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17EC52

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Digital Signal Processing

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

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.

Module-1

1 a. Show that finite duration sequence of length L can be reconstructed from the equidistant N samples of its Fourier transform, where $N \geq L$. **(06 Marks)**

b. Compute the 6 – point DFT of the sequence $x(n) = \{1, 0, 3, 2, 3, 0\}$. **(08 Marks)**

c. Find the N-point DFT of the sequence $x(n) = a^n, 0 \leq n \leq N-1$. **(06 Marks)**

OR

2 a. Determine the 6-point sequence x(n) having the DFT
$X(K) = \{12, -3-j\sqrt{3}, 0, 0, 0, -3+j\sqrt{3}\}$. **(08 Marks)**

b. Derive the equation to express z – transform of a finite duration sequence in terms of its N-point DFT. **(06 Marks)**

c. Compute the circular convolution of the sequences $x_1(n) = \{1, 2, 2, 1\}$ and $x_2(n) = \{-1, -2, -2, -1\}$. **(06 Marks)**

Module-2

3 a. State and prove the modulation property (multiplication in time-domain) of DFT. **(06 Marks)**

b. The even samples of an eleven-point DFT of a real sequence are : $X(0) = 8$, $X(2) = -2 + j3$, $X(4) = 3 - j5$, $X(6) = 4 + j7$, $X(8) = -5 - j9$ and $X(10) = \sqrt{3} - j2$. Determine the odd samples of the DFT. **(06 Marks)**

c. An LTI system has impulse response $h(n) = \{2, 1, -1\}$. Determine the output of the system for the input $x(n) = \{1, 2, 3, 3, 2, 1\}$ using circular convolution method. **(08 Marks)**

OR

4 a. State and prove circular time reversal property of DFT. **(06 Marks)**

b. Determine the number of real multiplications, real additions, and trigonometric functions required to compute the 8-point DFT using direct method. **(04 Marks)**

c. Find the output y(n) of a filter whose impulse response is $h(n) = \{1, 2, 1\}$, and the input is $x(n) = \{3, -1, 0, 1, 3, 2, 0, 1, 2, 1\}$ using overlap – add method, taking $N = 6$. **(10 Marks)**

Module-3

5 a. Compute the 8-pont DFT of the sequence $x(n) = \cos(\pi n/4)$, $0 \leq n \leq 7$, using DIT–FFT algorithm. **(10 Marks)**

b. Given $x(n) = \{1, 2, 3, 4\}$, compute the DFT sample X(3) using Goestzel algorithm. **(06 Marks)**

c. Determine the number of complex multiplications and complex additions required to compute 64-point DFT using radix.2 FFT algorithm. **(04 Marks)**

OR

6 a. Determine the sequence x(n) corresponding to the 8-point DFT $X(K) = \{4, 1-j2.414, 0, 1-j0.414, 0, 1+j0.414, 0, 1+j2.414\}$ using DIF-FFT algorithm. **(10 Marks)**

b. Draw the signal flow graph to compute the 16-point DFT using DIT-FFT algorithm. **(04 Marks)**

c. Write a short note on Chirp–z transform. **(06 Marks)**

Module-4

7 a. Draw the direct form I and direct form II structures for the system given by :

$$H(z) = \frac{z^{-1} - 3z^{-2}}{1 + 4z^{-1} + 2z^{-2} - 0.5z^{-3}}.$$ **(08 Marks)**

b. Design a digital Butterworth filter using impulse–invariance method to meet the following specifications :

$0.8 \le |H(\omega)| \le 1, \quad 0 \le \omega \le 0.2\pi$

$|H(\omega)| \le 0.2, \quad 0.6\pi \le \omega \le \pi$

Assume T = 1. **(12 Marks)**

OR

8 a. Draw the cascade structure for the system given by :

$$H(z) = \frac{(z-1)(z-3)(z^2 + 5z + 6)}{(z^2 + 6z + 5)(z^2 - 6z + 8)}.$$ **(08 Marks)**

b. Design a type–1 Chebyshev analog filter to meet the following specifications :

$-1 \le |H(\Omega)|\,dB \le 0, \quad 0 \le \Omega \le 1404\pi$ rad/sec

$|H(\Omega)|\,dB \le -60, \quad \Omega \ge 8268\pi$ rad/sec **(12 Marks)**

Module-5

9 a. Realize the linear phase digital filter given by :

$$H(z) = 1 + \frac{1}{2}z^{-1} + \frac{1}{3}z^{-2} + \frac{2}{5}z^{-3} + \frac{1}{3}z^{-4} + \frac{1}{2}z^{-5} + z^{-6}$$ **(06 Marks)**

b. List the advantages and disadvantages of FIR filter compared with IIR filter. **(04 Marks)**

c. Determine the values of h(n) of a detail low pass filter having cutoff frequency $\omega_C = \pi/2$ and length M = 11. Use rectangular window. **(10 Marks)**

OR

10 a. An FIR filter is given by : $y(n) = x(n) + \frac{2}{5}x(n-1) + \frac{3}{4}x(n-2) + \frac{1}{3}x(n-3)$. Draw the Lattice structure. **(06 Marks)**

b. Determine the values of filter coefficients h(n) of a high–pass filter having frequency response :

$$H_d(e^{j\omega}) = 1, \quad \frac{\pi}{4} \le |\omega| \le \pi$$

$$= 0, \quad |\omega| \le \frac{\pi}{4}$$

Choose M = 11 and use Hanning windows. **(10 Marks)**

c. Write the time domain equations, widths of main lobe and maximum stop band attenuation of Bartlett window and Hanning window. **(04 Marks)**

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