Code :R7320201

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III B.Tech II Semester(R07) Regular & Supplementary Examinations, April/May 2011

DIGITAL SIGNAL PROCESSING

(Common to Electrical & Electronics Engineering, Electronics & Control Engineering, Electronics & Communication Engineering, Electronics & Instrumentation Engineering)

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

Answer any FIVE questions
All questions carry equal marks

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1. (a) Explain the concept Digital Signal Processing.
   (b) Sketch following signal and find its energy or power whichever is appropriate. $X(n)=8(0.5)^n u(n)$
2. State and prove following properties of DFS
   (a) Linearity
   (b) Periodic Convolution
   (c) Shift of a sequence
   (d) Duality
3. Discuss in detail the concept of decimation in frequency FFT. Also sketch the necessary flow graph for N=8
4. (a) Explain the advantages and disadvantages of Direct form-II realization over Direct form-I.
   (b) Realize following system with difference equation in cascade form $y(n)=(3/4)\, y(n-1)-(1/8)\, y\,(n-2)+x(n)+(1/3)x(n-1)$
5. (a) Compare the backward and forward difference methods of digital filter approximations.
   (b) Convert following analog filter transfer function into digital filter transfer function using backward difference method $H(s)=1/(s+2)^2+9$
6. Design highpass filter using Bartlett window with a cutoff frequency of 1.2 rad/sec and N=9. Consider
   $H_d(e^{j\omega}) = e^{-ja\omega} \quad \omega_c \le |\omega| \le \pi$
   $=0 \quad$ otherwise
   Also find $H(e^{j\omega})$
7. Sketch the following signals
   $x_1(n) = n \qquad n > 0$
   $= 0 \qquad otherwise$
   $x_2(n) = n^2 \qquad n > 0$
   $= 0 \qquad otherwise$
   Also sketch decimated and interpolated version of above signals with factor of '2'.
8. (a) Distinguish between the dual-access RAM and single-access RAM used in the on-chip memory of 5X processor.
   (b) Discuss about Von Neumann architecture.

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1. (a) Sketch the following signals and describe how they are related
   i. $x(n) = \delta(n)$
   ii. $f(n) = rect(n)$
   iii. $g(n) = tri(n)$
   iv. $h(n) = \sin c(n)$

   (b) Explain how an arbitrary sequence is represented in terms of impulses.

2. (a) The first five points of the eight-point DFT of a real-valued sequence are {0,25, 0.125$_{-j}$0.3018, 0, 0.125$_{-j}$0.0518,0}. Determine the remaining three points.

   (b) Compute DFT of x(n)={0,1,2,3}

3. (a) What are the twiddle factors ? Explain.

   (b) Find DFT of sequence using DIT-FFT x(n)={1/2, 1/2, 1/2, 1/2 0,0,0,0 }

4. Find inverse z-transform of following z-transforms using partial fraction expansion

   (a) $X_{(z)} = 1/(1 - 1.5z^{-1} + 0.5z^{-2})$

   (b) $X_{(z)} = 1/(1 + z^{-1})(1 - z^{-1})^2$

5. Describe the IIR filter design approximation using Bilinear Transformation method. Also sketch the s-plane to z-plane mapping. State its merits and demerits.

6. A low pass filter has the desired frequency response as given by
   $H_d(e^{j\omega}) = 0 \quad -\pi/4 \leq \omega \leq \pi/4$
   $= e^{-j2\omega} \quad \pi/4 \leq |\omega| \leq \pi$
   Determine the filter coefficients hd(n) if the window function is used is
   $w(n) = 1 \quad 0 \leq \omega \leq 4$
   =0 otherwise Also determine the frequency response H(e^{jw}) of the designed filter.

7. Implement a two stage decimator for the following specifications. Sampling rate of the input signal =20,000Hz.
   M=100
   Pass band=0 to 50 Hz
   Transition band = 50 to 70 Hz
   Pass band ripple = 0.01
   Stop band ripple =0.002

8. With respect to TMS320C5X DSP processor, explain the following:

   (a) Central Arithmetic Logic Unit

   (b) Index Register

   (c) Memory - Mapped Registers.

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Code :R7320201 **3**

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1. Check whether the systems described by the following equations are causal
   (a) y(n) = 3x(n-2) + 3x (n+2)
   (b) y(n)=x(n-1) + ax (n-2)
   (c) y(n)=x(-n)
   (d) y(n)=3y^2(n-1)-nx(n)+4x(n-1)-2x(n+1)
2. Determine the DFT of a sequence x(n)={1,1,0,0} and check the validity of answer by calculating IDFT.
3. Find the 8-point DFT of a sequence x(n)=(1,1,1,1,0,0,0,0) using DIT-FFT radix-2 algorithm. Also sketch magnitude and phase of DFT coefficients.
4. State and prove following properties of z-transform
   (a) Time reversal
   (b) Time convolution
   (c) Differentiation in z-domain.
5. Convert the following analog filter transfer function using backward difference method, Impulse invariant method and Bilinear Transformation method. H(s)=1/(s+0.2) Consider T= 1 Sec.
6. Give the expression for rectangular window function. Find its frequency response and also sketch its spectrum. Also discuss its features.
7. The spectrum of a signal x(n) is symmetrical triangular pulse with amplitude of '2' and frequency boundaries are -0.2 to 0.2. Sketch the spectrum and sketch spectrums of
   (a) The zero interpolated signal y(n)=x(n/2)
   (b) The decimated signal d(n)=x(2n)
   (c) The signal g(n) that equals to x(n) for even n, and zero for odd n
8. Discuss about the following w.r.t programmable DSP's
   (a) Bit reversed addressing mode
   (b) Indirect addressing
   (c) TDM serial port.

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1. Determine the sequence corresponding to following frequency domain representation.
   $X(e^{j\omega}) = 1 \quad |\omega| \leq W$ or $-W \leq \omega \leq W$
   $=0 \quad \pi W \leq \omega \leq$
2. Given two sequences as under
   X(n)=1 for n=0
   =0.5 for n=1
   =0 else where
   h(n)=0.5 for n=0
   =1 for n=1
   =0 else where
   Compute circular convolution using DFT approach
3. Given the sequences X(n) and h(n) below, compute the circular convolution using DIT-FFT algorithm
   X(n)={1,1,1,1} h(n)={1,0,1,0}
4. Determine z-transform, ROC and pole-zero locations of
   (a) $\alpha^n u(n)$
   (b) $-\alpha^n u(-n-1)$
5. To meet following frequency specifications find the filter orders of Butter worth and Chybychev
   $0.8 \leq |H(e^{j\omega})| \geq 1 \quad 0 \leq \omega \leq 0.2\pi$
   $|H(e^{j\omega})| \geq 0.2 \quad 0.3\pi \leq \omega \leq \pi$
6. (a) Discuss about characteristics linear phase FIR filters.
   (b) What are the effects of windowing.
7. Let x(n)={1,2,5-1}
   Generate and sketch:
   (a) x(3n)
   (b) Zero interpolated of x(n) i.e. x(n/2)
   (c) Step interpolated of x(n) i. e. x(n/2)
   (d) Linearly interpolated of x(n) i.e. x(n/2).
8. Discuss about:
   (a) Von Neumann architecture.
   (b) Harvard architecture
   (c) Modified Harvard architecture.

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