Code No: R05311101 **Set No. 1**

III B.Tech I Semester Regular Examinations, November 2007
DIGITAL SIGNAL PROCESSING
(Common to Bio-Medical Engineering and Electronics & Computer Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Find the convolution of the given two signals:
graphically: x(n)=u(n)-u(n-5)
h(n)=2[u(n)-u(n-3)]
(b) Verify the result of part(a) by evaluating directly the convolution sum. [16]

2. (a) If x(n) is a periodic sequence with a period N, also periodic with period 2N. $X_1(K)$ denotes the discrete Fourier series coefficient of x(n) with period N and $X_2(k)$ denote the discrete Fourier series coefficient of x(n) with period 2N. Determine $X_2(K)$ in terms of $X_1(K)$.
(b) Prove the following properties.
i. $W_N^n x(n) \rightarrow X\left((K+1)\right)_N R_N(K)$
ii. $\mathrm{x} * (\mathrm{n}) \rightarrow \mathrm{X} * ((-\mathrm{K}))_{\mathrm{N}} \mathrm{R_N(K)}$ [8+8]

3. (a) Let x(n) be a real valued sequence with N-points and Let X(K) represent its DFT , with real and imaginary parts denoted by $X_R(K)$ and $X_I(K)$ respectively. So that $\mathrm{X(K)} = X_R(K) + JX_I(K)$. Now show that if x(n) is real, $X_R(K)$ is even and $X_I(K)$ is odd.
(b) Compute the FFT of the sequence x(n) = { 1, 0, 0, 0, 0, 0, 0, 0 } [8+8]

4. (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]

5. (a) Justify the statement IIR filter is less stable and give reasons for it.
(b) Find filter order for following specifications
$\sqrt{0.5} \leq |H\left(e^{j\omega}\right)| \leq 1 \qquad 0 \leq \omega \leq \pi/2$
$| \qquad H\left(e^{j\omega}\right)| \leq 0.2 \qquad 3\pi/4 \leq \omega \leq \pi$
With T = 1 sec. use Impulse Invariant method. [8+8]

6. (a) Describe the FIR filter characteristics in time domain.
(b) Determine the frequency response of a linear phase FIR filter given by
$\mathrm{y(n)} = \mathrm{A_1x(n)} + \mathrm{A_2x(n-1)} + \mathrm{A_3x(n-2)} + \mathrm{A_2x(n-3)} + \mathrm{A_1x(n-4)}$. [6+10]

7. Consider the signal $\mathrm{x(n)} = \mathrm{a}^{\,n}\ \mathrm{u(n)}$, $|\mathrm{a}| < 1$

(a) Determine the spectrum of a signal.

(b) The signal is applied to a decimator that reduces sampling rate by a factor by '2'. Determine its output spectrum.

(c) Show that the spectrum in part (ii) is simply Fourier transform of x(2n). [16]

8. (a) Describe programmable Digital signal processor with RISC and CISC.

(b) Mention some applications of on chip timer in programmable Digital signal processor. [8+8]

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Code No: R05311101 **Set No. 2**

III B.Tech I Semester Regular Examinations, November 2007
DIGITAL SIGNAL PROCESSING
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Find the frequency response of an LTI system given its impulse response

   i. h(n)= δ(n)+ 6δ(n-1)+ 3δ(n-2)
   ii. h(n)= $\left(\frac{1}{3}\right)^{n+2} . u\,(n-2)$

   (b) Find the magnetude, phase and group delay of a system that has a unit sample response
   h(n)=δ(n)=α δ(n-1), where α is real. [16]

2. (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. $x(n) = a^n$ $0 \le n \le N-1$

   (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]

3. 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]

4. (a) Determine the frequency response , magnitude response and phase response for the system given by $y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) - x(n-1)$

   (b) A causal LTI system is described by the difference equation y(n)=y(n-1)+y(n-2)+x(n-1), where x(n) is the input and y(n) is the output. Find

   i. The system function H(Z)=Y(Z)/X(Z) for the system, plot the poles and zeroes of H(Z) and indicate the region of convergence.
   ii. The unit sample response of the system.
   iii. Is this system stable or not? [6+10]

5. Design Butterworth filter with at least 66dB attenuation at $\Omega = 2000\pi$ rad /sec and 3dB attenuation at $\Omega = 1000\pi$ rad /sec . Also realize the filter with suitable technique. Use Impulse Invariant method for analog to digital conversion. [16]

6. (a) FIR filter is a linear phase filter? Justify the statement.
   (b) The length of an FIR filter is '9' , If the filter has linear phase , show that following equation is satisfied
   $\sum_{n=0}^{M-1} h(n)\mathrm{Sin}(\omega\tau - \omega n) = 0.$ [8+8]

