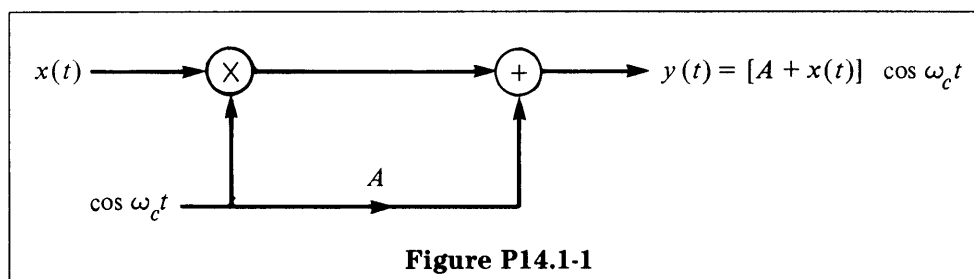


14 Demonstration of Amplitude Modulation

Recommended Problems

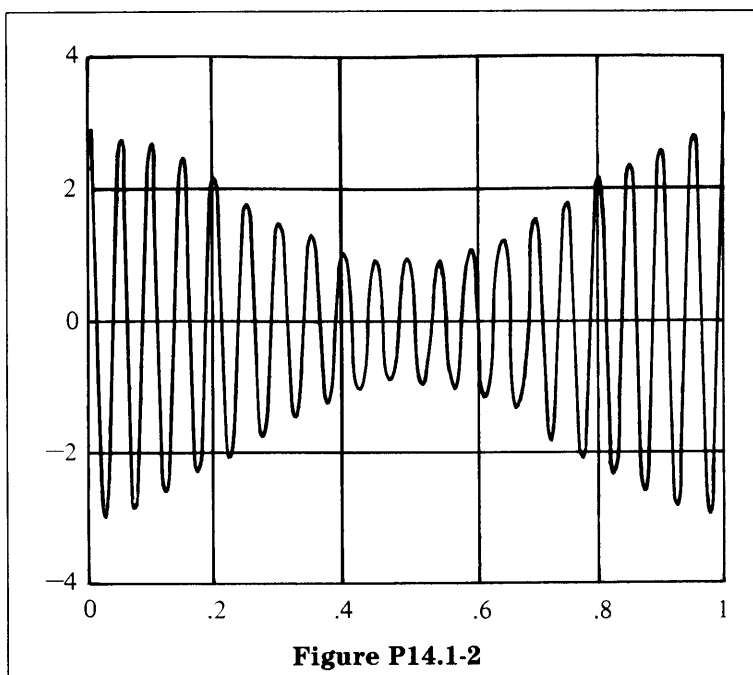
P14.1

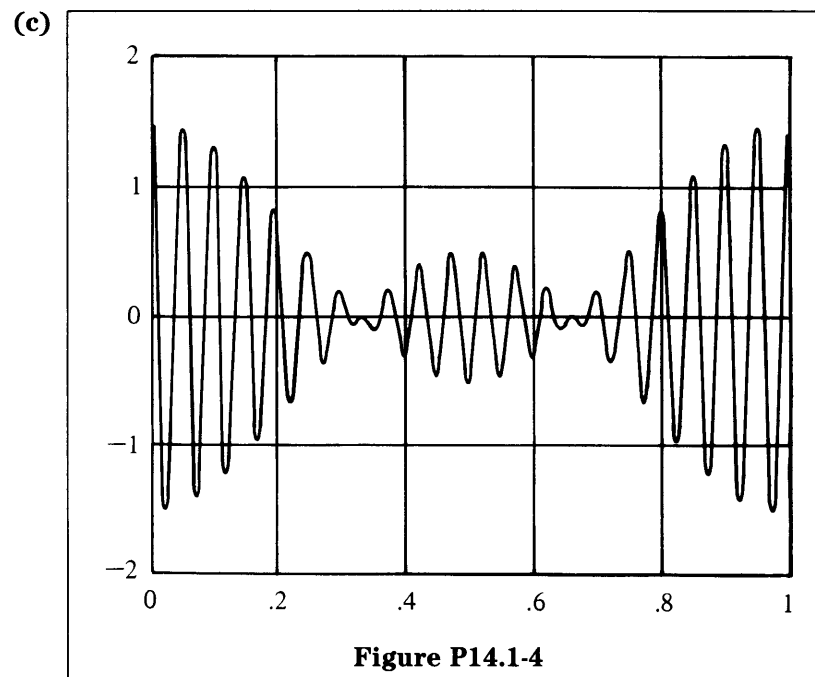
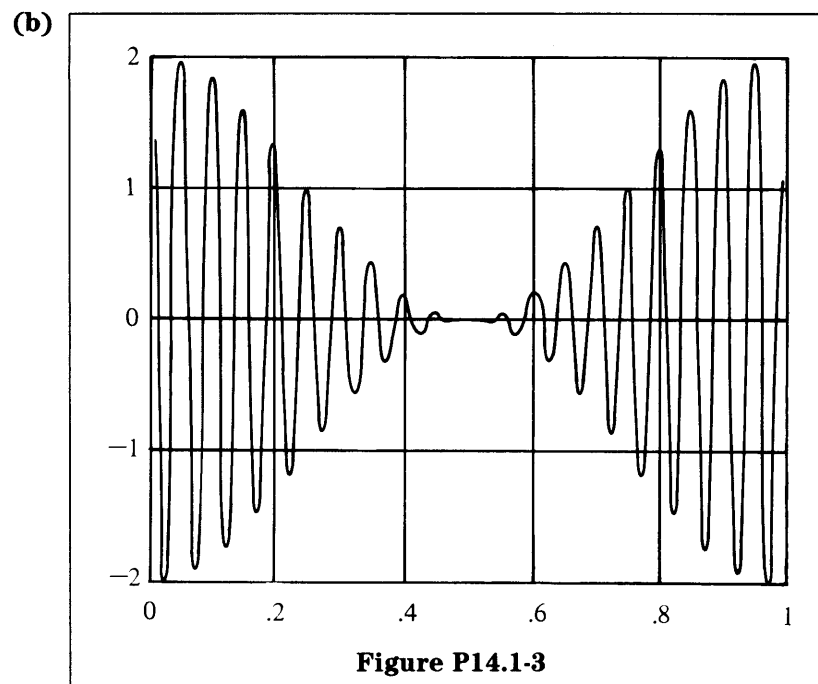
Consider the AM modulation system in Figure P14.1-1.



