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10EC52

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define sampling and Aliasing. Consider the analog signal $x_1(t) = 2\ \text{Cos}\ 2\pi\ (10t)$ and $x_2(t) = 2\ \text{Cos}\ 2\pi\ (50t)$. Find a sampling frequency so that 50Hz signal is an alias of the 10Hz signal. **(08 Marks)**

b. If $\begin{matrix} x(n) = 1 & 0 \le n \le 5 \\ = 0 & \text{elsewhere} \end{matrix}$ and x(z) its z transform. If x(z) is sampled at $z = e^{j\frac{2\pi}{4}k}$ $0 \le k \le 3$. Find y(n) obtained as IDFT of x(k). **(06 Marks)**

c. Prove the following identities:
i) DFT $(\delta(n)) = 1$ ii) $\text{DFT}[x^*(n)] = X^*(N-K)$ **(06 Marks)**

2 a. If $x(n) = \{1, 2, 3, 4\}$. Find $x_1(n) = x((n-1))_4$ and $x_2(n) = x((n+1))_4$. **(04 Marks)**

b. The first five point of 8-point DFT is $x(k) = \{0.5, 1 - j, 0, 1 - j1.72, 0\}$. Find the remaining three points. **(04 Marks)**

c. If the DFT of x(n) = x(k), What are the DFT's of $x(-n)_{\text{modN}}$, $X^*(N-K)$. **(12 Marks)**

3 a. Perform the circular convolution of the signals $x_1(n) = \{2, 1, 2, 1\}$, $x_2(n) = \{1, 2, 3, 4\}$. Using DFT and IDFT method. **(08 Marks)**

b. With Butterfly diagram, explain radia – 2 DIT FFT algorithms. **(08 Marks)**

c. State and prove Parseval's theorem pertaining to discrete Fourier transformation. **(04 Marks)**

4 a. If $x(n) = \{1, 2, 2, 3, 1, 1, 4, 2\}$. Find X(k) using Radix – 2 Decimation in Frequency FFT algorithm. **(10 Marks)**

b. If $X(k) = \{17, -1.12 - j7.12, j3, 3.121 + j2.87, 3, 3.12 - j2.87, -j3, -1.12 + j7.12\}$. Find x(n) using radiax-2 inverse DIT – FFT algorithm. **(10 Marks)**

PART – B

5 a. What is impulse invariant transformation? For the analog filter $H_a(s) = \dfrac{2}{(s+1)(s+2)}$. Find H(z) using impulse invariant transformation for T = 0.1Sec. **(08 Marks)**

b. Design Low Pass Butterworth filter using Bilenear Transformation for the following : Pass band = 0 – 400Hz, Stop band = 2.1 to 4Khz, Pass band ripple = 2dB, Stop band attenuation = 20dB, Sampling frequency = 10KHz **(12 Marks)**

6 a. Obtain Direct – Form II and cascade, realization of the system

$$y(n) = \frac{-3}{8}y(n-1) + \frac{3}{32}y(n-2) + \frac{1}{64}y(n-3) + x(n) + 3x(n-1) + 2x(n-2).$$ **(10 Marks)**

b. Realize the following system with minimum numbers of multipliers

$$H(z) = \left(1 + \frac{1}{2}z^{-1} + z^{2}\right)\left(1 + \frac{1}{4}z^{-1} + z^{-2}\right)$$ (04 Marks)

c. Explain procedure for designing FIR Filter using Kaiser window. (06 Marks)

7 a. Design Band Pass FIR Filter for N = 8, $w_{c_1} = 0.3$ radians, $w_{c_2} = 0.8$ radian, using hamming window. (10 Marks)

b. Design a high pass FIR filter for N = 4, $w_{c_1} = 1.5$ radians, using Hamming window. (10 Marks)

8 a. Design a high pass digital Chebyshev filter with cutoff frequency = 50Hz, N = 2, Pass band ripple = 1dB. Sampling frequency = 500Hz. (12 Marks)

b. Design a lowpass FIR Filter using frequency sampling method having cutoff frequency $w_c = \pi/3$ radians and N = 6. (08 Marks)

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