Code No: RR410201 **Set No. 1**

IV B.Tech I Semester Supplimentary Examinations, February 2008
DIGITAL SIGNAL PROCESSING
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Consider a LSI system with unit sample response $h(n)n = \alpha^n u(n)$ where α is real and $0 < \alpha < 1$. If the input is $x(n) = \beta^n\, u(n), 0 < |\beta| < 1$,determine the the output f(n) in the form $y(n) = (k_1\alpha^n + k_2\beta^n u(n)$ by explicitly evaluating the convolution sum.

   (b) Define causality and stability of LSI system and state the conditions for stability.

   [12+4]

2. Consider two periodic sequences x(n) and y(n), x(n) has period N and y(n) has period M. The sequence w(n) is defined as w(n) = x(n) + y(n).

   (a) Show that w(n) is periodic with period MN.

   (b) Determine W(K) in terms X(K) and Y(K) where X(K), Y(K) and W(K) are the Discrete Fourier series coefficients with a period of N, M and MN respectively. [8+8]

3. (a) State and prove the circular time shifting and frequency shifting properties of the DFT.

   (b) Compute the circular convolution of the sequences
   $x_1(n) = \{1, 2, 0, 1\}$ and
   $x_2(n) = \{2, 2, 1, 1\}$ Using DFT approach. [8+8]

4. (a) Implement the Decimation in frequency FFT algorithm of N-point DFT where N-8. Also explain the steps involved in this algorithm.

   (b) Compute the FFT for the sequence x(n) = { 1, 1, 1, 1, 1, 1, 1, 1 } [8+8]

5. (a) Explain how the analysis of discrete time invariant system can be obtained using convolution properties of Z transform.

   (b) Determine the impulse response of the system described by the difference equation y(n)-3y(n-1)-4y(n-2)=x(n)+2x(n-1) using Z transform. [8+8]

6. (a) Find the order and poles of a low pass Butterworth filter that has a -3db bandwidth of 500 Hz and an attenuation of 40db at 1KHz.

   (b) Convert the following analog filter with transfer function
   $H(S) = S + 0.1/(S + 0.2)^2 + 9$ into a digital IIR filter by using bilinear transformation method. The digital IIR filter is having a resonant frequency of $Wr = \pi/2$. [8+8]

7. (a) Design a band stop filter to reject frequencies in the range 1-2 radians/second using rectangular window N=7

   (b) Write the magnitude and phase function of FIR filter when impulse response is anti symmetric and N is odd function. [8+8]

8. (a) Obtain the cascade and parallel form realisation of the LTI system governed by the equation.

   (b) Compare cascade and performance of direct and canonic forms. [12+4]

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Code No: RR410201 **Set No. 2**

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DIGITAL SIGNAL PROCESSING
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Consider a LSI system with unit sample response $h(n)n = \alpha^n u(n)$ where α is real and $0 < \alpha < 1$. If the input is $x(n) = \beta^n\, u(n), 0 < |\beta| < 1$,determine the the output f(n) in the form $y(n) = (k_1\alpha^n + k_2\beta^n u(n)$ by explicitly evaluating the convolution sum.
   (b) Define causality and stability of LSI system and state the conditions for stability.
   [12+4]

2. (a) Prove that the convolution in time domain leads to multiplication in frequency domain for discrete time signals
   (b) The out put y(n) for a linear shit invariant system, with the input x(n) is given by
   Y(n) = x(n)-2x(n-1)+x(n-2)
   Compute and sketch the magnitude and phase response of the system $|w| \leq \pi$
   [8+8]

3. (a) What is " padding with Zeros " with an example, Explain the effect of padding a sequence of length N with L Zeros or frequency resolution.
   (b) Compute the DFT of the three point sequence $x(n) = \{2, 1, 2\}$. Using the same sequence, compute the 6 point DFT and compare the two DFTs. [8+8]

4. An 8 point sequence is given by x(n) = {2,2,2,2,1,1,1,1}. Compute 8 point DFT of x(n) by
   (a) radix - 2 D I T F F T
   (b) radix - 2 D I F FF T
   Also sketch magnitude and phase spectrum. [16]

5. (a) Explain how the analysis of discrete time invariant system can be obtained using convolution properties of Z transform.
   (b) Determine the impulse response of the system described by the difference equation y(n)-3y(n-1)-4y(n-2)=x(n)+2x(n-1) using Z transform. [8+8]

6. (a) What is an IIR digital filter?
   (b) How are IIR digital filter realized?
   (c) What are the various realizability constraints imposed on transfer function of an IIR digital filter. [4+4+6]

7. (a) Design a low pass digital FIR filter using Kaiser window satisfying the specifications given below.
   Pass band cut-off frequency = 150 Hz.
   Stop band cut-off frequency = 250 Hz.
   Pass band ripple = 0.1dB
   Stop band attenuation = 40 dB
   Sampling frequency = 1000 Hz.

   (b) Draw the butterfly line diagram for 8 - point FFT calculation and briefly explain. Use decimation -in-time algorithm. [8+8]

8. (a) Explain the structures for realisation of FIR system and draw the direct form structure of the FIR system described by the transfer function
   H(Z) = $1 + \frac{1}{2}Z^{-1} + \frac{3}{4}Z^{-2} + \frac{1}{4}Z^{-3} + \frac{1}{2}Z^{-4} + \frac{1}{8}Z^{-5}$

   (b) Realize the following IIR system by cascade and parallel forms.
   $y(n) + \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = x(n) - 2x(n-1) + x(n-2)$ [8+8]

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Code No: RR410201 **Set No. 3**

IV B.Tech I Semester Supplimentary Examinations, February 2008
DIGITAL SIGNAL PROCESSING
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Determine the impulse response for the systems given by the following difference equations.
   i. y(n)+3y(n-1)+2y(n-2)=2x(n)-x(n-1)
   ii. y(n)=x(n)+3x(n-1)-4x(n-2)+2x(n-3)

   (b) Obtain condition for stability?