K/A is called the modulation index, where K is the maximum amplitude of $x(t)$. Parts (a)–(c) contain plots of $y(t)$ versus t for several different modulation indices, with $x(t) = B \cos \omega_0 t$. Find the modulation index for each signal.

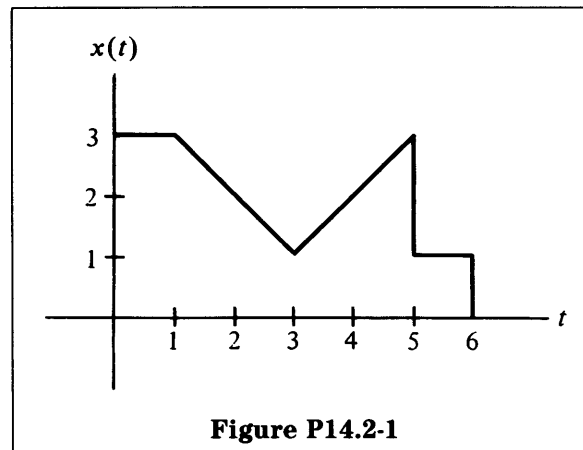
(a)



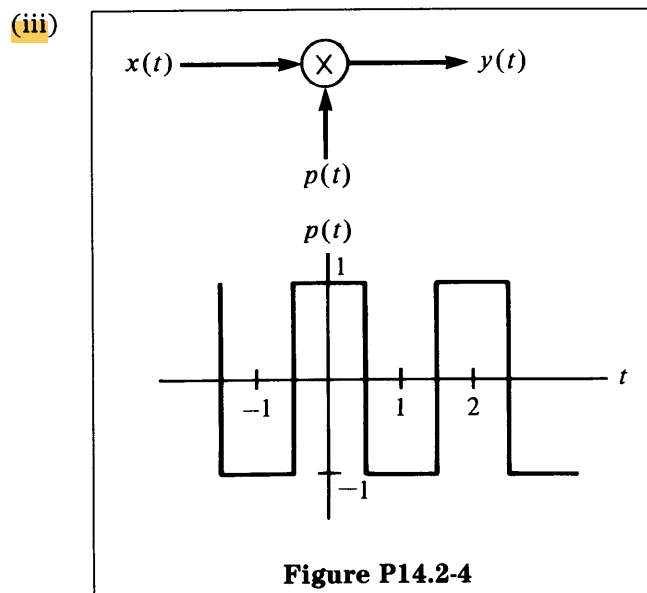
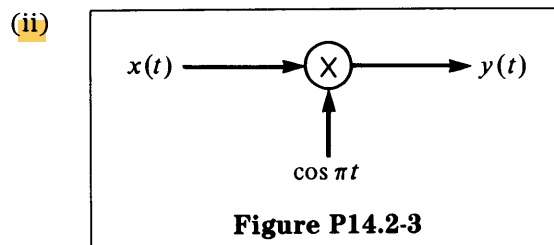
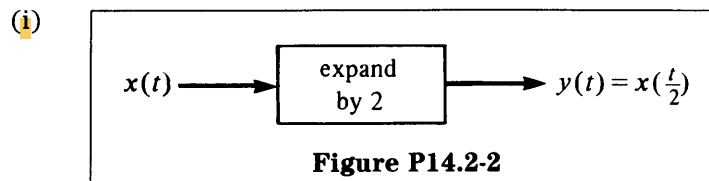


