10EE64

USN

Sixth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. If X(k) is N – point DFT of N-length sequence x(n), and if $x_1(n)$ is DFT of X(k), then determine $x_1(n)$ interms of x(n). **(05 Marks)**

b. Compute 8 – point DFT of the sequence x(n) = {1, 2, 2, 1, 2, 2} and verify conjugate symmetry about k = N/2. **(10 Marks)**

c. If X(k) represent 6-point DFT of sequence. X(n) = {2, –1, 3, 4, 0, 5}, then find y(n) of same length as x(n) such that its DFT $Y(k) = W_3^{2k} X(k)$. **(05 Marks)**

2 a. Using Stockham's method find circular convolution of the sequences : $g(n) = \delta(n) + 2\delta(n-1) + 3\delta(n-2) + 4\delta(n-3)$ and h(n) = n for $0 \le n \le 3$. **(07 Marks)**

b. Obtain output of the system having impulse response $h(n) = \cos\left(\frac{2\pi n}{N}\right)$ and input $x(n) = \sin\left(\frac{2\pi n}{N}\right)$, through N – point circular convolution. **(06 Marks)**

c. Use sectional convolution approach to find the response of filter having impulse response h(n) = {1, 2} and input x(n) = {1, 2, –1, 2, 3, –2, –3, –1, 1, 1, 2, –1}. Use 5-point circular convolution use overlap and add method. **(07 Marks)**

3 a. Develop DIF FFT algorithm for N = 8 from basic principles of decomposition of radix–2. **(10 Marks)**

b. Using time decomposition approach find the DFT of sequence for N point such that $N = 2^M$ and M = 3, the given sequence is y(n) = {1, 1, 1, 1 1}. **(10 Marks)**

4 a. The first five points of DFT of a sequence are given as {7, –0.707–j0.707, –j, 0.707–j0.707, 1}. Obtain the corresponding time domain sequence of length–8 using DIF FFT algorithm. **(10 Marks)**

b. Develop a N–composite DIT FFT algorithm for evaluating 9 point DFT. **(10 Marks)**

PART – B

5 a. A lowpass Butterworth filter has to meet the following specifications :
Passband gain, $K_p = -1$dB at $\Omega_p = 4$ rad/sec
Stopband attenuation greater than or equal to 20 dB at $\Omega_S = 8$ rad/sec.
Determine the transfer function $H_a(s)$ of the lowest order Butterworth filter to meet the above specifications. **(10 Marks)**

b. Design a Chebyshev – I filter to meet the following specifications :

Passband ripple	: ≤ 2dB
Passband edge	: 1 rad/sec
Stopband attenuation	: ≥ 20 dB
Stopband edge	: 1.3 rad/sec.

(10 Marks)

6 a. Using impulse invariant transformation, design a digital Chebyshev I filter that satisfies the following constraints. $0.8 \le |H(\omega)| \le 1, \quad 0 \le \omega \le 0.2\pi$

$|H(\omega)| \le 0.2, \quad 0.6\pi \le \omega \le \pi.$ **(12 Marks)**

b. Define the following windows along with their impulse response :

i) Rectangular window

ii) Hamming window

iii) Hanning window. **(08 Marks)**

7 a. The desired frequency response of a lowpass FIR filter is given by :

$$H_d(\omega) = \begin{cases} e^{-j3\omega}, & |\omega| < \frac{3\pi}{4} \\ 0, & \frac{3\pi}{4} < |\omega| < \pi \end{cases}$$

Determine the frequency response of the filter using Hamming window for N =7. **(10 Marks)**

b. Determine the filter coefficients h(n) obtained by sampling $H_d(\omega)$ given by :

$$H_d(\omega) = \begin{cases} e^{-j3\omega}, & 0 < \omega \le \frac{\pi}{2} \\ 0, & \frac{\pi}{2} < \omega < \pi \end{cases}$$

Also obtain frequency response taking N = 7. **(10 Marks)**

8 a. For a LTI system described by following input-output relation :

$2y(n) - y(n-2) - 4y(n-3) = 3x(n-2)$

Realize the system in following forms :

i) Direct form – I

ii) Direct form – II transposed realization. **(10 Marks)**

b. Obtain cascade realization for the system function given below :

$$H(z) = \frac{(1+z^{-1})^3}{\left(1-\frac{1}{4}z^{-1}\right)\left(1-z^{-1}+\frac{1}{2}z^{-2}\right)}.$$ **(06 Marks)**

c. Compare direct from – I and II realizations. **(04 Marks)**

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