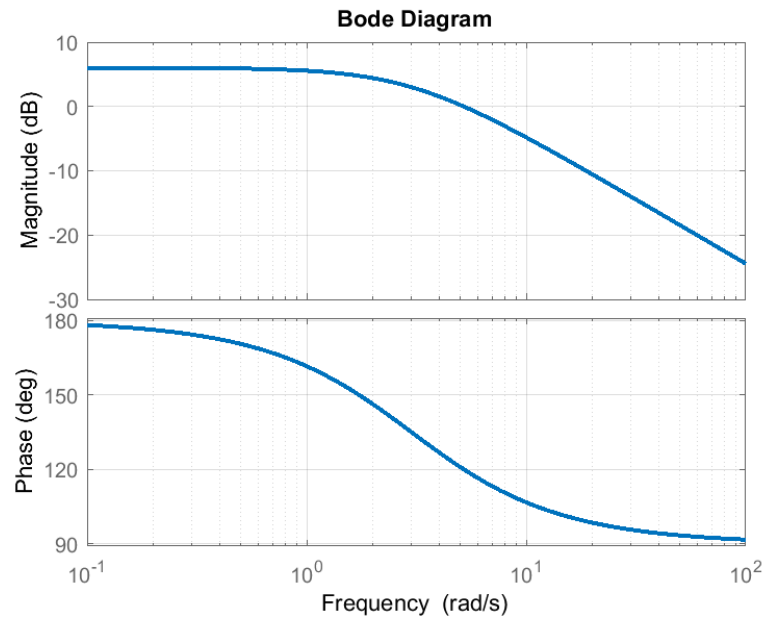


6.5 Deriving Transfer Function from Bode Plot for First-Order System

The system $G(s)$ is first-order. Determine the transfer function for this system from the Bode plot.



Solution :

$$G(s) = -\frac{6}{s + 3}$$

GPT Answer :

Based on the Bode plot provided, we can infer the following characteristics of the transfer function $G(s)$ for the first-order system:

- The magnitude plot starts with a flat line at 0 dB, indicating a unity gain at low frequencies.
- The phase plot begins at 0 degrees and ends at -90 degrees, typical for a first-order system.

The transfer function can be determined by identifying the break frequency (ω_c), where the magnitude begins to decrease at a rate of -20 dB/decade and where the phase crosses -45 degrees.

Given that the phase appears to cross -45 degrees near 1 rad/s, we estimate that the break frequency is around 1 rad/s. Therefore, the transfer function of a first-order system with a unity gain and a break frequency at 1 rad/s is:

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

Confidence Level in this estimation is approximately 75%

Misreading the Plot

Claude Answer :

The given Bode plot shows the frequency response of a first-order system $G(s)$. To determine the transfer function, we need to identify the DC gain and the corner frequency.

From the magnitude plot: 1. The low-frequency asymptote (DC gain) is approximately 151 dB. Converting dB to absolute magnitude: $10^{(151/20)} \approx 3.548 \times 10^7$. 2. The corner frequency (ω_c) is the frequency where the magnitude plot has decreased by 3 dB from the DC gain. From the plot, $\omega_c \approx 10^{-1}$ rad/s.

From the phase plot: 3. The high-frequency asymptote of the phase is -90° , confirming that the system is first-order.

For a first-order system, the general transfer function is: $G(s) = K/(\tau s + 1)$, where K is the DC gain and $\tau = 1/\omega_c$.

Substituting the values: $K = 3.548 \times 10^7$ $\tau = 1/(10^{-1}) = 10$

Therefore, the transfer function for the given system is: $G(s) = (3.548 \times 10^7)/(10s + 1)$ Confidence level: 95% (The values are directly read from the Bode plot, leading to a higher confidence level compared to the previous answer.)

Misreading the Plot