P14.2

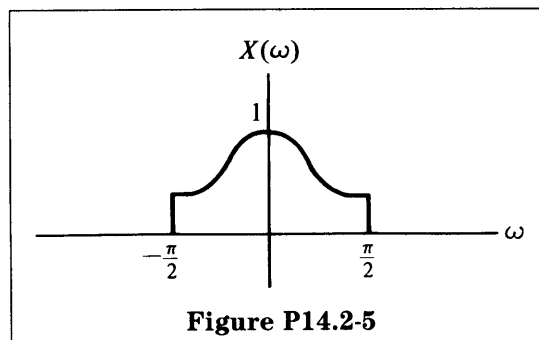
- (a) Consider the signal $x(t)$ in Figure P14.2-1.



Draw $y(t)$ for each of the following systems.

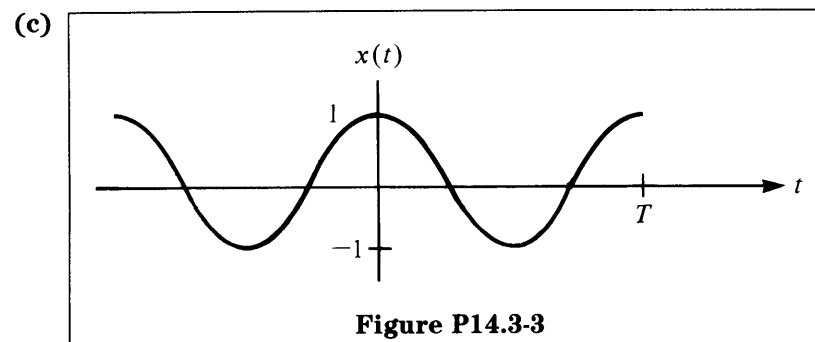
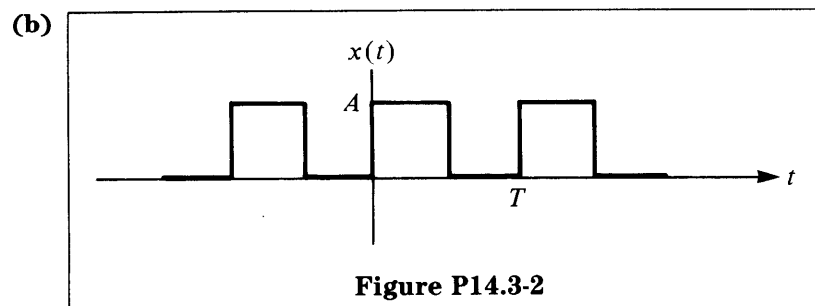
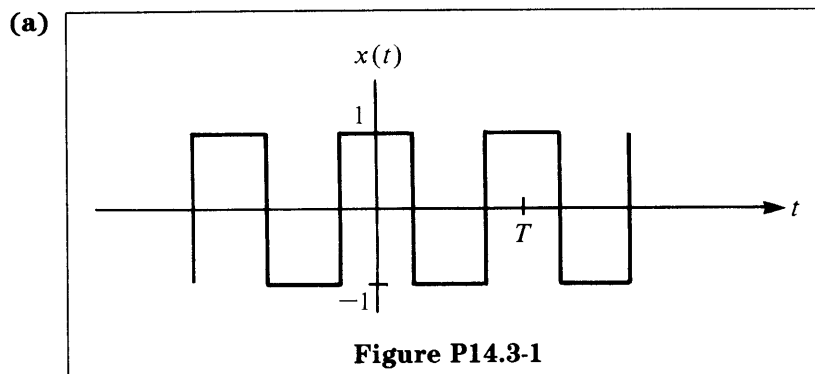


