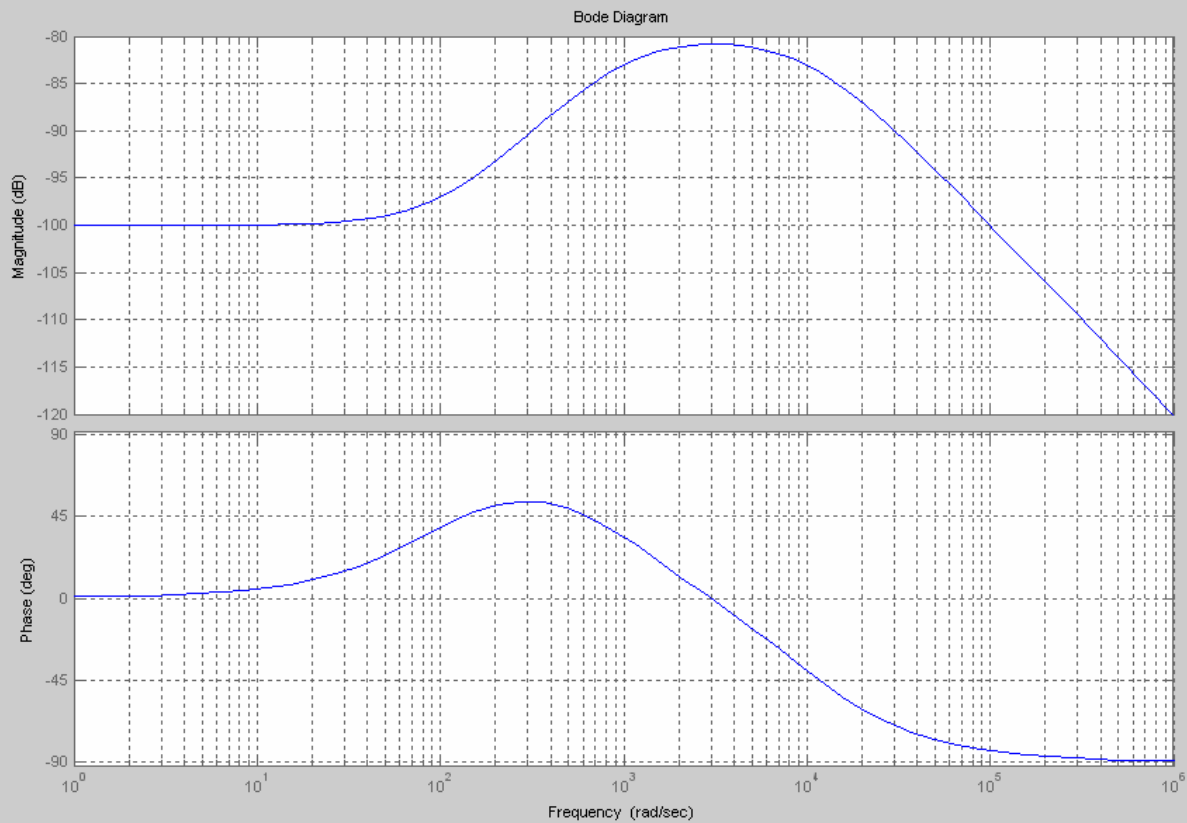


PROBLEM SESSION #1 PROBLEMS

1. Calculate Bode Plots of the following:

$$(a) H(s) = \frac{(s + 100)}{(s + 10^3)(s + 10^4)}$$

- Start value: $H(0) = 100/(10^3 \cdot 10^4) = 10^{-5} \Rightarrow 20\log_{10}(10^{-5}) = -100\text{dB}$
- Critical frequencies:
 - $\omega = 100$ – (negative zero) $\Rightarrow +20\text{dB/dec}$, $+45^\circ$ slope/dec (over 2 decades $\omega = 10 \rightarrow 1,000$)
 - $\omega = 1,000$ – (negative pole) $\Rightarrow -20\text{dB/dec}$, -45° slope/dec (over 2 decades $\omega = 100 \rightarrow 10,000$)
 - $\omega = 10,000$ – (negative pole) $\Rightarrow -20\text{dB/dec}$, -45° slope/dec (over 2 decades $\omega = 1,000 \rightarrow 100,000$)



