ECE 310 Recitation 8

Concept Check

1. Discrete Fourier Transform (DFT)

$$X_m = \sum_{n=0}^{N-1} x_n e^{-j\frac{2\pi}{N}mn} \leftrightarrow x_n = \frac{1}{N}\sum_{m=0}^{N-1} X_m e^{j\frac{2\pi}{N}mn}, \qquad \text{m, n} = 0,1,\ldots,N-1$$

2. DFT Properties
   - Linearity
   - Periodicity
   - Conjugate Symmetry
   - Time shift
   - Duality
   - Parseval theorem
   - Cyclic Convolution

Exercise

1. **[Fa18 midterm#2]** The length-4 sequences $x_1[n]$ *and* $x_2[n]$ have DFTs: $X_1[k] = \{1,2j,-1,1\}$ and $X_2[k] = \{1,2,1,-1\}$, respectively.

a) What is the DFT of $x_1[n] + 3x_2[n]$?

b) What is the DFT of $e^{j\pi n}x_1[n]$?

c) What is $\sum_{n=0}^{3}|x_2[n]|^2$?

d) What is $x_2[0]$?

e) What is $x_1[1]$?

2. Let X[m] be the 10-point DFT of the sequence x[n] = [1, −1, 2, 3, −3, 4, 0, 0, 0, 0]. Let y[n] be a finite length sequence whose DFT Y [m] is related to X[m] as $Y[m] = X[m]e^{-j\frac{2\pi}{5}mn_0}$, where $n_0 = 3$. Determine the sequence y[n].

3. Let X[m] denote the 240-point DFT of x[n], $0 \le n \le 239$. The sequence y[n] is obtained by zero-padding x[n] to length 256. Determine m_0 such that Y [32] = X[m_0].

4. Prove Cyclic Convolution Property.