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10EE64

Sixth Semester B.E. Degree Examination, June/July 2015
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. Determine DFT of sequence $x(n) = \frac{1}{3}$ for $0 \le n \le 2$ for N = 4. Plot magnitude and phase spectrum. **(06 Marks)**

b. Compute the 4 – point DFT of the sequence x(n) = (1, 0, 1, 0). Also find y(n), if $y(k) = x((k-2))_4$. **(06 Marks)**

c. Compute circular convolution using DFT + IDFT for the following sequences.
$x_1(n) = \{2, 3, 1, 1\}$ $x_2(n) = \{1, 3, 5, 3\}$. **(08 Marks)**

2 a. Two length - 4 sequences are defined below :
$x(n) = \cos(\pi n/2)$ n = 0, 1, 2, 3
$h(n) = 2^n$ n = 0, 1, 2, 3

i) calculate $x(n) \circledast_4 h(n)$ using circular convolution directly

ii) calculate $x(n) \circledast_4 h(n)$ using linear convolution. **(10 Marks)**

b. Find the output y(n) of a filter whose impulse response is h(n) = {1, 1, 1} and input signal x(n) = {3, –1, 0, 1, 3, 2, 0, 1, 2, 1} using :
i) overlap – save method
ii) overlap – add method.
Use circular convolution. **(10 Marks)**

3 a. Explain Decimation–in–time algorithm. Draw the basic butterfly diagram for DIT algorithm. **(08 Marks)**

b. Find the 8–point DFT of the sequence, x(n) = {1, 2, 3, 4, 4, 3, 2, 1}. Using DIT–FFT radix–2 algorithm. The basic computational block known as the butterfly should be as shown in Fig. Q3(b). **(12 Marks)**

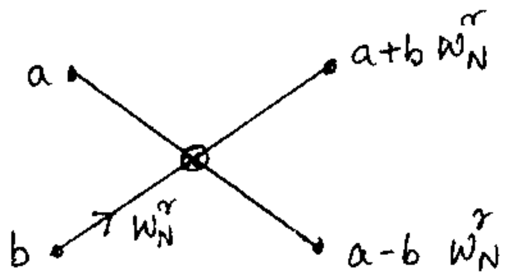

Fig.Q3(b)

4 a. Find the 4 – point DFT of the sequence, $x(n) = \cos\left(\frac{\pi}{4}n\right)$ using DIF–FFT algorithm. **(08 Marks)**

b. Using linear convolution find y(n) = x(n) * h(n) for the sequences :
x(n) = (1, 2, –1, 2, 3, –2, –3, –1, 1, 1, 2, –1) and h(n) = (1, 2).
Compare the result by solving the problem using :
i) Overlap – save method
ii) Overlap – add method. **(12 Marks)**

PART – B

5 a. Compare analog and digital filters. **(04 Marks)**

b. For the given specifications $k_p = 3\text{dB}$; $k_s = 15$ dB; $\Omega_p = 1000$ rad/sec; $\Omega_s = 500$ rad/sec. Design analog Butterworth high-pass filter. **(08 Marks)**

c. Design a Chebyshev analog low-pass filter that has a –3 dB cut off frequency of 100 rad/sec and a stop-band attenuation of 25 dB or greater for all radian frequencies past 250 rad/sec. **(08 Marks)**

6 a. Design a high-pass filter H(z) to meet the specifications shown in Fig. Q6(a). The sampling rate is fixed at 1000 samples/sec. Use Bilinear transformation. **(12 Marks)**

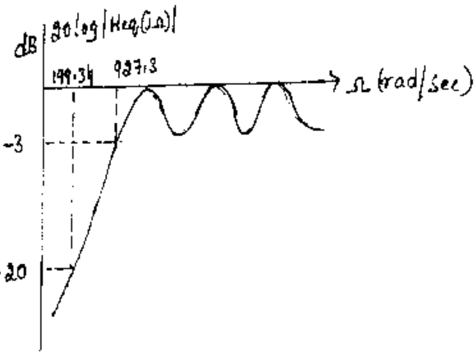

Fig.Q6(a)

b. Transform the analog filter :

$$H_a(s) = \frac{(s+1)}{s^2+5s+6}$$

into H(z) using impulse invariant transformation. Take T = 0.1 sec. **(08 Marks)**

7 a. Explain why windows are necessary in FIR filter design. What are the different windows in practice? Explain in brief. **(08 Marks)**

b. A filter is to be designed with the following desired frequency response :

$$H_d(\omega) = \begin{cases} 0, & -\frac{\pi}{4} < \omega < \frac{\pi}{\omega} \\ e^{-j2\omega}, & \frac{\pi}{4} < |\omega| < \pi \end{cases}$$

Find the frequency response of the FIR filter designed using a rectangular window defined below : $\omega_R(n) = \begin{cases} 1 & 0 \le n \le 4 \\ 0 & \text{otheriwse} \end{cases}$. **(12 Marks)**

8 Realize the following transfer function using :

$$H(z) = \left\{ \frac{0.7 - 0.25z^{-1} - z^{-2}}{1 + 0.1z^{-1} - 0.72z^{-2}} \right.$$

i) Direct form – I
ii) Direct form – II
iii) Cascade form
iv) Parallel form. **(20 Marks)**

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