

CBCS SCHEME



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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 $x(n) = \{1, 1, 1, 1, 1, 1, 1, 1\}$ 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)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and/or equations written eg, 42+8 = 50, will be treated as malpractice.

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:
- $$0.8 \leq |H(e^{jw})| \leq 1 \text{ for } 0 \leq w \leq 0.2\pi$$
- $$|H(e^{jw})| \leq 0 \text{ for } 0.6\pi \leq w \leq \pi$$

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)
