Code No: V3218/R07

Set No -1

III B. Tech II Semester Regular Examinations, Apr/May 2010

DIGITAL SIGNAL PROCESSING

(Common to EEE, ECE, EIE, ICE)

Time: 3 Hours Max Marks: 80

Answer Any FIVE Questions

All Questions Carry Equal Marks

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1.
   a. Define a linear-time invariant system in discrete time. Define the terms causality and stability of such systems. Discuss the above properties for the following sequences.

$$y(n) = \begin{cases} x(n), & \text{for } n \geq 1 \\ 0, & \text{for } n = 0 \\ x(n+1), & \text{for } n \leq -1 \end{cases}$$

   b. Determine the impulse response and step response of the causal system given below and discuss on stability:

$$y(n) + y(n-1) - 2y(n-2) = x(n-1)+2x(n-2)$$

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. $x^*(n) \rightarrow X^*((-K))_N\, R_N(K)$

3.
   a. Compute the FFT of the sequence x(n) = { 1, 0, 0, 0, 0, 0, 0, 0 } using DIFFFT.
   b. Explain the inverse FFT algorithm to compute inverse DFT of N=8 sequence. Draw the flow graph for the same.

4.
   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.

5. Design a Digital IIR low pass filter with pass band edge at 1000 Hz and stop band edge at 1500 Hz for a sampling frequency of 5000 Hz. The filter is to have a pass band ripple of 0.5 dB and stop band ripple below 30 dB. Design Butter worth filler using both impulse invariant and Bi-linear transformations.

6.
   a. Write the magnitude and phase functions of Finite Impulse Response filter when
      i. impulse response is symmetric & N is odd
      ii. impulse response is symmetric & N is even
   b. Design a linear phase low pass filter with a cut-off frequency of $\pi/2$ radians/seconds. Take N=7
7.
   a. Obtain the necessary expression for Interpolation process.
   b. Obtain the necessary expression for decimation process.

8. What are the on-chip peripherals available on programmable Digital signal processors and explain their functions?

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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. Consider an LSI system with unit sample response $h(n)= \alpha^n u(n)$ 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 an LSI system and state the conditions for stability.

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

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 F F T

   Also sketch magnitude and phase spectrum

4.
   a. With reference to Z-transform, state the initial and final value theorem.
   b. Determine the causal signal x(n) having the Z-transform

$$X(z) = \frac{Z^2+Z}{\left(Z-\frac{1}{2}\right)^2\left(Z-\frac{1}{4}\right)}$$

5.
   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. Find filter order for following specifications

$\sqrt{0.5} \le \left|H\left(e^{jw}\right)\right| \le 1\ for\ 0 \le w \le \frac{\pi}{2}$ and $\left|H\left(e^{jw}\right)\right| \le 0.2\ for \frac{3\pi}{4} \le w \le \pi$

   With T = 1 sec. Use Impulse Invariant method.

6. Design a band pass FIR filter that approximate the following frequency response:

$$H(f) = \begin{cases} 1; & 160 \leq f \leq 200 \\ 0; elsewhere\ in\ the\ range\ 0 \leq f \leq \frac{fs}{2} \end{cases}$$

when the sampling frequency is 8000 sps. Limit the duration of impulse response to 2 msec. Draw the filter structure.

7.
   a. Discuss the applications of Multirate Digital Signal Processing.
   b. Describe the decimation process with a factor of 'M'. Obtain necessary expression.

8. Explain with help of block diagram the architecture of TMS320C5X processor.

Code No: V3218/R07 **Set No -3**

III B. Tech II Semester Regular Examinations, Apr/May 2010

DIGITAL SIGNAL PROCESSING

(Common to EEE, ECE, EIE, ICE)

Time: 3 Hours Max Marks: 80

Answer Any FIVE Questions

All Questions Carry Equal Marks

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1.
   a. Find out the convolution sum y(n) of the given signals:
      i. $x_1(n)=2^n\ u(-n)$
      ii. $x_2(n) = u(n)$.
   b. Determine and sketch the magnitude and phase response of the system:
      $y(n) = \frac{1}{3}[x(n) + x(n-1) + x(n-2)]$.

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

3.
   a. Draw the butterfly line diagram for 8 - point FFT calculation and briefly explain. Use decimation in-time algorithm.
   b. Evaluate the 8-point DFT for the following sequences using DIT-FFT algorithm. $x_1(n) = 1$ for $-3 \le n \le 3$ and 0 otherwise

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 $y(n)=x(n) + bx(n-1)$.

5. Convert analog filter with transfer function $\frac{(s+0.1)}{(s+0.1)^2+9}$ into digital IIR filter using Impulse Invariant method. Also sketch response and comment on 'T' value how it affects aliasing.

6.
   a. Design a FIR low pass filter with a cut-off frequency of 1 kHz and sampling rate of 4 kHz with eleven samples using Fourier series method.
   b. Design a high pass filter using hamming window with a cut-off frequency of 1.2radians/second and N=9

7. Design one stage and two stage interpolators to meet following specifications.

   I = 20

   a. Pass band : $0 \leq F \leq 90$
   b. Transition band : $90 \leq F \leq 100$
   c. Input sampling rate : 10,000Hz
   d. Ripple : $\delta 1 = 10^{-2}$, $\delta 2 = 10^{-3}$.

8.
   a. What are the advantages of CISC?
   b. What are the advantages of RISC?

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Set No -4

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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. Test the following systems for linearity, time invariance, causality and stability.
      i. $y(n) = a^{|x(n)|}$
      ii. $y(n) = \sin(2nf\pi/F)\, x(n)$
   b. A causal LTI system is defined by the difference equation
      $2y(n) - y(n-2) = x(n-1)+3x(n-2)+2x(n-3)$.
      Find the frequency response $H(e^{jw})$, magnitude response and phase response.

2.
   a. State and prove time and frequency shifting properties of Fourier transform.
   b. 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 $X_1(K)$.

3.
   a. Implement the decimation in time FFT algorithm for N=16.
   b. In the above Question how many non trivial multiplications are required?

4.
   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.

5.
   a. Justify the statement IIR filter is less stable and give reasons for it.
   b. Convert the following analog filter with transfer function $H(s) = \frac{(s+0.1)}{(s+0.1)^2+9}$ into a digital IIR filter by using bilinear transformation method. The digital IIR filter is having a resonant frequency of $Wr = \pi/2$.

6.
   a. Design a low pass filter using rectangular window by taking samples of w(n) and with a cut-off frequency of 1.2radians/sec.
   b. Compare the various window functions.

7.
   a. Explain Multirate Digital Signal Processing.
   b. Consider a ramp sequence and sketch its interpolated and decimated versions with a factor of '3'.

8. Discuss various interrupt types supported by TMS320C5X processor.