2. Calculate the Bode plot for the following:

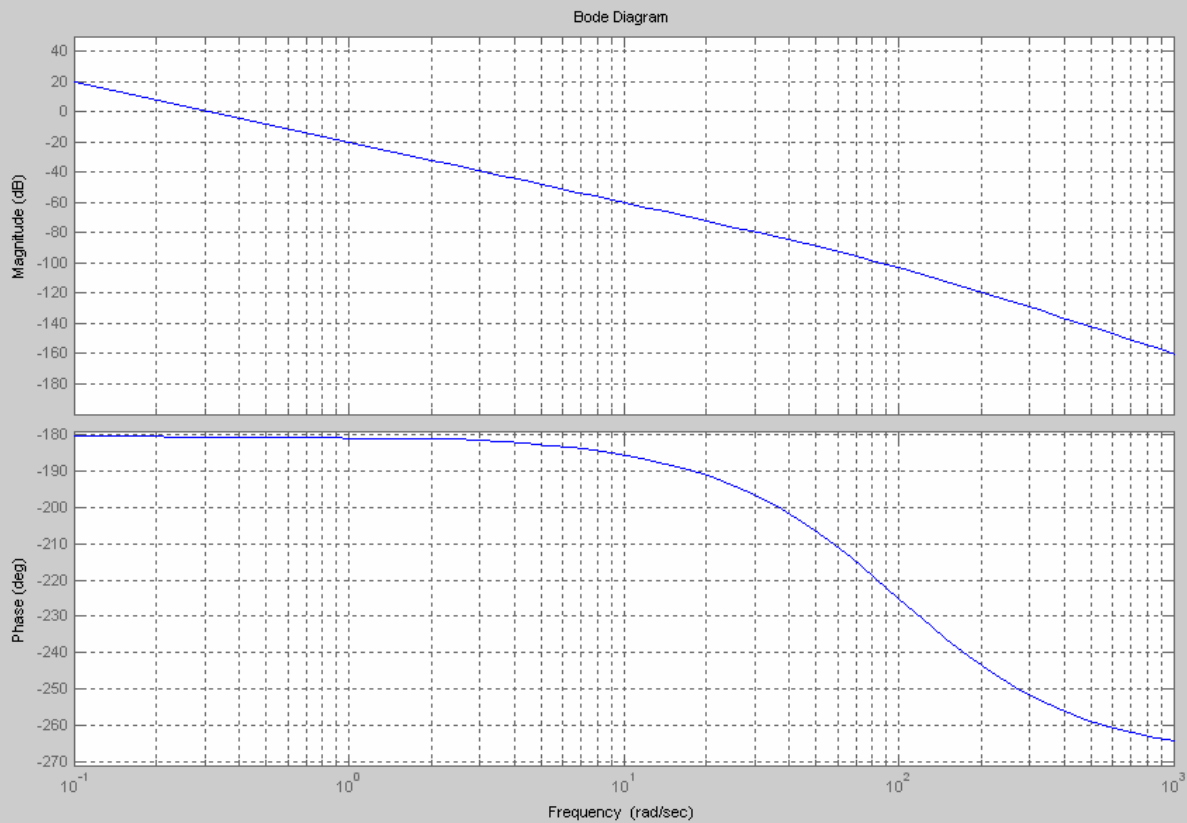
$$H(s) = \frac{10}{s^2(s+100)}$$

(a) $n=-2$ (the number of poles or zeros at the origin – 2 poles at the origin)

