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10EE64

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021

Digital Signal Processing

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer FIVE full questions, selecting atleast TWO questions from each part.
2. Use of Data sheets may be permitted.

PART - A

- 1 a. Define DFT and IDFT. State and prove the following properties :
i) Periodicity ii) Circular time shift. (10 Marks)
- b. Compute the 8 point DFT of a sequence $x(n) = (-1)^{n+1}$, $0 \leq n \leq 7$. Also plot the magnitude and phase plot of DFT. (10 Marks)
- 2 a. Let $X(k)$ be a 11 point DFT of real sequence $x(n)$, where length is 11. The even samples of $X(K)$ are given by $X(0) = 2$, $X(2) = -1 - j3$, $X(4) = 1 + j4$, $X(6) = 9 + j3$, $X(8) = 5$, $X(10) = 2 - j2$. Determine the missing odd samples of the DFT. Find $x(0)$ and $\Sigma x(n)$. (10 Marks)
- b. Compute the convolution of two sequences using circular array and tabular array.
 $x(n) = (1, 1, 1, 1, -1, -1, -1, -1)$ and $h(n) = (0, 1, 2, 3, 4, 3, 2, 1)$. (10 Marks)
- 3 a. Using linear convolution find $y(n) = x(n) * h(n)$ for the sequences $x(n) = (3, 0, -2, 0, 2, 1, 0, -2, -1, 0)$ and $h(n) = (2, 2, 1)$. Verify the results by solving the problem using overlap-save method. (14 Marks)
- b. Tabulate the comparison of complex multiplications and additions for direct computation of DFT versus the FFT algorithm for $N = 32, 128$ and 512 . (06 Marks)
- 4 a. Compute the 8 point DFT of sequence $x(n) = \sin \frac{\pi}{2} n$ using DIT - FFT algorithm. (10 Marks)
- b. Find the circular convolution of $x(n) = (1, 1, 1, 1)$ with $h(n) = (1, 2, 3, 4)$ using radix 2 DIF-FFT for DFT's and radix 2 DIT-FFT to find IDFT. (10 Marks)

PART - B

- 5 a. Explain the comparison between :
i) Analog and digital filters
ii) Butterworth and Chebyshev filter. (12 Marks)
- b. Obtain the transfer function of IIR digital filter for given $H_a(S)$ using impulse invariance method. $H_a(s) = \frac{0.5(s+4)}{(s+1)(s+2)}$. (08 Marks)
- 6 a. Design an analog Chebyshev filter with the following specifications :
 $A_p = -3\text{db}$ $\Omega_p = 2 \text{ rad/sec}$
 $A_s = -20\text{db}$ $\Omega_s = 4 \text{ rad/sec}$
Obtain ϵ , N , $H_a(S)$. (10 Marks)
- b. Design an analog low-pass Butterworth filter by impulse invariance for the following specifications.
 $0.89125 \leq |H(\omega)| \leq 1$ for $0 \leq \omega_p \leq 0.2\pi$
 $|H(\omega)| \leq 0.17783$ for $0.3 \pi \leq \omega_s \leq \pi$. (10 Marks)

- 7 a. What are the advantages and disadvantages with the design of FIR filters using window function? (08 Marks)

- b. The desired frequency response of a low pass filter is given by

$$H_d(\omega) = \begin{cases} e^{-j\omega} & |\omega| \leq \frac{3\pi}{4} \\ 0 & \frac{3\pi}{4} \leq |\omega| < \pi \end{cases}$$

Determine the frequency response of the FIR filter if Hamming window is used with $N=7$. (12 Marks)

- 8 a. Obtain the direct form – I, direct form – II realizations for the following systems :

$$y(n] = 0.75y(n-1) - 0.125y(n-2) + 6x(n) + 5x(n-1) + x(n-2).$$

(06 Marks)

- b. A discrete time system $H(z)$ is expressed as,

$$H_d(z) = \frac{10\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - \frac{2}{3}z^{-1}\right)\left(1 + 2z^{-1}\right)}{\left(1 - \frac{3}{4}z^{-1}\right)\left(1 - \frac{1}{8}z^{-1}\right)\left[1 - \left(\frac{1}{2} + \frac{1}{2}j\right)z^{-1}\right]\left[1 - \left(\frac{1}{2} - \frac{1}{2}j\right)z^{-1}\right]}$$

Realize cascade forms using second order systems. (10 Marks)

- c. Compare direct form-I and form-II realizations. (04 Marks)