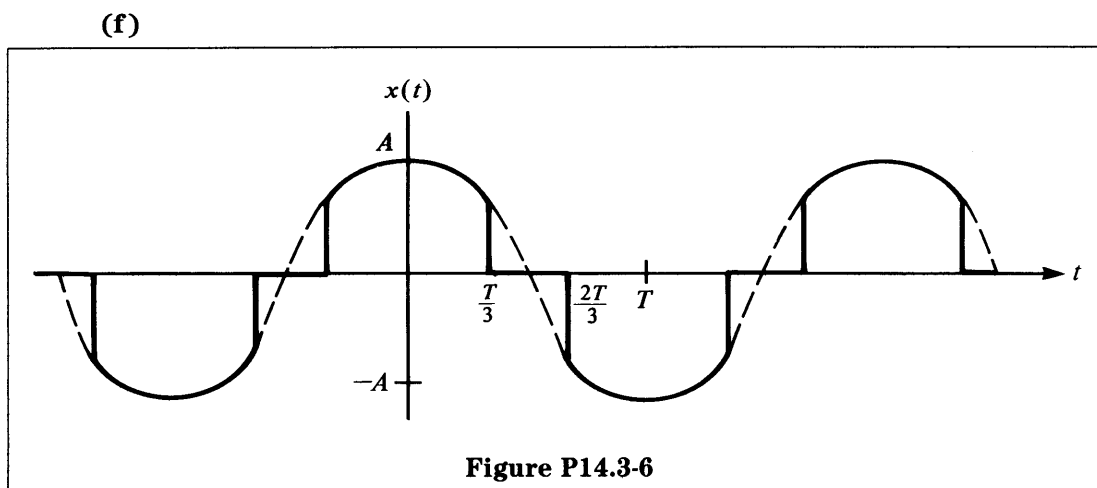
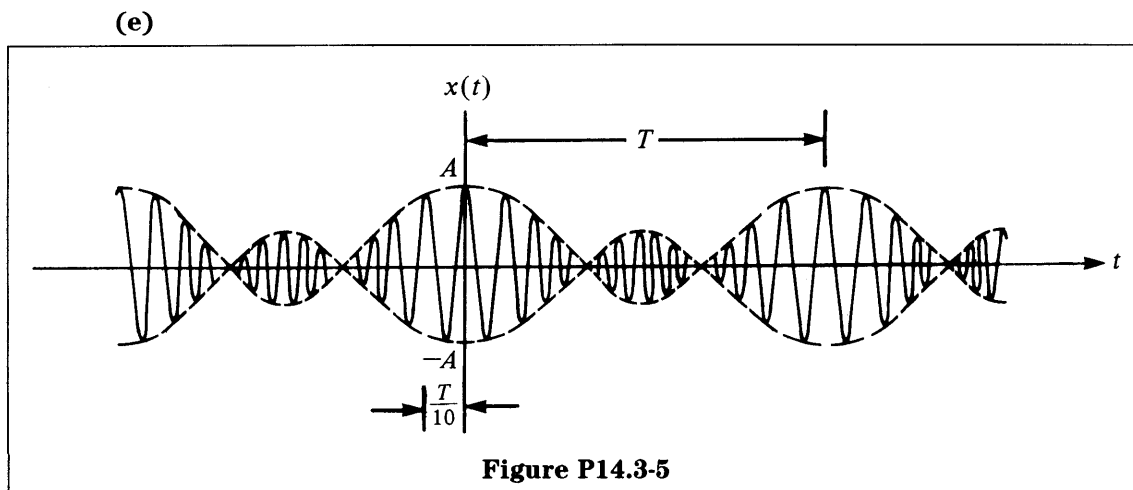
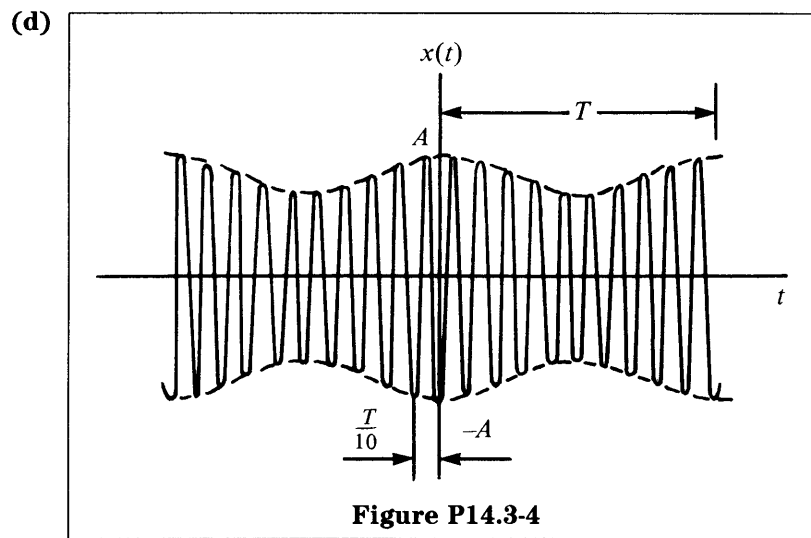
- (b) Suppose that $x(t)$ has the Fourier transform shown in Figure P14.2-5. Find $Y(\omega)$ for each case in part (a).



