7 Discrete Fourier Transform

Multiple Choice Questions

Q.1 The first six points of the 8-point DFT of a real valued sequence are 5, $1 - j3$, 0, $3 - j4$, and $3 + j4$. The last two points of the DFT are respectively

(a) 0, $1 - j3$ (b) 0, $1 + j3$

(c) $1 + j3$, 5 (d) $1 - j3$, 5

[GATE-2011]

Q.2 The DFT of a vector [a b c d] is the vector [α β γ δ]. Consider the product

$$[p\ q\ r\ s] = [a\ b\ c\ d]\begin{bmatrix} a & b & c & d \\ d & a & b & c \\ c & d & a & b \\ b & c & d & a \end{bmatrix}$$

The DFT of the vector [p q r s] is a scaled version of

(a) $\begin{bmatrix}\alpha^2 & \beta^2 & \gamma^2 & \delta^2\end{bmatrix}$

(b) $\begin{bmatrix}\sqrt{\alpha} & \sqrt{\beta} & \sqrt{\gamma} & \sqrt{\delta}\end{bmatrix}$

(c) $\begin{bmatrix}\alpha+\beta & \beta+\delta & \delta+\gamma & \gamma+\alpha\end{bmatrix}$

(d) $\begin{bmatrix}\alpha & \beta & \gamma & \delta\end{bmatrix}$

[GATE-2013]

Q.3 The N-point DFT of a sequence $x[n], 0 \le n \le N-1$ is given by

$$X[K] = \frac{1}{\sqrt{N}}\sum_{n=0}^{N-1} x[n]e^{-j\frac{2\pi}{N}nK},\ 0 \le K \le N-1.$$

Denote this relation as X = DFT (x). For $N = 4$, which one of the following sequences satisfies DFT (DFT (x)) = x.

(a) $x = [1\ 2\ 3\ 4]$ (b) $x = [1\ 2\ 3\ 2]$

(c) $x = [1\ 3\ 2\ 2]$ (d) $x = [1\ 2\ 2\ 3]$

[GATE-2014]

Numerical Data Type Questions

Q.4 The DFT of a real valued signal $x[n]$ is given as {6, $1 + 2j$, A, $3 + j$, –3, B, $4 + 2j$, C}

The value of the auto correlation function $x[n]$ at origin is __________.

Q.5 If twiddle factor $W_N = e^{-j2\pi/N}$, then the value of

$W_6^{31} + W_6^{35} =$ ____?

Try Yourself

T1. The DFT of a vector [a b c d] is the vector [1 3 5 8] then the value of vector defined as

$$\bar{k} = DFT\{[a\,b\,c\,d] \otimes [a\,b\,c\,d]\}$$

is (where $\otimes$ denotes circular convolution).

(a) [1 3 5 8]

(b) [2 6 10 16]

(c) [1 9 25 64]

(d) [$1 + 3j$ $3 + 5j$ $5 + 8j$ $8 + j$]

[Ans. (c)]

T2. The 4-point DFT of $x[n] = \begin{cases} \frac{1}{3}; & 0 \le n \le 2 \\ 0; & \text{elsewhere} \end{cases}$ is

(a) $X[k] = \left\{1, \frac{-j}{3}, \frac{1}{3}, \frac{j}{3}\right\}$

(b) $X[k]=\left\{1,\frac{j}{3},\frac{1}{3},\frac{-j}{3}\right\}$

(c) $X[k]=\left\{1,\frac{1}{3},\frac{j}{3},\frac{-j}{3}\right\}$

(d) $X[k]=\left\{1,\frac{-1}{3},\frac{-j}{3},\frac{j}{3}\right\}$

[Ans. (a)]

T3. Assume that a complex multiplication takes 1 μsec and that the amount of time to complete a DFT or FFT is determined by the amount of time it takes to perform all the complex multiplications. The time required to compute 1024 point DFT with radix-2 FFT algorithm is

(a) 10.24 msec (b) 5.12 msec
(c) 10 msec (d) 5 msec

[Ans. (b)]

T4. Let a discrete time signal be given as $x[n]$ with its DFT $X[k]$, then DFT of circular time shifted sequence $\{x[n+M]_N\}$ can be expressed as

(a) $X(k)e^{\frac{-j2\pi kM}{N}}$ (b) $X(k)e^{\frac{-j2\pi k}{MN}}$

(c) $X(k)e^{\frac{j2\pi kM}{N}}$ (d) $X(k)e^{\frac{j\pi k}{MN}}$

[Ans. (c)]

T5. An 8-point Discrete Fourier transform of a real discrete time signal $x[n]$ is given as

$$X_{DFT}[k]=\{\underset{\uparrow}{1},2,a,b,0,1-j,-2,c\}$$

Then the value of a = ____________.

[Ans. –2]

T6. The first six points of the 8-point DFT of a real valued sequence are 5, $1-j3$, 0, $3-j4$, and $3+j4$. The last two points of the DFT are respectively

(a) 0, $1-j3$ (b) 0, $1+j3$
(c) $1+j3$, 5 (d) $1-j3$, 5

[Ans:(b)]