USN

10MT74

Seventh Semester B.E. Degree Examination, July/August 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. Determine the 8 – point DFT of the sequence x(n) = {1, 1, 1, 1, 1, 1, 0, 0}. Draw its magnitude and phase plots. **(12 Marks)**

b. If x(k) is the DFT of the sequence x(n) determine the N – point DFTs of the sequences.

$x_c(n) = x(n)\,\mathrm{Cos}\dfrac{2\pi k_o n}{N}; \ 0 \le n \le N-1$ and

$x_s(n) = x(n)\,\mathrm{Sin}\dfrac{2\pi k_o n}{N}; \ 0 \le n \le N-1$ use appropriate properties. **(08 Marks)**

2 a. Calculate the circular convolution of the two sequence using DFT and IDFT method.
$x_1(n) = \{1, 2, 3, 4\}$ $x_2(n) = \{4, 1, 1, 4\}$. **(12 Marks)**

b. Explain symmetric properties of a DFT. **(08 Marks)**

3 a. A designer is having a number of 8 – point FFT chips. Show explicitly how he should interconnect three chips in order to compute a 24 – point DFT. **(08 Marks)**

b. Calculate the percentage saving in calculation in a 512 – point Radix – 2 FFT when compare to Direct DFT. [Both addition and multiplications]. **(06 Marks)**

c. Why FFT is needed? **(02 Marks)**

d. Prove the periodicity and symmetry property of W_N. **(04 Marks)**

4 a. Using DIF – FFT algorithm compute DFT of the sequence x(n) = {1, 2, -1, 2, 4, 2, -1, 2}. **(10 Marks)**

b. Derive the signal flow graph for 8 – point Radix – 2 DIT – FFT algorithm. **(10 Marks)**

PART – B

5 a. Derive the expression for high pass filter in terms of lowpass filter using analog frequency transformation. **(06 Marks)**

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

c. Determine the system function H(s) of the lowest order Butterworth filter that meets the following specifications.

$$0.9 \le |H(e^{j\omega})| \le 1 \qquad 0 \le \omega \le \pi/2$$
$$|H(e^{j\omega})| \le 0.2 \qquad 3\pi/4 \le \omega \le \pi$$

(10 Marks)

6 a. What are the advantages and disadvantages of the window technique? **(04 Marks)**

b. Determine the filter coefficients h(n) obtained by sampling H_d (w) given by

$$H_d(\omega) = \begin{cases} e^{-j3\omega} & 0 < \omega < \pi/2 \\ 0 & \pi/2 < \omega < \pi \end{cases}$$

Also obtain the frequency response h(w) . Take N = 7. **(16 Marks)**

7 a. Let $H_a(s) = \frac{6}{(s+a)^2 b^2}$ be a causal second order analog transfer function show that the causal second order digital transfer function H(z) obtained from H_a(S) through inpulse invariance method is given by

$$H(z) = \frac{e^{-aT} \text{ Sin } bTz^{-1}}{1 - 2e^{-aT} \text{ Cos } bTz^{-1} + e^{-2aT} z^{-2}}$$

Also find H(z) when $H_a(s) = \frac{1}{s^2 + 2s + 2}$ **(10 Marks)**

b. Determine the system function H(z) of the lowest order chebyshev filter meets the following specifications.

i) 3dB ripple in the passband $0 \le \omega \le 0.3\pi$.

ii) At least 20dB attenuation in the stopband $0.6\pi \le |\omega| \le \pi$ use the bilinear transformation. **(10 Marks)**

8 a. Realize the linear phase FIR filter having the following impulse response. Direct form – I and direct form – II

$h(n) = \delta(n) - \frac{1}{4}\delta(n-1) + \frac{1}{2}\delta(n-2) + \frac{1}{2}\delta(n-3) - \frac{1}{4}\delta(n-4) + \delta(n-5)$. **(08 Marks)**

b. Draw the signal flow graph for H(z) using cascade and parallel realization using direct form – II

$$H(z) = \frac{1 + 0.875z^{-1}}{(1 + 0.2z^{-1} + 0.9z^{-2})(1 - 0.7z^{-1})}.$$ **(08 Marks)**

c. Draw the three stage FIR lattice structure if the coefficients $k_1 = 0.1$, $k_2 = 0.2$ and $k_3 = 0.3$. **(04 Marks)**

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