- gain: $K=H(s)*s^2|_{s=0} = 10/100 = .1 \Rightarrow 20\log_{10}(.1*1^{-2}) = -20\text{dB}$
 - choose $\omega_{\text{start}} = 0.1$ and you get $20\log_{10}(.1*1^{-2}) = 20\text{dB}$
- phase: $K>0, n*90^\circ = -2*90^\circ = -180^\circ$

(b) critical frequencies:

- $\omega=0$ – (pole at origin) $\Rightarrow -40\text{dB/dec}, -180^\circ$ start
- $\omega=1,00$ – (negative pole) $\Rightarrow -20\text{dB/dec}, -45^\circ$ slope/dec (over 2 decades $\omega=10 \rightarrow 1,000$)



Problem 2 – (25 points)

Sp '05

- a) Sketch the Bode (both magnitude & phase) plot for: {label your axis and show all your work}

$$H(s) = \frac{(100)(s+100)(s+10)}{(s^2)(s+10,000)}$$

- b) What is the estimated magnitude value at $\omega=1$ rad/sec:

$$K = H(0) = \frac{100(100)(10)}{10,000} = 10$$

$$\omega_{\text{start}} = 1 \quad n = -2 \quad \Rightarrow \quad 20 \log(10(1)^{-2}) = \boxed{+20\text{dB}}$$

- c) For the magnitude plot, what is the slope of the line going through $\omega=1$ rad/sec:

$$n * 20\text{dB/dec} = -40\text{dB/dec.}$$

- d) What is the estimated phase value at $\omega = 1$ rad/sec:

$$K > 0 \quad \therefore n * 90^\circ = -180 \text{ degrees}$$

- e) For the phase plot, what is the slope of the line to the left of $\omega = 1$ rad/sec:

