**Registration No.:** | | | | | | | | | | |

**Total Number of Pages: 02**

**Course: B.Tech**
**Sub_Code:**
**RCS4G002/REE4G001/REL4G001/RIT4G002**

**4th Semester Back Examination: 2024-25**
**SUBJECT: Digital Signal Processing**
**BRANCH(S): CSE, CSEAI, CSEAIML, CSEDS, CST, EEE, ELECTRICAL, CSIT, IT**
**Time: 3 Hours**
**Max Marks: 100**
**Q.Code: S334**

**Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.**
**The figures in the right hand margin indicate marks.**



## Part-I

**Q1** **Answer the following questions:** **(2 x 10)**

**a)** Define BIBO (Bounded Input Bounded Output) stability for discrete-time systems.
**b)** State and explain the time-reversal property of Z-transform.
**c)** What is the relationship between correlation and convolution in discrete signals?
**d)** List two advantages of using Radix-2 FFT algorithm.
**e)** Define Frequency Domain Sampling.
**f)** Write the difference between symmetric and antisymmetric FIR filters.
**g)** Draw a block diagram of 2-point DIT-FFT butterfly computation.
**h)** Find the Z-transform of an exponentially decaying sequence.
**i)** Differentiate between Impulse Invariant method and Bilinear transformation method.
**j)** What is the role of adaptive filters in noise cancellation?

## Part-II

**Q2** **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

**a)** Analyze the stability of the discrete-time system with impulse response $h[n] = (0.8)^n u[n]$.
**b)** Derive the circular convolution relation for two sequences of length N and solve an example for x[n] = {1, 2, 3, 0} and h[n] = {1, 0, 1, 0}.
**c)** Prove that DFT converts convolution in time domain into multiplication in frequency domain. Illustrate with an example.
**d)** Find the inverse Z-transform of:

$$X(z) = \frac{z}{(z-0.5)(z+0.3)}$$

using partial fraction expansion.
**e)** Compute the 8-point DIT-FFT of the sequence x[n] = {1, 1, 1, 1, 0, 0, 0, and 0}.
**f)** Using Decimation-In-Frequency (DIF) method, find the FFT of sequence x[n] = {1, 2, 3, and 4}.
**g)** List and explain any five properties of the Z-transform with examples.

**h)** Design a linear-phase FIR filter to approximate an ideal lowpass filter using the windowing method.

**i)** For the system $H(s) = 1/(s^2 + 4s + 5)$ design an equivalent discrete-time system using bilinear transformation (T = 1s).

**j)** Differentiate between DIT-FFT and DIF-FFT techniques both structurally and mathematically.

**k)** Draw and explain the 8-point Radix-2 DIF-FFT structure.

**l)** Explain with an example how an Adaptive FIR filter can perform system identification.

## Part-III

**Only Long Answer Type Questions (Answer Any Two out of Four)** **(16 x 2)**

**Q3** **a)** $x[n] = \{1, 2, 1, 2, 1, 2\}$ and $h[n] = \{1, –1, 1\}$. **(8 + 8)**
Use Overlap-Add method to perform the convolution assuming block length of 3.

**b)** Use Overlap-Save method with block length 3 for the same signals.

**Q4** **a)** State and prove any four fundamental properties of DFT with neat mathematical explanation. **(8 + 8)**

**b)** The impulse response of a system is given by: $h[n] = \{2, 1, 2, 1\}$. Draw the Direct Form-I and Direct Form-II structures for its realization.

**Q5** **a)** Using Radix-2 DIT-FFT algorithm, compute the DFT of the sequence: $x[n] = \{1, 0, 2, 3, 4, 0, 1, 2\}$. **(8 + 8)**

**b)** From the obtained DFT, reconstruct x[n] using the DIF-FFT algorithm.

**Q6** **Write notes (any two)** **(8 + 8)**

a) Structure and properties of Adaptive FIR filters for noise cancellation.
b) Comparison between IIR and FIR filter realization methods.
c) Application of Z-transform in analyzing discrete systems.