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

III B.Tech I Semester Regular Examinations, November 2008
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 out the convolution sum y(n) of the given signals:
   $x_1(n)=2^n$ u(-n)
   $x_2(n)$ = u(n).
   (b) State and prove time shifting and differentiation properties of DTFT. [16]

2. (a) Distinguish between DFT and DTFT.
   (b) Consider a sequence x(n) of length L. Consider its DTFT $X_d(w)$ is sampled and N is the number of frequency samples. Discuss the relation between L and N for inverse DTFT = inverse DFT comment on the aliasing problem.
   (c) Compute the DFT of $x(n) = \{1, 0, 0, 0\}$ and compare with $X_d(w)$. [4+6+6]

3. (a) Explain what you understand by 'Bit reversal' and In - place computation.
   (b) Given a sequence $x(n) = nfor0 \leq n \leq 7$, find its frequency spectrum via FFT. How do you improve the spectral resolution? [6+10]

4. (a) How will you test the stability of a digital filter? Discuss the stability of the system described by $H(Z) = \frac{Z^{-1}}{1-Z^{-1}-Z^{-2}}$
   (b) Determine the frequency, magnitude and phase responses and time delay for the system
   $y(n) + \frac{1}{4}y(n-1) = x(n) - x(n-1)$ [8+8]

5. Design a digital low pass filter with pass band cut off frequency $\omega_p = 0.375\pi$ with δ_p= 0.01 and stop band frequency ω_s =0.5p with δ_s = 0.01.The filter is to be designed with bilinear transformation. What is the order of Butterworth and chebyshev approximations. [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. Design two stage decimator for the following specifications.
   D = 100
   Passband : $0 \leq F \leq 50$
   Transitionband : $50 \leq F \leq 55$
   Inputsamplingrate : 10,000HZ
   Ripple : $\delta_1 = 10^{-1}$, $\delta_2 = 10^{-3}$ [16]

8. (a) What are the advantages of CISC?
   (b) What are the advantages of RISC? [16]

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

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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) State and prove parseval's theorem for the sequence x(n).
   (b) Compute the inverse DTFT of
   $X\left(e^{jw}\right) = j\left(4 + 2\cos w + 3\cos 2w\right).\sin\left(\frac{w}{2}\right).e^{\frac{jw}{2}}$
   (c) What are the properties of LTI system? Prove them. [6+6+4]

2. (a) Define DFT of a sequence x(n). Obtain the relationship between DFT and DTFT.
   (b) Consider a sequence $x(n) = \{2, -1, 1, 1\}$ and T = 0.5 compute its DFT and compare it with its DTFT. [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. [12+4]

4. (a) How will you test the stability of a digital filter? Discuss the stability of the system described by $H(Z) = \frac{Z^{-1}}{1-Z^{-1}-Z^{-2}}$
   (b) Determine the frequency, magnitude and phase responses and time delay for the system
   $y(n) + \frac{1}{4}y(n-1) = x(n) - x(n-1)$ [8+8]

5. Use Impulse Invarient method to design a low pass digital Butterworth to meet following specifications of the filter:
   $0.9 \leq \left|H\left(e^{j\omega}\right)\right| \leq 1 \qquad 0 \leq \omega \leq 0.2\pi$
   and $\left|H\left(e^{j\omega}\right)\right| \leq 0.2 \qquad 0.3\pi \leq \omega \leq \pi$
   [16]

6. (a) Give the comparison of FIR and IIR filters.
   (b) Express the different window functions used in FIR filter design and sketch the plots in time domain . [8+8]

7. Design a linear phase FIR filter that satisfy following specifications based on a single and two stage multi structures.
   (a) Pass band : $0 \leq$ F ≤ 60
   (b) Transition band : $60 \leq$ F ≤ 65
   (c) Input sampling rate : $10,000$HZ

(d) Ripple : $\delta_1 = 10^{-1}$, $\delta_2 = 10^{-3}$. [16]

8. Explain with help of block diagram the architecture of TMS320C5X processor.[16]

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

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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) State and prove duality and convolution properties of DTFT
   (b) Determine and sketch the magnitude and phase response of the sytem: $y(n) = \frac{1}{3}[x(n) + x(n-1) + x(n-2)]$. [16]