○

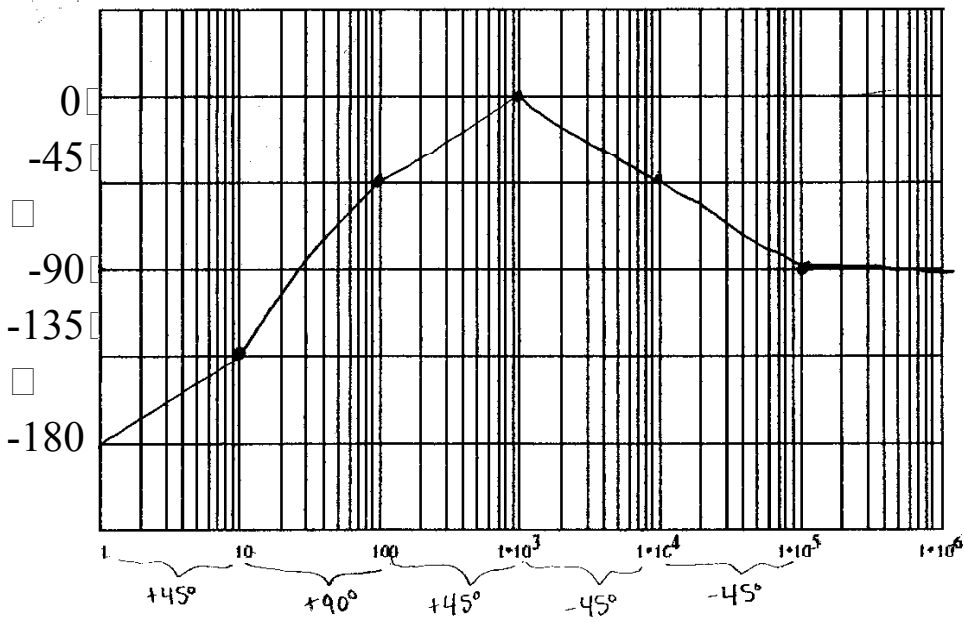
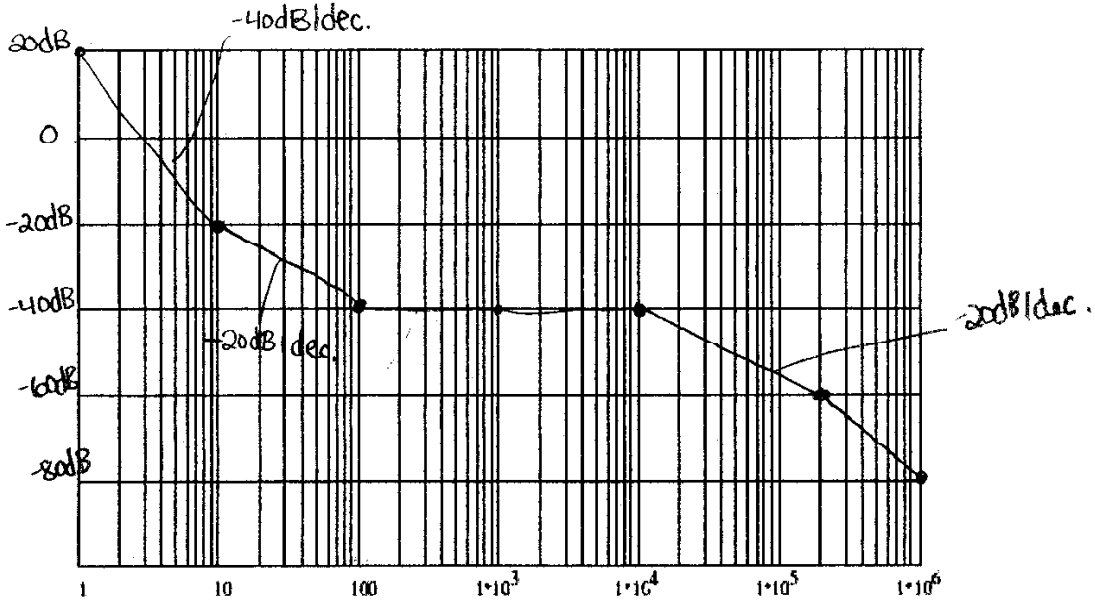
- f) For the phase plot, what is the slope of the line to the right of $\omega = 1$ rad/sec:

$$+45^\circ \text{ slope/dec.}$$

- g) List the three frequencies other than 0 where the bode plots will have a change in slope (or value):

$\omega = 10,000$ $\omega = 100$ $\omega = 10$:	neg. pole $\rightarrow \omega = 1,000 \rightarrow 100,000 : -45^\circ$ -20dB/dec.
	:	$+20 \text{ dB/dec.} \rightarrow \omega = 10 \rightarrow 1,000 : +45^\circ$
	:	$+20 \text{ dB/dec.} \rightarrow \omega = 1 \rightarrow 100 : +45^\circ$

$$H(s) = \frac{(100)(s+100)(s+10)}{(s^2)(s+10,000)}$$



NAME: _____

Solution

ECE2100

Quiz #1 Sp 05
(open book/notes)

I certify that the work below is my own.

Signature: _____

Sketch the Bode (both magnitude & phase) plot for: {label your axis}

$$H(s) = \frac{(1 \times 10^8)(s+10)}{(s+(1 \times 10^4))(s+(1 \times 10^5))}$$

(+20dB/dec. -20dB/dec.)

$$H(0) = \frac{(1 \times 10^8)(10)}{(1 \times 10^4)(1 \times 10^5)} = 1$$

$$20 \log_{10}(1) = 0 \text{ dB}$$

$$\text{phase} \Rightarrow 0^\circ$$

critical frequencies:

$\omega = 10$: +20dB/dec
+45° slope/dec
(over 2 decades)

$\omega = 1 \times 10^4$: -20dB/dec.
-45° slope/dec.
(over 2 decades)

$\omega = 1 \times 10^5$: -20dB/dec.
-45° slope/dec.
(over 2 decades)

