



# CBCS SCHEME

18EC52

## Fifth Semester B.E. 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. Compute N-point DFT of the following signals :  
i)  $x(n) = a^n, 0 \leq n \leq N-1$   
ii)  $x(n) = 1, 0 \leq n \leq N-1$ . (10 Marks)  
b. Determine 4-point circular convolution of the sequences.  
 $x_1(n) = \{2, 1, 2, 1\}$  and  $x_2(n) = \{1, 2, 3, 4\}$  using graphical method. (05 Marks)  
c. Compute the DFT of the sequence defined by  $x(n) = (-1)^n$  for i)  $N = 3$  ii)  $N = 4$ . (05 Marks)

OR

- 2 a. Illustrate the following properties of DFT :  
i) Linearly  
ii) Circular time shift (10 Marks)  
b. Compute the IDFT of 4-point sequence :  
 $X(K) = \{4, -j2, 0, j2\}$  using DFT. (10 Marks)

### Module-2

- 3 a. Develop radix - 2 decimation - in - time FFT algorithm and write signal flow graph for  $N = 8$ . (10 Marks)  
b. i) Compute the 4-point DFT of the sequence  $x(n) = \{1, 0, 1, 0\}$  using DIT FFT radix - 2 algorithm.  
ii) Find  $x(n)$  for  $X(K)$  found in part(i) by DIF FFT algorithm. (10 Marks)

OR

- 4 a. Find the o/p  $y(n)$  of a filter whose impulse response is  $h(n) = \{3, 2, 1, 1\}$  and input  $x(n) = \{1, 2, 3, 3, 2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1\}$  using overlap - add method assuming the length of block is 7. (10 Marks)  
b. Explain overlap-save method to find the output of the filter. (10 Marks)

### Module-3

- 5 a. Explain any three window functions to design FIR filters. (10 Marks)  
b. A lowpass filter is to be designed with the following desired frequency response

$$H_d(e^{jw}) = H_d(w) = \begin{cases} e^{-j2w}, & |w| < \frac{\pi}{4} \\ 0, & \frac{\pi}{4} \leq |w| < \pi \end{cases}$$

Determine the filter coefficients  $h_d(n)$  and  $h(n)$  if  $w(n)$  is a rectangular window defined as follows :

$$w_R(n) = \begin{cases} 1, & 0 \leq n \leq 4 \\ 0, & \text{otherwise} \end{cases}$$

Also, find the frequency response,  $H(w)$  of the resulting FIR filter.

(10 Marks)

OR

- 6 a. Realize the FIR filter whose impulse response is given by  

$$h(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2) + \frac{1}{4}\delta(n-3) + \delta(n-4).$$
 (10 Marks)
- b. Consider a three stage FIR Lattice structure having the co-efficient  $K_1 = -0.65$ ,  $k_2 = -0.34$  and  $k_3 = 0.8$ . Realize this filter in direct form. (10 Marks)

Module-4

- 7 a. Compare IIR filter with FIR filter. (10 Marks)
- b. Derive an expression for the order of analog Butterworth prototype low pass filter. (10 Marks)

OR

- 8 a. Design an Buterworth filter for which gain  $K_p = 0.5$ ,  $K_s = 0.1$  and passband frequency is 2 rad/sec, stopband frequency is 10 rad/sec. (10 Marks)
- b. Draw the block diagrams of direct form – I realizations for a digital IIR filter described by the system function :

$$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{\left(z - \frac{1}{4}\right)\left(z^2 - z + \frac{1}{2}\right)}.$$
 (10 Marks)

Module-5

- 9 a. Discuss briefly the following DSP hardware units :  
 i) MAC unit ii) Shifter iii) Address generators. (10 Marks)
- b. Convert the following decimal numbers into Q – 15 representation :  
 i) 0.560123 ii) 0.160123. (10 Marks)

OR

- 10 a. Explain briefly the basic architecture of TMS320C54X family processor. (10 Marks)
- b. Discuss the following IEEE floating – point formats  
 i) Single precision format  
 ii) Double precision format. (10 Marks)

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