EI331 Signals and Systems

Homework 7

Due: Thursday, April 18

April 12, 2019

1. (Duality of DFT and IDFT) Suppose you have an implementation of `fft` but not `ifft`. How can you use it to compute `ifft` as well? Assume you can also take complex conjugation.

2. (OWN 3.36) Consider a causal DT LTI system whose input x and output y are related by the following difference equation

$$y[n] - \frac{1}{4}y[n-1] = x[n]$$

Find the DT FS representation of the output y for the input $x[n] = \sin(\frac{3\pi}{4}n)$. Hint: We have found the frequency response of this system in class.

3. Consider the 5-point moving average

$$y[n] = \frac{1}{5}\sum_{k=-2}^{2} x[n-k]$$

What is the output y for the input $x[n] = 1 + \sin(\frac{\pi}{5}n) + \sin(\frac{2\pi}{5}n)$? Are there any frequency components that get eliminated completely?

4. (OWN 4.1) Use the analysis equation to compute the Fourier transforms of the following signals

(a). $x_1(t) = e^{-2(t-1)}u(t-1)$

(b). $x_2(t) = e^{-2|t-1|}$

5. (OWN 4.4) Use the synthesis equation to compute the inverse Fourier transforms of the following signals

(a). $X_1(j\omega) = 2\pi\delta(\omega) + \pi\delta(\omega - 4\pi) + \pi\delta(\omega + 4\pi)$

(b). $X_2(j\omega) = \begin{cases} 2, & 0 \le \omega \le 2 \\ -2 & -2 \le \omega < 0 \\ 0, & |\omega| > 2 \end{cases}$

6. Compute the Fourier transform of the signal

$$x(t) = \begin{cases} \cos t, & -\frac{\pi}{2} \leq t \leq \frac{\pi}{2} \\ 0, & \text{elsewhere} \end{cases}$$

7. Compute the Fourier transform of the **full-wave rectified** cosine $x(t) = |\cos t|$.