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10MT74

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Seventh Semester B.E. Degree Examination, Feb./Mar. 2022
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. Explain frequency domain sampling and reconstruction of DT signals. **(10 Marks)**

b. Find the 4-pint DFT of the sequence $x(n) = \cos\left(\frac{n\pi}{4}\right)$. **(04 Marks)**

c. Explain the relationship between :
i) DFT and Z – transform
ii) DFT and DTFT. **(06 Marks)**

2 a. Compute the circular convolution of $x_1(n) = \{2, 1, 2, 1\}$; $x_2(n) = \{1, 2, 3, 4\}$ using DFT and IDFT method. **(06 Marks)**

b. State and prove :
i) Circular time shift property
ii) Parseval's theorem. **(06 Marks)**

c. Find the output y(n) of a filter with impulse response h(n) = {1, 2} and input signal x(n) = {1, 2, -1, 2, 3, -2, -3, -1, 1, 2, -1} using overlap save method. [Use 4-point circular convolution in your approach]. **(08 Marks)**

3 a. Tabulate the number of complex multiplications and complex additions required for direct computation of DFT and FFT algorithms for N = 8, 32, 512, 1024. **(10 Marks)**

b. Compute the circular convolution using DIT – FFT algorithm.
$x_1(n) = \{2, 3, 1, 1\}$, $x_2(n) = \{1, 3, 5, 3\}$. **(10 Marks)**

4 a. Derive the radix-2 DIT – FFT algorithm for N = 8 and draw the signal flow graph. **(10 Marks)**

b. If x(n) = {2, 1, 2, 1} compute 8-point DFT of x(n) using DIF – FFT algorithm. **(10 Marks)**

PART – B

5 a. Design an analog filter with maximally flat response in the passband and an acceptable attenuation of –2dB at 20rad/sec. The attenuation in the passband should be more than 10dB beyond 30rad/sec. **(10 Marks)**

b. Deign a lowpass 1rad/sec bandwidth Chebyshev filter with the following characteristics :
i) Acceptable passband ripple of 2dB
ii) Cut-off radiance frequencies of 1 rad/sec
iii) Stopband attenuation of 20dB or greater beyond 1.3rad/sec. **(10 Marks)**

6 a. Design a FIR filter for the desired frequency response of a lowpass filter given by

$$H_d(e^{j\omega}) = e^{-j2\omega} \quad \text{for} \quad \frac{-\pi}{4} \le \omega \le \frac{\pi}{4}$$
$$0 \quad \text{for} \quad \frac{\pi}{4} \le |\omega| \le \pi$$

Using rectangular window of length 5. **(10 Marks)**

b. Determine the impulse response h(n) of a filter having desired frequency response.

$$H_d(e^{j\omega}) = e^{-j(N-1)\omega/2} \quad \text{for } 0 \le |\omega| \le \frac{\pi}{2}$$

N = 7, use frequency sampling approach. **(10 Marks)**

7 a. Design the Chebyshev filter using bilinear transformation to meet the following specification :

$$0.707 \le |H(e^{J\omega})| \le 1 \qquad 0 \le \omega \le 0.2\pi$$
$$|H(e^{J\omega})| \le 0.1 \qquad 0.5\pi \le \omega \le \pi$$

(14 Marks)

b. Find the $H_a(s) = \dfrac{1}{(s+1)(s+2)}$ corresponding H(z) using impulse invariance method for sampling frequency of 5 samples/sec. **(06 Marks)**

8 a. $H(z) = \dfrac{1+\frac{1}{5}z^{-1}}{\left(1-\frac{1}{2}z^{-1}+\frac{1}{3}z^{-2}\right)\left(1+\frac{1}{4}z^{-1}\right)}$. Realize disect form 1 and cascade. **(08 Marks)**

b. Realize using linear phase $H(z) = \frac{1}{2}+\frac{1}{3}z^{-1}+z^{-2}+\frac{1}{4}z^{-3}+z^{-4}+\frac{1}{3}z^{-5}+\frac{1}{2}z^{-6}$. **(04 Marks)**

c. Consider a FIR filter with system function, $H(z) = 1 + 2.82z^{-1} + 3.4048z^{-2} + 1.74z^{-3}$, sketch the lattice realization of the filter. **(08 Marks)**

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