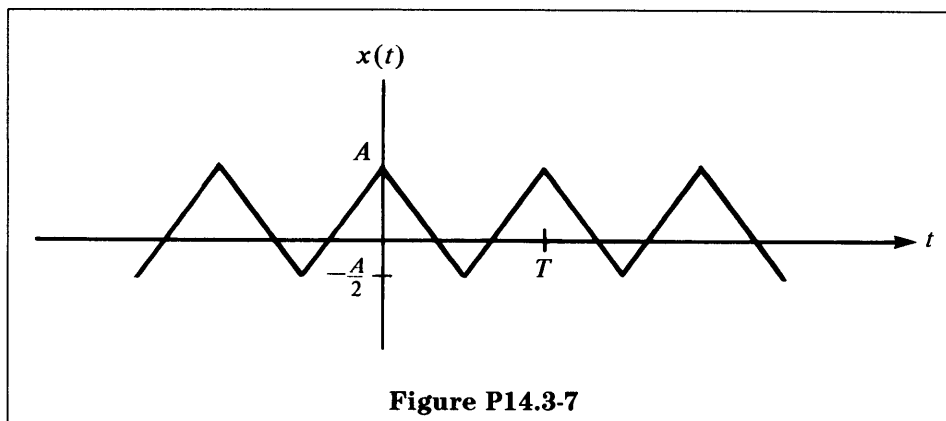
P14.3

For each of the time waveforms (a)–(j) (Figures P14.3-1 to P14.3-10), match its possible spectrum (i)–(x) (Figures P14.3-11 to P14.3-20).

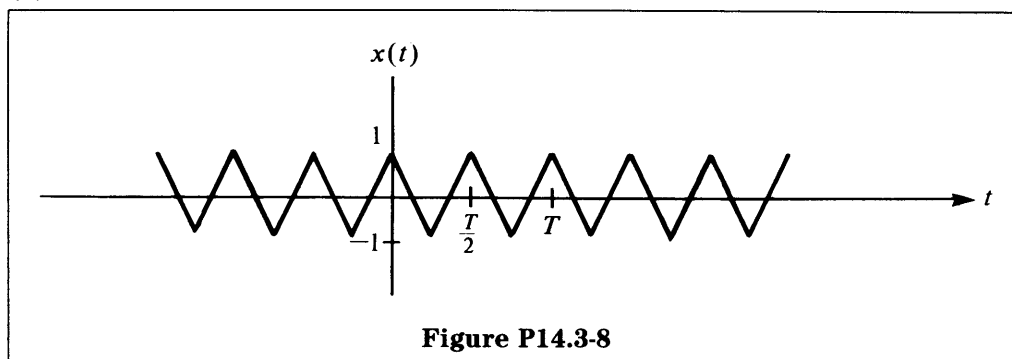




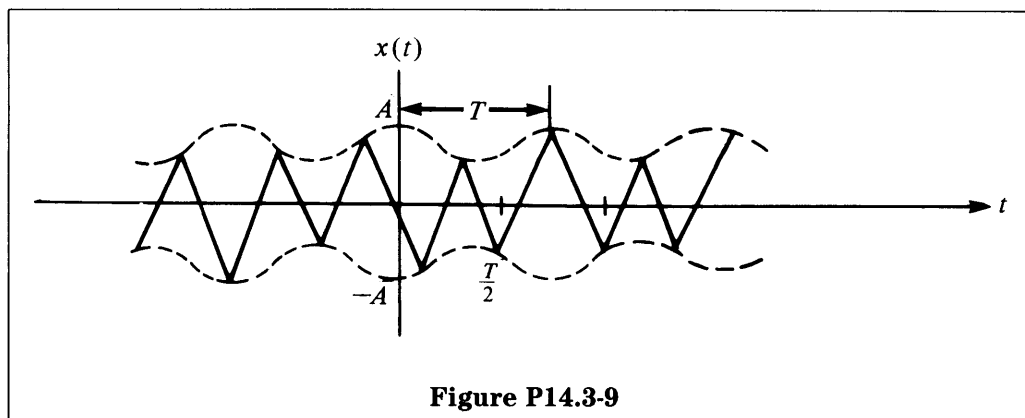
(g)



