

- The Magnitude-Phase Representation of the Fourier Transform
- The Magnitude-Phase Representation of Frequency Response of LTI Systems (p. 427)
- Time-Domain Properties of Ideal Frequency-Selective Filters
- Time-Domain and Frequency-Domain Aspects of Non-ideal Filters (p. 448)
- 1st-Order & 2nd-Order Continuous-Time Systems
- 1st-Order & 2nd-Order Discrete-Time Systems
- Time- & Frequency-Domain Analysis of Systems

6.1: CT $H(j\omega)$ Output

6.1. Consider a continuous-time LTI system with frequency response $H(j\omega) = |H(j\omega)| e^{j\angle H(j\omega)}$ and real impulse response $h(t)$. Suppose that we apply an input $x(t) = \cos(\omega_0 t + \phi_0)$ to this system. The resulting output can be shown to be of the form

$$y(t) = Ax(t - t_0),$$

where A is a nonnegative real number representing an *amplitude-scaling* factor and t_0 is a time delay.

- (a) Express A in terms of $|H(j\omega_0)|$.
- (b) Express t_0 in terms of $\angle H(j\omega_0)$.

6.2: DT $H(e^{j\omega})$ Output

6.2. Consider a discrete-time LTI system with frequency response $H(e^{j\omega}) = |H(e^{j\omega})|e^{j\angle H(e^{j\omega})}$ and real impulse response $h[n]$. Suppose that we apply the input $x[n] = \sin(\omega_0 n + \phi_0)$ to this system. The resulting output can be shown to be of the form

$$y[n] = |H(e^{j\omega_0})|x[n - n_0],$$

provided that $\angle H(e^{j\omega_0})$ and ω_0 are related in a particular way. Determine this relationship.

6.11: CT 2nd Bode Plot

6.11. For each second-order system whose frequency response is as follows, specify the straight-line approximation of the Bode magnitude plot:

(a) $\frac{250}{(j\omega)^2 + 50.5j\omega + 25}$ (b) $0.02 \frac{j\omega + 50}{(j\omega)^2 + 0.2j\omega + 1}$

6.12: CT Bode Plot

6.12. A continuous-time LTI system S with frequency response $H(j\omega)$ is constructed by cascading two continuous-time LTI systems with frequency responses $H_1(j\omega)$ and $H_2(j\omega)$, respectively. Figures P6.12(a) and P6.12(b) show the straight-line approximations of the Bode magnitude plots of $H_1(j\omega)$ and $H(j\omega)$, respectively. Specify $H_2(j\omega)$.

