2022

INFORMATION TECHNOLOGY

Paper : IT-GE-31

[Digital Signal Processing]

Full Marks : 50

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer *any five* questions.

1. (a) Define the following discrete signal sequences and show their respective plots :
   - (i) Unit Step
   - (ii) Unit Ramp
   - (iii) Unit Impulse
   (b) Define Discrete Time (i) Even and (ii) Odd Signals with proper examples. $\qquad$ (2+2+2)+(2+2)

2. (a) Plot the following discrete sequence :
   $$x[n] = -5\delta(n+4) - 2\delta(n+1) + 2\delta(n) + 3\delta(n-2)$$
   (b) "Any arbitrary sequence can be represented using delay unit"— Explain.
   (c) Discuss the computation of signal power for a signal sequence $x[n]$, where n is an integer and ranges between (0, ..., N-1).
   (d) Define an LTI system. $\qquad$ 2+3+2+3

3. (a) What is a causal system? Prove that a moving average filter is LTI but not causal.
   (b) Explain the process of linear convolution sum between two discrete sequences using proper illustrations.
   (c) Evaluate the linear convolution of the two following discrete signals :
   $$x[n] = \{-1, 1, 2, 3\} \ \& \ h[n] = \{-1, 2, 2\}$$ $\qquad$ (1+2)+3+4

4. (a) Draw the region of convergence of the Z transform of the sequence $a^n u[n]$, where $u[n] = 0$ for all $n<0$ and $u[n] = 1$ for $n>=0$.
   Can the ROC of a Z transform contain Pole? Give reasons to your answer. Where are the poles and zeros of the function $F(z) = \dfrac{(z-3)}{(z-4)\left(z^2 + z + 4\right)}$?
   (b) Prove the linearity and time shifting property of the Z transform. $\qquad$ (2+2+2)+4

Please Turn Over

(2)

5. (a) What do you mean by Discrete Fourier Series and Discrete Fourier Transform? Compute DFT for the sequence $x = [1, 2, 1, 2]$.

   (b) Discuss the (i) Linearity, (ii) Time Shifting and (iii) Frequency Shifting Properties of Discrete Fourier Series.

   $(1+1+2)+(2+2+2)$

6. (a) What are the advantages of FFT over conventional DFT? Describe the FFT algorithm with $N = 8$.

   (b) With proper example show the use of Linear Constant-coefficient Difference Equations for describing LTI systems.   ③ $(2+5)+3$

7. (a) State the key features of an FIR Filter. Describe the design of a low-pass FIR filter.

   (b) Compare FIR and IIR Digital Filtering techniques.

   $(3+5)+2$

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$$\frac{z^2 + 2 + 4}{-b \pm \sqrt{b^2 - 4ac}}$$
$$2a$$