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:

$$0.8 \le \left|H(e^{jw})\right| \le 1 \text{ for } 0 \le w \le 0.2\pi$$
$$\left|H(e^{jw})\right| \le 0 \text{ for } 0.6\pi \le w \le \pi$$

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) = δ(n) + 2 δ(n-1) + δ(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

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

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