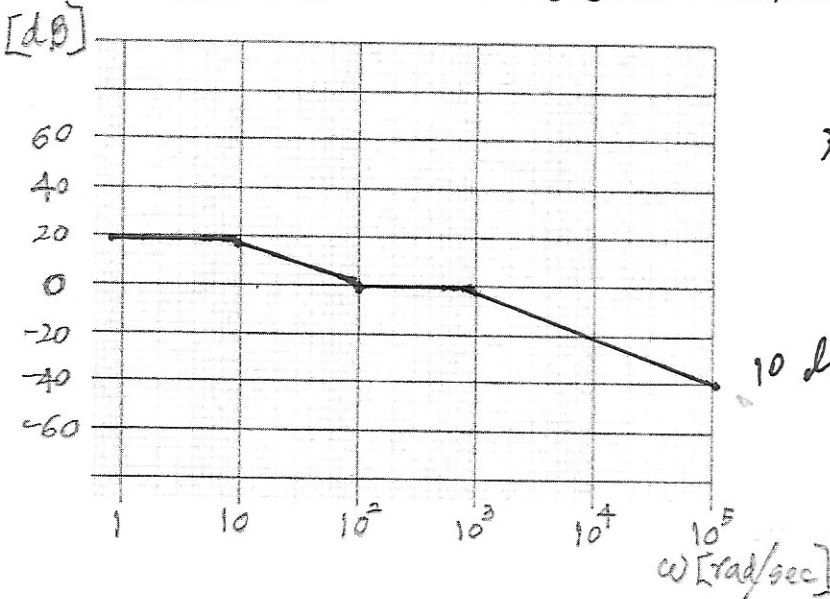


Solution  
ECE103 Quiz 6, November 14, 2018

Name \_\_\_\_\_ Student ID No. \_\_\_\_\_

This quiz tests your understanding of Bode plot and its relationship with the system/transfer function  $H(\omega)$ .

Part 1 (5 points): For  $H(s) = 1000 (s+100) / [(s+10)(s+1000)]$ , draw its Bode Plot for  $10 \log_{10} |H(\omega)|^2$  vs.  $\omega$  for  $\omega$  ranging from 1 to 10,000 rad/second.



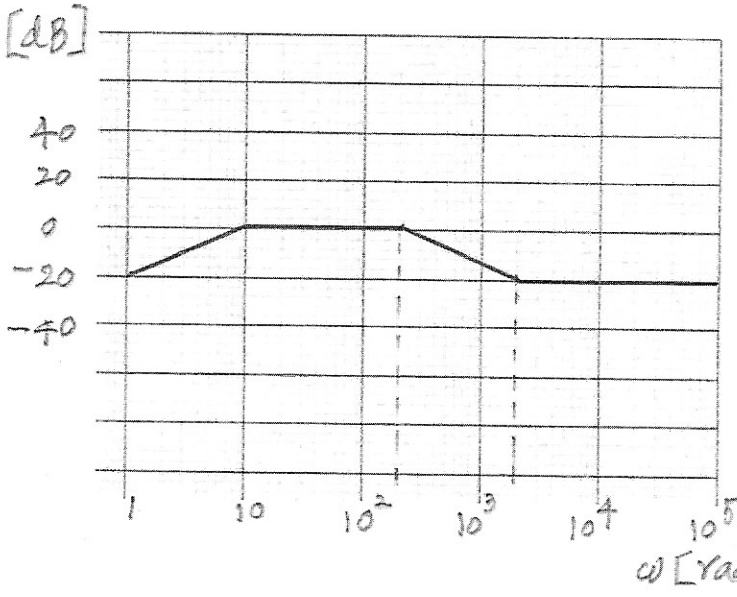
$$20 \log_{10} |H(\omega)|^2 = 20 \log_{10} |H(\omega)|$$

$$H(\omega) = 1000 \frac{(100 + \frac{s}{100})}{10(1 + \frac{s}{10}) 1000(1 + \frac{s}{1000})} \quad s = j\omega$$

$$= 10 \frac{(1 + \frac{j\omega}{100})}{(1 + \frac{j\omega}{10})(1 + \frac{j\omega}{1000})}$$

$$20 \log_{10} |H(\omega)| = 20 \log_{10} 10 + 20 \log_{10} |1 + \frac{j\omega}{100}| - 20 \log_{10} |1 + \frac{j\omega}{10}| - 20 \log_{10} |1 + \frac{j\omega}{1000}|$$

Part 2 (5 points) For the Bode plot of  $10 \log_{10} |H(\omega)|^2$  vs.  $\omega$ .



From the Bode plot

$$H(\omega) = 0.1 \frac{(1 + j\omega/1)(1 + j\omega/2000)}{(1 + j\omega/10)(1 + j\omega/200)}$$

$$\angle H(\omega) = 0^\circ + \angle 1 + j100 + \angle 1 + j\frac{100}{2000} - \angle 1 + j10 - \angle 1 + j\frac{1}{2}$$

From the table

$$0^\circ + 89.43^\circ + 2.86^\circ - 84.29^\circ - 25.57^\circ = -17.57^\circ$$

Thus

$$y(t) = 1 \sin(100t - 17.57^\circ)$$

Find  $y(t) = x(t) * h(t)$  for  $x(t) = \sin 100t$ . Use the following information for phase angle calculation.

$$Y(\omega) = H(\omega) X(\omega)$$

$$|Y(\omega)| = |H(\omega)| |X(\omega)|$$

$$\angle Y(\omega) = \angle H(\omega) + \angle X(\omega) = -17.57^\circ + 0^\circ$$

(4/5)