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2002 SCHEME

Fifth Semester B.E. Degree Examination, Dec.08 / Jan.09

Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note : *Answer any FIVE full questions.*

1 a. If N-point DFT of the sequence $\tilde{x}(n) = \tilde{X}(k)$, find the N-point DFT of the sequence $\tilde{y}(n) = \tilde{x}(n-n_0)_N$. Prove the property used. **(06 Marks)**

b. Compute the N-point DFT of the sequence defined by $\tilde{x}(n) = (-1)^n$ for $0 \le n \le N-1$; N even. **(06 Marks)**

c. Given $x_1(n) = \{\underset{\uparrow}{1}, 2, 0, 1\}$ and $x_2(n) = \{\underset{\uparrow}{1}, 3, 3, 1\}$, obtain the circular convolution of $x_1(n)$ with $x_2(n)$ using circular array method. **(04 Marks)**

d. The 5-point DFT of a complex sequence X(n) is given by $x(k) = [j, 1+j, 1+j2, 2+j2, 4+j]$. Compute DFT of $y(n) = x^*(n)$, without evaluating IDFT and DFT. Use relevant properly. **(04 Marks)**

2 a. Given the impulse response of a system $h(n) = \{1, \frac{1}{2}, \frac{1}{4}\}$. The input to the system is a long duration sequence x(n), given as $x(n) = \{1, 2, 3, 3, 4, 5, 5, 6, 7\}$. Find the response of the system using overlap-save method. Use matrix method and block length of each response block as 6. **(10 Marks)**

b. Compute IDFT of $X(K) = [6, -2+2j, -2, -2-j]$, using FFT algorithm, which accepts input to the butterfly diagram in normal order. **(05 Marks)**

c. Explain the merits of FFT algorithms, considering an example of evaluation of 16 point DFT using Radix-2, in place computation and conventional matrix operator method. **(05 Marks)**

3 a. Draw the signal flow graph for the evaluation of DFT using Radix – 2 decimation in time algorithm for N = 8. Hence find DFT of the sequence $x(n) = \{1,1,1,1\}$ for N = 8. **(10 Marks)**

b. Explain the basic butterfly structure as used in a DIT FFT algorithm. **(05 Marks)**

c. Obtain cascade realization for the system described by, $H(z) = (1+z^{-1})\left(\frac{1}{4} - \frac{1}{8}z^{-1} + \frac{1}{4}z^{-2}\right)$. **(05 Marks)**

4 a. Obtain Parallel realization for, $H(z) = \dfrac{(1+z^{-1})^3}{\left(1-\frac{1}{4}z^{-1}\right)\left(1-z^{-1}+\frac{1}{2}z^{-2}\right)}$. **(09 Marks)**

b. Obtain a 2-point ladder realization for the system described by,

$$H(z) = \frac{4}{z^{-4} - 2z^{-3} - 2z^{-2} - z^{-1} + 4}$$ **(07 Marks)**

c. Explain the effect of finite precision arithmetic on digital system realization. How is it taken care in implementation? **(04 Marks)**

5 Design a digital Butterworth filter satisfying constraints
$$\frac{1}{\sqrt{2}} \le \left|H(e^{j\omega})\right| \le 1 \qquad 0 \le \omega \le \frac{\pi}{2}$$
$$\left|H(e^{j\omega})\right| \le 0.2 \qquad \frac{3\pi}{4} \le \omega \le \pi$$
with T = 1 sec, and Bilinear transformation. **(20 Marks)**

6 a. Use impulse invariant transformation and show that,

$$\frac{s+a}{(s+a)^2+b^2} \rightarrow \frac{1-e^{-aT}(\cos bT)z^{-1}}{1-2e^{-aT}(\cos bT)z^{-1}+e^{-2aT}z^{-2}}$$ **(06 Marks)**

b. Design an analog Chebyshev type I low pass filter transfer function that satisfies the constraints,

$$\frac{1}{\sqrt{2}} \le |H_a(j\Omega)| \le 1 \qquad 0 \le \Omega \le 2 \text{ rad/sec}$$

$$|H_a(j\Omega)| \le 0.1 \qquad \Omega \ge 4 \text{ rad/sec}$$ **(14 Marks)**

7 a. Explain frequency transformation method to transform analog normalized low pass filter into analog low pass, high pass, band pass and band rejection filters. **(08 Marks)**

b. For the desired response,

$$H_d(e^{j\omega}) = \begin{cases} e^{-j3\omega} & -\frac{\pi}{8} \le \omega \le \frac{\pi}{8} \\ 0 & \frac{\pi}{8} \le |\omega| \le \pi \end{cases}$$

determine the finite impulse response coefficients using i) Hamming window and ii) Hann's window. In each case express $H(e^{j\omega})$. Consider N = 7. **(12 Marks)**

8 a. Compare the performance of FIR filters with IIR filters. **(06 Marks)**

b. Explain Gibb's phenomenon exhibited by digital filters. **(06 Marks)**

c. Explain with block diagram, the architecture of fixed point DSP processor. **(08 Marks)**