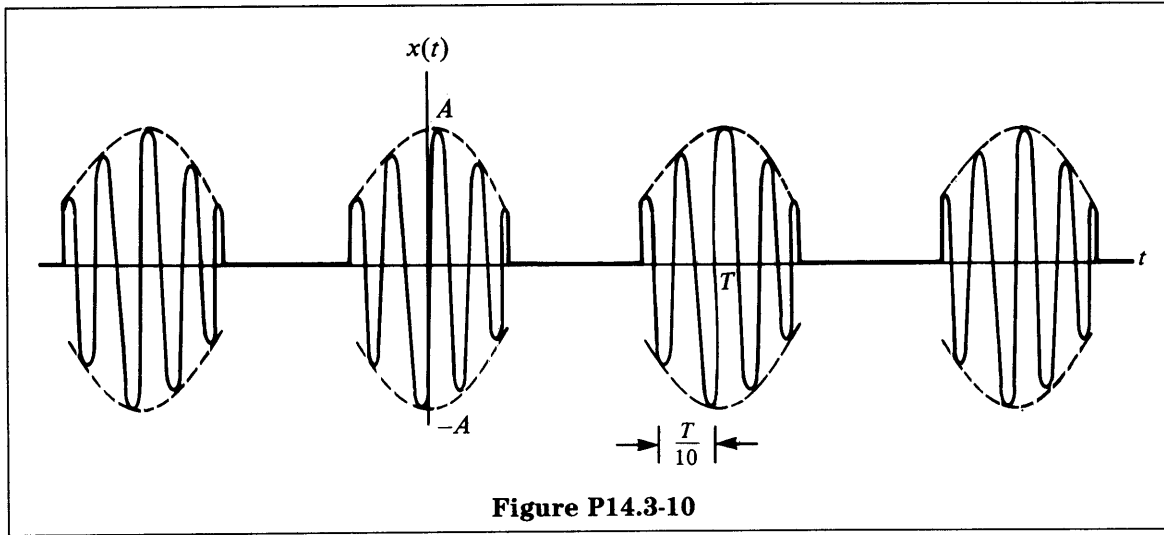
(h)



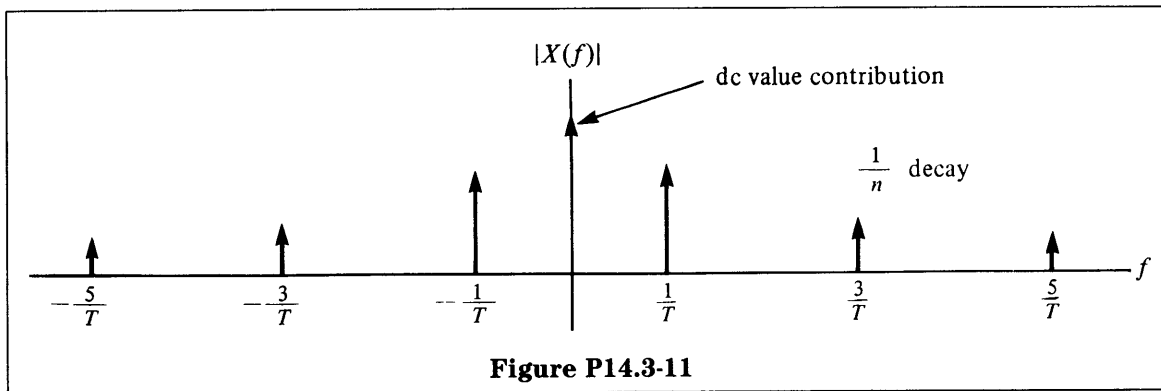
(i)



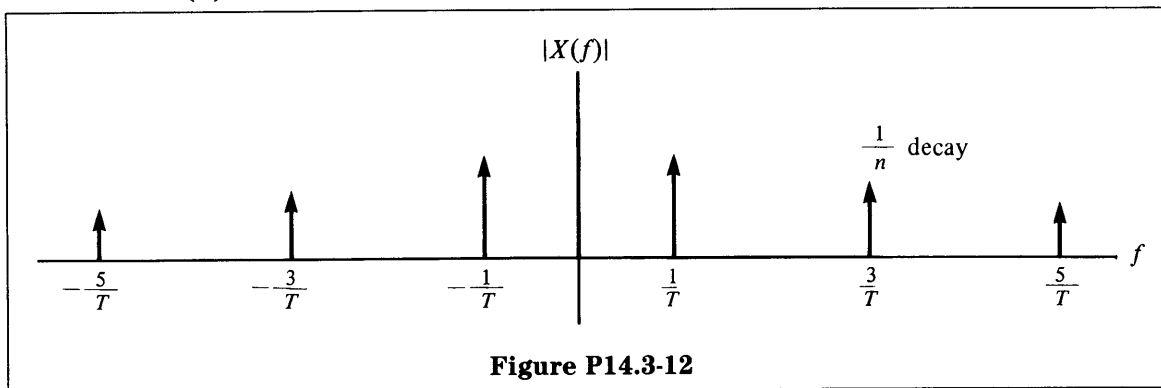
(j)



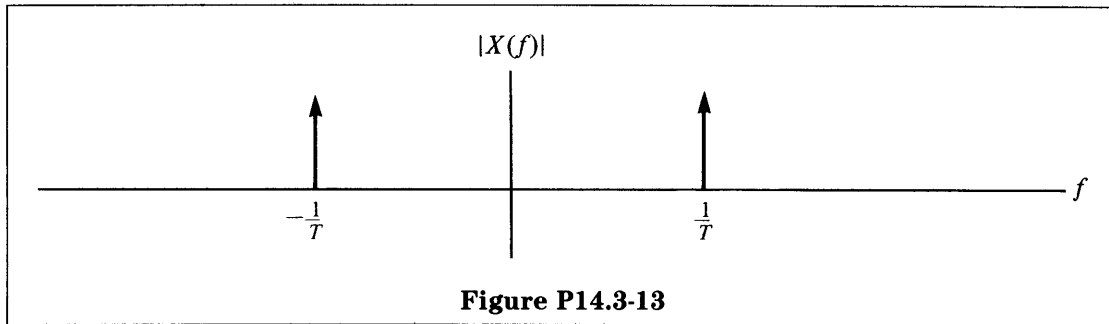
(i)



