Chapter 4: Fast Bode Magnitude Plotting

4.1C   Quickly sketch the Bode magnitude plot for each of the following transfer functions:

$$G(\omega) = \frac{\omega + 20\,j\omega^2}{3\,j\omega^2 + 1}, \quad H(\omega) = \frac{(j\omega - 20)(6\omega^2 - 11\,j\omega + 8)}{-j\omega^2 - 5}, \quad N(\omega) = \frac{15\,j + 1}{\omega^2} + \frac{1}{\omega}$$

Clearly label all slopes in dB/decade and the magnitude of the function at some frequency (preferably, if possible, at $\omega = 0$) in dB. Compare the sketch with a more accurate computer-generated plot.

4.2C   Repeat Problem 4.1 for the following functions:

$$M(\omega) = \frac{2\,j - 20\,j\omega^2}{\omega(\omega^2 + 12\,j)}, \quad K(\omega) = \frac{\omega(3\omega^2 - 11\omega + 8\,j)}{-2\omega^2 + 5\,j}, \quad P(\omega) = \frac{j + 15}{\omega^4}$$

4.3   Using the nontransform test provided in this chapter, which of the functions given in Problem 4.1 are not representing a real system?

4.4   Using the nontransform test provided in this chapter, which of the functions given in Problem 4.2 are not representing a real system?

4.5   Sketch the time function and the Bode magnitude plot of the corresponding Fourier Transform for the following function:

$$x(t) = t\exp(-\alpha t)u(t) \iff X(f) = \left(\frac{1}{\alpha + j2\pi f}\right)^2$$

4.6   Sketch the time function and the Bode magnitude plot of the corresponding Fourier Transform for the following function:

$$x(t) = \exp(-\alpha|t|)u(t) \iff X(f) = \frac{2\alpha}{\alpha^2 + (2\pi f)^2}$$

4.7   For the Bode magnitude plot shown in Figure 1, determine expressions for the magnitude of the spectrum for all frequencies. If this plot is representing the gain of a system, at what frequency is the gain unity?

Figure 1

4.8   For the Bode magnitude plot shown in Figure 2, determine expressions for the magnitude of the spectrum for all frequencies. If this plot is representing the gain of a system, at what frequency is the gain unity?
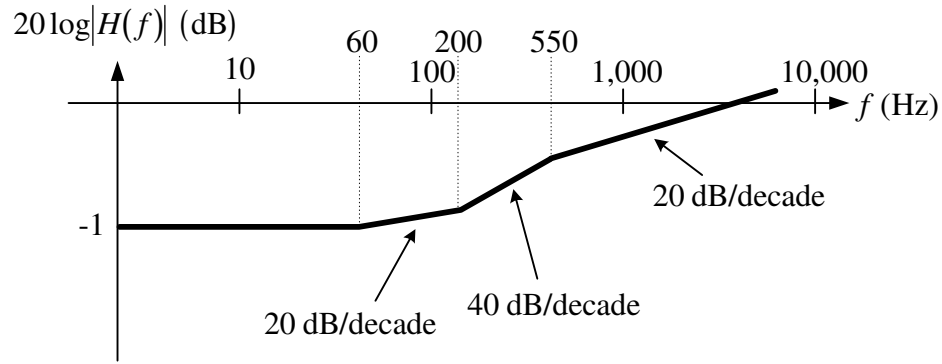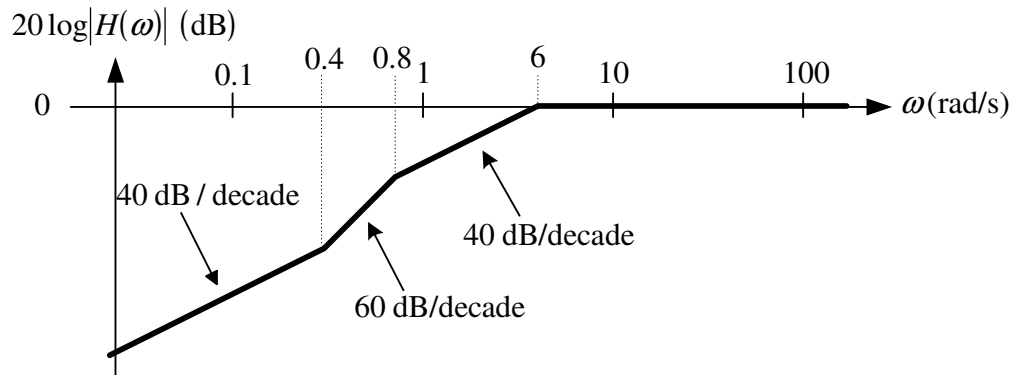

Figure 2

4.9C   For the Bode magnitude plot given in Figure 1, determine an expression for the $H(f)$. Check the expression using a numerical package. Can other functions have the same magnitude plot?

4.10C   For the Bode magnitude plot given in Figure 2, determine an expression for the $H(\omega)$. Check the expression using a numerical package. Can other functions have the same magnitude plot?

4.11   For Bode magnitude plot #X (to be provided by your instructor) provide one possible transfer function. The variables n and m can be equal to 20, 40, or 60.

1	$20\log(A)$ $-n$ dB/dec. $-m$ dB/dec. ω_1 ω_2	7	20 dB/dec. $20\log(A)$ ω_1 ω_2
2	$20\log(A)$ $-n$ dB/dec. ω_1	8	$-n$ dB/dec. $20\log(A)$ ω_1 ω_2
3	m dB/dec. $20\log(A)$ n dB/dec. ω_1 ω_2	9	n dB/dec. $-m$ dB/dec. ω_1 ω_2
4	$-n$ dB/dec. ω_1 ω_2 m dB/dec.	10	$20\log(A)$ $-n$ dB/dec. ω_1 ω_2
5	n dB/dec. $20\log(A)$ ω_1	11	$-n$ dB/dec. $20\log(A)$ ω_1
6	$-n$ dB/dec. $-m$ dB/dec. ω_1 ω_2	12	$20\log(A)$ n dB/dec. ω_1