

Figure 7.4 Exact recovery of a continuous-time signal from its samples using an ideal lowpass filter: (a) system for sampling and reconstruction; (b) representative spectrum for $x(t)$; (c) corresponding spectrum for $x_p(t)$; (d) ideal lowpass filter to recover $X(j\omega)$ from $X_p(j\omega)$; (e) spectrum of $x_r(t)$.

The frequency $2\omega_M$, which, under the sampling theorem, must be exceeded by the sampling frequency, is commonly referred to as the *Nyquist rate*.²

As discussed in Chapter 6, ideal filters are generally not used in practice for a variety of reasons. In any practical application, the ideal lowpass filter in Figure 7.4 would be

²The frequency ω_M corresponding to one-half the Nyquist rate is often referred to as the *Nyquist frequency*.

continued (c) spectrum with $\omega_s > 2\omega_M$; sampled signal with

less than $\omega_s - \omega_M$, sampling theorem, can be

$x(t)$ is uniquely

impulse train in the values. This in T and cutoff output signal will

variety of forms in theory," (New York: of communication on in the Presence of and D. Gabor in 1946 represent a function sion Theory," *AIEE* 26 (1946), p. 429.]

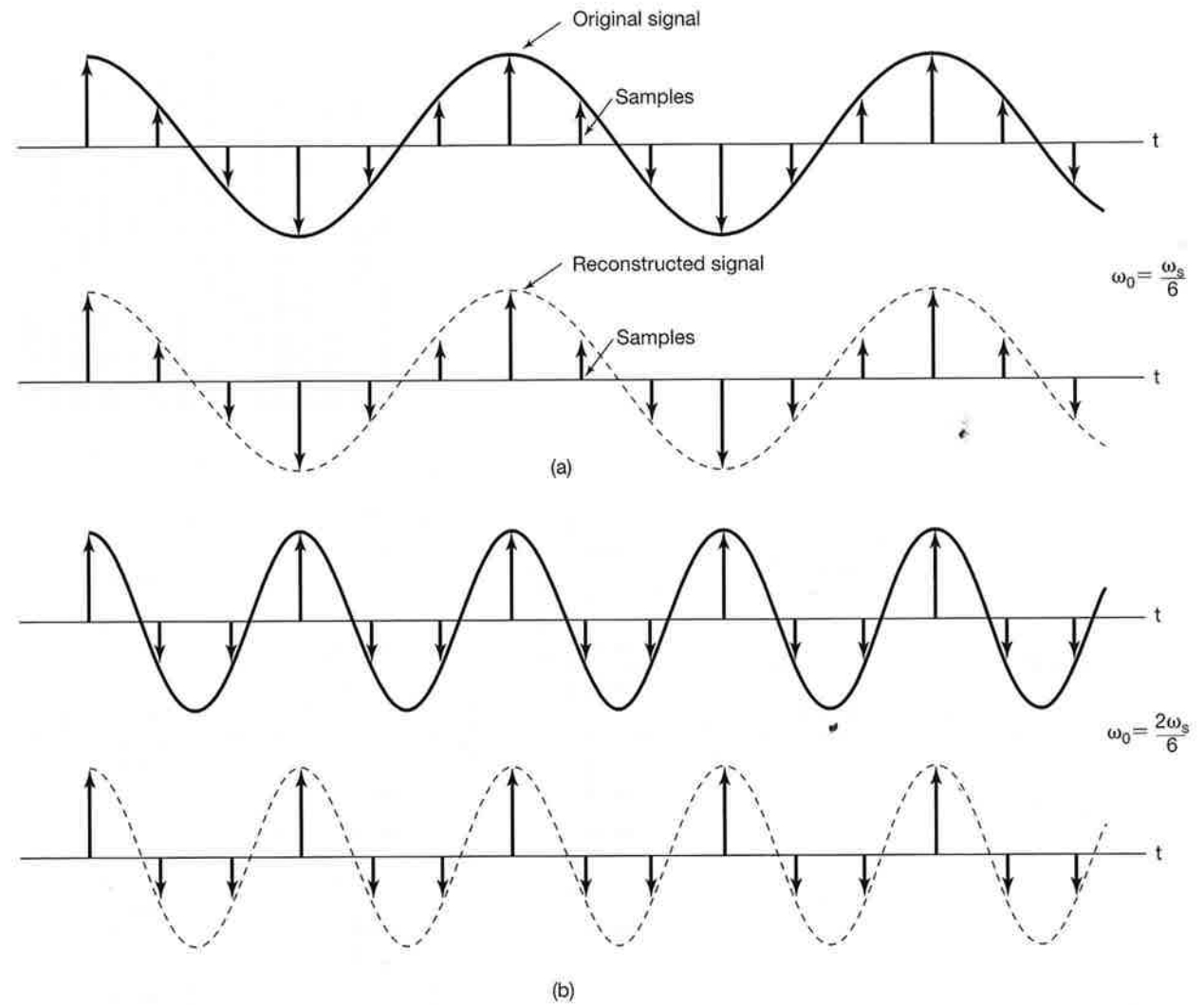


Figure 7.16 Effect of aliasing on a sinusoidal signal. For each of four values of ω_0 , the original sinusoidal signal (solid curve), its samples, and the reconstructed signal (dashed curve) are illustrated: (a) $\omega_0 = \omega_s/6$; (b) $\omega_0 = 2\omega_s/6$; (c) $\omega_0 = 4\omega_s/6$; (d) $\omega_0 = 5\omega_s/6$. In (a) and (b) no aliasing occurs, whereas in (c) and (d) there is aliasing.

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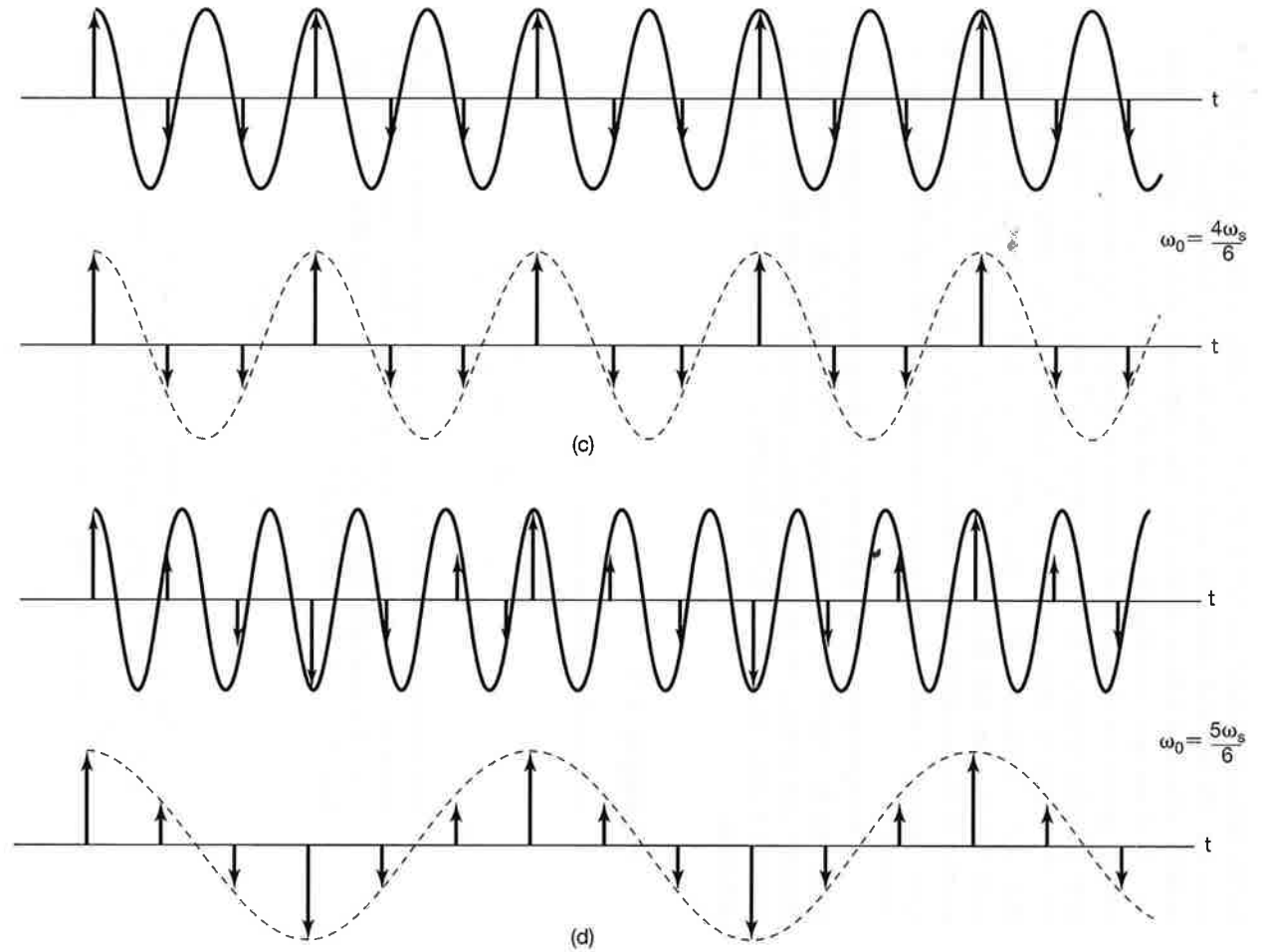


Figure 7.16 Continued