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10EC52

Fifth Semester B.E. Degree Examination, June/July 2015

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. Compute the DFT of the sequence $x(n) = \cos\left(\frac{n\pi}{4}\right)$ for N = 4, plot $|x(k)|$ and $\angle x(k)$. **(09 Marks)**

b. Find the DFT of the sequence $x(n) = 0.5^n\ u(n)$ for $0 < n \leq 3$ by evaluating $x(n) = a^n$ for $0 < n < N-1$. **(07 Marks)**

c. Find the relation between DFT and Z transform. **(04 Marks)**

2 a. State and prove the linearity property of DFT and symmetrical property. **(05 Marks)**

b. The five samples of the 8 point DFT x(k) are given as $x(0) = 0.25, x(1) = 1.25 - j0.3018, x(6) = x(4) = 0, x(5) = 0.125 - j0.0518$. **(05 Marks)**
Determine the remaining sample if the sequence x(n) is real valued?

c. For $x(n) = \{1, -2, 3 - 4, 5, -6\}$, without computing its DFT, find the following

i) x (o) ii) $\sum_{k=0}^{5} \times (k)$ iii) X(3) iv) $\sum_{k=0}^{5} 1 \times (k)|^2$ v) $\sum_{k=0}^{5} (-1)^k \times (k)$ **(10 Marks)**

3 a. Consider a FIR filter with impulse response
h(n) = { 1, 1, 1 }, if the input is
X(n) = { 1, 2, 0, -3, 4, 2, -1, 1, -2, 3, 2, 1 -3). Find the output y(n) using overlap add method. **(12 Marks)**

b. What is in plane computation? What is total number of complex additions and multiplication required for N =256 point, if DFT is computed directly and if FFT is used? **(03 Marks)**

c. For sequence x(n) = { 2, 0, 2, 0 } determine x(2) using Goertzel Filter. Assume the zero initial conditions. **(05 Marks)**

4 a. Find the circular convolution of x(n) = {1, 1, 1, 1 } and h(n) = {1, 0, 1, 0 } using DIF-FFT algorithm. **(12 Marks)**

b. Derive DIT-FFT algorithm for N = 4. Draw the complete signal How graph? **(08 Marks)**

PART – B

5 a. Design a Chebyshev analog filter (low pass) that has a -3dB cutoff frequency of 100 rad/sce and a stopband attenuation 25dB or greater for all radian frequencies past 250 rad/sec **(14 Marks)**

b. Compare Butterworth and Chebyshev filters. **(03 Marks)**

c. Let $H(s) = \frac{1}{s^2 + s + 1}$ represent the transfer function of LPF with a passband of 1 rad/sec. Use frequency transformation (Analog to Analog) to find the transfer function of a band pass fitter with passband 10 rad/sec and a centre frequency of 100 rad/sec. **(03 Marks)**

6 a. Obtain block diagram of the direct form I and direct form II realization for a digital IIR fitter described by the system function.

$$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{\left(z - \frac{1}{4}\right)\left(z^2 - z + \frac{1}{2}\right)}$$ **(10 Marks)**

b. Find the transfer function and difference equation realization shown in Fig.Q 6(b).

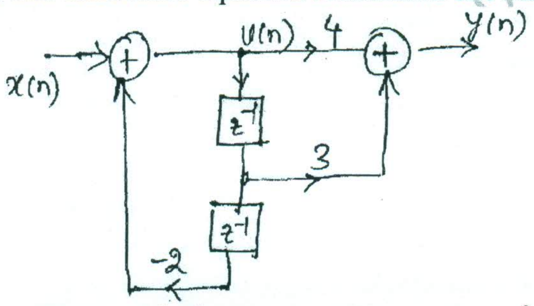

Fig.Q 6(b)

(06 Marks)

c. Obtain the direct form realization of linear phase FIR system given by

$$H(z) = 1 + \frac{2}{3}z^{-1} + \frac{15}{8}z^{-2}$$ **(04 Marks)**

7 a. The desired frequency response of a low pass fitter is given by

$$H_d(e^{jw}) = H_d(\omega) = \begin{cases} e^{-j3w} & |\omega| \frac{3\pi}{4} \\ 0 & \frac{3\pi}{4} < |\omega| < \pi \end{cases}$$

Determine the frequency response of the FIR if Hamming window is used with N = 7. **(10 Marks)**

b. Compare IIR filter and FIR filters. **(06 Marks)**

c. Consider the pole-zero plot as shown in Fig Q.7(c) i) Does it represent an FIR fitter? ii) Is it linear phase system? **(04 Marks)**

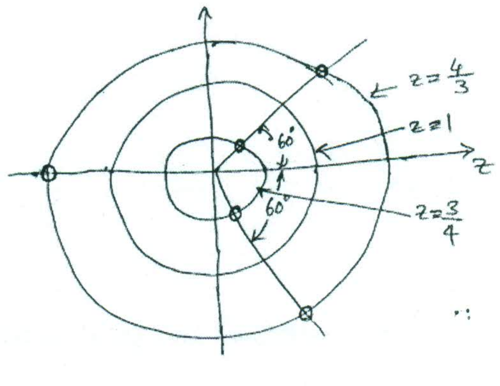

Fig.Q 7(c)

8 a. Design a digital filter H(z) that when used in an A/D-H(z)-D/A structures gives an equivalent analog filter with the following specification :

Passband ripple : ≤ 3.01dB

Passband edge : 500Hz

Stopband attenuation : ≥ 15dB

Stopband edge : 750 Hz

Sample Rate : 2 KHz

Use Bilinear transformation to design the filter on an analog system function. Use Butterworth filter prototype. Also obtain the difference equation. **(14 Marks)**

b. Transform the analog filter

$$H_a(s) = \frac{s+1}{s^2+5s+6}$$

Into H(z) using impulse invariant transformation Take T = 0.1 Sec. **(06 Marks)**

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