USN

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 $x(n) = (-1)^{n+1}$, $0 \le n \le 7$. 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 Σx(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 Ha(S) using impulse invariance method. $Ha(s) = \frac{0.5(s+4)}{(s+1)(s+2)}$. **(08 Marks)**

6 a. Design an analog Chebyshev filter with the following specifications :
$A_P = -3$db $\Omega_P = 2$ rad/sec
$A_S = -20$db $\Omega_S = 4$ 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.
$0.89125 \le |H(\omega)| \le 1$ for $0 \le \omega_P \le 0.2\pi$
$|H(\omega)| \le 0.17783$ for $0.3\pi \le \omega_S \le \pi$. **(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

$$H_d(\omega) = e^{-je\omega} \quad |\omega| \le 3\pi/4$$
$$= 0 \quad 3\pi/4 \le |\omega| < \pi$$

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)**

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