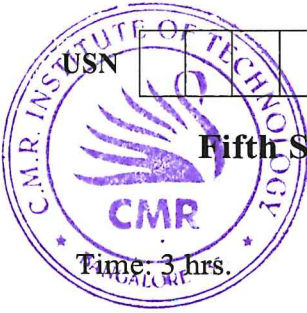


CBCS SCHEME

15EC52



Fifth Semester B.E. Degree Examination, July/August 2022

Digital Signal Processing

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Consider the signal $x(n) = a^n u(n)$, $0 < a < 1$. The spectra of this signal is sampled at frequencies $W_k = \frac{2\pi K}{N}$, $K = 0, 1, \dots, N - 1$. Determine the reconstructed spectra for $a = 0.8$ when $N = 5$. (08 Marks)
- b. Compute the 8-point DFT of $x(n) = (-1)^{n+1}$, $0 \leq n \leq 7$. (08 Marks)

OR

- 2 a. Establish the relationship between (i) DFT and DFS (ii) DFT and DTFT (05 Marks)
- b. Define DFT and IDFT. Compute IDFT of the sequence $X(K) = \{2, 1 + j, 0, 1 - j\}$. (11 Marks)

Module-2

- 3 a. State and prove the following DFT properties:
(i) Time reversal of a sequence (ii) Circular frequency shift (08 Marks)
- b. The five samples of 8-point DFT $X(K)$ are given as follows:
 $X(0) = 0.25$, $X(1) = 0.125 - j0.3018$, $X(6) = X(4) = 0$, $X(5) = 0.125 - j0.0518$
Determine the remaining samples if sequence $x(n)$ is real valued sequence. (08 Marks)

OR

- 4 a. Find the output $y(n)$ of a filter whose impulse response is $h(n) = \{1, 1, 1\}$ and the input signal to the filter is $x(n) = \{3, -1, 0, 1, 3, 2, 0, 1, 2, 1\}$ using overlap save method. (08 Marks)
- b. What are FFT algorithms? State their advantages over the direct computation of DFT. (04 Marks)
- c. Compute the 8-point circular convolution of $x_1(n) = \left(\frac{1}{4}\right)^n$, $0 \leq n \leq 7$ and $x_2(n) = \cos \frac{3\pi}{8} n$, $0 \leq n \leq 7$. (04 Marks)

Module-3

- 5 a. Derive the signal flow graph for $N = 8$ point Radix-2 DIF-FFT algorithm. (08 Marks)
- b. Use the 8-point Radix-2 DIT-FFT algorithm to find the DFT of sequence:
 $x(n) = \{0.707, 1, 0.707, 0, -0.707, -1, -0.707, 0\}$ (08 Marks)

OR

- 6 a. What is Goertzel algorithm? Obtain the Direct form-II realization of it. (08 Marks)
- b. For $X(K) = \{0, 0, -j4, 2 - j2, 0, 2 + j2, 0, 2 - j2\}$, find sequence $x(n)$ using DIF-FFT algorithm. (08 Marks)

Module-4

- 7 a. Design a Chebyshev filter to meet the following specifications:
 (i) Passband ripple ≤ 2 dB
 (ii) Stopband attenuation ≥ 20 dB
 (iii) Passband edge : 1 rad/sec
 (iv) Stopband edge : 1.3 rad/sec (10 Marks)
- b. The system function of low pass digital filter is given by $H(z) = 0.5 \left(\frac{1+z^{-1}}{2-z^{-1}} \right)$. From the above equation find $y(n)$. (06 Marks)

OR

- 8 a. Derive an expression for order and cutoff frequency of the Butterworth filter. (06 Marks)
- b. The system function of the analog filter is given as $H_a(s) = \frac{s+0.1}{(s+0.1)^2+16}$. Obtain the system function of the digital filter using Bilinear transformation which is resonant at $\omega_r = \frac{\pi}{2}$. (10 Marks)

Module-5

- 9 a. Determine the filter coefficients $h_d(n)$ for the desired frequency response of the low pass filter given by

$$H_d(e^{j\omega}) = \begin{cases} e^{-j2\omega} & \text{for } -\frac{\pi}{4} \leq \omega \leq \frac{\pi}{4} \\ 0 & \text{for } \frac{\pi}{4} \leq |\omega| \leq \pi \end{cases}$$

If we define new filter coefficient by $h(n) = h_d(n) \cdot \omega(n)$,

$$\text{where } \omega(n) = \begin{cases} 1 & \text{for } 0 \leq n \leq 4 \\ 0 & \text{elsewhere} \end{cases}$$

Determine $h(n)$ and also the frequency response $H(e^{j\omega})$ and compare with $H_d(e^{j\omega})$. (08 Marks)

- b. Explain the frequency sampling method of designing linear phase FIR filters. (08 Marks)

OR

- 10 a. The coefficients of three stages FIR lattice structure is $K_1 = 0.1$, $K_2 = 0.2$ and $K_3 = 0.3$. Find the coefficients of direct form – I FIR filter and draw its block diagram. (08 Marks)
- b. Write short notes on:
 (i) Hamming window
 (ii) Hanning window
 (iii) Bartlett window

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(08 Marks)
