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

Fifth Semester B.E. Degree Examination, June/July 2016

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.*
3. *Standard notations are used.*
4. *Missing data be suitable assumed.*
5. *Draw neat diagram wherever necessary.*

PART – A

1 a. Define DFT. Derive the relationship and DFT to i) the DTFT ii) the Z – transform **(08 Marks)**

b. 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 $y(k) = e^{\frac{j4\pi}{10}} x(k)$ where x(k) is the 10 point DFT of x[n] iii) 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 $w[n] = u[n] - u[n-7]$. **(12 Marks)**

2 a. Compare linear convolution and circular convolution compute the linear convolution compute the linear convolution of the sequences :
$x_1[n] = \{\underset{\uparrow}{1}, 2, 3, 1\}$ and $x_2[n] = \{\underset{\uparrow}{4}, 3, 2, 2\}$ using circular convolution. **(08 Marks)**

b. Consider a FIR filter with inpules response $h[n] = \{\underset{\uparrow}{3}, 2, 1, 1\}$, If the input x[n] = {1, 2, 3, 3, 2, 1, -1, -2, $\overset{\downarrow}{-3}$, 5, 6, -1, 2, 0, 2, 1}, find the output using over lap Add method assuming the length of the block as 7. **(12 Marks)**

3 a. What are FFT algorithms? Explain the advantages of FFT algorithms over the direct computation of DFT for a complex valued sequence x[n]. **(04 Marks)**

b. Derive the Radix 2 decimation in frequency FFT algorithm to compute the DFT of a N = 8 point sequence and draw the final complete signal flow graph. **(08 Marks)**

c. Let x[n] be a finite length sequence with x(k) = {0, 1 + j, 1, 1 – j}. Using the properties of DFT, find the DFTs of the following sequences :

i) $x_1[n] = e^{j\pi/2^n} x[n]$

ii) $x_2[n] = \text{Cos}\{(\pi/2)n\} x[n]$

iii) $x_3[n] = x((n-1)_4)$ **(08 Marks)**

4 a. Find the sequence x[n] corresponding to the 8 point DFT:
$x(k) = \{\underset{\uparrow}{4}, 1 - j2.414, 0, 1 - j0.414, 0, 1 + j0.414, 0, 1 + j2.414\}$ **(12 Marks)**
By using any of the Radix 2 FFT algorithms to compute the IDFT. Draw the final signal flow graph. Show the outputs for each stage.

b. With the help of suitable diagrams, explain the chirp Z – transform algorithm. **(08 Marks)**

PART – B

5 a. Given that $|Ha(j\Omega)|^2 = \dfrac{1}{1+64\Omega^6}$, determine the analog filter system function Ha(s). **(08 Marks)**

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

c. Design a Chebyshev filter with a maximum passband attenuation of 2.5dB at Ω_p = 20 rad/sec and the stop band attenuation of 30db at Ω_c = 50rad/sec. **(08 Marks)**

6 a. Find an expression for inpulse response h[n] of a linear phase low pass FIR filter using Kaiser window to satisfy the following magnitude response specification for the equivalent analog filter stop band attenuation = 40dB, pass band, ripple = 0.01dB transition width = 1000π rad/sec, Ideal cut off frequency = 2400 rad/sec, sampling frequency = 10KHz. **(15 Marks)**

b. Explain the frequency sampling method of designing FIR filters and draw the corresponding block diagram. **(05 Marks)**

7 a. Design a digital low pas filter using the bilinear transformation method to satisfy the following characteristics i) Monotonic stopband and pass band ii) -3dB cutoff frequency of 0.5π rad iii) Magnitude down at least 15dB at 0.75π rad. **(04 Marks)**

b. Transform the analog filter : $H(s) = \dfrac{(s+0.1)^2}{(s+0.1)^2+9}$ to H(z) using impulse invariance transformation. **(08 Marks)**

c. Design a Butterworth digital filter using the Impulse Invariance method for the following specifications : Assume T = 1 sec

$0.8 \le |H(e^{jw})| \le 1 \;;\; 0 \le w \le 2\pi$

$|H(e^{jw})| \le 0.2 \quad 0.6\pi \le w \le \pi$

Assume T = 1 sec **(08 Marks)**

8 a. Obtain the Direct form II (Canonic) and Cascade realization of :

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

c. An analog signal is sampled at 10KHz and the DFT of 512 samples is computed. Determine the frequency spacing between spectral samples of the DFT. **(04 Marks)**

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