

**15.1** Find the exponential Fourier series for the periodic signal shown in Fig. P15.1.

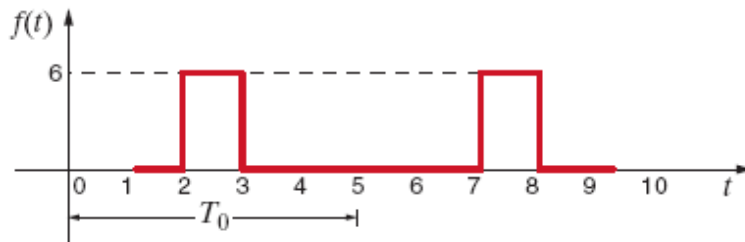


Figure P15.1

**SOLUTION:**

$$T_0 = 5 \text{ s}, \quad \omega_0 = \frac{2\pi}{5} \text{ rad/s}$$

$$C_n = \frac{1}{T_0} \int_0^{T_0} f(t) e^{-jn\omega_0 t} dt$$

$$C_n = \frac{1}{T_0} \int_2^3 6 e^{-jn\omega_0 t} dt$$

$$C_n = \frac{6}{T_0} \left[ \frac{e^{-jn\omega_0 t}}{-jn\omega_0} \right]_2^3$$

$$C_n = \frac{6}{-jn2\pi} \left[ e^{-jn\frac{6\pi}{5}} - e^{-jn\frac{2\pi}{5}} \right]$$

$$C_n = \frac{6 e^{-jn\frac{4\pi}{5}}}{jn2\pi} \left[ e^{jn\frac{2\pi}{5}} - e^{-jn\frac{2\pi}{5}} \right]$$

$$C_n = \frac{6}{n\pi} e^{-jn\frac{4\pi}{5}} \sin n\frac{2\pi}{5}$$

$$F(t) = \sum_{n=-\infty}^{\infty} \frac{6}{n\pi} e^{-jn\frac{4\pi}{5}} \sin n\frac{2\pi}{5} e^{j0.4\pi t}$$

$$C_0 = \frac{1}{T_0} \int_0^5 f(t) dt \Rightarrow \frac{1}{5} \int_2^3 6 dt$$

$$C_0 = \frac{6}{5} \left( t \Big|_2^3 \right) = \frac{6}{5} \times (3-2) = 1.2$$