



# CBCS SCHEME

15EC52

## Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020 Digital Signal Processing

Time: 3 hrs.

Max. Marks: 80

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

### Module-1

- 1 a. Derive the expression for DFT and IDFT by using frequency domain sampling of DTFT. (08 Marks)
- b. Find IDFT of  $X(k) = \{4, -j2, 0, j2\}$ . (04 Marks)
- c. Determine the circular convolution of the sequences  
 $x_1(n) = \{2, 4, 6, 3\}$      $x_2(n) = \{1, 3, 2, 1\}$ . (04 Marks)

**OR**

- 2 a. Find the 8-point DFT of the sequence  $x(n) = \{1, 1, 1, 1, 1, 1\}$  by matrix method. (08 Marks)
- b. Show that the multiplication of two DFT's leads to circular convolution of respective time sequences. (08 Marks)

### Module-2

- 3 a. An FIR filter has the impulse response  $h(n) = \{1, 2, 3\}$ , determine the response of the filter for input sequence  $x(n) = \{1, 2\}$ . Use DFT and IDFT technique. (08 Marks)
- b. In the direct computation of N-point DFT of  $x(n)$ , how many
  - i) Complex multiplications
  - ii) Complex additions
  - iii) Real multiplications
  - iv) Real additions
  - v) Trigonometric functions, evaluations are required. (08 Marks)

**OR**

- 4 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 assuming the 7 point circular convolution. (10 Marks)
- b. The 4 point DFT of a real sequence  $x(n)$  is  $X(k) = \{1, j, 1, -j\}$ . Find the DFT's of the following sequence:
  - i)  $x_1(n) = (-1)^n x(n)$
  - ii)  $x_2(n) = x((n+1))_4$
  - iii)  $x_3(n) = x((4-n))_4$  (06 Marks)

### Module-3

- 5 a. Derive 8-point DIT-FFT radix-2 algorithm and draw signal flow graph. (08 Marks)
- b. Find IDFT of  $x(k) = \{36, -4 + j9.7, -4 + j4, -4 + j1.7, -4, -4 - j1.7, -4 - j4, -4 - j9.7\}$ . Using DIF FFT radix -2 algorithm. Use butterfly diagram. (08 Marks)

OR

- 6 a. Derive Goertzel algorithm to compute N-point DFT of an N-point sequence. Provide the direct form – II structure of this algorithm. (08 Marks)
- b. For sequence  $x(n) = (2, 0, 2, 0)$  determine  $x(2)$  using Goertzel algorithm. Assume initial conditions are zero. (04 Marks)
- c. What is chirp signal? Mention the applications of chirp Z transform. (04 Marks)

Module-4

- 7 a. Design a Butterworth analog high pass filter to meet the following specifications: Maximum passband attenuation = 2dB, minimum stop band attenuation = 20dB, passband edge frequency = 200rad/sec, stop band edge frequency = 100 rad/sec. (12 Marks)
- b. Obtain the direct form – I and direct form – II realization for the following system:  $y(n) = 0.75y(n-1) - 0.125y(n-2) + 6x(n) + 7x(n-1) + x(n-2)$  (04 Marks)

OR

- 8 a. Design a butterworth low pass filter using the bilinear transformation for the following specification:  
 $0.8 \leq |H(e^{jw})| \leq 1$  for  $0 \leq w \leq 0.2\pi$   
 $|H(e^{jw})| \leq 0$  for  $0.6\pi \leq w \leq \pi$   
 Assume  $T = 2$  (10 Marks)
- b. Obtain the parallel realization of the system function

$$H(z) = \frac{1 + \frac{1}{3}z^{-1}}{1 - \frac{3}{4}z^{-1} + \frac{1}{8}z^{-2}}$$
 (06 Marks)

Module-5

- 9 a. Determine the transfer function  $H(z)$  of an FIR filter to implement  $h(n) = \delta(n) + 2\delta(n-1) + \delta(n-2)$ , Using frequency sampling technique. (08 Marks)
- b. Develop the lattice structure for the difference equation  
 $y(n) = x(n) + \frac{2}{5}x(n-1) + \frac{3}{4}x(n-2) + \frac{1}{3}x(n-3)$  (08 Marks)

OR

- 10 a. Realize FIR linear phase filter for N, even. (08 Marks)
- b. Design FIR low pass filter for the frequency response

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

Use Hamming window to determine filter coefficient and frequency response. Take  $M = 5$ . (08 Marks)

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