USN | | | | | | | | | | 06EC52

Fifth Semester B.E. Degree Examination, May/June 2010
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

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

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.

PART – A

1 a. For the following sequences, find: **(12 Marks)**
i) N-point DFT of $x(n) = \cos\frac{2\pi}{N}K_o n$ ii) 5-point DFT of $x(n) = \{1, 1, 1\}$

b. Find IDFT for the sequence : $x(k) = \{5, 0, (1-j), 0, 1, 0, (1+j), 0\}$ **(08 Marks)**

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

b. Compute the circular convolution of the sequences $x_1(n) = \{2, 1, 2, 1\}$ and $x_2(n) = \{1, 2, 3, 4\}$ using DFT and IDFT method. **(08 Marks)**

c. Find the output y(n) of a filter whose impulse response is $h(n) = \{1, 2\}$ and the input signal to the filter is $x(n) = \{1, 2, -1, 2, 3, -2, -3, -1, 1, 1, 2, -1\}$ using overlap-save method. **(08 Marks)**

3 a. Determine the number of complex multiplications, complex additions and trigonometric functions, required for direct computation of N-point DFT, **(10 Marks)**

b. How many complex multiplications and additions are required for 64-point DFT in FFT? **(04 Marks)**

c. Prove : i) Symmetry and ii) Periodicity property of a twiddle factor. **(06 Marks)**

4 a. Develop Radix-2 N-point DIT-FFT algorithm and draw the signal flow graph. **(12 Marks)**

b. Obtain 8-point DFT of the sequence, $x(n) = \{2, 1, 2, 1, 0, 0, 0, 0\}$. Using Radix-2 DIF-FFT algorithm. Show clearly all the intermediate results. **(08 Marks)**

PART – B

5 a. Given $|Ha(j\Omega)|^2 = \frac{1}{1+16\Omega^4}$, determine the analog filter system function Ha(S). **(08 Marks)**

b. Derive an expression for 'N' and Ω_{cp} of Butterworth filter if passband and stopband attenuations are in dB. **(08 Marks)**

c. Let $H(s) = \frac{1}{s^2+s+1}$ represents transfer function of a low pass filter with a passband of 1 rad/sec. Use frequency transformation to find the transfer function of the following analog filters:
i) A LPF with $\Omega'p = 10$ rad/sec ii) A HPF with $\Omega'p = 100$ rad/sec. **(04 Marks)**

6 a. Derive an expression for frequency response of a symmetric impulse response for N-odd. **(08 Marks)**

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

$$H_d(e^{j\omega}) = H_d(\omega) = \begin{cases} e^{-j2w}, & |\omega| < \pi/4 \\ 0, & \pi/4 < |\omega| < \pi \end{cases}$$

Determine the filter coefficients $h_d(n)$ and $h(n)$ if $\omega(n)$ is a rectangular window defined as follows:

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

Also, find the frequency response, $H(\omega)$ of the resulting FIR filter. **(12 Marks)**

7 a. Derive the expression for the bilinear transformation, to transform an analog filter to a digital filter, by trapezoidal rule and explain the mapping from s-plane to z-plane. **(08 Marks)**

b. Convert the analog filter with system function $Ha(s) = \dfrac{(s+0.1)}{(s+0.1)^2+9}$ into a digital filter (IIR) by means of impulse invariance method. **(08 Marks)**

c. Given the analog transfer function, $H(s) = \dfrac{(s+2)}{(s+1)+(s+3)}$. Find H(z), using matched z-transform design. The system uses sampling rate of 10Hz (T = 0.1 sec). **(04 Marks)**

8 a. Obtain direct form I, direct form II, cascade and parallel structure for the system described by $y(n) = -0.1y(n-1) + 0.72y(n-2) + 0.7x(n) - 0.252x(n-2)$. **(16 Marks)**

b. Obtain the direct form realization of linear phase FIR system given by $H(z) = 1 + \frac{2}{3}z^{-1} + \frac{15}{8}z^{-2} + \frac{2}{3}z^{-3} + z^{-4}$. **(04 Marks)**

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