USN | | | | | | | | | | **06EC52**

Fifth Semester B.E. Degree Examination, December 2012
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note:1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of normalized chebyshev and butter worth proto type tables not allowed.***

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. Compute the N-point DFT of the sequence x(n) = an $0 \le n \le N-1$. **(05 Marks)**

b. Compute DFT {x(n)} of the sequence given below using the linearity property, $x(n) = \cosh an \ 0 \le n \le N-1$. **(05 Marks)**

c. If x(n) denotes a finite length sequence of length N. Show that DFT $\{x((-n))_N\} = x((-K))_N$. **(05 Marks)**

d. Find the energy of the 4-point sequence $x(n) = \sin\left(\frac{2\pi}{N}n\right)$, $0 \le n \le 3$. **(05 Marks)**

2 a. Let x(n) be a finite length sequence with $X(K) = (0, 1+j, 1, 1-j)$ using the properties of the DFT, find DFTS of the following sequences:

i) $x_1(n) = e^{j\frac{\pi}{2}n} x(n)$

ii) $x_2(n) = \cos\left(\frac{\pi}{2}n\right) x(n)$

iii) $x_3(n) = x((n-1))_4$

iv) $x_4(n) = (0, 0, 1, 0) \circledast_4 x(n)$ **(10 Marks)**

b. For the DFT pair shown, compute the values of the boxed quantities using appropriate properties:

$(\boxed{X_0}, 3, -4, 0, 2) \xleftrightarrow{DFT} (5, \boxed{X_1}, -1.28-j3.49 \boxed{X_3}, 8.78-j1.4)$ **(05 Marks)**

c. Given the finite lengths sequence,
$x(n) = 2\delta(n) + \delta(n-1) + \delta(n-3)$ find the following:
i) 5 point DFT X(K)
ii) 5 point inverse DFT of $Y(K) = X^2(K)$ for n = 0, 1, ….4 **(05 Marks)**

3 a. Develop the DIF FFT algorithm for N = 8. **(10 Marks)**

b. Given $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$, find X(K) using DIT FFT algorithm. **(10 Marks)**

4 a. Consider a FIR filter with impulse response h(n) = {3, 2, 1, 1}. If the input is x(n) = {1, 2, 3, 3, 2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1}, find the output using overlap add method assuming the length of the block as 7. **(10 Marks)**

b. A designer is having a number of 8-point FFT chips. Show explicitly how he should interconnect three chips in order to compute a 24 point DFT. **(05 Marks)**

c. Develop the Goertzel algorithm for the computation of DFT. **(05 Marks)**

PART – B

5 a. A system function $H_5(s)$ represents a 1 rad/sec fifth-order normalized butter worth filter,
i) Give H5(s) in both the polynomial and factored forms.
ii) What is the gain $|H_5(j\Omega)|$ at $\Omega = 1$ rad/sec? What is the gain in decibels? **(10 Marks)**

b. Determine the transfer function of a normalized butterworth filter of order N = 6. Show the pole locations in the s-plane. **(10 Marks)**

6 a. Explain the frequency sampling method of designing FIR filters and draw the corresponding block diagram. **(10 Marks)**

b. Use the window method with a rectangular window to design a 11 top Hilbert transformer. The magnitude response of an ideal Hilbert transformer is as shown in Fig. Q6 (b). Also, find the following:
i) Transfer function of the FIR Hilbert transformer.
ii) The difference equation realization for the FIR Hilbert transformer, and
iii) Expression for magnitude frequency response. **(10 Marks)**

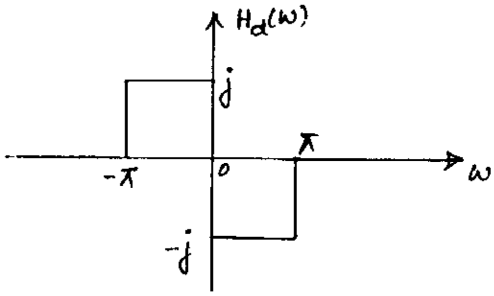

Fig. Q6 (b)

7 a. Design a butterworth filter for the specification given below using bilinear transformation technique:
Pass band frequency = 0.2 π
Pass band attenuation = 1 dB
Stop band frequency = 0.3 π
Stop band attenuation = 15 dB
Assume T = 1 **(14 Marks)**

b. Use Impulse invariance method to design a digital filter from an analog prototype that has a system function,

$$H(s) = \frac{(s+a)}{(s+a)^2 + b^2}, \; T = 1 \text{ sec}$$ **(06 Marks)**

8 a. A system is specified by its transfer function,

$$H(z) = \frac{(z-1)(z-2)(z+1)z}{\left[z-\left(\frac{1}{2}+j\frac{1}{2}\right)\right]\left[z-\left[\frac{1}{2}-j\frac{1}{2}\right]\right]\left[z-j\frac{1}{4}\right]\left[z+j\frac{1}{4}\right]}$$

Realize the systems in the following forms,
i) Cascade of two biquadratic sections.
ii) A parallel realization in constant, linear and biquadratic sections. **(15 Marks)**

b. Realize the linear phase FIR filter having the following impulse response $h(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2) + \frac{1}{4}\delta(n-3) + \delta(n-4)$. **(05 Marks)**

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