ENEE 222: 4/04 Class

Material: Lecture videos *15.2*, **16.1**, **16.2**

1. Given that

$$[\ 1 \quad 2 \quad 4 \quad 8\ ]^T \quad \overset{\text{DFT}}{\longleftrightarrow} \quad [\ 15 \quad -3+6j \quad -5 \quad -3-6j\ ]^T\ ,$$

which of the following vectors is the DFT of

$$[\ 15 \quad -6-3j \quad 5 \quad -6+3j\ ]^T\ ?$$

A. $[\ 4 \quad 2 \quad 16 \quad 32\ ]^T$

B. $[\ 4 \quad 32 \quad 16 \quad 8\ ]^T$

C. $[\ 8 \quad 4 \quad 32 \quad 16\ ]^T$

D. $[\ 16 \quad 8 \quad 4 \quad 32\ ]^T$

2. The circular convolution of

$$[\ 1 \quad 2 \quad 4 \quad 8\ ]^T \quad \text{and} \quad [\ a \quad b \quad c \quad d\ ]^T$$

produces a vector whose last entry equals

A. $a+2b+4c+8d$

B. $a+8b+4c+2d$

C. $2a+4b+8c+d$

D. $8a+4b+2c+d$

3. Let $\mathbf{x}$ be a real-valued vector of length $N > 2$ and $\mathbf{y}$ be a Fourier sinusoid for that length (i.e., $\mathbf{y} = \mathbf{v}^{(m)}$ for some integer m). Which (one or more) the following statements is true about the circular convolution vector

$$\mathbf{s} \ = \ \mathbf{x} \circledast \mathbf{y}\ ?$$

A. $\mathbf{s}$ is real-valued.

B. $\mathbf{s}$ is circularly conjugate-symmetric.

C. The DFT $\mathbf{S}$ contains only one nonzero entry.

D. $\mathbf{s}$ is a scalar multiple of $\mathbf{y}$.

4. Suppose the DFT of the vector

$$[\ a \quad b \quad c \quad d\ ]^T$$

contains no zero entries. Which (one or more) of the following vectors $\mathbf{x}$ is certain to have *exactly* four nonzero entries in its DFT $\mathbf{X}$?

A. $\mathbf{x} = [\ a \quad b \quad c \quad d \quad a \quad b\ ]^T$

B. $\mathbf{x} = [\ a \quad b \quad c \quad d \quad a \quad b \quad c \quad d\ ]^T$

C. $\mathbf{x} = [\ a \quad b \quad c \quad d \quad a \quad b \quad c \quad d \quad a \quad b\ ]^T$

D. $\mathbf{x} = [\ a \quad b \quad c \quad d \quad a \quad b \quad c \quad d \quad a \quad b \quad c \quad d \quad a \quad b \quad c \quad d\ ]^T$

5. (HW 18 ∼v) Let $N > 2$. For what values of ω_0 in $(0, \pi]$ is the signal vector $\mathbf{u}$ defined by

$$u[n] \;=\; \cos(\omega_0 n)\,, \qquad n = 0 : N-1$$

circularly symmetric?

6. (HW 19 ∼ii) How are $\mathbf{x} \circledast \mathbf{y}$ and $(\mathbf{P}\mathbf{x}) \circledast \mathbf{y}$ related?

7. (HW 19 iii) If

$$\begin{bmatrix} 2 & -2 & 3 & -3 & 5 & -1 \\ -1 & 2 & -2 & 3 & -3 & 5 \\ 5 & -1 & 2 & -2 & 3 & -3 \\ -3 & 5 & -1 & 2 & -2 & 3 \\ 3 & -3 & 5 & -1 & 2 & -2 \\ -2 & 3 & -3 & 5 & -1 & 2 \end{bmatrix} \begin{bmatrix} x_0 \\ x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{bmatrix} = \begin{bmatrix} -1 \\ -7 \\ 9 \\ 2 \\ 12 \\ -7 \end{bmatrix},$$

explain how the vector $\mathbf{x}$ can be obtained using DFTs (as opposed to a conventional solution of a 6×6 system of linear equations).