ENEE 222: 3/26 Class

Material: Lecture videos **13.1**, **13.2**

1. The DFT of a *real-valued* vector $\mathbf{x} = x[0:7]$ is given by

$$\mathbf{X} = [\ 1 \quad 2+j \quad -4 \quad 5+3j \quad X_4 \quad X_5 \quad X_6 \quad X_7\ ]^T$$

Which (one or more) of the following statements are true?

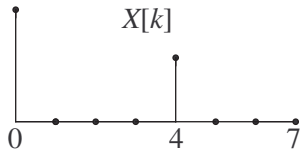
A. X_4 is not necessarily real-valued.

B. The values X_5, X_6 and X_7 are arbitrary (i.e., unrestricted).

C. $X_5 = 2 - j$

D. $X_5 = 5 - 3j$

2. Which of the following signals $\mathbf{x}$ could have the (real-valued) DFT $\mathbf{X}$ plotted below?



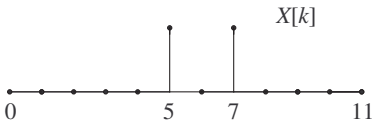
A. $\mathbf{x} = [\ 0 \quad 1 \quad 2 \quad 3 \quad 4 \quad 3 \quad 2 \quad 1\ ]^T$

B. $\mathbf{x} = [\ 5 \quad 1 \quad 5 \quad 1 \quad 5 \quad 1 \quad 5 \quad 1\ ]^T$

C. $\mathbf{x} = [\ 1 \quad 0 \quad 3 \quad 0 \quad 5 \quad 0 \quad 3 \quad 0\ ]^T$

D. $\mathbf{x} = [\ 2 \quad 0 \quad 0 \quad 0 \quad 2 \quad 0 \quad 0 \quad 0\ ]^T$

3. Which of the following signals $\mathbf{x} = x[0:11]$ could have the (real-valued) DFT $\mathbf{X}$ plotted below?



A. $x[n] = \cos(5\pi n/6)$

B. $x[n] = \sin(5\pi n/6)$

C. $x[n] = \cos(5\pi n/6) + 2\sin(5\pi n/6)$

D. $x[n] = \cos(5\pi n/6) + \sin(7\pi n/6)$

4. (HW 14 i) The entries of the time-domain vector

$$\mathbf{x}^{(1)} = \begin{bmatrix} 2 & -1 & -1 & 2 & -1 & -1 & 2 & -1 & -1 \end{bmatrix}^T$$

are given by $2\cos\omega n$, where $n = 0:8$. What is the value of ω? Express $\mathbf{x}^{(1)}$ as the sum of two Fourier sinusoids. By considering the appropriate column of the Fourier matrix $\mathbf{V}$, determine and display the DFT $\mathbf{X}^{(1)}$.

5. (HW 14 ii) Similarly, express the time-domain vector

$$\mathbf{x}^{(2)} = \begin{bmatrix} 0 & 1 & -1 & 0 & 1 & -1 & 0 & 1 & -1 \end{bmatrix}^T$$

as a linear combination of the same two Fourier sinusoids as in **4** above. Hence determine and display the DFT $\mathbf{X}^{(2)}$.

6. (HW 15 i) A real-valued signal vector $\mathbf{s}$ of length $N = 8$ has DFT

$$\mathbf{S} = \begin{bmatrix} 16 & z_1 & z_2 & z_3 & -4 & 7+j & 2j & -4+j5 \end{bmatrix}^T$$

What are the values of z_1, z_2 and z_3?

7. (HW 15 ∼ii, iii) Without inverting the DFT $\mathbf{S}$ in **6** above, evaluate the sum

$$s[0] - s[1] + s[2] - s[3] + s[4] - s[5] + s[6] - s[7]$$