USN

10EC52

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

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 Butterworth tables are not allowed.

PART – A

1 a. Prove that the sampling of DTFT of a sequence x(n) result in N-point DFT. **(07 Marks)**

b. If $w(n) = \frac{1}{2}+\frac{1}{2}\cos\left[\frac{2\pi}{N}\left(n-\frac{N}{2}\right)\right]$, what is the DFT of the window sequence $y(n) = x(n).w(n)$? Keep the answer in terms of X(k). **(07 Marks)**

c. Compute the inverse DFT of the sequence $X(k) = \{\underset{\uparrow}{2}, 1+j, 0, 1-j\}$ **(06 Marks)**

2 a. Consider the following 8-point sequences defined for $0 \le n \le 7$.
(i) $x_1(n) = \{1, 1, 1, 0, 0, 0, 1, 1\}$ (ii) $x_2(n) = \{1, 1, 0, 0, 0, 0, -1, -1\}$
Which sequences have a real 8-point DFT? Which sequences have an imaginary valued 8-point DFT? **(05 Marks)**

b. Two 8-point sequences $x_1(n)$ and $x_2(n)$ are as shown in Fig.Q2(b). Determine the relation between their DFTs $X_1(k)$ and $X_2(k)$. **(05 Marks)**

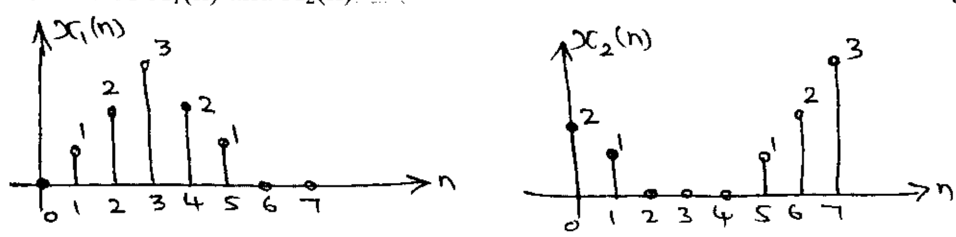

Fig.Q2(b)

c. Given the two sequences $x(n) = \alpha^n$ and $h(n) = \beta^n$ of length = 4, determine
$y(n) = x(n) \circledast_4 h(n)$ **(05 Marks)**

d. For DFT pair shown, compute the values of the boxed quantities using appropriate properties.
$\{\underset{\uparrow}{\boxed{x(0)}}, 1, 2, 2, 3, 3\} \xleftrightarrow{DFT} \{\underset{\uparrow}{12}, \boxed{X(1)}, -1.5+j0.866, 0, \boxed{X(4)}\ -1.5-j2.598\}$ **(05 Marks)**

3 a. What is sectional convolution? Explain any one of them. **(08 Marks)**

b. An FIR filter has the unit impulse response $h(n) = \{1, 2\}$. Determine the output sequence in response to the input sequence.
$x(n) = \{1, -1, 2, 1, 2, -1, 1, 3\}$
using over lap-add technique. Use 5-point circular convolution. **(07 Marks)**

c. Calculate the percentage saving in calculations in a 512-point radix-2 FFT, when compared to direct DFT. **(05 Marks)**

4 a. Determine 8-point DFT of a continuous time signal $x(t) = \sin(2\pi ft)$ with f = 50 Hz. Use DIFFFT algorithm. **(08 Marks)**

b. What is Geortzel algorithm? Obtain DF-II realization of two pole resonator for computing the DFT. **(08 Marks)**

c. What are the differences and similarities between DIF-FFT and DIT-FFT algorithm? **(04 Marks)**

PART – B

5 a. Determine the system function $H_a(s)$ that exhibits Chebyshev characteristics for the following filter specifications:
(i) Ripple of 0.5 dB in band $|\Omega| \le 1$
(ii) At $\Omega = 3$ rad/s, amplitude is down by 30 dB. **(12 Marks)**

b. Derive the expression of order and cutoff frequency of a Butterworth low pass filter. **(08 Marks)**

6 a. Obtain DF-I and DF-II structure of the filter is given by
$$y(n) = 2b\cos\omega_o\, y(n-1) - b^2\, y(n-2) + x(n) - b\cos\omega_o\, x(n-1)$$ **(07 Marks)**

b. Obtain the cascade and parallel realization of the system
$$H(z)\,\frac{1+\frac{1}{3}z^{-1}}{\left(1-\frac{1}{5}z^{-1}\right)\left(1-\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}\right)}$$ **(08 Marks)**

c. What are features of FIR lattice structures? **(05 Marks)**

7 a. Compare the rectangular window and hamming window. **(04 Marks)**

b. A low pass filter has the desired response as given by
$$H_d\left(e^{jw}\right) = \begin{cases} e^{-j3w}, & 0 \le w \le \frac{\pi}{2} \\ 0\ , & \frac{\pi}{2} \le w \le \pi \end{cases}$$
Determine the filter coefficients h(n) for M = 7 using frequency sampling technique. **(08 Marks)**

c. The desired response of a low pass filter is
$$H_d\left(e^{jw}\right) = \begin{cases} e^{-j3w}, & -\frac{3\pi}{4} \le w \le \frac{3\pi}{4} \\ 0\ , & \frac{3\pi}{4} < |w| \le \pi \end{cases}$$
Determine $H(e^{jw})$ for M = 7 using a Hamming window. **(08 Marks)**

8 a. Design an IIR digital filter that when used in the prefilter A/D – H(z) – D/A structure will satisfy the following analog specifications:
(i) LPF with –1dB cutoff at 100π rad/sec
(ii) Stop band attenuation of 35 dB or greater at 1000π rad/sec
(iii) Monotonic in SB and PB
(iv) Sampling rate 2000 sample/sec
Use Bilinear transformation technique. **(14 Marks)**

b. An analog filter has the following system function. Convert this filter into a digital filter using backward difference for the derivative
$$H(s) = \frac{1}{(s+0.1)^2 + 9}$$ **(06 Marks)**

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