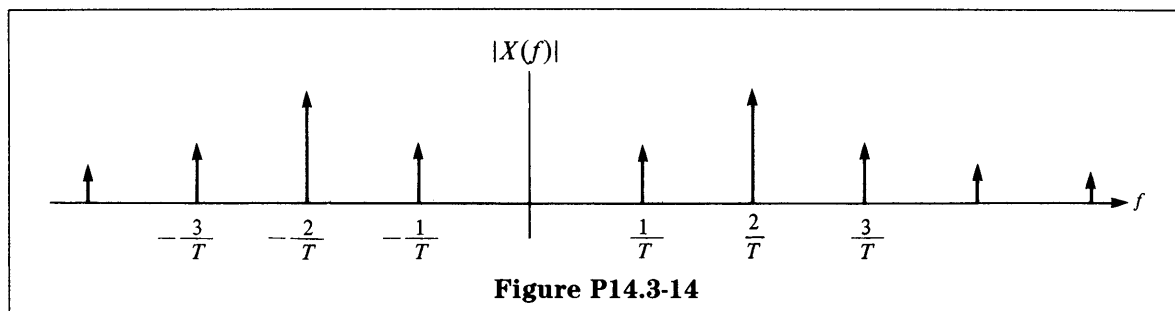
(ii)



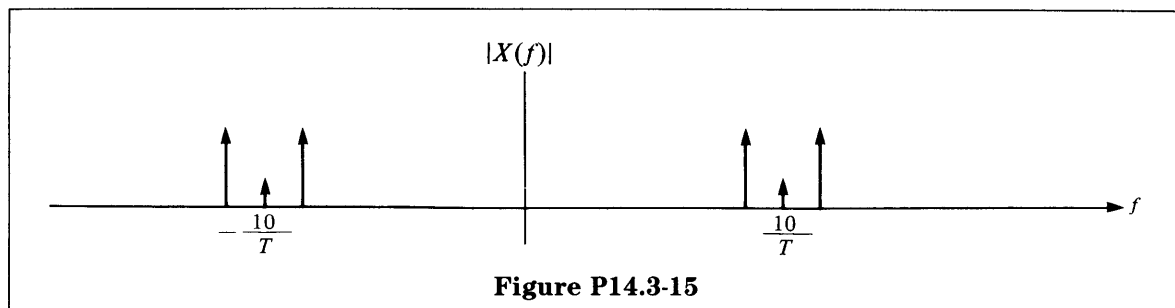
(iii)



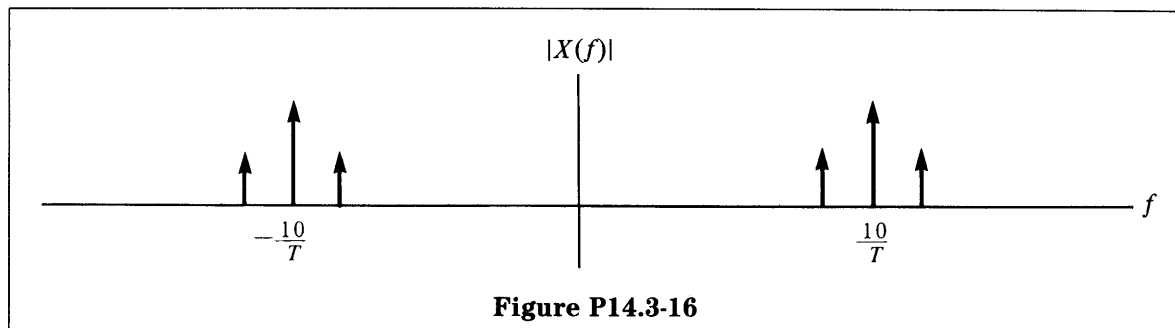
(iv)



