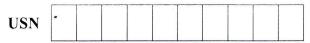
## CBCS SCHEME



18EE63

# Sixth Semester B.E. Degree Examination, June/July 2024 **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. Calculate 8-point DFT of  $x(n) = \cos\left(\frac{n\pi}{4}\right)$ . Draw magnitude and phase of x(k). (10 Marks)

b. Derive the DFT properties for Periodicity and linearity property.

(10 Marks)

#### OR

2 a. Compute circular convolution of discrete sequence  $x_1(n) = \{1, 3, 5, 3\}$   $x_2(n) = \{2, 3, 1, 1\}$  by i) Circular method ii) Matrix method. (10 Marks)

b. 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.

(10 Marks)

## **Module-2**

a. Develop an 8-point DIF-FFT algorithm starting from DFT. State clearly all the step. Explain how it reduces the number of computation. (10 Marks)

b. Find DFT of  $x(n) = \{1, 1, 1, 1, 0, 0, 0, 0\}$  using DIT – FFT algorithm show all the intermediate result in signal flow graph. (10 Marks)

#### OR

4 a. The DFT x(k) of sequence is given as  $x(k) = \{0, 2, +2j, -j4, 2-j2, 0, 2+2j, j4, 2-j2\}$  using using IDIF – FFT. Determine x(n). (10 Marks)

b. Develop an 8-point IDIT-FFT algorithm starting from DFT. Draw the complete signal flow graph to find x(n). (10 Marks)

#### Module-3

5 a. Design an analog Butterfly filter has a gain – 2dB and 20r/s and attenuation in excess of 10dB beyond 30r/s. (10 Marks)

- b. Determine the transfer function if Chebyshev filter for the following specification:
  - i) Maximum passband repple is 1dB
  - ii) Stop and band attenuation is 40dB for  $\Omega \ge 4r/s$ .

(10 Marks)

#### OR

6 a. For the constraints  $0.8 \le |H(e^{jw})| \le |$  for  $0 \le w \le 0.2\pi$ ,  $|H(e^{jw})| \le 0.2$  for  $0.6\pi \le w \le \pi$ . Design a Butterworth digital filter using bilinear transformation. Assume T = 1 Second. (10 Marks)

Using Impulse invariant technique find the transfer function of digital filter H(z) for analog Transform function

$$H(s) = \frac{b}{(s+a)^2 + b^2}.$$
 (10 Marks)

#### Module-4

- 7 a. Design a Chebyshev filter with  $T = \overline{1}$  second using Bilinear transformation for the following specification.
  - i)  $0.8 \le |H(e^{jw})| \le 1$  for  $0 \le w \le 0.2\pi$
  - ii)  $|H(e^{jw})| \le 0.1$  for  $0.5\pi \le w \le \pi$  (10 Marks)
  - b. Realise the system for direct Form I and direct form II.

$$H(z) = \frac{0.7 - 0.25z^{-1} - z^{-2}}{1 + 0.1z^{-1} - 0.72z^{-2}}.$$
 (10 Marks)

#### OR

8 a. Obtain the parallel form and cascade form for given system.

y(n) = 0.75 y(n-1) - 0.125y(n-2) + 6 x(n) + 7x(n-1) + x(n-2)

(10 Marks)

b. Design a maximally flat digital LPF to meet following specification.

 $0.8 \le |H(e^{jw})| \le 1 \text{ for } 0 \le w \le \pi/4$ 

 $|H(e^{jw})| \le 0.18$  for  $0.75\pi \le w \le \pi$ 

Using impulse invariant transformation. Assume T = 1 Sec.

(10 Marks)

### Module-5

- 9 a. For a given FIR filter y(n) = x(n) + 2/5 x(n-1) + 3/4x(n-2) +. Draw direct form I and Lattice structure. (10 Marks)
  - b. Design the symmetric FIR lowpass filter whose desired frequency response is given as

$$H_{d}(w) = \begin{cases} e^{-jwz} & \text{for } |w| \le w_{c} \\ 0 & \text{otherwise} \end{cases}$$

The length of the filter should be 7 and  $w_c = 1$  radius/sample use rectangular window.

(10 Marks)

#### OF

10 a. Determine the filter coefficient h<sub>d</sub>(n) for the desired frequency response of a low pass filter given by

$$H_{d}(e^{jw}) = \begin{cases} e^{-j2w} & \text{for } -\frac{\pi}{4} \le w \le \frac{\pi}{4} \\ 0 & \text{for } \frac{\pi}{4} \le |w| \le \pi \end{cases}$$

If we define the new filter coefficient by  $h(n) = h_d(n) \cdot w(n)$  where

$$w(n) = \begin{cases} 1 & \text{for } 0 \le n \le 4 \\ 0 & \text{for otherwise} \end{cases}$$

Determine h(n) and also the necessary response  $|H(e^{jw})|$  and compare with  $|H_d(e^{jw})|$  determine  $H(e^{jw})|$  Determine  $H(e^{jw})|$  using Hamming window. (10 Marks)

b. Determine form structures of casecade first order section also as a cascade  $1^{st}$  and  $2^{nd}$  order section form FIR lattice filter for  $H(z) = |(1 + 0.6z^{-1})^5|$ . (10 Marks)

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