Code No: R32043 **R10** **Set No: 1**

III B.Tech. II Semester Regular Examinations, April/May -2013

DIGITAL SIGNAL PROCESSING

(Comm to Electronics and Communication Engineering & Electronics and Computer Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) Check whether the following systems are linear , causal and time variant
   (**i**) y(n)=x(n)x(n-2) (**ii**) $y(n)=a^n u(n)$ (**iii**) $y(t)=at^2x(t)+btx(t-4)$
   (b) Find the magnitude and phase response for the system characterized by the difference equation $y(n)=\frac{1}{6}x(n)+\frac{1}{3}x(n-1)+\frac{1}{6}x(n-2)$ [9+6]

2. (a) Expand the following function over the interval (-4,4) by a complex Fourier series
$$f(t)=\begin{cases}1 & -2\le t\le 2\\ 0 & otherwise\end{cases}$$
   (b) Perform the circular convolution of the following sequences using DFT and IDFT:
   $x_1(n)$ =[1 2 1 2] and $x_2(n)$=[4 3 2 1] [8+7]

3. (a) Write the procedure to compute IDFT using radix-2 FFT.
   (b) Compute the DFT of the following sequence by DIT-FFT
   x(n) = [1 -1 1 -1 -1 1 1 1] [7+8]

4. (a) Find the inverse z-transform of the following function:
$$X(z)=\frac{1}{1-15z^{-1}+0.5z_{-2}}\quad R0C;|z|>1$$
   (b) An LTI system is described by the difference equation
$$y(n)=-\frac{3}{8}y(n-1)-\frac{3}{32}y(n-2)+\frac{1}{64}y(n-3)+x(n)-3x(n-1)+2x(n-2)$$
   Realize it in direct form-II and Cascade form structures. [7+8]

5. Design a Chebyshev IIR digital low-pass filter to satisfy the constraints using bilinear transformation .
   $0.9 < |H(w)| < 1.0$ $0 < w < 0.3\pi$
   $|H(w)| < 0.15$ $0.5\pi < w < \pi$ [15]

6. Design a high-pass filter using Hamming window, with a cutoff frequency of 1.2 rad/sec and N=9. [15]

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7. Consider the signal $x(n)=a^n u(n)$, $|a|<1$.
   (i) Determine the spectrum of the signal
   (ii) The signal is applied to an interpolator that increases sampling rate by a factor of 2. Determine its output spectrum.
   (iii) Show that the spectrum in part(ii) is simply Fourier transform of x(n/2). [4+7+4]

8. (a) Explain the concept of pipelining in DSP processors.
   (b) What are the advantages of DSP Processors over conventional processors?
   (c) What is role of a central arithmetic logic unit in a DSP processor? Explain
   [5+5+5]

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Code No: R32043 **R10** **Set No: 2**

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DIGITAL SIGNAL PROCESSING

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Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) Check whether the following systems are linear , causal and time variant
   (**i**) y(n)= $\log_{10}$|x(n)| (**ii**) y(t)= x(t/2) (**iii**) y(t)=x(t)+ t x(t-1)
   (b) Find the magnitude and frequency response for the system characterized by the difference equation $y(n)-y(n-1)+\frac{3}{16}y(n-2)=x(n)-\frac{1}{3}x(n-1)+\frac{1}{6}x(n-2)$ [9+6]

2. (a) obtain the trigonometric Fourier Series for the following function

$$f(t)=\begin{cases}0 & -T/2<t<-T/4\\ A & -T/4<t<T/4\\ 0 & T/4<t<T/2\end{cases}$$

   (b)Find the DFT of the discrete time sequence x(n)=[1 1 2 2 3 3] and determine the corresponding amplitude and phase spectrum. [8+7]

3. (a) Compare DIT and DIF FFT algorithms.
   (b) Compute the DFT of the following sequence by DIT-FFT
   x(n) = [1 -2 1 -1 2 1 -2 1] [7+8]

4. (a) Find the inverse z-transform of the following function:

$$X(z)=\frac{1-(1/4)z^{-1}}{1-(5/6)z^{-1}+(1/6)z^{-2}}\quad ROC;|z|>1/2$$

   (b) An LTI system is described by the difference equation

$$y(n)=\frac{1}{6}y(n-1)-\frac{1}{6}y(n-2)+x(n)-\frac{1}{6}x(n-1)+3x(n-2)$$

   Realize it in direct form-II and Parallel form structures. [7+8]

5. Design a Chebyshev IIR digital low-pass filter to satisfy the constraints using bilinear transformation and assuming T=1s.

$$0.707<|H(w)|<1 \qquad 0<w<0.2\pi$$
$$|H(w)|<0.1 \qquad 0.5\pi<w<\pi$$

   [15]

6. Design a Band-pass filter to pass frequencies in the range 1 to 2 rad/sec using Hanning window with N=5. [15]

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7. Consider the signal x(n)=nu(n).
   (i) Determine the spectrum of the signal
   (ii) The signal is applied to decimator that reduces the sampling rate by a factor of 3. Determine the output spectrum.
   (iii) Show that the spectrum in part(ii) is simply Fourier transform of x(3n). [4+7+4]

8. (a) Draw the block diagram of TMS320C50 digital signal processor and explain the functionality of CALU and PLU.
   (b) What is the function of Indexed Register and Auxilary Register? [9+6]

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Code No: R32043 **R10** **Set No: 3**

