USN | | | | | | | | | | |

06EC52

Fifth Semester B.E. Degree Examination, June/July 2013
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Consider two periodic sequences x(n) and y(n). x(n) and y(n) has the period N and M respectively. The sequence w(n) = x(n) + y(n). (i) Show that w(n) is periodic with period MN. (ii) Also show that w(k) represents MN point DFT of an MN point sequence w(n). **(06 Marks)**

b. Find the 4 point DFT of the sequence $x(n) = \cos(n\pi/4)$. **(06 Marks)**

c. Obtain the relationship between (i) DFT and DTFT (ii) DFT and DFS. **(08 Marks)**

2 a. Let x(k) denote the N point DFT of the N point sequence x(n).
(i) Show that if x(n) satisfies the relation x(n) = – x(N-1-n), then x(0) = 0
(ii) Show that when N even and if x(n) = x(N-1-n), then x(N/2) = 0. **(10 Marks)**

b. Compute the circular convolution using DFT and IDFT for the following sequence
$x_1(n) = \{2, 3, 1, 1\}$ and $x_2(n) = \{1, 3, 5, 3\}$ **(10 Marks)**

3 a. g(n) and h(n) are two sequences of length 6. They have 6 point DFTS G(k) and H(k) respectively. Let g(n) = {4.1, 3.5, 1.2, 5, 2, 3.3}. The DTFS G(k) and H(k) are related by the circular frequency shift as $H(k) = G((k-3))_6$. Determine h(n) without computing DFT and IDFT. **(08 Marks)**

b. Determine 8-point DFT of x(n) = {1, 0, –1, 2, 1, 1, 0, 2} using radix 2 DIT FFT algorithm. **(12 Marks)**

4 a. Compute DFT of two real sequences using FFT algorithms. **(08 Marks)**

b. Explain Geortzal algorithm. **(08 Marks)**

c. Discuss memory requirement and Inplace computation related to DIT and DIF FFTs. **(04 Marks)**

PART – B

5 a. Design a low pass 1 rad/sec bandwidth Chebyshev filter with the following characteristics:
(i) Acceptable pass band ripple of 2 dB
(ii) Cutoff radian frequency of 1 rad/sec
(iii) Stopband attenuation of 20 dB or greater beyond 1.3 rad/sec. **(12 Marks)**

b. Convert the following low pass digital filter of cutoff frequency 0.2π into high pass filter of cutoff frequency 0.3π radians

$$H(z) = \frac{0.245(1+z^{-1})}{1-0.509z^{-1}}$$ **(08 Marks)**

6 a. What are the properties of FIR filters? State their importance. **(04 Marks)**

b. What is Gibbs phenomenon? How it can be reduced? **(04 Marks)**

c. Determine the filter coefficients $h_d(n)$ for the desired frequency response of a low pass filter given by,

$$H_d(e^{jw}) = \begin{cases} e^{-j2w} & \text{for } -\pi/4 \le |w| \le \pi/4 \\ 0 & \text{for } \pi/4 \le |w| \le \pi \end{cases}$$

If we define the new filter coefficients by $h(n) = h_d(n).w(n)$

where $w(n) = \begin{cases} 1 & \text{for } 0 \le n \le 4 \\ 0 & \text{elsewhere} \end{cases}$

Determine $h(n)$ and also frequency response $H(e^{jw})$. **(12 Marks)**

7 a. Explain how an analog filter is mapped on to a digital filter using impulse invariance method. What are the limitations of the method? **(08 Marks)**

b. Design a digital LPF to satisfy the following pass band ripple $1 \le |H(j\Omega)| \le 0$ for $0 \le \Omega \le 1404\pi$ rad/sec and stop band attenuation $|H(j\Omega)| > 60$ dB for $\Omega \ge 8268\pi$ radian/sec. Sampling interval $T_s = 10^{-4}$ sec use Bilinear transformation techniques for designing. **(12 Marks)**

8 a. Develop the lattice ladder structure for the filter with difference equation

$$y(n) + \frac{3}{4}y(n-1) + \frac{1}{4}y(n-2) = x(n) + 2x(n-1)$$ **(10Marks)**

b. For $y(n) = -0.1y(n-1) + 0.2y(n-2) + 3x(n) + 3.6x(n-1) + 0.6x(n-2)$, obtain direct form I and II and cascade form with single pole-zero subsystem. **(10 Marks)**