

ECE351: Signals and Systems I - Fall 2023- Dr. Thinh Nguyen
Homework 7
Due 11/20/2023

Problem 1:

Determine the time domain signal corresponding to each of the frequency domain representations:

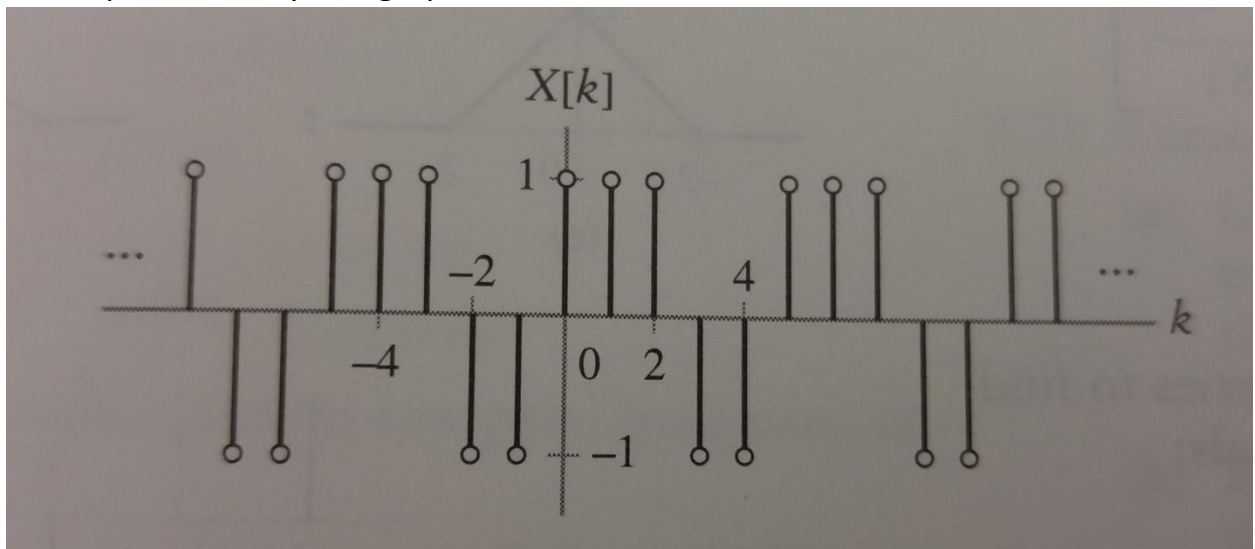
a.

$$X[k] = \begin{cases} e^{-jk\pi/2} & |k| < 10 \\ 0 & \text{Otherwise} \end{cases}$$

Fundamental period of time domain signal is $T = 1$

b.

X[k] represented by this graph



C.

$$X(jw) = \begin{cases} \cos(\frac{w}{4}) + j\sin(\frac{w}{4}) & |w| < \pi \\ 0 & \text{Otherwise} \end{cases}$$

Problem 2

Use the tables of transforms and properties to find the inverse FTs of the following signals

a.

$$X(jw) = \frac{jw}{(1 + jw)^2}$$

b.

$$X(jw) = \frac{4\sin(2w - 4)}{2w - 4} - \frac{4\sin(2w + 4)}{2w + 4}$$

c.

$$X(jw) = \frac{d}{dw} \left[4\sin(4w) \frac{\sin(2w)}{w} \right]$$

Problem 3

Use the tables of transforms and properties to find the DTFTs of the following signals

a.

$$x[n] = \left(\frac{1}{3}\right)^n u[n + 2]$$

b.

$$x[n] = \cos\left(\frac{\pi}{4}n\right) \left(\frac{1}{2}\right)^n u[n - 2]$$

c.

$$x[n] = \frac{\sin\left(\frac{\pi}{4}n\right)}{\pi n} * \frac{\sin\left(\frac{\pi}{4}(n - 8)\right)}{\pi(n - 8)}$$

