Code No: V3218/R07

Set No: 1

III B.Tech II Semester Regular & Supplementary Examinations, April/May - 2012

DIGITAL SIGNAL PROCESSING

(Common to Electrical and Electronics Engineering & Electronics and Communications Engineering & Electronics and Instrumentation Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

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1. a) Check the following systems for linearity, causality, time invariance and stability using appropriate tests.

   i) $y[n] = ne^{|x[n]|}$ ii) $y[n] = a^n \cos(\frac{2\pi n}{N})$

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

2. a)State and prove the circular time shifting and frequency shifting properties of the DFT.
   b) Compute the circular convolution of the sequences using DFT approach. $x_1[n] = \{1,2,0,1\}$ and $x_2[n] = \{2,2,1,1\}$

3. a) Explain what you understand by 'Bit reversal' and in – place computation.
   b) Implement the decimation in time FFT algorithm for N=16.

4. a) Compare lattice structures with direct form structures.
   b) Draw the lattice form implementation for FIR filter having transfer function
   $H[z] = (1+2z^{-1})(3+4z^{-1})(5+6z^{-1})$.

5. a)What is warping effect? Discuss influence of warping effect on amplitude response and phase response of a derived digital filter from a corresponding analog filter.
   b) Determine the order and transfer function of the Chebyshev filter for following specifications:
      i. Maximum pass band ripple is 1dB for $\Omega \leq 4$ radians/sec.
      ii. Stop band attenuation is 40 db for $\Omega \geq 4$ radians/sec.

6. a) Compare various window techniques used in FIR filter design.
   b) Design a low pass filter using Fourier series method using rectangular windows for 5 taps only, if the folding frequency is 5 kHz and the corner frequencies are 1 and 3 kHz.

7. a) What is the need of sampling rate conversion? Explain in detail.
   b) Define Decimator?
   c) For a given discrete sequence $x[n] = \{1,2,3,4,5,6,7,8,9\}$, determine and sketch the up sampling sequence $y[n] = x[2n]$.

8. Discuss various interrupt types supported by TMS320C5X processor.

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Set No: 2

Code No: V3218/R07

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1. a) Define a linear-shift invariant system. Define the terms causality and stability of such systems. Discuss the properties for the following sequence.

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

b) A system is described by the difference equation: $y[n]-y[n-1]-y[n-2]=x[n-1]$ Assuming that the system is initially relaxed, determine its unit sample response *h(n)*.

2. a)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 the above two sequences.
b) Compute the DFT of the 3-point sequence $x[n]=\{2,1,2\}$. Using the same sequence, compute the 6-point DFT and compare the two DFTs.

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.

4. a) Draw and explain the single stage lattice structure and implement the same for two independent outputs
   i. $y_1[n]=x[n]+k_1x[n-1]$.
   ii. $y_2[n]=k_1x[n]+x[n-1]$

b) Draw the lattice form implementation for FIR filter having transfer function

i $H[z]=1+2z^{-1}+3z^{-2}+4z^{-3}+5z^{-4}$.

ii $H[z]=1-2z^{-1}+3z^{-2}-4z^{-3}+5z^{-4}$

5. a) Derive the expression for bilinear transformation method.
b) Design a digital filter that will pass a 1Hz signal with attenuation less than 2dB and suppress 4Hz signal down to at least 42dB from the magnitude of the 1Hz signal.

6. a) Outline the steps involved in the design of FIR filter using windows.
b) Design a Finite Impulse Response low pass filter with a cut-off frequency of 1 kHz and sampling rate of 4 kHz with eleven samples using Fourier series method.

Set No: 2

Code No: V3218/R07

7. a) Obtain the necessary expression for Interpolation process.
   b) Consider a signal $x[n] = \sin(\pi n) \cdot u[n]$
      i. Obtain a signal with a decimation factor '2'
      ii. Obtain a signal with a interpolation factor '2'..

