EXERCISE 11.6: Substitute (11.35) into the inverse Fourier transform integral in (11.2) and show that when evaluated using the properties of the impulse function, the result is identical to (11.33).

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SOLUTION

$$X(j\omega) = \sum_{k=-\infty}^{\infty} 2\pi a_k \,\delta(\omega - k\omega_0)$$

Take the inverse Fourier transform:

$$x(t) = \frac{1}{2\pi}\int_{-\infty}^{\infty} X(j\omega)\, e^{j\omega t}\, d\omega$$

$$= \frac{1}{2\pi}\int_{-\infty}^{\infty} \sum_{k=-\infty}^{\infty} 2\pi a_k\, \delta(\omega - k\omega_0)\, e^{j\omega t}\, d\omega$$

$$= \sum_{k=-\infty}^{\infty} \frac{1}{2\pi}\int_{-\infty}^{\infty} 2\pi a_k\, \delta(\omega - k\omega_0)\, e^{jk\omega_0 t}\, d\omega$$

$$= \sum_{k=-\infty}^{\infty} a_k e^{jk\omega_0 t} \underbrace{\int_{-\infty}^{\infty} \delta(\omega - k\omega_0)\, d\omega}_{=1}$$

$$= \sum_{k=-\infty}^{\infty} a_k e^{jk\omega_0 t}$$

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