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10EE64

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016
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. List and state any four properties of DFT. **(06 Marks)**

b. Find the DFT of a sequence $x(n) = \{1, 1, 0, 0\}$ and find the IDFT of $Y(K) = (2, 1+j, 0, 1-j)$ **(08 Marks)**

c. Consider the finite length sequence x(n) shown in Fig. Q1 (c). The five point DFT of x(n) is denoted by X(K). Plot the sequence whose DFT is $Y(K) = e^{\frac{-4\pi K}{5}} X(K)$. **(06 Marks)**

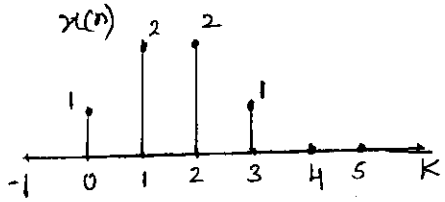

Fig. Q1 (c)

2 a. Perform the circular convolution of the following sequence $x(n) = \{1, 1, 2, 1\}$, $h(n) = \{1, 2, 3, 4\}$ using DFT and IDFT method. **(08 Marks)**

b. Find the output y(n) of a filter whose impulse response is $h(n) = \{1, 1, 1\}$ and input signal $x(n) = \{3, -1, 0, 1, 3, 2, 0, 1, 2, 1\}$ using overlap–add method. Use 5-point circular convolution in your approach. **(12 Marks)**

3 a. What is FFT? Explain Decimation-in-Time algorithm. **(08 Marks)**

b. Given the sequences $x_1(n)$ and $x_2(n)$ below. Compute the circular convolution $x_1(n) \circledast x_2(n)$ for N = 4. Use DIT – FFT algorithm. **(12 Marks)**

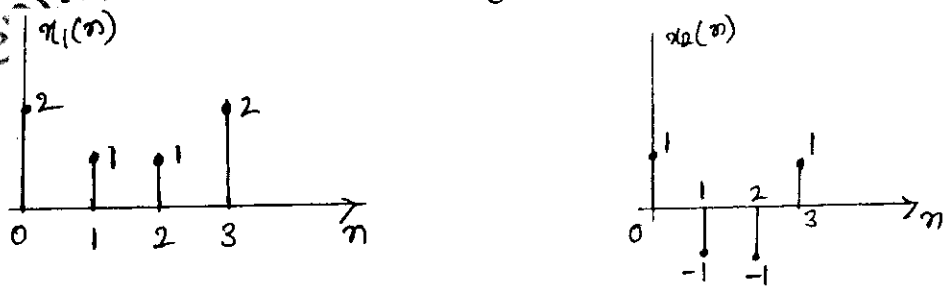

Fig. Q3 (b)

4 a. What is DIF algorithm? Draw the 4-point radix-2 DIF-FFT Butterfly structure for DFT. **(06 Marks)**

b. Find the 4-point real sequence x(n), if its 4-point DFT samples are $X(0) = 6$, $X(1) = -2 + j2$, $X(2) = -2$. Use DIF-FFT algorithm. **(08 Marks)**

c. Find the 4-point DFT of the sequence, $x(n) = \cos\left(\frac{\pi}{4}n\right)$ using DIF-FFT algorithm. **(06 Marks)**

PART – B

5 a. Distinguish between analog and digital filters. **(04 Marks)**

b. Design an analog Bandpass filter to meet the following frequency-domain specifications:
i) a -3.0103 dB upper and lower cutoff frequency of 50 Hz and 20 kHz.
ii) a stopband attenuation of atleast 20 dB at 20 Hz and 45 kHz and
iii) a monotonic frequency response. **(10 Marks)**

c. The system function of the analog filter is given by $H_a(s) = \frac{s+0.1}{(s+0.1)^2+9}$.
Obtain the system function of the IIR digital filter by using Impulse invariance method. **(06 Marks)**

6 a. A Chebyshev – I filter of order N = 3 and unit bandwidth is known to have a pole at $s = -1$.
i) Find the two other poles of the filter and parameter ε.
ii) The analog filter is mapped to the z-domain using the bilinear transformation with T = 2. Find the transfer function H(z) of the digital filter. **(12 Marks)**

b. Distinguish between Butterworth and Chebyshev filter. **(04 Marks)**

c. What is Bilinear transformation? Explain warping and prewarping effect. **(04 Marks)**

7 a. What is Gibb's phenomenon? **(04 Marks)**

b. Distinguish between FIR and IIR filters. **(04 Marks)**

c. A filter is to be designed with the following desired frequency response:

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

Find the frequency response of the FIR filter designed using a rectangular window defined below:

$$W_R(n) = \begin{cases} 1 & 0 < n < 4 \\ 0 & \text{Otherwise} \end{cases}$$ **(12 Marks)**

8 a. Sketch the direct form-I, direct form-II realizations for the system function given below:

$$H(z) = \frac{2z^2 + z - 2}{z^2}.$$ **(10 Marks)**

b. Obtain a Cascade realization for a system having the following system function:

$$H(z) = \frac{(z-1)(z-2)(z+1)z}{\left(z-\frac{1}{2}-j\frac{1}{2}\right)\left(z-\frac{1}{2}+j\frac{1}{2}\right)\left(z-j\frac{1}{4}\right)\left(z+j\frac{1}{4}\right)}.$$ **(10 Marks)**

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