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10EC52

Fifth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define DFT and IDFT of a signal. Establish relation between DFT and Z-transform. **(06 Marks)**

b. Find the IDFT of x(k) = (24, -2j, 0, +2j) **(06 Marks)**

c. Find the 8-point DFT of the sequence x(n) = {1, 1, 1, 0}. **(08 Marks)**

2 a. State and prove the circular (i) Time-shift and (ii) Frequency – shift properties of an N-point sequence. **(06 Marks)**

b. Find the 4-point circular convolution of the sequences $x_1(n) = (1, 2, 3, 1)$ and $x_2(n) = (4, 3, 2, 2)$. **(04 Marks)**

c. Let x(k) be a 14-point DFT of length – 14 real sequence x(n). The first 8-samples of x(k) are given by x(0) = 12, x(1) = -1+3j, x(2) = 3+4j, x(3) = 1-5j, x(5) = 6+3j, x(6) = -2-3j, x(7) = 10. Find the remaining samples of x(k). Also evaluate the following :

i) x(0) ii) x(7) iii) $\sum_{n=0}^{13} x(n)$ iv) $\sum_{n=0}^{13} |x(n)|^2$ **(10 Marks)**

3 a. In the direct computation of N-point DFT of x(n), how many

i) Complex additions
ii) Complex multiplications
iii) Real multiplication
iv) Real additions and
v) Trigonometric functions, evaluations are required? **(10 Marks)**

b. Find the output y(n) of a filter whose impulse response h(n) ={ 1, 2, 3, 4} and the input signal to the filter is x(n) = { 1, 2, 1, -1, 3, 0, 5, 6, 2, -2, -5, -6, 7, 1, 2, 0, 1 } using overlap add method with 6-point circular convolution. **(10 Marks)**

4 a. What is chirp-z-transform? Mention its applications. **(04 Marks)**

b. Given x(n) = {1, 0, 1, 0}, find x(2) using Goertzel algorithm. **(06 Marks)**

c. Determine 8-point DFT of a signal x(n) using, Radix – 2 DIF-FFT algorithm, draw the signal flow graph. $x(n) = \{\underset{\uparrow}{0}, 0.707, 1, 0.707, 0, -0.707, -1, -0.707\}$ **(10 Marks)**

PART – B

5 a. For Analog Butterworth filter, derive an expression for order, cut off frequency for design of low pass filter. **(10 Marks)**

b. Design Butterworth filter for following specifications :
$0.8 \le Ha(s) \le 1$ for $0 \le F \le 1KHz$ and $|Ha(s)| \le 0.2$ for $F \ge 5KHz$ **(10 Marks)**

6 a. Realize an FIR filter given by $h(n) = \left(\frac{1}{2}\right)^n [u(n) - u(n-4)]$ using direct form – I. **(06 Marks)**

b. Obtain the direct form – I, direct form – II, cascade and parallel form realization for the following system.
$Y(n) = 0.75\, y(n-1) - 0.125y\,(n-2) + 6x(n) + 7x(n-1) + x(n-2)$. **(14 Marks)**

7 a. Write equations of any four different windows used in design of FIR filters. **(08 Marks)**

b. Design the symmetric FIR, low pass filter whose desired frequency response is given as,

$$H_d(w) = \begin{cases} e^{-jw\tau}, & \text{for } |w| \le w_c \\ 0, & \text{otherwise} \end{cases}$$

The length of the filter should be 7 and $w_c = 1$ radian/sample. Use rectangular window. **(12 Marks)**

8 a. Explain how analog filter is mapped on to a digital filter using impulse invariant method. **(08 Marks)**

b. Design a digital low pass filter to satisfy the following pass band ripple $1 \le H(j\Omega) \le 0$, for $0 \le \Omega \le 1404\pi$ rad/sec and stop band attenuation $|H(\Omega)| > 60$dB for $\Omega \ge 8268\pi$ rad/sec. sampling interval $T_s = \frac{1}{10^{-4}}$ sec. Use BLT for designing. **(12 Marks)**

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