   [12+4]

2. A LTI system is described by the difference equation y(n)=ay(n-1)+bx(n). Find the impulse response, magnitude function and phase function. Find the value of b if $|H(jw)| = 1$. Sketch the magnitude and phase response for a=0.9. [16]

3. (a) Compute the discrete Fourier transform of each of the following finite length sequences considered to be of length N.
   i. $x(n) = \delta(n)$
   ii. $x(n) = \delta(n - n_0) where 0 < n_0 < N$
   iii. $x(n) = a^n 0 \leq n \leq N - 1$

   (b) Let $x_2(n)$ be a finite duration sequence of length N and $x_1(n) = \delta(n - n_0)$ where $n_0 < N$. Obtain the circular convolution of two sequences. [8+8]

4. (a) Implement the Decimation in frequency FFT algorithm of N-point DFT where N-8. Also explain the steps involved in this algorithm.

   (b) Compute the FFT for the sequence x(n) = { 1, 1, 1, 1, 1, 1, 1, 1 } [8+8]

5. (a) An LTI system is described by the equation y(n)=x(n)+0.81x(n-1)-0.81x(n-2)-0.45y(n-2). Determine the transfer function of the system. Sketch the poles and zeroes on the Z-plane.

   (b) Define stable and unstable system test the condition for stability of the first-order IIR filter governed by the equation y(n)=x(n)+bx(n-1). [8+8]

6. (a) Discuss Bilinear transformation method of deriving IIR digital filter from corresponding analog filter.

   (b) Convert the following analog filter with transfer function.
   $H_A(S) = S + 0.2/(S + 0.2)^2 + 16$ using Bilinear transformation method. [8+8]

7. Design a low pass Finite Impulse Response filter that approximate the following frequency response:

$$H(f) = \begin{cases} 1\,; & 0 \le f \le 1000\,Hz \\ 0\,; & elsewhere\,\text{in}\,the\,range\,0 \le f \le f_s/2 \end{cases}$$

when the sampling frequency is 8000 sps. The impulse response duration is to be limited to 2.5 msec. Draw the filter structure. [16]

8. (a) Realize the following systems with minimum number of multipliers.
   H(Z) = $\frac{1}{4} + \frac{1}{2}Z^{-1} + \frac{3}{4}Z^{-2} + \frac{1}{2}Z^{-3} + \frac{1}{4}Z^{-4}$
   H(Z) = $\left[1 + \frac{1}{2}Z^{-1} + Z^{-2}\right]\left[1 + \frac{1}{4}Z^{-1} + Z^{-2}\right]$

   (b) Explain the principles of VOCODERS. [10+6]

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Code No: RR410201

Set No. 4

IV B.Tech I Semester Supplimentary Examinations, February 2008
DIGITAL SIGNAL PROCESSING
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. By explicitly evaluating the convolution sum, evaluate the convolution y(n)=(n)*h(n) of the sequences
$h(n) = \begin{cases} \alpha^n & 0 \le n < N \\ 0 & elsewhere \end{cases}$
$X(n) = \begin{cases} \beta^{n-n0}, & n_0 \le n \\ 0 \quad , & n \le n_0 \end{cases}$ [16]

2. (a) Discuss the frequency-domain representation of discrete-time systems and signals. By deriving the necessary relation.
   (b) Draw the frequency response of LSI system with impulse response $h(n) = a^n u(-n)$ $(|a| < 1)$

   [8+8]

3. (a) Compute Discrete Fourier transform of the following finite length sequence considered to be of length N.
      i. $x(n) = \delta(n + n_0)$ *where* $0 < n_0 < N$
      ii. $x(n) = \infty^n$ *where* $0 < \infty < 1$.
   (b) If x(n) denotes a finite length sequence of length N, show that $x((-n))_N = x((N - n))_N$. [8+8]

4. (a) Explain the inverse FFT algorithm to compute inverse DFT of a N=8. Draw the flow graph for the same.
   (b) Compute the FFT for the sequence { 1, 0, 0, 0, 0, 0, 0, 0 } [8+8]

5. (a) With reference to Z-transform, state the initial and final value theorem.
   (b) Determine the causal signal x(n) having the Z-transform $X(Z) = \frac{Z^2+Z}{\left(Z-\frac{1}{2}\right)^2\left(Z-\frac{1}{4}\right)}$. [6+10]

6. Determine the system function H(Z) of the lowest order Chebyshev digital filter that meets the following specifications.
   (a) 1 db ripple in the passband $0 \le |W| \le 0.3\pi$
   (b) At least 60 db attenuation in the stopband $0.35\pi \le |W| \le \pi$. Use the bilinear transformation. [16]

7. (a) Explain briefly the method of designing FIR filter using Fourier series method

(b) Design a FIR filter approximating the ideal frequency response

$$H_d(e^{j\Omega}) = \begin{cases} e^{-j\alpha\Omega}, & for\ |\Omega| \leq \pi/6 \\ 0, & for\ \pi/6 \leq |\Omega| \leq \pi \end{cases}$$

Determine the filter coefficients for N=13. [6+10]

8. (a) Write the difference equations for FIR and IIR system and hence derive the transfer function of FIR and IIR system.

(b) Realize the following system with minimum number of multipliers

$$H(Z) = 0.5+0.75Z^{-1}+0.8Z^{-2}+0.9Z^{-3}+2Z^{-4}+0.9Z^{-5}+0.8Z^{-6}+0.75Z^{-7}+0.5Z^{-8}$$

[8+8]

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