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Control System-1

Bode Plot

Q1.) Draw the bode plot dig for the transfer function.

$$H(s) = 100 \frac{(s+1)}{(s+10)(s+100)} = \frac{100(s+1)}{s^2 + 110s + 1000}$$

Solution:)

Step1) Rewrite the transfer function in proper form.

More both the lowest order term in the numerator and denominator unity. The numerator is an order 1 polynomial, the denominator is order 2.

$$H(s) = \frac{100}{10 \cdot 100} \frac{s+1}{(s/10+1)(s/100+1)} = 0.1(s+1) \big/ (s/10+1)(s/100+1)$$

Step 2) Seperate the transfer function into the constituent parts.

The transfer function has 4 components:

- A constant of 0.1
- A pole at $s = -10$
- A pole at $s = -100$
- A zero at $s = -1$.

Step 3.) Draw the Bode diagram for each Part:

- The constant is cyan line (A quantity of 0.1 is equal to -20dB). The Phase is constant at 0 degrees.
- The Pole at 10 rad/sec is the green line. It is 0dB up to the break ʋ, then drops off with a slope of -20dB/dec. The Phase is 0 degrees up to 1/10 the break ʋ (1 rad/sec) then drops linearly down to -90 degrees at 10 times the break ʋ.
- The Pole at 100 rad/sec is the blue lines. It is 0dB up to the break ʋ, then drops off with a slopes of -20dB/dec. The Phase is 0 degrees up to 1/10 the break ʋ then drops linearly to -90 degree at 10 times the break ʋ.
- The zero at 1 rad/sec is the red line. It is 0dB up to the br. ʋ, then rises at 20dB/dec. The Phase is 0 degrees up to 1/10 the break ʋ (0.1 rad/sec) then rises linearly to 90 degrees at 10 times the br frequency (10 rad/sec).

Step 4.) Draw the overall Bode diagram by adding up the result from step 3.

The exact response is the black line.

Asymptotic Bode Plot

$$H(s) = \frac{100\,s + 100}{s^2 + 110\,s + 1000}$$

Magnitude Plot

Legend:
- Exact Bode Plot (solid black)
- Zero Value (for reference only) (dashed yellow)
- Constant = 0.1 (-20 dB) (dashed cyan)
- Real Pole at -1e+002 (dashed blue)
- Real Pole at -10 (dashed green)
- Real Zero at -1 (dashed red)

Magnitude - dB (vertical axis: -60 to 80)
Horizontal axis: 10^{-2} to 10^4