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10EC52

Fifth Semester B.E. Degree Examination, July/August 2022
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting atleast TWO questions from each Part.*
2. Missing data, if any, may be suitably assumed.

PART – A

1 a. Derive the relationship of N-point DFT with other transforms. **(08 Marks)**

b. Find the N-point DFT of the sequence $x(n) = e^{twmn}\ 0 \le n \le N-1$ **(04 Marks)**

c. Compute 8 point DFT of the sequence $x(n) = (1, 1, 1, 1, 0, 0, 0, 0)$. **(08 Marks)**

2 a. State and prove circulative shift property of DFT. **(04 Marks)**

b. Find 4 point DFT of the sequence $x(n) = \cos\left(\frac{\pi}{4}n\right) + \sin\left(\frac{\pi}{4}n\right)$. **(08 Marks)**

c. Compute circular convolution of the following sequences :

$x_1(n) = \left\{\underset{\uparrow}{2}, 1, 2, 1\right\}$

$x_2(n) = \{1, 2, 3, 4\}$. **(08 Marks)**

3 a. Determine number of real multiplications, real additions and trigonometric functions required for direct computation of N-point DFT. **(08 Marks)**

b. Find the output y(n) of a filter whose impulse response is $h(n) = \{1, 1, 1\}$ and input signal to the filter is $x(n) = \{1, 2, 0, -3, 4, 2, -1, 1, -2, 3, 2, 1, -3\}$ using overlap add technique. **(12 Marks)**

4 a. Develop Radix-2 DIF FFT algorithm and draw the complete flow graph for an 8 point DFT. **(10 Marks)**

b. Compute circular convolution for N = 4 using DIT FFT algorithm for the following sequences.

$x_1(n) = \{2, 1, 1, 2\}$

$x_2(n) = \{1, -1, -1, 1\}$. **(10 Marks)**

PART – B

5 a. Determine the transfer function $H_a(s)$ of the lowest order Butterworth filter to meet the following specification :

i) Passband gain $K_P = -1$db at $\Omega_p = 4$ rad/sec

ii) Passband attenuation greater than or equal to 20db at $\Omega_S = 8$ rad/sec. **(10 Marks)**

b. Let $H(s) = \frac{1}{s^2 + s + 1}$ represent the transfer function of LPF with a passband of 1 rad/sec. by using frequency transformation techniques find the transfer function of the following analog filter.

i) A high pass filter with a cutoff frequency of 10 rad/sec

ii) A lowpass filter with a passband of 10rad/sec

iii) A bandpass filter with apassband of 10rad/sec a centre frequency of 100 rad/sec. **(06 Marks)**

c. Mention the important properties of Chebyshev polynomial. **(04 Marks)**

6 a. Draw the block diagram of Direct Form-I and Direct Form-II realization for digital IIR filter described by the following system function :

$$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{(z - \frac{1}{4})(z^2 - z + \frac{1}{2})}.$$ **(10 Marks)**

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

i) $h(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2) + \frac{1}{4}\delta(n-3) + \delta(n-4)$

ii) $h(n) = \delta(n) - \frac{1}{4}\delta(n-1) + \frac{1}{2}\delta(n-2) + \frac{1}{2}\delta(n-3) - \frac{1}{4}\delta(n-4) + \delta(n-5)$. **(10 Marks)**

7 a. Derive an expression for FIR frequency response of Even–N symmetric impulse response. **(08 Marks)**

b. An FIR filter is to be designed with the following desired frequency response

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

Determine the filter co-efficient h(n). If the windows defined by

$$W_R(n) = \begin{cases} 1 & 0 \le n \le 4 \\ 0 & \text{otherwise} \end{cases}$$

Also find frequency response of H(W). **(12 Marks)**

8 a. Discuss Bilinear transformation method. Also explain the mapping of splane to Z plane. **(08 Marks)**

b. Convert the analog filter transform function :

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

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

c. Distinguish IIR and FIR filter. **(04 Marks)**

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