2. (a) Define DFT and list the properties of DFT.
   (b) Discuss the effects of truncating a sequence x(n) of infinite duration.
   (c) Compute the DFT of $x(n) = \{-1, 0, -1\}$ with T = 0.5. Plot the DFT sequence suggest a method for improving frequency resolution. [4+6+6]

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. [8+8]

4. (a) Check for the stability of the following system: $H(z) = \frac{2.2z^3 - 4.57028z^2 - 3.06z - 0.593}{z^4 - 1.84z^3 + 1.2294z^2 + 0.23z - 0.354}$.
   (b) State and prove the necessary and sufficient condition for stability of a system. [8+8]

5. If the specifications of analog low pass filter are to have a 1 dB attenuation at cutoff frequency of 1KHZ and maximum stop band ripple $\delta_s = 0.01$ for |f| > 5KHZ , determine required filter order for
   (a) Butterworth
   (b) Type - I Chebyshev
   (c) Type- II Chebyshev. [16]

6. Design a band pass filter with frequency response

   $H_d(e^{j\omega}) = e^{-j2\omega n_o}$ $\omega_{c1} \leq |\omega| \leq \omega_{c2}$
   $= 0$ otherwise

   Design a filter for N = 7 and cut off frequency $\omega_{c1}=\pi/4$ and $\omega_{c2}=\pi/2$ Using
   (a) Hanning window.
   (b) Hamming window. [16]

7. (a) Obtain the necessary expression for Interpolation process.
   (b) Obtain the necessary expression for decimation process. [8+8]
8. Explain the features of TMS320C54x DSP processor. [16]

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Code No: R05311101

Set No. 4

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

Answer any FIVE Questions
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1. (a) From the fundamentals obtain the expression for the DTFT and obtain its inverse transform.
   (b) Given the causal system
   y(n)-y(n-1)=x(n)+x(n-1)
   Find the response to the following:
      i. x(n)=u(n)
      ii. x(n)=2^{-n}u(n). [16]

2. (a) State and prove convolution property of DFS in frequency domain.
   (b) Find the N-point DFT of the sequence
   x(n)=cos(nw_o), $0 \leq n \leq N-1$
   Compare the values of the DFT coefficients $X(k)$ when $\omega_0 = \frac{2\pi k_o}{N}$ to those when $\omega_o \neq \frac{2\pi k0}{N}$. [6+10]

3. (a) Summarise the steps of radix - 2DIT - FFT algorithm and draw the flow graph.
   (b) Evaluate the 8-point DFT for the following sequences using DIT-FFT algorithm.
   $x_1(n) = \begin{cases} 1 & for\ -3 \leq n \leq 3 \\ 0 & otherwise \end{cases}$ [8+8]

4. (a) Determine the frequency 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 and realize a digital low pass Butterworth filter using bilinear transformation to meet following specifications.
   Pass band edge frequency = 1.25 KHZ
   Stop band edge frequency = 2.75 KHZ
   Pass band ripple $\leq$ 0.5dB
   Stopband attenuation $\geq$ 15 dB
   Sampling frequency - 10KHZ. [16]

6. Design a band stop filter with desired frequency response
   $H_d(e^{j\omega}) = e^{-j2\omega n_o}$ $\quad -\omega_{c1} \leq \omega \leq \omega_{c2}$
   $\quad \& \omega_{c2} \leq |\omega| \leq \pi$
   $= 0$ $\quad$ otherwise

   Design a filter for N = 7 and cutoff frequency $\omega_{c1}=\pi/4$ and $\omega_{c2}= 3\pi/4$ Using

   (a) Hanning window.

   (b) Hamming window. [16]

7. (a) 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'.

   (b) Consider a signal x(n) = Sinπn. u(n)
      i. Obtain a signal with a decimation factor '2'
      ii. Obtain a signal with a interpolation factor '2'. [6+10]

8. Discuss the on chip peripherals available on the TMS320C5X processor and explain their function. [16]

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