15.5 Compute the exponential Fourier series for the waveform that is the sum of the two waveforms in Fig. P15.5 by computing the exponential Fourier series of the two waveforms and adding them.

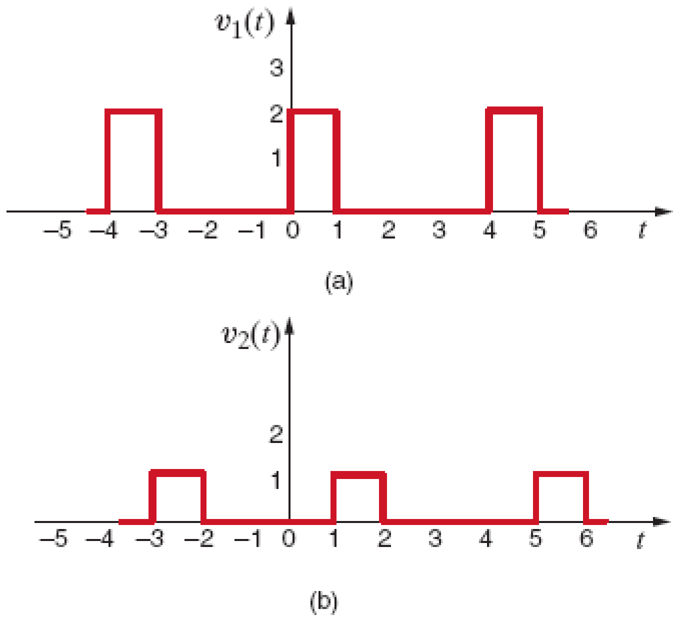

Figure P15.5

SOLUTION:

For $V_1(t)$

$T_0 = 4s$, $\omega_0 = \frac{\pi}{2}$ rad/s

$$C_{n_1} = \frac{2}{T_0}\int_0^1 e^{-jn\omega_0 t}\,dt$$

$$C_{n_1} = \frac{2}{T_0}\left[\frac{e^{-jn\omega_0 t}}{-jn\omega_0}\right]_0^1$$

$$C_{n_1} = \frac{1}{2jn\omega_0}\left[-e^{-jn\pi/2} + 1\right]$$

$$C_{n_1} = \frac{2}{jn2\pi}\left[1 - e^{-jn\pi/2}\right]$$

For $V_2(t)$

$$C_{n_2} = \frac{C_{n_1}}{2} e^{-jn\omega_0}$$

$$C_n = C_{n_1} + C_{n_2}$$

$$C_n = \frac{1}{jn2\pi}\left[2 - 2e^{-jn\pi/2} + e^{-jn\pi/2} - e^{-jn2\pi}\right]$$

$$C_n = \frac{1}{jn\pi}\left[1 - e^{-jn\,3\pi/4}\left[\frac{e^{jn\pi/4} + e^{-jn\pi/4}}{2}\right]\right]$$

$$C_n = \frac{1}{jn\pi}\left[1 - e^{-jn3\pi/4}\cos n\pi/4\right]$$

$$V(t) = \sum_{n=-\infty}^{\infty} \frac{1}{jn\pi}\left[1 - e^{-jn\frac{3\pi}{4}}\cos n\pi/4\right]e^{\frac{jn\pi t}{2}}\ \text{V}$$