2023

INFORMATION TECHNOLOGY

Paper : IT-502

(Digital Signal Processing)

Full Marks : 70

The figures in the margin indicate full marks.

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

Answer ***question no.*** **1** and ***any four*** questions from the rest.

1. Answer ***any five*** questions : 2×5

   (a) Is $y(t) = x^2(t)$ a linear system?

   (b) Define unit ramp function.

   (c) Define unit impulse train.

   (d) What is meant by linear time-invariant system?

   (e) Prove whether $x(t) = \cos^2(2t - (\Pi/3))$ is periodic or not.

   (f) Find the Z transform of the sequence : $x = \{-2, -1, 1, 2, 3, 4, 5\}$.

2. (a) Briefly discuss about the classification of signals.

   (b) State the different operations on sequences.

   Plot the sequence : $p[n] = a_{-3}\delta(n+3) + a_1\delta[n-1] + a_2\delta[n-3] + a_7\delta[n-7]$

   ~~$p[n] = a_{-3}\delta[n+3] + a_1\delta[n-1] + a_2\delta[n-3] + a_7\delta[n-7]$~~

   (c) Briefly explain with example: Energy and Power Signals. 6+(2+3)+(2+2)

3. (a) What do you mean by digital signal processing? Explain each component of digital signal processing with the help of a block diagram.

   (b) What is a system? Discuss about the different types of systems with example.

   (c) Define a Linear Shift Invariant System with an example. Is $y(n) = \sum_{k=-\infty}^{\infty} x(k)T[\delta(n-k)]$ a linear shift invariant system? (2+3)+(2+4)+(3+1)

4. (a) Explain with examples in how many ways an LTI system can be characterized.

(b) Define Convolution. What are the properties of convolution?

(c) Find the convolution of

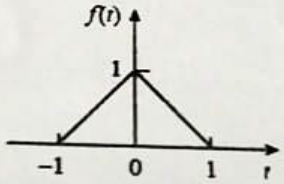
(i) $X(n) = \{2,\underset{\uparrow}{1},-2,3,-4\}$ and $h(n) = \{3,\underset{\uparrow}{1},2.1,4\}$

(ii) $h[n] = a^n u[n]$, $|a| < 1$, $x[n] = u[n]$

4+(2+3)+(4+2)

5. (a) What do you understand by Discrete Fourier Transform? Explain, in brief, the properties of DFT.

(b) Find the Fourier transform of the following function :



(c) Explain Fast Fourier Transform with an example.

(2+5)+4+4

6. (a) What do you mean by DFS?

(b) What do you mean by magnitude and phase spectrum?

(c) Discuss, in brief, the properties of DFS.

(d) What do you mean by poles and zeroes of a Z transform?

(e) Find the Z transform of : $y(n) = x(n+3)u(n)$.

2+4+5+2+2

7. Write short notes on ***any three*** of the following :

5×3

(a) Butterworth Filters

(b) ROC of Z transform

(c) Causal and anti-causal systems

(d) Memory-less systems.