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DIGITAL SIGNAL PROCESSING

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Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) Check whether the following systems are linear , causal and time variant

   (i) $y(n) = n^2 x(2n)$ $(ii)\ y(n) = \sum_{k=-\infty}^{n+2} x(k)$ $(iii)\ y(t) = x^2(t) + x(t-3)$

   (b) Find the magnitude and frequency response for the system characterized by the difference equation $y(n) + y(n-1) = x(n) - x(n-1)$ [9+6]

2. (a) Find the trigonometric Fourier series of the waveform shown in fig.2(a)

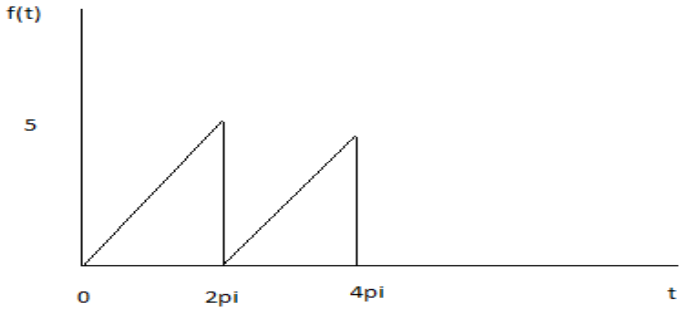

Fig.2(a)

   (b) If the DFT[x(n)] = X(K)=[2 -j3 0 j3] using properties of DFT find the following (i)DFT of $x^2(n)$ (ii)DFT of x*(n) [9+6]

3. (a) Draw the butterfly diagram for 8-point DIF-FFT algorithm and explain it.

   (b) Compute the IDFT of the following sequence by DIT-FFT

   X(K) = [1 1 1 1 1 1 1 1] [7+8]

4. (a) Find the Z-transform of the following function: $x(n) = n(1/2)^n u(n)$

   (b) An LTI system is described by the difference equation

$$y(n) = \frac{13}{12} y(n-1) - \frac{9}{24} y(n-2) + \frac{1}{24} y(n-3) + x(n) - 4x(n-1) + 3x(n-2)$$

   Realize it in direct form-I and Parallel form structures. [7+8]

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5. A digital low-pass filter is required to meet the following specifications. Pass band attenuation <1dB; Pass band edge = 4KHz; Stop band attenuation >40dB; Stop band edge = = 8KHZ; Sampling rate =24KHz. The filter is to be designed by performing the bilinear transformation on an analog system function . Design the Butterworth filter. [15]
6. Design a band –stop filter to reject frequencies in the range 1 to 2 rad/sec using rectangular window with N=7. [15]
7. Compare the single-stage, two-stage, three-stage and multistage realization of the decimator with the following specification: Sampling rate of a signal has to be reduced from 10kHz to 500Hz. The decimation filter H(z) has the pass band edge(Fp) to be 150Hz, stop band edge (Fs) to be 180Hz, pass band ripple (δp) to be 0.002 and stop band ripple (δs) to be 0.001. [15]
8. (a) Discuss the various interrupt types supported by TMS320C5X processor.
   (b) What are the advantages of CISC and RISC Processor? [10+5]

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Code No: R32043 **R10** **Set No: 4**

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DIGITAL SIGNAL PROCESSING

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Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks
*****

1. (a) Check whether the following systems are linear , causal and time variant
   (**i**) y(n)=x(-2n) (**ii**) y(n)=8x(n-4) (**iii**) $y(t) = \int_{-\infty}^{t} x(\tau)\, d\tau$
   (b) Find the magnitude and frequency response for the system characterized by the difference equation $y(n) - y(n-1) + y(n-2) = x(n) - \frac{1}{4}x(n-1)$ [9+6]

2. (a) Prove the Parseval's identity for Fourier Series
   (b) If x(n)=[2 1 2 0] then find IDFT [X(k)] and also IDFT [X(k-1)] [7+8]

3. (a) Draw the butterfly diagram for 8-point DIT-FFT algorithm and explain it.
   (b) Compute the IDFT of the following sequence by DIF-FFT
   X(k) = [12 0 2 -j2 0 0 0 -2+j2 0] [7+8]

4. (a) Find the Z-transform of the following function: $x(n) = (1/3)^n \sin\left(\frac{\pi}{4}n\right)u(n)$
   (b) An LTI system is described by the difference equation
   $y(n) = a_1 y(n-1) + x(n) + b_1 x(n-1)$
   Realize it in direct form-I and direct form-II structures. [7+8]

5. Design a Low-pass Butterworth filter using the bilinear transformation method for satisfying the following constraints:
   Pass band : 0-400 Hz; Stop band: 2.1-5KHz; Pass band ripple: 2dB; Stop band attenuation:20dB; Sampling frequency:10KHz. [15]

6. Design a filter with

$$H(e^{jw}) = \begin{cases} e^{-j3w} & -\frac{\pi}{4} \le w \le \frac{\pi}{4} \\ 0 & \frac{\pi}{4} \le w \le \pi \end{cases}$$

   Using a Hamming window with N=7 [15]

7. (a) Derive the transfer formula of an interpolator and also explain the operator with neat diagram.
   (b) Discuss about the practical implementation of multirate sampling operations. [7+8]

8. (a) What are the on-chip peripherals available in TMS320C5X processor? Explain any two peripherals.
   (b) Explain the pipeline operation with suitable example. [10+5]

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