2002 SCHEME

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EC52

Fifth Semester B.E. Degree Examination, December 2010

Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions.***
2. ***Use of normalized Butterworth/Chebyshev filter tables is not allowed.***

1 a. Show that DFT and IDFT form a consistent discrete Fourier transform pairs. **(04 Marks)**

b. Let X(K) denote the N point DFT of an N point sequence x(n). If the DFT of X(K) is computed to obtain a sequence $x_1(n)$, determine $x_1(n)$ in terms of x(n). **(06 Marks)**

c. Let x(n) , $0 \le n \le N-1$ be a sequence with an N point DFT X(K), , $0 \le n \le N-1$:

i) If x(n) is symmetric, satisfying the condition $x(n) = x(N-1-n)$, show that $X(N/2) = 0$ for N even.

ii) If x(n) is anti symmetric sequence satisfying the condition x(n) = – x(N – *l* – n), show that X(0) = 0 for N even.

iii) iii) If N even and $x(n) = -x(n + N/2)$ then X(K) = 0for K even. **(10 Marks)**

2 a. State and prove the time shifting property of DFT. **(05 Marks)**

b. Establish the relation between DFT and ZT. **(05 Marks)**

c. Compute the DFT of the sequence whose value for one period is given by $\tilde{x}(n) = (1, 1, -2, -2)$. **(05 Marks)**

d. Determine the output response y(n) if h(n) = (1, 1, 1) and x(n) = {1, 2, 3, 1} by using:

i) Circular convolution

ii) Circular convolution with zero padding. **(05 Marks)**

3 a. What is Chirp Z transform? Derive the CZT algorithm. **(08 Marks)**

b. What are the methods used to perform fast convolution? Explain any one method giving all the steps involved to perform it. **(04 Marks)**

c. Given x(n) = (0, 1, 2, 3, 4, 5, 6, 7), find X(K) using the DIT FFT algorithm. **(08 Marks)**

4 a. Find X(Z), given x(n) = (1; 0, 1,0). Use Goertzel algorithm and assume IC $Y_2(-1) = 0$. **(04 Marks)**

b. Consider a first order LPF with passband edge frequency Ωp having its transfer function :

$$Ha(S) = \frac{\Omega p}{S + \Omega p}$$

Transfer the filter to:

i) LPF with passband edge frequency Ω_1

ii) Transfer Ha(S) to HPF with cut off frequency Ω_1 **(06 Marks)**

c. Compare DIT and DIF radix – 2 FFT. **(05 Marks)**

d. How will you compute IDFT using radix – 2 FFT algorithms? **(05 Marks)**

5 a. Compare IIR and FIR filters. **(05 Marks)**

b. Compare different types of windows used in FIR filter design. **(05 Marks)**

c. A low pass filter has the desired response,

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

Determine the filter coefficients h(n) for M = 7, using the frequency sampling method (type I). **(10 Marks)**

6 a. Explain the method of IIR filter design by impulse invariant technique. **(06 Marks)**

b. Design a Butterworth digital filter using bilinear transformation technique and hence realize direct form – I.

$$0.8 \le |H(e^{j\omega})| \le 1 \qquad 0 \le \omega \le 0.2\pi$$

$$|H(e^{j\omega})| \le 0.2 \qquad 0.6\pi \le \omega \le \pi$$

Assume r = 1 sec. **(14 Marks)**

7 a. Briefly explain the design procedure of Chebyshev type I filter. **(06 Marks)**

b. The transfer function of analog filter is given by $H(s) = \frac{s+a}{(s+a)^2 + b^2}$. Find H(Z) by the impulse invariance method. **(06 Marks)**

c. Explain briefly the design of:

i) FIR differentiators

ii) Design of Hilbert transformers **(08 Marks)**

8 a. Find the : i) direct form II , ii) cascade form and iii) parallel form realization of the transfer function H(Z).

$$H(Z) = \frac{(8Z^3 - 4Z^2 + 11Z - 2)}{(Z - \frac{1}{4})(Z^2 - Z + \frac{1}{2})}$$ **(09 Marks)**

b. Realize the linear phase FIR filter having the following impulse response:

$$h(n) = \delta(n) + \tfrac{1}{2}\delta(n-1) - \tfrac{1}{4}\delta(n-2) + \tfrac{1}{8}\delta(n-3) + \delta(n-4)$$ **(04 Marks)**

c. Discuss how to obtain the structure of second order FIR lattice structure. **(07 Marks)**

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