B. Tech Degree VI Semester Examination, April 2009

CS/EI/EE 601 DIGITAL SIGNAL PROCESSING

(2002 Scheme)

Time : 3 Hours Maximum Marks : 100

I. (a) Determine the zero-input response of the linear time invariant discrete time system described by the difference equation

$$y(k+2)-0.6\,y(k+1)-0.16\,y(k)=5x(k+2),\text{ with}$$

$y(-1)=0,\ y(-2)=\frac{25}{4},\ y(k)$ denote the o/p and $x(k)$ denote the input. (10)

(b) Use z – transform to perform the convolution of the following two sequences.

$$h(n)=\left(\frac{1}{2}\right)^n \quad 0\le n\le 2$$
$$=0 \quad else$$
$$x(n)=\delta(n)+\delta(n-1)+4\delta(n-2).$$ (10)

OR

II. (a) Consider a system whose output $y(n)$ is related to the input $x(n)$ by

$y(n)=\sum_{k=-\alpha}^{\alpha}x(k)x(n+k)$. Determine whether the system is

(i) Linear (ii) Shift invariant

(iii) Stable (iv) Causal (10)

(b) Prove (i) Commutative property

(ii) Distributive property of convolution. (10)

III. (a) Discuss the circular shift property of DFT. (5)

(b) $G(k)$ and $H(k)$ are 6 point DFT of the sequences $g(n)$ and $h(n)$ respectively. The DFT of $G(k)$ is given as

$$G(k)=\{1+j,-2.1+j3.2,-1.2-j2.4,0,0.9+j3.1,-0.3+j1.1\}$$

The sequences $g(n)$ and $h(n)$ are related by the circular time shift as

$h(n)=g[<n-n>_N]$. Determine $H(k)$ without computing DFT. (15)

OR

IV. (a) Discuss the Linearity and Conjugate Symmetry property of DFT. (5)

(b) First five points of the eight point DFT of a real valued sequence is given by

$$X[0]=0, X[1]=2+j2,\ X[2]=-j4, X[3]=2-j2, X[4]=0.$$

Determine the remaining points. Hence find the original sequence $x(n)$ using DIFFFT algorithm. Also draw the butterfly diagram. (15)

(Turn Over)

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V. (a) Obtain the direct form and cascade form realization of the transfer function for an FIR system given by $H(z)=\left(1-\frac{1}{4}z^{-1}+\frac{3}{8}z^{-2}\right)\left(1-\frac{1}{8}z^{-1}-\frac{1}{2}z^{-2}\right)$. (10)

(b) What is Gibb's Phenomenon? What is the principle of designing FIR filter using windows? Write the equation for any four window function. (10)

OR

VI. (a) Discuss the Fourier series method of designing FIR Filters. (5)

(b) Design an FIR HPF with the frequency response

$$H_d\left(e^{jw}\right)=1 \quad \text{for } \frac{-\pi}{4}\le w\le\pi$$
$$=0 \quad \text{for } |w|\le\pi/4$$

Using Hanning Window. Take $N=11$. (15)

VII. (a) Obtain the direct form I and II for the second order IIR Filter given by

$$y(n)=2b\,Cosw_0 y(n-1)-b^2y(n-2)+x(n)-bCosw_0x(n-1).$$ (10)

(b) For the analog Transfer function $H(s)=\frac{2}{(s+1)(s+2)}$, determine $H(z)$ using impulse invariance method. Assume $T=1$ second. (10)

OR

VIII. (a) Explain bilinear transformation. (5)

(b) Design a digital butter worth IIR filter satisfying the specification.

$$0.707\le\left|H\left(e^{jw}\right)\right|\le 1 \quad \text{for} \quad 0\le w\le \pi/2$$
$$\left|H\left(e^{jw}\right)\right|\le 0.2 \quad \text{for} \quad \frac{3\pi}{2}\le w\le\pi$$

with $T=1\sec$. Using bilinear transformation and realize the filter in direct form II. (15)

IX. (a) Explain fixed point arithmetic and floating point arithmetic. (10)

(b) Discuss the coefficient quntization effects in direct form realization of IIR filter. (10)

OR

X. (a) List the features of DSP processor. (5)

(b) Explain the architecture of a typical DSP processor with a neat diagram. (15)

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