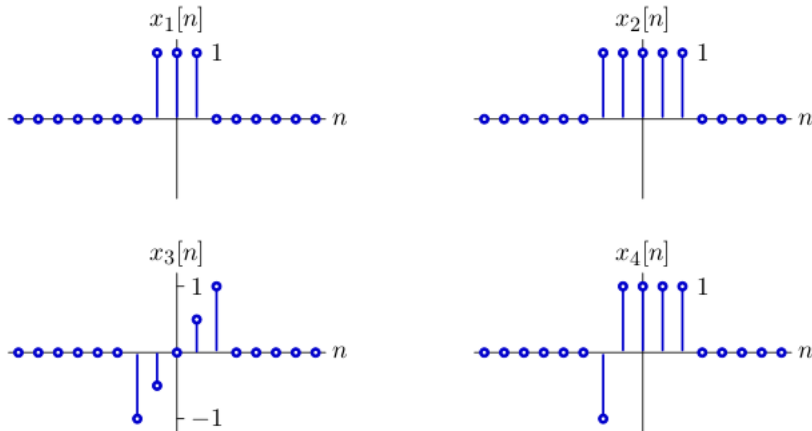


Date Due:

Homework 5 (Chapter 5)

Problems

1. Find the Fourier transforms of the following signals, which are 0 for $|n| > 7$.



2. Computing the Fourier transform.

- (a) **5-21.** b
5-21. d
5-21. j
5-21. k
 (b) $x[n] = \left(\frac{\sin(\frac{\pi n}{5})}{\pi n}\right)\cos\left(\frac{7\pi n}{2}\right)$
 (c) $x[n] = (n - 1)\left(\frac{1}{3}\right)^{|n|}$

3. Determining corresponding signals of the transforms.

- (a) **5-22.** a
5-22. b
5-22. d
5-22. h
 (b) $X(e^{j\omega}) = \frac{1 - \frac{1}{3}e^{-j\omega}}{1 - \frac{1}{4}e^{-j\omega} - \frac{1}{8}e^{-2j\omega}}$
 (c) $X(e^{j\omega}) = \sum_{k=-\infty}^{\infty} (-1)^k \delta\left(\omega - \frac{\pi}{4}k\right)$

4. Problem 5-10

5. Problem 5-34

6. Any real-world signal will be measured over a finite *time-window*, which acts in effect as a filter on the original signal. So while the original signal $x[n]$ has spectrum $\mathcal{F}\{x[n]\} = X(e^{j\omega})$, the measured signal $y[n] = x[n]w[n]$ has spectrum $\mathcal{F}\{y[n]\} = Y(e^{j\omega})$. Consider an input ∞ signal $x[n] = \sum_{k=-\infty}^{\infty} \delta[n - k]$ and the *rectangular time-window*

$$w[n] = \begin{cases} 1 & \text{for } -M \leq n \leq M \\ 0 & \text{otherwise} \end{cases}$$

- Find $\mathcal{F}\{x[n]\}$.
 - Sketch $\mathcal{F}\{y[n]\}$ for $-\pi \leq \omega \leq \pi$ when $M = 1$.
 - Sketch $\mathcal{F}\{y[n]\}$ for $-\pi \leq \omega \leq \pi$ when $M = 10$.
 - Which value of M generates $Y(e^{j\omega})$ that is more similar to $X(e^{j\omega})$?
7. A continuous-time signal $x(t)$ has the Fourier transform:

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

where b is a constant. Determine the Fourier transform $V(j\omega)$ of the following signals.

- $v(t) = x(5t - 4)$
- $v(t) = x(t)e^{j2t}$
- $v(t) = x(t)\cos 4t$
- $v(t) = x^2(t)$

Practical Assignment

- Provide a simple m-file in MATLAB to compute the discrete Fourier transform of a given sequence. The inputs of the function are the input sequence x as a row vector and the length of the transform N . It checks the length of x to be satisfied with N . Then a transformation matrix W will be formed and the DFT vector X will be produced by a matrix-vector multiplication. The magnitude of the DFT should be plotted at the end.
- Find the Fourier transform of the signals shown below. Plot the magnitude and phase of the Fourier transform using your m-file. Compare the output of your function to output of standard function "fft".

