CBCS SCHEME

USN



# Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
# Digital Signal Processing

Time: 3 hrs. Max. Marks: 100

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



## Module-1

1 a. Describe the process of frequency domain sampling and reconstruction of discrete time signal. **(10 Marks)**

b. Find the 4-point DFT of the sequence x(n) = {0, 1, 2, 3} using matrix method and verify the answer by taking the 4 point IDFT of the result. **(10 Marks)**

**OR**

2 a. State and prove the following properties:
i) Circular time shift of a sequence
ii) Parseval's theorem. **(10 Marks)**

b. Compute the circular convolution of the following sequences using DFT and IDFT method $x_1(n)$ = {1, 2, 3, 4} and $x_2(n)$ = {4, 3, 2, 1}. **(10 Marks)**



## Module-2

3 a. Find the output y(n) of a filter whose impulse response h(n) = {3, 2, 1, 1} and input x(n) = {1, 2, 3, 3, 2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1} using overlap add method by assuming the 7-point circular convolution. **(12 Marks)**

b. Given x(n) = {1, 2, 3, 4}, find y(n), if $y(k) = x((k-2))_4$. **(04 Marks)**

c. Write a program to find the circular convolution of two sequences. **(04 Marks)**

**OR**

4 a. Compute the 8-point DFT of the sequence x(n) = {2, 2, 2, -1, -1, -1, -2, 1} using decimation in time-FFT algorithm. **(12 Marks)**

b. Prove the periodically and symmetry properties of twiddle factor. **(08 Marks)**

## Module-3

5 a. A low pass filter is to be designed with the following desired frequency response

$$H_d(e^{jw}) = \begin{cases} e^{-j3w}; & \text{for } -3\pi/4 \le w \le 3\pi/4 \\ 0; & \text{Otherwise} \end{cases}$$

Determine $H(e^{jw})$ for M = 7 using Hamming window. Also write a program to design low pass FIR filter to meet the specifications. **(12 Marks)**

b. Explain the following:
i) Rectangular window
ii) Hamming window
iii) Hanning window. **(08 Marks)**





**OR**

6 a. A FIR filter is given by

$$y(n) = x(n) + \frac{2}{5}x(n-1) + \frac{3}{4}x(n-2) + \frac{1}{3}x(n-3)$$

Draw the lattice structure. **(10 Marks)**

b. The frequency response of an FIR filter is given by $H(W) = e^{-j3w}(1 + 1.8\cos 3w + 1.2\cos 2w + 0.5\cos w)$. Determine the coefficients of the impulse response h(n) of the FIR filter. **(06 Marks)**

c. List the advantages of FIR filter. **(04 Marks)**

## Module-4

7 a. Realize the following digital filter using direct form I and direct form II:

$$H(Z) = \frac{0.7 + 1.4z^{-1} + 0.74z^{-2} + 0.5z^{-3}}{1 + 1.3z^{-1} + 0.5z^{-2} + 0.7z^{-3} + 0.3z^{-4}}$$

Also write a program to design IIR Butterworth low pass filter to meet the specifications. **(10 Marks)**

b. Assuming that T = 2 sec is bilinear transformation and given the following points :
i) S = -1 + j on the left half of s-plane
ii) S = 1 – j on the right half of s place
iii) S = j on the positive jw on the s-plane
iv) S = -j on the negative jw on the s-plane.
Convert each of these points in s-plane to z-plane and verify the mapping properties. **(10 Marks)**



**OR**

8 a. Using bilinear transformation, design a digital low pass Butterworth filter with the following specifications: sampling frequency: 8000 Hz, 3 dB attenuation at 1.5 kHz, 10 dB stop band attenuation at 3 kHz. **(12 Marks)**

b. Discuss the general procedure for IIR filter design using Bilinear transformation. **(08 Marks)**

## Module-5

9 a. Discuss briefly :
i) Multiplier and Accumulator
ii) Shifters
iii) Address generators in digital signal processor hardware units **(10 Marks)**

b. Explain digital signal processors using Harvard architecture. **(10 Marks)**

**OR**

10 a. Implement the following IIR filter using Q-15 fixed point format y(n) = 2x(n) + 0.5y(n-1) maximum input is $x_{max} = (0.0100\ldots0)_2$ in Q-15 format. **(10 Marks)**

b. Explain the basic architecture of TMS320CS54X used in fixed point digital signal processor. **(10 Marks)**

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