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10EE64

Sixth Semester B.E. Degree Examination, June/July 2018
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

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

PART – A

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

b. State and prove circular convolution property. **(06 Marks)**

c. Determine the DFT of the sequence $x(n) = n^2$, $0 \le n \le 7$. **(08 Marks)**

2 a. A discrete time LTI system has impulse response $h(n) = 2\delta(n) - \delta(n-1) + 2\delta(n-2)$. Determine the output of the system if the input is $x(n) = 4\delta(n) - 4\delta(n-1) + 8\delta(n-2) - 8\delta(n-3)$; using circular convolution. **(04 Marks)**

b. Using overlap and save method, determine output y(n) of a filter whose impulse response is $h(n) = \{1, 2, 3\}$ and input $x(n) = \{1, -1, 2, -2, 3, -3, 4, -4\}$. Use 6 point circular convolution. **(10 Marks)**

c. Consider the sequence $x(n) = 2\delta(n) + 3\delta(n-1) + 4\delta(n-2) + 5\delta(n-3)$. Compute 6 point DFT of the sequence x(n). Also determine the finite length sequence y(n), that has 6 point DFT $Y(K) = W_6^{4k} X(K)$. **(06 Marks)**

3 a. Determine the 8-point DFT of sequence $x(n) = 2(n+1)$, using DIF-FFT algorithm. Also plot magnitude and phase spectra. **(12 Marks)**

b. Develop DITFFT algorithm for decomposing the DFT for N = 9 with flow diagrams. **(08 Marks)**

4 a. Determine IDFT using DIT-FFT for given frequency samples $x(k) = \{0, 2-j4.828, 0, 2-j0.828, 0, 2+j0.828, 0, 2+j4.828\}$ **(10 Marks)**

b. Explain in-place computation technique in FFT algorithm. **(05 Marks)**

c. Calculate the number of multiplications and additions required in DFT and FFT, with 32 point sequence. Also find the speed improvement factor and number of stages. **(05 Marks)**

PART – B

5 a. Compare IIR & FIR filters. **(04 Marks)**

b. Explain the transformation of an analog normalized lowpass filter into analog lowpass, high pass filter using frequency transformation methods. **(06 Marks)**

c. A digital lowpass filter is required to meet the following specifications:

(i) Monotonic passband and stopband.

(ii) – 3.01 dB cutoff frequency of 0.5π rad.

(iii) Stopband attenuation of atleast 15 dB at 0.75π rad.

Find the system function H(z) and the difference equation realization. **(10 Marks)**

6 a. Derive the bilinear transformation for transforming an analog filter to a digital filter. **(10 Marks)**

b. Design a Butterworth analog highpass filter that will meet the following specifications.
   (i) maximum passband attenuation = 4 dB
   (ii) passband edge frequency = 400 rad/sec
   (iii) minimum stopband attenuation = 40 dB
   (iv) stopband edge frequency = 200 rad/sec. **(10 Marks)**

7 a. Design a Chebyshev I filter to meet the following specifications:
   (i) Passband ripple : ≤ 2 dB
   (ii) Passband edge 1 rad/sec
   (iii) Stopband attenuation ≥ 20 dB
   (iv) Stopband edge 1.3 rad/sec **(10 Marks)**

b. Determine the Butterworth polynomial of the order N = 5. **(10 Marks)**

8 a. Obtain cascade realization for a system having the following system function : **(05 Marks)**

$$H(z) = \frac{(z-1)(z-2)(z+1)z}{\left(z-\frac{1}{2}-j\frac{1}{2}\right)\left(z-\frac{1}{2}+j\frac{1}{2}\right)\left(z-j\frac{1}{4}\right)\left(z+j\frac{1}{4}\right)}$$

b. Obtain parallel realization for the given system **(05 Marks)**

$$H(z) = \frac{\left(1+z^{-1}\right)\left(1+2z^{-1}\right)}{\left(1+\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)\left(1+\frac{1}{8}z^{-1}\right)}$$

c. Realize an FIR linear phase filter for N even, and hence realize the following system filter **(10 Marks)**

$$h(n) = \delta(n) + \frac{1}{16}\delta(n-1) - \frac{1}{32}\delta(n-2) + \frac{1}{16}\delta(n-3) + \delta(n-4)$$

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