DSP (BE EXTC) Sem VII (R) 21/11/14

QP Code : 15306

(3 Hours) [Total Marks : 100

N.B : (1) Question no.1 is **compulsory**.
(2) Answer any **four** questions out of remaining **six** question.
(3) **Figures** to the **right** indicate **full** marks.
(4) Illustrate the answers with sketches wherever required.

1. (a) Compare impulse invariant and Bilinear transformation techniques. 5

(b) A two pole low pass filter has the system function 5

$$H(z) = \frac{b_0}{\left(1 - pz^{-1}\right)^2}$$

Determine the value of b_0 and p such that the frequency response $H(\omega)$ statisfies the conditions $H(0) = 1$ and $\left|H\left(\frac{\pi}{4}\right)\right|^2 = \frac{1}{2}$

(c) Explain Multirate sampling? What are the basic methods? List the advantages of it. 5

(d) Explain the sub band coding of speech signal as an application of multirate signal processing. 5

2. (a) If the impulse response of a FIR filters has the property $h(n) = \pm h(N-1-n)$, find the expression for magnitude response and phase response and show that filters will have linear phase response. 10

(b) An 8 point sequence $x(n) = \{1, 2, 3, 4, 5, 6, 7, 8\}$ 10
(i) Find X[k] using DIF-FFT algorithm
(ii) Let $x_1[n] = \{5, 6, 7, 8, 1, 2, 3, 4\}$ using appropriate DFT property and result of part (i) determine $X_1[k]$

3. (a) Draw a lattice filter implementation for the all pole filter, 10

$$H(z) = \frac{1}{1 - 0.2z^{-1} + 0.4z^{-2} + 0.6z^{-3}}$$

and determine the number of multiplications, additons and delays required to implement the filter.

(b) Compare minimum phase, maximum phase and mixed phase system. Determine the zeros of the following FIR systems and indicate whether the system is minimum phase, maximum phase or mixed phase, $H(z) = 6 + z^{-1} + z^{-2}$ 10

4. (a) Develop DIT - FFT algorithm for decomposing the DFT for N = 6 and draw the flow diagrams for (i) N = 2 x 3 (ii) N = 3 x 2 **10**

(b) (i) Convert the following analog filter system function into digital IIR filter by means of Bilinear transformation. The digital filter should have resonant frequency of $\omega_r = \pi/4$. **10**

$$Ha(s) = \frac{(s+0.1)}{[(s+0.1)^2+9]}$$

(ii) For the analog transfer function

$$H(s) = \frac{1}{(s+1)(s+2)}$$

Determine H(z) using impulse invariant technique. Assume T = 1sec.

5. (a) The transfer function of discrete time causal system is given below **10**

$$H(z) = \frac{(1-z^{-1})}{(1-0.2z^{-1}+0.15z^{-2})}$$

(i) Find the differece equation.
(ii) DF - I and DF - II
(iii) Draw Parallel and Cascade realization.
(iv) Show pole and zero diagram and find magnitude at $\omega = 0$ and $\omega = \pi$.

(b) A filter is to be designed with the following desired frequency response **10**

$$H(e^{j\omega}) = 0 \quad ; \quad -\pi/4 \le |\omega| \le \pi/4$$
$$= e^{-j2\omega} \quad ; \quad -\pi/4 \le |\omega| \le \pi$$

Determine the filter coefficient h(n) if the window function is defined as

$$w(n) = 1, \quad 0 \le n \le 4$$
$$= 0, \quad \text{otherwise}$$

Also determine the frequency response $H(e^{j\omega})$ of the designed filter.

6. (a) Determine H(z) for a digital Butterworth filter that satisfying the following constraints **10**

$$\sqrt{0.5} \le |H_d(e^{j\omega})| \le 1 \quad ; \quad 0 \le \omega \le \pi/2$$
$$|H_d(e^{j\omega})| \le 0.2 \quad ; \quad 3\pi/4 \le \omega \le \pi$$

with T = 1sec. Apply impulse Invariant transformation.

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(b) (i) A sequence is given as $x(n) = \{1 + 2j, 1 + 3j, 2 + 4j, 2 + 2j\}$, from the basic definition, find X(k). If $x_1(n) = \{1, 1, 2, 2\}$ and $x_1(n) = \{1, 1, 2, 2\}$. Find $X_1(k)$ and $X_2(k)$ by using DFT only. **10**

(ii) Sequence $x_p(n)$ is a periodic repletion of sequence x(n). What is the relationship between C_k of discrete time Fourier series of $x_p(n)$ and X(k) of x(n)?

7. Write notes on (any **three**) :— **10**

(a) Adaptive television echo cancellation
(b) Goertzel algorithm
(c) Decimation by integer factor (M) and interpolation by integer factor (L)
(d) Ovderlap add and overlap save method for long data sequence.
