



# CBCS SCHEME

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17EC52

Fifth Semester B.E. Degree Examination, Feb./Mar.2022

## 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. Define DFT. Establish the relationship of DFT with z-transform and DTFT. (05 Marks)
- b. Compute the DFT of the sequences :
- i)  $x(n) = \cos \frac{2\pi}{N} k_0 n$
- ii)  $x_2(n) = \delta(n) + 2\delta(n-1) + 3\delta(n-2) + 4\delta(n-3)$ . (10 Marks)
- c. Determine the inverse DFT of the sequence  $y(k) = [0, 2 - 2j, 0, 2 + 2j]$ . (05 Marks)

OR

- 2 a. Evaluate the circular convolution of the following two sequences using concentric circle method.  
 $x_1(n) = [2, 1, 2, 1, 3]$ ,  $x_2[n] = [1, 2, 3, 4]$ . (10 Marks)
- b. The first five points of eight point DFT of a real valued sequence are  $(0.25, 0.125 - j0.30, 0, 0.125 - j0.05, 0)$ . Determine :
- i) Remaining points ii)  $x(0)$  iii)  $x(4)$  iv)  $\sum_{n=0}^7 x(n)$  v)  $\sum_{n=0}^7 |x(n)|^2$ . (10 Marks)

### Module-2

- 3 a. State and prove the following properties of DFT
- i) Circular time reversal
- ii) Circular frequency shift
- iii) Parseval's theorem. (12 Marks)
- b. If  $X(k)$  is the DFT of the sequence  $x(n)$ . Determine the N point DFT of the sequences
- $x_c(n) = x(n) \cos \frac{2\pi k_0 n}{N}$  and
- $x_s(n) = x(n) \sin \frac{2\pi k_0 n}{N}$  in terms of  $x(k)$ . (08 Marks)

OR

- 4 a. How many complex multiplications and additions required for computing DFT using direct DFT and FFT algorithm for  $N = 512$ . (06 Marks)
- b. Consider a FIR filter with impulse response  $h(n) = [3, 2, 1]$ . If the input sequence  $x(n) = [2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1]$  using overlap save method. Use 8 point circular convolution. (14 Marks)

### Module-3

- 5 a. Develop 8 - point DIT - FFT algorithm. (10 Marks)
- b. Compute DFT of the sequence  $x(n) = [1, 2, 3, 4, 4, 3, 2, 1]$  using DIF-FFT algorithm. (10 Marks)

OR

- 6 a. Perform circular convolution of the sequences  $x(n) = [1, 2, 3, 4]$  and  $h(n) = [1, 1, 1, 1]$  using DIF FFT algorithm. (10 Marks)
- b. With relevant equations, explain Goertzel and chirp Z – transform algorithm. (10 Marks)

**Module-4**

- 7 a. Design an IIR lowpass analog butter worth filter that meets following specification.  
 $0.8 \leq |H(j\Omega)| \leq 1$  for  $0 \leq \Omega \leq 0.2\pi$   
 $|H(j\Omega)| \leq 0.2$  for  $0.6\pi \leq \Omega \leq \pi$  (12 Marks)
- b. Let  $H(s) = \frac{1}{s^2 + \sqrt{2}s + 1}$  represent the transfer function of low pass filter with a passband of 1 rad/sec. Use frequency transformation to find the transfer function of the following analog filters.  
 i) A lowpass filter with passband of 10 rad/sec  
 ii) A high pass filter with cut off frequency of 10 rad/sec. (08 Marks)

OR

- 8 a. Realize the filter described the transfer function :  

$$H(z) = \frac{(1 + \frac{1}{4}z^{-1})}{(1 + \frac{1}{2}z^{-1})(1 + \frac{1}{2}z^{-1} + \frac{1}{4}z^{-2})}$$
 Using cascade and parallel form structure. (10 Marks)
- b. The system function of an analog filter is given as  $H_a(s) = \frac{1}{(s+1)(s+2)}$ . Obtain  $H(z)$  using impulse invariant and bilinear transform method. take sampling frequency of 5 samples/sec. (10 Marks)

**Module-5**

- 9 a. Realize FIR filter with impulse response  $h(n) = [1, 2, 3, 4, 3, 2, 1]$  using direct form and linear phase structure. (10 Marks)
- b. Draw direct form I and Lattice structure for the filter given by  

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

OR

- 10 a. Name any four types of windows used in the design of FIR filters. Write the analytical equations and draw the magnitude response characteristics of each window. (08 Marks)
- b. Determine the filter coefficients  $h_d(n)$  for the desired frequency response of a lowpass filter given by

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

Also determine  $h(n)$  and frequency response  $H(e^{j\omega})$  using Hamming window. (12 Marks)

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