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10MT74

Seventh Semester B.E. Degree Examination, June/July 2019
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO full questions from each part.***

PART – A

1 a. Compute the DFT of the sequence

$$x(n) = \begin{cases} 1 & 0 \le n \le 2 \\ 0 & \text{otherwise} \end{cases} \text{ for } N = 4 \text{ and plot } |x(k)|, \ \underline{|x(k)}.$$ **(06 Marks)**

b. Compute the DFT of the sequence x(n) $x(n) = \{\underset{\uparrow}{1}, 0, 0, 0, 0, 1, 1, 1\}$. **(06 Marks)**

c. Derive the relationship of DFT to
i) DFS coefficients
ii) Z-transform. **(08 Marks)**

2 a. Derive the expression for the circular convolution property of DFT. **(08 Marks)**

b. Consider a FIR filter within impulse response
$h(n) = \{3, 2, 2, 1\}$ if the input is x(n)
$x(n) = \{1, 2, 3, 3, 2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1\}$
Find the output using overlap add method assuming the length of block as 7. **(12 Marks)**

3 a. What are the FFT algorithms? Explain the advantages of FFT algorithms over the direct computations of DFT for a sequence. **(06 Marks)**

b. Tabulate the complex additions, complex multiplications required for the direct computation of DFT and FFT algorithms for N = 16, 128. **(04 Marks)**

c. Compute circular convolution using DFT and IDFT formulate for the following sequences:

$$x_1(n) = n \qquad x_2(n) = \frac{\cos n\pi}{2} \quad \text{for} \quad 0 \le n \le 3$$ **(10 Marks)**

4 a. Derive the Radix-2 decimation in time FFT algorithm to compute the DFT of an N = 8 point sequence and draw the complete signal flow graph. **(10 Marks)**

b. Find the sequence x(n) corresponding to the 8-point DFT
$X(K) = \{4, 1 - J2.414, 0, 1 - J0.414, 0, 1 + J0.414, 0, 1 + J2.414\}$ by using Radix-2 DIF FFT algorithm compute IDFT. **(10 Marks)**

PART – B

5 a. Determine the order of Butterworth and Chebyshev approximation analog filters used to meet the following specifications.
Passband attenuation of 1dB at 4kHz and stop band attenuation of 40dB at 6kHz. **(06 Marks)**

b. Design a Chebyshev type 1 analog filter to meet the following specifications passband attenuation 2dB at 4 rad/sec stopband attenuation of 10 dB at 7 rad/sec. **(14 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

6 a. Design a FIR lowpass filter with

$$H_d(e^{Jw}) = e^{-3JW} \quad \text{for} \quad |w| \le \frac{\pi}{4}$$
$$= 0 \quad \text{for} \quad \frac{\pi}{4} < |w| \le \pi$$

Using Hanning window with N = 7. **(10 Marks)**

b. Determine the filter coefficients obtained by frequency sampling technique. For N = 7

$$H_d(e^{Jw}) = e^{-(J(N-1))W/2} \quad 0 \le |w| \le \frac{\pi}{2}$$
$$= 0 \quad \frac{\pi}{2} \le |w| \le \pi$$

(10 Marks)

7 a. Design a digital IIR lowpass Butterworth filter that has a 2dB passband attenuation at a frequency of 300π rad/sec and at least 60 dB stop band attenuation at 4500π rad/sec. Use backward difference transformation. **(10 Marks)**

b. A third order Butterworth lowpass filter has the transfer function $H(s) = \frac{1}{(s+1)(s^2+s+1)}$. Design H(z) using impulse invariant technique. **(10 Marks)**

8 a. Obtain the direct form II and cascade realizations of $H(z) = \frac{(z-1)(z^2+5z+6)(z-3)}{(z^2+6z+5)(z^2-6z+8)}$ and also the cascade system should consist of two biquadratic sections. **(10 Marks)**

b. A FIR filter is given by $y(n) = x[n] + \frac{2}{5}x[n-1] + \frac{3}{4}x[n-2] + \frac{1}{3}x[x-3]$. Draw the lattice structure. **(10 Marks)**

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