(* = convolution, not multiplication)

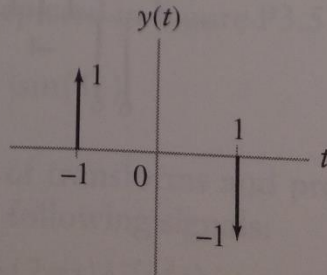
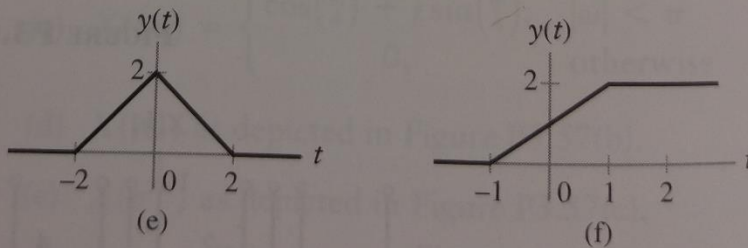
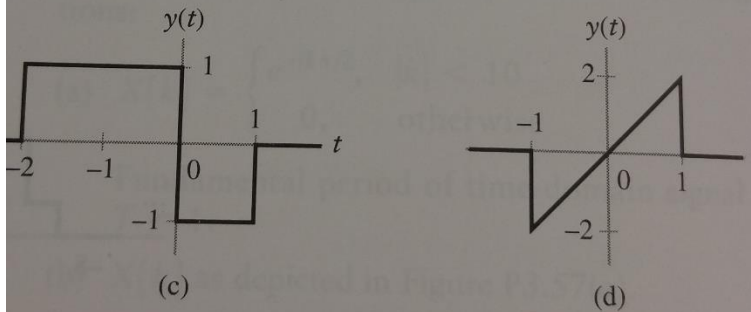
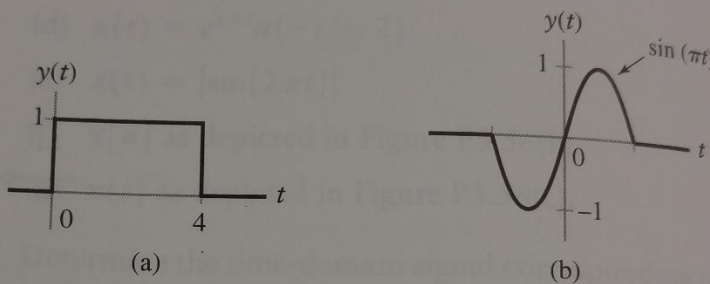
Problem 4

Only do problems (a) and (c)

3.62 Use the FT pair

$$x(t) = \begin{cases} 1 & |t| < 1 \\ 0 & \text{otherwise} \end{cases} \xleftrightarrow{FT} X(j\omega) = \frac{2 \sin(\omega)}{\omega}$$

and the FT properties to evaluate the frequency-domain representations of the signals depicted in Figures P3.62(a)–(g).



Problem 5

Do problems (a) (c) (d) (f)

3.63 You are given $x[n] = n\left(\frac{3}{4}\right)^{|n|} \xleftrightarrow{DTFT} X(e^{j\Omega})$.

Without evaluating $X(e^{j\Omega})$, find $y[n]$ if

(a) $Y(e^{j\Omega}) = e^{-j4\Omega} X(e^{j\Omega})$

(b) $Y(e^{j\Omega}) = \text{Re}\{X(e^{j\Omega})\}$

(c) $Y(e^{j\Omega}) = \frac{d}{d\Omega} X(e^{j\Omega})$

(d) $Y(e^{j\Omega}) = X(e^{j\Omega}) \odot X(e^{j(\Omega - \pi/2)})$

(e) $Y(e^{j\Omega}) = \frac{d}{d\Omega} X(e^{j2\Omega})$

(f) $Y(e^{j\Omega}) = X(e^{j\Omega}) + X(e^{-j\Omega})$