USN

Fifth Semester B.E. Degree Examination, June / July 2014
Digital Signal Processing

Time: 3 hrs. Max. Marks: 100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Find the N-point DFT of the sequence
$x(n) = 1$; n even
$= 0$; n odd $0 \le n \le N-1$ and N odd. **(04 Marks)**

b. Consider a signal of length equal to 4 defined by $x(n) = \{1, 2, 3, 1\}$. Compute 4 point DFT by solving explicitly 4 by 4 system of linear equations defined by the inverse DFT formula. **(06 Marks)**

c. Determine the 8 point DFT of the sequence $x(n) = \{8, 8, 8, 8, 1, 1, 0, 0\}$. Sketch its magnitude and phase spectra. **(10 Marks)**

2 a. A 4 point sequence $x(n) = \{1, 2, 3, 4\}$ has DFT $x(k)$ for $0 \le K \le 3$. Find the signal values which has DFT $X((K-1))_N$ without performing DFT or IDFT. **(04 Marks)**

b. Compute the 4 point circular convolution of the sequences given by $x(n) = \{1, 8, 1, 8\}$ and $h(n) = \{2, 9, 2, 9\}$ using DFT and IDFT method. **(06 Marks)**

c. Find the N point circular auto correlation of signals $x_1(n) = \cos\frac{2\pi}{N}n \quad 0 \le n \le N-1$. **(04 Marks)**

d. Find the output y(n) of a FIR filter whose impulse response $h(n) = \{3, 2, 1\}$ and input signal to the filter is $x(n) = \{2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1\}$ using overlap-save method. Assume block length of 8. **(06 Marks)**

3 a. What is the need of FFT? Determine the following for a 128 point FFT computation number of: i) Stages ii) Butterflies in each stage iii) Butterflies needed for entire computation iv) total number of complex multiplications v) total number of complex additions vi) speed improvement factor compared with direct computation. **(08 Marks)**

b. Explain the shuffling of data and bit reversal as applied to DIT FFT algorithm for N = 8. **(04 Marks)**

c. Show that 2N point sequence can be computed using N point FFT algorithm. **(08 Marks)**

4 a. Develop DIF-FFT algorithm for N = 8,
(i) Using resulting signal flow graph compute 8 point DFT of the sequence,
$x_1(n) = \{1, 2, -1, 2, 4, 2, -1, 2\}$. Show all intermediate results.
(ii) If $x_2(n) = x_1(-n)$ without performing FFT find $x_2(k)$ using $x_1(k)$. **(14 Marks)**

b. Consider $x_1(n) = \{1, 0.5, 0.25, 0.125\}$, $x_2(n) = \{1, 1, 1, 1\}$. Determine $x_1(k)$ using decimation in time FFT algorithm and $x_2(k)$ using decimation in frequency FFT algorithm hence find circular convolution of $x_1(n)$ ④ $x_2(n)$. **(06 Marks)**

PART – B

5 a. Distinguish between Butterworth and Chebyshev type I filter. **(04 Marks)**

b. Design a chebyshev type I filter to meet the following specifications :

(i) Passband ripple $\leq$ 2 db. (iii) Stop band attenuation $\geq$ 20db

(ii) Passband edge |rad|sec. (iv) Stop band edge 1.3 rad/sec. **(12 Marks)**

c. Transform $H(s)=\frac{1}{(s^2+s+1)(s+1)}$ normalized Butterworth LPF to HPF with passband edge at 2 rad/sec. **(04 Marks)**

6 a. Derive an expression for frequency response of linear phase FIR filter for symmetric impulse response with M odd. **(08 Marks)**

b. The desired frequency response of a LPF is

$$H_d(e^{j\omega}) = e^{-j3\omega} \quad \frac{3\pi}{4} \leq \omega \leq \frac{3\pi}{4}$$
$$= 0 \quad \frac{3\pi}{4} \leq |\omega| \leq \pi$$

Design using Hamming window (M = 7). Also obtain the frequency response. **(12 Marks)**

7 a. Determine the order and the poles of a Butterworth filter that has 3 dB bandwidth of 1000 Hz and an attenuation of 20 dB at 2000 Hz. Find the system function H(z) by bilinear transformation using $T=\frac{1}{10000}$. **(14 Marks)**

b. If $H_a(s)=\frac{1}{(s+1)(s+2)}$, find the corresponding H(z) using impulse invariance method for sampling frequency of 5 samples / second. **(06 Marks)**

8 a. Distinguish between IIR and FIR filters. **(06 Marks)**

b. Obtain direct form II, cascade and parallel structure for the system described by $y(n)=\frac{1}{16}y(n-2)+x(n)$ **(08 Marks)**

c. Determine the co-efficients K_m of the lattice filter corresponding to FIR filter described by $H(z)=1+2z^{-1}+\frac{1}{3}z^{-2}$. Draw the corresponding second order lattice structure. **(06 Marks)**

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