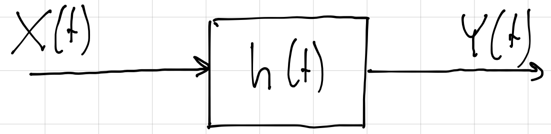
Es 1 ESAME DEL 30/01/2018



$$X(t) = 1 + 9\cos(2\pi f_0 t + 2\theta_0)$$

$$h(t) = \exp(-t)\,u(t-2) = \exp(-t)\,u(t)\,u(t-2)$$

$$H(f) = \int_2^{+\infty} e^{-t} e^{-j2\pi f t}\,dt = \int_2^{+\infty} e^{-(1+j2\pi f)t}\,dt$$

$$= -\frac{1}{1+j2\pi f}\, e^{-(1+j2\pi f)t}\Big|_2^{+\infty} = \frac{1}{1+j2\pi f}\, e^{-(1+j2\pi f)2}$$

$$= \frac{e^{-2(1+j2\pi f)}}{1+j2\pi f} = \frac{e^{-2}}{1+j2\pi f}\, e^{-j4\pi f}$$

$$\eta_Y = \eta_X H(0) = e^{-2}$$

$$\eta_X = \frac{1}{2\pi}\int_{-\pi}^{\pi} 1 + 9\cos(2\pi f_0 t + 2\theta_0)\,d\theta_0 = 1 + \underbrace{\frac{9}{2\pi}\int_{-\pi}^{\pi}\cos(2\theta_0 + 2\pi f_0 t)\,d\theta_0}_{0}$$

$$\eta_X = 1$$

$$S_Y(f) = S_X(f)\,|H(f)|^2$$

$$S_X(f) = TCF\left[R_X(\tau)\right]$$

$$R_X(\tau) = E\left[X(t)\,X(t-\tau)\right] = E\Big\{\left[1 + 9\cos(2\theta + 2\pi f_0 t)\right]\cdot$$

$$\cdot\left[1 + 9\cos(2\theta + 2\pi f_0 (t-\tau))\right]\Big\} =$$

$$= E\Big[1 + 9\cos\left(2\vartheta_0 + 2\pi f_0 t\right) + 9\cos\left(2\vartheta_0 + 2\pi f_0 (t-T)\right) +$$
$$+ \frac{81}{2}\cos\left(4\vartheta + 4\pi f_0 t - 2\pi f_0 T\right) + \frac{81}{2}\cos\left(2\pi f_0 T\right)\Big] =$$

$$= 1 + 0 + 0 + 0 + \frac{81}{2}\cos\left(2\pi f_0 T\right)$$

$$= 1 + \frac{81}{2}\cos\left(2\pi f_0 T\right)$$

$$S_X(f) = \delta(f) + \frac{81}{4}\delta(f - f_0) + \frac{81}{4}\delta(f + f_0)$$

$$|H(f)|^2 = H(f)\,H^*(f) = \frac{e^{-2}}{1 + j2\pi f}\,\cancel{e^{-j4\pi f}} \cdot \frac{e^{-2}}{1 - j2\pi f}\,\cancel{e^{j4\pi f}}$$

$$= \frac{e^{-4}}{1 + 4\pi^2 f^2}$$

$$S_Y(f) = S_X(f)\,|H(f)|^2 = e^{-4}\delta(f) + \frac{81}{4}\frac{e^{-4}}{1 + 4\pi^2 f_0^2}\delta(f - f_0)$$
$$+ \frac{81}{4}\frac{e^{-4}}{1 + 4\pi^2 f_0^2}\delta(f + f_0)$$