PVP 19

Code: 19EC3502

III B.Tech - I Semester – Regular Examinations – JANUARY 2022

DIGITAL SIGNAL PROCESSING
(ELECTRONICS & COMMUNICATION ENGINEERING)

Duration: 3 hours Max. Marks: 70

Note: 1. This question paper contains two Parts A and B.
2. Part-A contains 5 short answer questions. Each Question carries 2 Marks.
3. Part-B contains 5 essay questions with an internal choice from each unit. Each question carries 12 marks.
4. All parts of Question paper must be answered in one place

PART – A

1. a) Find the fundamental period of the signal $x(n) = e^{j6\pi n}$
   b) State the frequency shifting property of DFT.
   c) Give the formulae for complex multiplications and additions in an N-point FFT.
   d) Write the stages involved in the design of digital filters.
   e) Explain Gibbs Phenomenon in FIR filters.

PART – B

UNIT – I

2. a) Test if the following systems are causal or not
   i. $y(n) = x(n) + x^2(n-1)$
   ii. $y(n) = x(n+1) + 3x(n) + 5x(n-1)$
   iii. $y(n) = x(2n)$ 6 M

b) Test whether the following systems are time-invariant or not:

i. $y(n) = nx(n)$

ii. $y(n) = \cos\{x(n)\}$

iii. $y(n) = \sum_{k=n_0}^{n} x(k)$ 6 M

OR

3. a) Determine the impulse response $h[n]$ of the system described by the difference equation using Z transform.

$$y[n] - 3y[n-1] - 4y[n-2] = x[n] + 2x[n-1]$$ 6 M

b) Obtain the Direct Form I and Direct Form II realization for the IIR system described by

$$H(z) = \frac{1 + 2z^{-1} + z^{-2}}{1 - \frac{3}{4}z^{-1} + \frac{1}{8}z^{-2}}$$ 6 M

UNIT – II

4. a) Compute the DFT of $x[n] = \begin{cases} n-1 \; ; \; 1 \le n \le 4 \\ 0 \quad\quad ; \; \text{otherwise} \end{cases}$ 6 M

b) Perform the circular convolution of the following sequences using DFT:

$x[n] = \{2,1,2,1\}$ and $h[n] = \{1,2,3,4\}$ 6 M

OR

5. a) Explain the steps involved in convolution of long sequences using Overlap-save method. 6 M

b) Determine the Inverse DFT of the sequence:

$$X(\mathrm{K}) = [6, -2 + 2j, -2, -2 - 2j]$$ 6 M

UNIT-III

6. a) Derive the equation to implement a butterfly structure in DIF-FFT algorithm. 6 M

   b) Compute the 8-point DFT of the sequence $x[n] = \{0,1,2,3,4,5,6,7\}$ using Radix-2 DIF-FFT Algorithm. 6 M

OR

7. a) Construct the IDFT of a sequence $X[k] = \{8,0,0,0,0,0,0,0\}$ using DIT- FFT algorithm. 6 M

   b) Compare Radix-2 DIT and DIF FFT algorithms. 6 M

UNIT – IV

8. a) Explain about frequency transformation of digital filters in analog domain. 6 M

   b) Find the order of chebyshev filter for following specifications:

$$\sqrt{0.5} \leq \left|H\left(e^{j\omega}\right)\right| \leq 1 \; ; \; 0 \leq \omega \leq 0.2\pi$$
$$\left|H\left(e^{j\omega}\right)\right| \leq 0.1 \; ; \; 0.5\pi \leq \omega \leq \pi$$

   6 M

OR

9. a) Derive the relationship between S-plane and Z-plane poles in Bilinear Transformation Method. 6 M

   b) Determine H(z) using bilinear transformation method for the following analog system function.

$$H(s) = \frac{2}{(s+1)(s+3)}$$

   6 M

   Assume T=0.1s

UNIT – V

10. Design an ideal differentiator with frequency response

$$H\left(e^{j\omega}\right) = j\omega\ ; \quad -\pi \leq |\omega| \leq \pi$$

Using Hamming window for N=8. 12 M

OR

11. a) Explain how an FIR Filter can be designed using Windowing technique? 6 M

    b) Obtain the frequency response of Linear phase FIR filter for a symmetrical impulse function with N odd. 6 M