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10EE64

Sixth Semester B.E. Degree Examination, Feb./Mar. 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. ***Assume any missing data suitably.***

PART – A

1 a. Find the N-point DFT of the sequence $x(n) = a^n$ for $0 < a < 1$. **(04 Marks)**

b. Compute the 8-point DFT of the sequence x(n) given below.
$x(n) = (1, 1, 1, 1, 0, 0, 0, 0)$. **(10 Marks)**

c. Given $x(n) = 1, -1, -2, 3, -1)$ and $x_2(n) = (1, 2, 3)$, find the circular convolution of $x_1(n)$ and $x_2(n)$ using matrix method. **(06 Marks)**

2 a. G(k) and H(k) are 6-point DFTS of sequences g(n) and h(n) respectively. The DFT $G(k) = (1 + j, -2.1 + j3.2, -1.2 - j2.4, 0, 0.9 + j3.1, -0.3 + j1.1)$. The sequences g(n) and h(n) are related by circular time shift as $h(n) = g((n-4))6$. Determine H(k) without computing the D.F.T. **(08 Marks)**

b. A long sequence x(n) is filtered through a filter with impulse response h(n) to yield the output y(n). If $x(n) = (1, 1, 1, 1, 1, 3, 1, 1, 4, 2, 1, 1, 3, 1)$, $h(n) = (1, -1)$. Compute y(n) using overlap save method. Use only 5-point circular convolution in your approach. **(12 Marks)**

3 a. Determine 8-point D.F.T for a continuous time signal, $x(t) = \sin 2\pi ft$ with $f = 50Hz$. Using D.I.F – FFT algorithm. **(12 Marks)**

b. Find the 4-point circular convolution of the following two sequences, using D.I.T-FFT algorithm $x_1(n) = (2, 1, 1, 2)$ and $x_2(n) = (1, -1, -1, 1)$. **(08 Marks)**

4 a. Find the 8-point DFT of $x(n) = (1, 1, 1, 1, 0, 0, 0, 0)$ using DIT-FFT algorithm. **(12 Marks)**

b. Develop a radix – 3 DIT – FFT algorithm for evaluating the DFT for N = 9. **(08 Marks)**

PART – B

5 a. Design an analog low-pass Butterworth filter that will have –1dB cutoff frequency at 75Hz and have greater than 20dB attenuation for all frequencies greater than 150Hz. **(10 Marks)**

b. Design a Chebyshev filter to meet the following specifications.
  i) Pass band ripple : ≤ 2dB
  ii) Pass band edge frequency : 1 rad/sec
  iii) Stop band attenuation : ≥ 20dB
  iv) Stop band edge frequency : 1.3 rad/sec **(10 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. A third order Butterworth filter has the transfer function $H(s) = \frac{1}{(s+1)(s^2+s+1)}$, obtain H(z) using impulse – invariant transformation. **(10 Marks)**

b. A digital low pass filter is required to meet the following specifications

$20\log|H(w)|\ w = 0.2\pi \geq -1.9328\text{dB}$

$20\log|H(w)|\ w = 0.6\pi \leq -13.9794\text{dB}$

The filter must have a maximally flat frequency response. Find H(z) to meet the above specifications using impulse invariant transformation. **(10 Marks)**

7 a. The frequency response of an FIR filter is given by

$$H(w) = e^{-j3w}(1 + 1.8\cos 3w + 1.2\cos 2w + \frac{1}{2}\cos w)$$

Determine the coefficient of the impulse response h(n) of the FIR filter. **(10 Marks)**

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

$$H_d(w) = \begin{cases} 0 & -\frac{\pi}{4} < w < \frac{\pi}{4} \\ e^{-j2w} & \frac{\pi}{4} < |w| < \pi \end{cases}$$

Find the frequency response of the FIR filter designed using a rectangular window defined below:

$$W_R(n) = \begin{cases} 1, & 0 \leq n \leq 4 \\ 0 & \text{Otherwise} \end{cases}$$

(10 Marks)

8 a. Draw the direct form – I and direct form – II realizations of an in linear time invariant system described by the following input output relation

$2y(n) - y(n-2) - 4y(n-3) = 3x(n-2)$. **(06 Marks)**

b. The transfer function of a discrete causal system is given by

$$H(z) = \frac{1 - z^2}{1 - 0.2z^{-1} - 0.15z^{-2}}$$

Draw the cascade and parallel form. **(08 Marks)**

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

$$h(n) = \delta(n) - \frac{1}{4}\delta(n-1) + \frac{1}{2}\delta(n-2) + \frac{1}{2}\delta(n-3) - \frac{1}{4}\delta(n-4) + \delta(n-5)$$ **(06 Marks)**

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