CENG 384 - Signals and Systems for Computer Engineers
Spring 2023
Homework 4

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June 6, 2023

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1. (a)

$$H(j\omega) = \frac{j\omega - 1}{j\omega + 1}$$

$$\frac{Y(j\omega)}{X(j\omega)} = \frac{j\omega - 1}{j\omega + 1}$$

$$Y(j\omega)(j\omega + 1) = X(j\omega)(j\omega - 1)$$

$$y'(t) + y(t) = x'(t) - x(t)$$

(b)

$$H(j\omega) = \frac{j\omega - 1}{j\omega + 1}$$

$$h(t) = \mathcal{F}^{-1}\{H(j\omega)\}$$

$$= \mathcal{F}^{-1}\{\frac{j\omega - 1}{j\omega + 1}\}$$

$$= \mathcal{F}^{-1}\{\frac{j\omega + 1 - 2}{j\omega + 1}\}$$

$$= \mathcal{F}^{-1}\{\frac{j\omega + 1}{j\omega + 1}\} - \mathcal{F}^{-1}\{\frac{2}{j\omega + 1}\}$$

$$= \mathcal{F}^{-1}\{1\} - 2\mathcal{F}^{-1}\{\frac{1}{j\omega + 1}\}$$

$$= \delta(t) - 2e^{-t}u(t)$$

(c)

$$y'(t) + y(t) = x'(t) - x(t)$$
$$y'(t) + y(t) = -2e^{-2t}u(t) - e^{-2t}u(t)$$
$$y'(t) + y(t) = -3e^{-2t}u(t)$$
$$y_p(t) = Ae^{-2t}$$
$$y_p'(t) = -2Ae^{-2t}$$
$$-2Ae^{-2t} + Ae^{-2t} = -3e^{-2t}u(t)$$
$$A = 3$$
$$y_p(t) = 3e^{-2t}$$
$$y_h(t) = c_1e^{-t}u(t)$$
$$y(t) = y_p(t) + y_h(t)$$
$$= 3e^{-2t} + c_1e^{-t}u(t)$$
$$y(0) = 0$$
$$0 = 3e^{-2(0)} + c_1e^{-0}u(0)$$
$$0 = 3 + c_1$$
$$c_1 = -3$$
$$y(t) = 3e^{-2t} - 3e^{-t}u(t)$$

(d)

2. (a)

(b)

(c)

3. (a)

(b)

(c)

4. (a)

(b)

(c)

5.