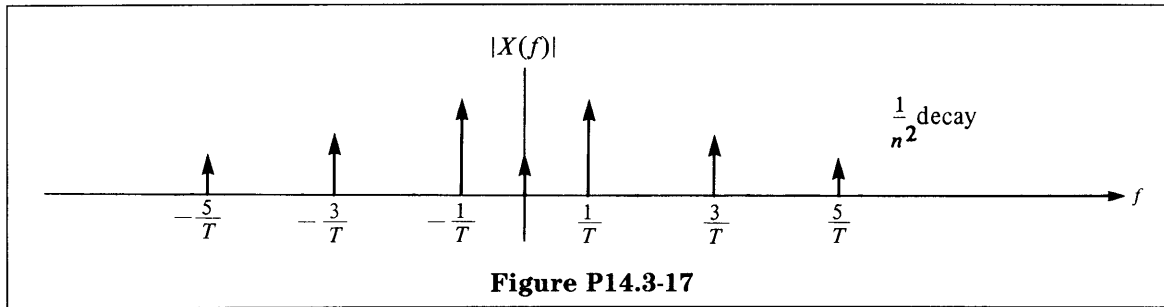
(v)



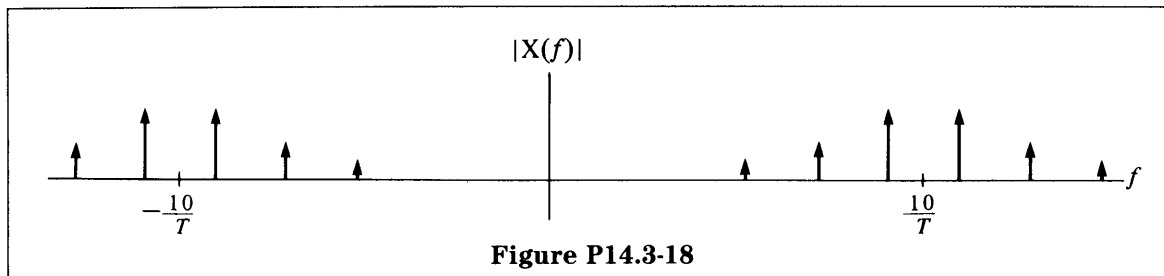
(vi)



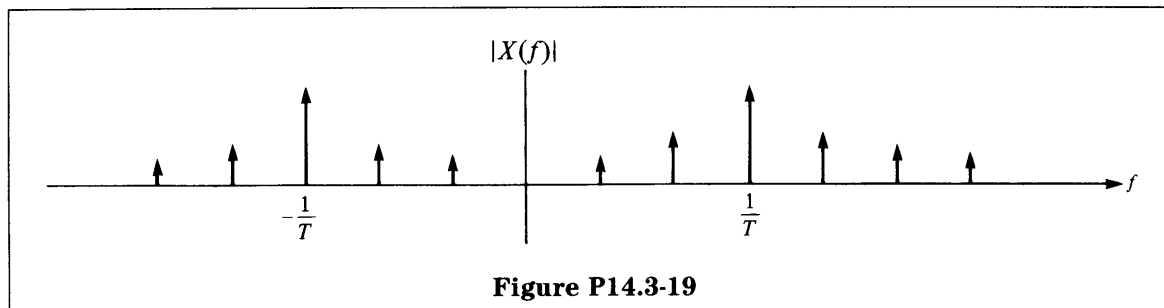
(vii)



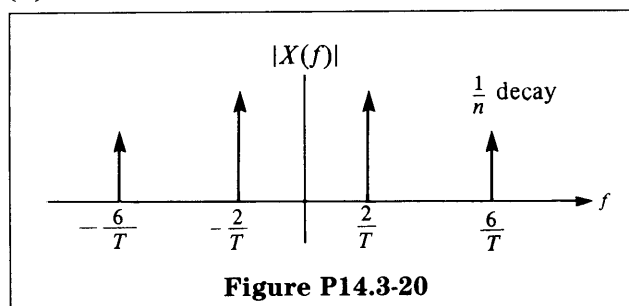
(viii)



(ix)



(x)



P14.4

The spectrum analyzer discussed in the lecture computed the estimate of the magnitude of the Fourier transform of $x_s(t)$ by taking samples of $x_s(t)$ at equally spaced intervals T , stopping after N samples, and computing the discrete-time Fourier transform of the N -point sequence.

Thus,

$$X(\Omega) = \sum_{n=0}^{N-1} x[n]e^{-j\Omega n}, \quad \text{where } x[n] = x_s(nT)$$

- (a) Suppose $x_s(t) = \cos \omega_0 t$. Find and sketch $|X(\Omega)|$.
- (b) In any practical system, $X(\Omega)$ can be explicitly calculated only at a finite set of Ω . A common choice is

$$\omega_k = \frac{2\pi k}{N} \quad \text{for } K = 0, \dots, N-1$$

For the following situations, sketch

$$\left| X\left(\frac{2\pi k}{N}\right) \right| \quad \text{for } K = 0, \dots, N-1$$

if $x_s(t) = \cos \omega_0 t$.

(i) $N = 5, \quad \omega_0 = \frac{2\pi}{T} \left(\frac{2}{5}\right)$

(ii) $N = 5, \quad \omega_0 = \frac{2\pi}{T} \left(\frac{3}{10}\right)$

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