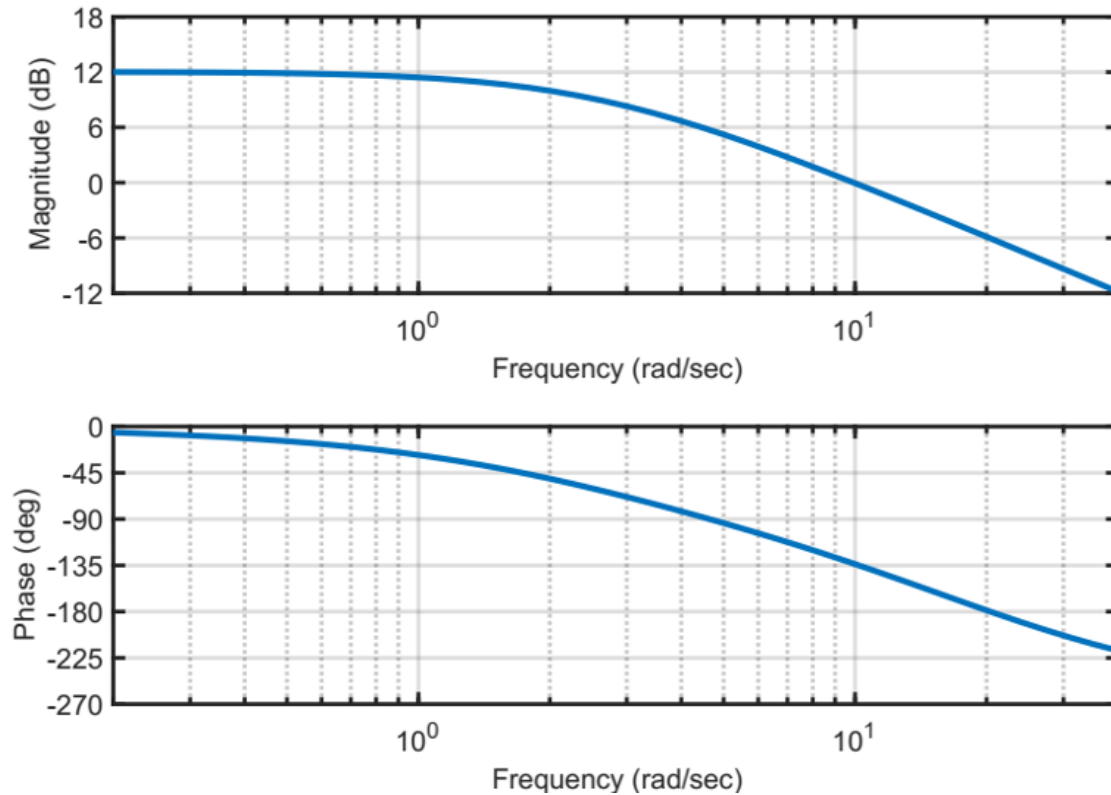


6.2 Gain Crossover and Phase Margin Analysis

Consider a standard closed-loop system with the loop transfer function $L(s)$ with the Bode plot below. Assume the closed-loop is stable with the loop $L(s)$:

$$L(s) = \frac{-4s + 72}{0.39s^2 + 8.02s + 18}$$



- What is the gain crossover frequency, ω_0 ?
- What is the phase margin, θ_0 , of the closed-loop?

Solution :

- $\omega_0 = 10 \text{ rad/sec}$.
- $\theta_0 = 45^\circ$.

GPT Answer :

The calculations yield the following results for the closed-loop system:

- The gain crossover frequency, ω_0 , is approximately 9.33 rad/sec. - The phase margin, θ_0 , is approximately 50.59 degrees.

Confidence Level: 90%

Misreading the Plot

Claude Answer :

Here is my response, with the answer, confidence score, and full LaTeX code:

- (a) The gain crossover frequency ω_0 occurs where the magnitude plot crosses 0 dB. From the Bode plot, this happens at approximately $\omega_0 = 4.2$ rad/sec.
- (b) The phase margin θ_0 is the phase angle above -180° at the gain crossover frequency ω_0 . At $\omega_0 = 4.2$ rad/sec, the phase is approximately -130° . Therefore, the phase margin is $\theta_0 \approx -130^\circ - (-180^\circ) = 50^\circ$.

Confidence: 90/100

Misreading The Plot