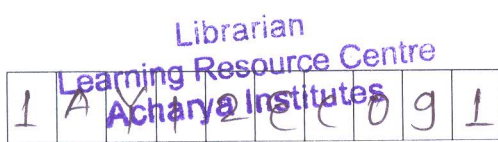


USN



10EC52

**Fifth Semester B.E. Degree Examination, July/August 2022**  
**Digital Signal Processing**

Time: 3 hrs.

Max. Marks: 100

**Note:** 1. Answer any FIVE full questions, selecting atleast TWO questions from each Part.  
2. Missing data, if any, may be suitably assumed.

**PART – A**

- 1 a. Derive the relationship of N-point DFT with other transforms. (08 Marks)  
b. Find the N-point DFT of the sequence  $x(n) = e^{j\omega n}$   $0 \leq n \leq N-1$  (04 Marks)  
c. Compute 8 point DFT of the sequence  $x(n) = (1, 1, 1, 1, 0, 0, 0, 0)$ . (08 Marks)
- 2 a. State and prove circulative shift property of DFT. (04 Marks)  
b. Find 4 point DFT of the sequence  $x(n) = \cos\left(\frac{\pi}{4}n\right) + \sin\left(\frac{\pi}{4}n\right)$ . (08 Marks)  
c. Compute circular convolution of the following sequences :  
 $x_1(n) = \{2, 1, 2, 1\}$   
 $x_2(n) = \{1, 2, 3, 4\}$ . (08 Marks)
- 3 a. Determine number of real multiplications, real additions and trigonometric functions required for direct computation of N-point DFT. (08 Marks)  
b. Find the output  $y(n)$  of a filter whose impulse response is  $h(n) = \{1, 1, 1\}$  and input signal to the filter is  $x(n) = \{1, 2, 0, -3, 4, 2, -1, 1, -2, 3, 2, 1, -3\}$  using overlap add technique. (12 Marks)
- 4 a. Develop Radix-2 DIF FFT algorithm and draw the complete flow graph for an 8 point DFT. (10 Marks)  
b. Compute circular convolution for  $N = 4$  using DIT FFT algorithm for the following sequences.  
 $x_1(n) = \{2, 1, 1, 2\}$   
 $x_2(n) = \{1, -1, -1, 1\}$ . (10 Marks)

**PART – B**

- 5 a. Determine the transfer function  $H_a(s)$  of the lowest order Butterworth filter to meet the following specification :  
i) Passband gain  $K_p = -1$  db at  $\Omega_p = 4$  rad/sec  
ii) Passband attenuation greater than or equal to 20db at  $\Omega_s = 8$  rad/sec. (10 Marks)
- b. Let  $H(s) = \frac{1}{s^2 + s + 1}$  represent the transfer function of LPF with a passband of 1 rad/sec. by using frequency transformation techniques find the transfer function of the following analog filter.  
i) A high pass filter with a cutoff frequency of 10 rad/sec  
ii) A lowpass filter with a passband of 10 rad/sec  
iii) A bandpass filter with a passband of 10 rad/sec a centre frequency of 100 rad/sec. (06 Marks)
- c. Mention the important properties of Chebyshev polynomial. (04 Marks)

- 6 a. Draw the block diagram of Direct Form-I and Direct Form-II realization for digital IIR filter described by the following system function :

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

- b. Realize the linear phase FIR filter having the following impulse response.

i)  $h(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2) + \frac{1}{4}\delta(n-3) + \delta(n-4)$

ii)  $h(n) = \delta(n) - \frac{1}{4}\delta(n-1) + \frac{1}{2}\delta(n-2) + \frac{1}{2}\delta(n-3) - \frac{1}{4}\delta(n-4) + \delta(n-5).$  (10 Marks)

- 7 a. Derive an expression for FIR frequency response of Even-N symmetric impulse response. (08 Marks)

- b. An FIR filter is to be designed with the following desired frequency response

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

Determine the filter co-efficient  $h(n)$ . If the windows defined by

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

Also find frequency response of  $H(W)$ .

(12 Marks)

- 8 a. Discuss Bilinear transformation method. Also explain the mapping of s-plane to Z plane. (08 Marks)

- b. Convert the analog filter transform function :

$$H_a(S) = \frac{S+1}{S^2+5S+6}$$

into  $H(z)$  by using impulse invariant method ( $T = 0.1 \text{ sec}$ ).

(08 Marks)

- c. Distinguish IIR and FIR filter. (04 Marks)

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