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Chapter 2

2.1-1 Let us denote the signal in question by $x(t)$ and its energy by E_x . For parts (a) and (b)

$$E_x = \int_{-\infty}^{\infty} \cos^2 t \, dt = \frac{1}{2} \int_{-\infty}^{\infty} (1 + \cos 2t) \, dt = \frac{1}{2} \int_{-\infty}^{\infty} 1 \, dt + \frac{1}{2} \int_{-\infty}^{\infty} \cos 2t \, dt = \infty + 0 = \infty$$

(a) $E_x = \int_{-\infty}^{\infty} \cos^2 t \, dt = \frac{1}{2} \int_{-\infty}^{\infty} (1 + \cos 2t) \, dt = \frac{1}{2} \int_{-\infty}^{\infty} 1 \, dt + \frac{1}{2} \int_{-\infty}^{\infty} \cos 2t \, dt = \infty + 0 = \infty$

(b) $E_x = \int_{-\infty}^{\infty} (2 \cos t)^2 \, dt = 4 \int_{-\infty}^{\infty} \cos^2 t \, dt = 4 \left(\frac{1}{2} \int_{-\infty}^{\infty} (1 + \cos 2t) \, dt \right) = 2 \int_{-\infty}^{\infty} 1 \, dt + 2 \int_{-\infty}^{\infty} \cos 2t \, dt = \infty + 0 = \infty$

2.1-2 (a) $E_x = \int_{-\infty}^{\infty} (1/t)^2 \, dt = \int_{-\infty}^{\infty} 1/t^2 \, dt = \int_{-\infty}^{-1} 1/t^2 \, dt + \int_{1}^{\infty} 1/t^2 \, dt = \left[-1/t \right]_{-\infty}^{-1} + \left[-1/t \right]_{1}^{\infty} = 1 + 1 = 2$

Therefore $E_{2x} = E_x = 2$.

(b) $E_x = \int_{-\infty}^{\infty} (1/t^2)^2 \, dt = \int_{-\infty}^{\infty} 1/t^4 \, dt = \int_{-\infty}^{-1} 1/t^4 \, dt + \int_{1}^{\infty} 1/t^4 \, dt = \left[-1/3t^3 \right]_{-\infty}^{-1} + \left[-1/3t^3 \right]_{1}^{\infty} = 1/3 + 1/3 = 2/3$

Therefore $E_{2x} = 4E_x = 8/3$.

2.1-3 $E_x = \int_{-\infty}^{\infty} \cos^2 t \, dt = \frac{1}{2} \int_{-\infty}^{\infty} (1 + \cos 2t) \, dt = \frac{1}{2} \int_{-\infty}^{\infty} 1 \, dt + \frac{1}{2} \int_{-\infty}^{\infty} \cos 2t \, dt = \infty + 0 = \infty$

2.1-4 This problem is identical to Example 2.2b, except that $\omega_1 \neq \omega_2$. In this case the third integral in P_3 (see p. 15) is not zero. That integral is given by

$$I_3 = \int_{-\infty}^{\infty} \cos(\omega_1 t) \cos(\omega_2 t) \, dt = \frac{1}{2} \int_{-\infty}^{\infty} (\cos(\omega_1 t + \omega_2 t) + \cos(\omega_1 t - \omega_2 t)) \, dt$$
$$= \frac{1}{2} \int_{-\infty}^{\infty} \cos((\omega_1 + \omega_2)t) \, dt + \frac{1}{2} \int_{-\infty}^{\infty} \cos((\omega_1 - \omega_2)t) \, dt$$
$$= \frac{1}{2} \int_{-\infty}^{\infty} \cos(\omega_3 t) \, dt + \frac{1}{2} \int_{-\infty}^{\infty} \cos(\omega_4 t) \, dt = 0 + 0 = 0$$

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