7. (a) What is the need for Multirate Digital Signal Processing.
   (b) Consider a signal $x(n) = a^n \quad n > 0$
   $= 0 \quad$ otherwise
      i. Obtain a signal with a decimation factor '3'
      ii. Obtain a signal with a interpolation factor '3'. [6+10]

8. (a) What are the advantages of DSP processors over conventional microprocessors?
   (b) Explain the Implementation of convolver with single multiplier/adder . [8+8]

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Code No: R05311101 **Set No. 3**

III B.Tech I Semester Regular Examinations, November 2007
DIGITAL SIGNAL PROCESSING
(Common to Bio-Medical Engineering and Electronics & Computer Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Define the following terms as referred to LTI discrete time system:
   i. Stability
   ii. Causality
   iii. Time invariance
   iv. Linearity.
   (b) Determine whether the following system is
   i. Linear
   ii. Causal
   iii. Stable
   iv. Time invariant
   $y(n) = \log_{10}|x(n)|$
   Justify your answer. [16]

2. (a) If x(n) is a periodic sequence with a period N, also periodic with period 2N. $X_1(K)$ denotes the discrete Fourier series coefficient of x(n) with period N and $X_2(k)$ denote the discrete Fourier series coefficient of x(n) with period 2N. Determine $X_2(K)$ in terms of $X_1(K)$.
   (b) Prove the following properties.
   i. $W_N^n x(n) \rightarrow X((K+1))_N R_N(K)$
   ii. $x*(n) \rightarrow X*((-K))_N R_N(K)$ [8+8]

3. (a) Implement the decimation in time FFT algorithm for N=16.
   (b) In the above Question how many non - trivial multiplications are required. [10+6]

4. (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]

5. (a) With Impulse Invarience method a first order pole in Ha (s) at $s=s_k$ is mapped to a pole in H(Z)at$Z = e^{skTs}$ as
   $1/(s - sk) ==> 1/(1 - e^{skTs}Z^{-1})$
   Determine how a second order will be mapped

(b) Discuss the concept of frequency transformation in analog domain . [8+8]

6. (a) Describe the FIR filter characteristics in Z - domain

   (b) The length of an FIR filter is '13' , If the filter has linear phase , show that following equation is satisfied.

   $$\sum_{n=0}^{(M-1/)/2} h(n)Sin(\omega\tau - \omega n) = 0.$$ [6+10]

7. (a) Explain Multirate Digital Signal Processing.

   (b) Consider ramp sequence and sketch its interpolated and decimated versions with a factor of '3'. [6+10]

8. (a) What are the advantages of DSP processors over conventional microprocessors?

   (b) Explain the Implementation of convolver with single multiplier/adder . [8+8]

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Code No: R05311101 **Set No. 4**

III B.Tech I Semester Regular Examinations, November 2007
DIGITAL SIGNAL PROCESSING
(Common to Bio-Medical Engineering and Electronics & Computer Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Find the convolution of the given two signals:
graphically: x(n)=u(n)-u(n-5)
h(n)=2[u(n)-u(n-3)]
(b) Verify the result of part(a) by evaluating directly the convolution sum. [16]

2. (a) Prove the following properties.
i. $x^*(n) \rightarrow X^*((-K))_N R_N(K)$
ii. $x^*((-n))_N R_N(n) \rightarrow X_{ep}(k)$
(b) Let X(K) denotes the N-point DFT of the N-point sequence x(n) show that if x(n) satisfies the relation $x(n) = -x(N-1-n) then X(0) = 0$. [8+8]

3. (a) Implement the decimation in time FFT algorithm for N=16.
(b) In the above Question how many non - trivial multiplications are required. [10+6]

4. (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]

5. (a) What is frequency warping ? How it will arise.
(b) Compare Impulse invariant and bilinear transformation methods. [8+8]

6. (a) Describe the FIR filter characteristics in time domain.
(b) Determine the frequency response of a linear phase FIR filter given by $y(n) = A_1x(n) + A_2x(n-1) + A_3x(n-2) + A_2x(n-3) + A_1x(n-4)$. [6+10]

7. Consider the signal $x(n) = a^n u(n)$, $|a| < 1$
(a) Determine the spectrum of a signal.
(b) The signal is applied to a decimator that reduces sampling rate by a factor by '2'. Determine its output spectrum.
(c) Show that the spectrum in part (ii) is simply Fourier transform of x(2n). [16]

8. (a) What are the advantages of DSP processors over conventional microprocessors?

(b) Explain the Implementation of convolver with single multiplier/adder . [8+8]

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