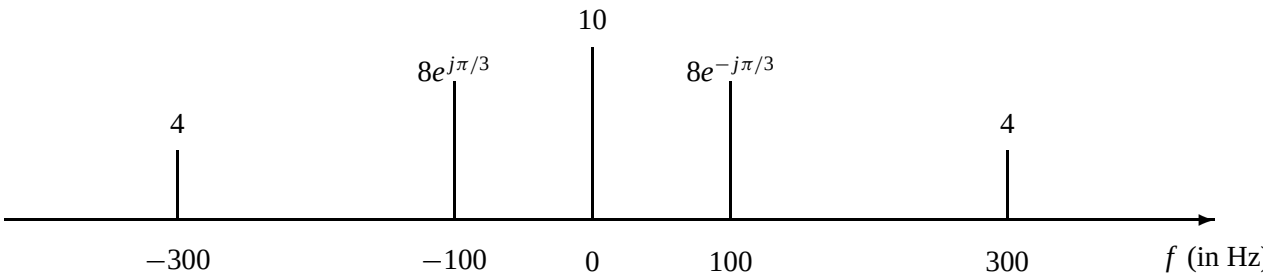
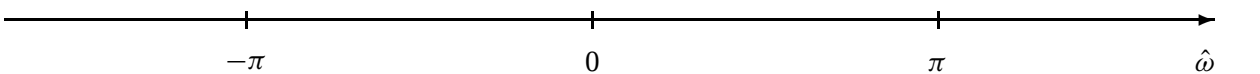
PROBLEM:

A signal $x(t)$ has the two-sided spectrum representation shown below.



(a) Write an equation for $x(t)$.

(b) The signal $x(t)$ is sampled with sampling frequency $f_s = 300 = 1/T$ samples/second to obtain the discrete-time signal $x[n] = x(nT)$. Write an equation for $x[n]$ and plot the spectrum of $x[n]$ for normalized frequencies $-\pi \leq \hat{\omega} \leq \pi$.



McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458.

SOLUTION

(a) Add the five components together

$$x(t) = 4e^{+j2\pi(-300)t} + 8e^{j\pi/3}e^{j2\pi(-100)t} + 10 + 8e^{-j\pi/3}e^{j2\pi(100)t} + 4e^{j2\pi(300)t}$$

$$x(t) = 10 + 16\cos(2\pi(100)t - \pi/3) + 8\cos(2\pi(300)t)$$

(b) $F_s = 1/T_s = 300$ samples/sec

$$x[n] = x(nT_s) = x(n/F_s) = x(n/300)$$

$$x[n] = 10 + 16\cos\left(2\pi(100)\frac{n}{300} - \pi/3\right) + 8\cos\left(2\pi(300)\frac{n}{300}\right)$$

$$= 10 + 16\cos\left(\frac{2\pi}{3}n - \pi/3\right) + \underbrace{8\cos(2\pi n)}_{\text{EQUALS 8 FOR ALL } n.}$$