USN

06EE64

Sixth Semester B.E. Degree Examination, Dec.09/Jan.10
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

Important Note: 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and/or equations written eg, 42+8=50, will be treated as malpractice.

PART – A

1 a. Find N point DFT of the sequence $x(n) = a^n$ for $0 \le n \le N-1$. **(06 Marks)**

b. Compute 5 point DFT of $x(n) = \{1, 0, 1, 0, 1\}$ and hence sketch it's magnitude and phase spectra. **(10 Marks)**

c. Perform circular convolution of the sequences $x_1(n) = \{1, 1, 2, 2\}$ and $x_2(n) = \{1, 2, 3, 4\}$ using circular arrays. **(04 Marks)**

2 a. Consider a finite length sequence $x(n) = \delta(n) + 2\delta(n-5)$.

i) Determine 10 point DFT of x(n).

ii) Find a sequence, that has DFT $y(k) = e^{j4\pi k/10} X(k)$, where X(k) is 10 point DFT of x(n).

iii) Find a 10 point sequence that has a DFT $Y(k) = X(k)\ W(k)$, where W(k) is a 10 point DFT of w(n) as defined by $w(n) = \begin{cases} 1, & 0 \le n \le 2 \\ 0, & \text{otherwise} \end{cases}$. **(10 Marks)**

b. A long sequence x(n) is filtered using a filter having impulse response $h(n) = \{2, 2, 1\}$. Determine the output sequence y(n) if $x(n) = \{3, 0, -2, 0, 2, 1, 0, -2, -1, 0\}$. Use OVERLAPADD fast convolution method. **(10 Marks)**

3 a. Determine X(k) using DIT-FFT algorithm, given $x(n) = 2^n$, where $0 \le n \le 7$. **(10 Marks)**

b. An 8 point DFT of a sequence x(n) is given by $X(k) = \{0, 2-j4.8284, 0, 2 \pm j0.8284, 0, 2 + j4.8284, 0, 2 + j4.8284\}$. Determine x(n) using DIF_FFT algorithm. **(10 Marks)**

4 a. Obtain the cascade and parallel realization for the system function given by

$$H(z) = \frac{1+0.25z^{-1}}{(1+0.5z^{-1})(1+0.5z^{-1}+0.25z^{-1})}.$$ **(14 Marks)**

b. Realize a linear phase FIR filter having following impulse response.

$$h(n) = \delta(n) - \frac{1}{2}\delta(n-1) + \frac{1}{4}\delta(n-2) + \frac{1}{4}\delta(n-3) - \frac{1}{2}\delta(n-4) + \delta(n-5).$$ **(06 Marks)**

PART – B

5 a. Design a low pass, Chebyshev filter with following specifications

i) Acceptable pass land ripple of 2 dB

ii) Cutoff frequency of 1 rad/ sec

iii) Stop band attenuation of 20dB or more beyond 1.3 rad /sec. **(10 Marks)**

b. Design a low pass filter using bilinear transformation to satisfy the following specifications.

i) Monotonic pass and stop bands

ii) -3.01 dB cutoff frequency of 0.5π

iii) Magnitude down atleast by 15 dB at 0.75π. **(10 Marks)**

6 a. Transform $H_a(s) = \frac{s+1}{s^2+5s+6}$ into a digital filter using impulse invariant transformation with $T = 0.1$ sec. **(08 Marks)**

b. Design and realize a digital low pass filter using impulse invariant transformation. The digital filter specifications are as follows.
   i) Monotonic pass and stop bands.
   ii) -3.01 dB cutoff frequency of 2 rad
   iii) Magnitude down atleast by 15 dB at 4.8284 radians. **(12 Marks)**

7 a. Explain transforming an analog normalized low pass filter into analog low pass, high pass, band pass and band reject filters using frequency transformation methods. **(08 Marks)**

b. A low pass FIR filter is to be designed with the following desired frequency transformation methods.

$$H_d(e^{jw}) = \begin{cases} e^{-j2w}, & -\pi/4 \le w \le \pi/4 \\ 0, & \pi/4 < |w| \le \pi \end{cases}$$

Determine the filter co-efficient $h_d(n)$ if the window function is defined as

$$w(n) = \begin{cases} 1, & 0 \le n \le 4 \\ 0, & \text{otherwise} \end{cases}.$$

Also, determine the frequency response $H(e^{jw})$ of the designed filter. **(12 Marks)**

8 a. Compare IIR and FIR filters. **(06 Marks)**

b. Write a note on computational efficiency of DIT-FFT algorithm. Compare it with direct computation of DFT. **(06 Marks)**

c. Explain the architecture of TMS 320 C5 × DSP processor. **(08 Marks)**

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