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

Fifth Semester B.E. Degree Examination, June 2012

Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer FIVE full questions, selecting at least TWO questions from each part.*
2. *Use of normalized filter tables not permitted.*

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. Consider the finite length sequence $x[n] = \delta[n] + 2\delta[n-5]$. Find:
   i) The 10 point DFT of x[n]
   ii) The sequence that has a DFT, $Y(K) = e^{\frac{-j4\pi K}{10}} X(K)$ where X(K) is the 10 point DFT of x[n]
   iii) Find the 10 point sequence y[n] that has a DFT Y(K) = X(K)W(K) where X(K) is the 10 point DFT of x[n] and W(K) is the 10 point DFT of u[n] – u[n – 7]. **(15 Marks)**

b. Find the N point DFT of the sequence,
$$x[n] = 4 + \left\{\cos^2 \frac{2\pi n}{N}\right\} \qquad 0 \le n \le (N-1)$$ **(05 Marks)**

2 a. Determine the circular convolution of the sequence x[n] = {2, 1, 2, 1} and h[n] = {1, 2, 3, 4} using DFT and IDFT equations. **(08 Marks)**

b. Determine the response of a LTI system with h[n] = {1, -1, 2} for an input x[n] = {1, 0, 1, -2, 1, 2, 3, -1, 0, 2} using overlap. Add method and 6 point circular convolution. **(12 Marks)**

3 a. What are the two properties of phase factor W_N that are exploited in fast Fourier transform algorithm? Prove them. **(04 Marks)**

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

c. Let x[n] be a finite length sequence with X(K) = {0, 1+j, 1, 1–j}. Using the properties of the DFT find the DFTs of the following sequences:
   i) $x_1[n] = e^{\frac{j\pi n}{2}} x[n]$ ii) $x_2[n] = \cos\left(\frac{\pi}{2} n\right) x[n]$ iii) $x_3[n] = x\{(n-1)_4\}$ **(06 Marks)**

4 a. Find the DFT of the sequence x[n] = {1, , 3, 4, 4, 3, 2, 1} using the decimation in time FFT algorithm and draw the signal flow graph. **(10 Marks)**

b. Given x[n] = {1, 0, 1, 0}, find X(2) using Goertzel algorithm. **(05 Marks)**

c. Write a note on Chirp Z transform algorithm. **(05 Marks)**

PART – B

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

b. Compare Butterworth and Chebyshev filters. **(04 Marks)**

c. Design an analog lowpass Butterworth filter that has a -2 dB or better cut off frequency of 20 rad/sec and atleast 10 dB attenuation at 30 rad/sec. **(08 Marks)**

6 a. Design a FIR lowpass filter with a desired frequency response

$$Hd(e^{jw}) = \begin{cases} e^{-j3w}, & -\frac{3\pi}{4} \le w \le \frac{3\pi}{4} \\ 0, & \frac{3\pi}{4} \le |w| \le \pi \end{cases}.$$

Use Hamming window with M = 7. **(10 Marks)**

b. Using frequency sampling method, design a band pass filter with the following specifications. Determine the filter coefficients for N = 7, sampling frequency, F = 8000 Hz, cut off frequencies fc_1 = 1000 Hz, fc_2 = 3000 Hz. **(10 Marks)**

7 a. Design a digital lowpass filter using the bilinear transformation method to satisfy the following characteristics:

i) Monotonic stopband and passband

ii) -3dB cut off frequency of 0.5 π rad

iii) Magnitude down atleast 15 dB at 0.75 π rad. **(10 Marks)**

b. Transform the analog filter $H(s) = \frac{(s+0.1)^2}{(s+0.1)^2 + 9}$ to H(z) using the impulse invariance transformation. **(04 Marks)**

c. Determine the order of a Chebyshev digital lowpass filter to meet the following specifications:

In the passband extending from 0 to 0.25π, a ripple of not more than 2 dB is allowed. In the stopband extending from 0.4π to π, attenuation can be more than 40 dB. Use bilinear transformation method. **(06 Marks)**

8 a. Obtain the direct form II (Canonic) and cascade realization of

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

The cascade section should consist of two biquadratic sections. **(10 Marks)**

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

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