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

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Set No: 3

Code No: V3218/R07

III B.Tech II Semester Regular & Supplementary Examinations, April/May - 2012

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) A discrete time system can be (i) static or dynamic, (ii) linear or non linear, (iii) causal or non causal, (iv) stable or unstable. Examine the following with respect to the properties above. (i) $y[n] = x[-n]$ (ii) $y[n] = \cos\{x[n]\}$ (iii) $y[n] = x[-n+2]$
   b) Find the
      i. impulse response
      ii. output response for a step input applied at $n=0$ of a discrete time linear time invariant system whose difference equation is given by $y[n] = y[n-1] + 0.5y[n-2] + x[n] + x[n-1]$.

2. a) Define DFT of a sequence x(n). Obtain the relationship between DFT and DTFT.
   b) 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) $x[n] = a^n$ *where* $0 \le n \le N-1$

3. a) Summarise the steps of radix–2 DIT–FFT algorithm and draw the flow graph.
   b) Compute the FFT of the sequence $x[n] = \{1, 0, 0, 0, 0, 0, 0, 0\}$ using DITFFT.

4. Realize the following system using all possible realization methods:

$$H(z) = \frac{1 - \frac{1}{2}Z^{-1}}{(1 - \frac{1}{4}Z^{-1})(1 + \frac{1}{4}Z^{-1})}.$$

5. a)Find filter order for following specifications: $\sqrt{0.5} \le |H(e^{jw})| \le 1 \; for \; 0 \le w \le \frac{\pi}{2}$ and $|H(e^{jw})| \le 0.2 \; for \; \frac{3\pi}{4} \le w \le \pi$ With T = 1 sec. Use Impulse Invariant method.
   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 $W_r = \pi/2$.

6. a)Design a high pass filter using hamming window with a cut-off frequency of 1.2 radians/second and N=9.
   b) Compare the various window functions.

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7. a) Obtain the necessary expression for decimation process.
   b) Consider a signal $x[n] = u[n]$
      i. Obtain a signal with a decimation factor '3'
      ii. Obtain a signal with a interpolation factor '3'.

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

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Set No: 4

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1. a)A system is described by the following difference equation:
$y[n] = 3y[n-1] - nx[n] + 4x[n-1] - 2x[n+1]$
Verify whether the system is linear, shift invariant and causal.
b) Determine the impulse response and unit step response of the system described by the difference equation. $y[n] = 0.7y[n-1] - 0.1y[n-2] + 2x[n] - x[n-2]$

2. a) The DTFT of $x[n] = \left(\frac{1}{5}\right)^n u[n+2]$ is $X(e^{jw})$, find the sequence that has a DTFT given by $Y(e^{jw}) = X(e^{j2w})$.
b) Explain how DFT can be obtained by sampling DFS for a given sequence.

3. a) Draw the butterfly line diagram for 8–point DITFFT algorithm and briefly explain.
b) Compute the eight point DFT of the sequence $x[n] = \{1, 1, 1, 1, 1, 1, 1, 1\}$ using DIF-FFT algorithms.

4. Test for the stability of the following system:
$$y[n] = \frac{3}{4}y[n-1] - \frac{1}{8}y[n-2] + x[n] + \frac{1}{3}x[n-1]$$
Is it an IIR system or an FIR system? Explain the reason. Also realize the system using cascade structure.

5. Design a digital low pass filter with pass band cut off frequency ωp=0.375π with δp=0.01 and stop band frequency ωs=0.5π with δs=0.01.The filter is to be designed with bilinear transformation method. What is the order of Butterworth and Chebyshev approximations?

6. a) Design a linear phase low pass filter with a cut-off frequency of $\frac{\pi}{2}$ radians/second. Take N=7.
b) 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.

7. Design one stage and two stage Interpolator for the following specifications:
I=100, Pass band: $0 \le F \le 90$ transition band: $90 \le F \le 100$
Input sampling rate: 10,000Hz, Ripple: $\delta_1 = 10^{-2}$, $\delta_2 = 10^{-3}$

8. a) What are different steps required to execute the DSP Program.
b) Compare TMS320C fixed and floating point processors.

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