# 2023

## ELECTRONIC SCIENCE

**Paper : ITGE-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) State any two advantages of Digital Signal Processing.
   (b) Define unit step sequence.
   (c) What is time-invariant system?
   (d) Check the BIBO stability of the discrete time system described of impulse response $h[n] = (2)n\ U[-n-1]$.
   (e) Plot the sequence : $p[n] = a_{-3}\,\delta[n+3] + a_1\,\delta[n-1] + a_2\,\delta[n-2] + a_7\,\delta[n-7]$. 2+2+2+2+2

2. (a) Explain the process of analog to digital conversion of signal in terms of sampling quantization and coding.
   (b) Analog signal is given as $x(t) = 2\cos(150\,\Pi\,t) + 3\sin(140\,\Pi\,t)$.
      (i) Find the Nyquist rate and the discrete signal form of the signal at Nyquist rate.
      (ii) Hence compute the period of the discrete signal. 6+(2+2)

3. (a) Draw the time reversal of the discrete signal $x[n] = \{1, -2, -1, 2, 1\}$.
   (b) What is the period of $x[n] = \exp(-j\,7\,\Pi\,n)$?
   (c) $x[n] = \sin(0.2\,\Pi\,n) + \sin(0.3\,\Pi\,n)$, check the periodicity of the signal and find the period. 2+3+5

4. (a) Find the convolution of $X(n) = \{3, 1, 2\}$ and $h(n) = \{3, 2, 1\}$. (↑ under 3 in $X(n)$, ↑ under 3 in $h(n)$)
   (b) In how many ways a LTI system can be characterized? State three properties of convolution with an example. 4+(3+3)

5. (a) What do you understand by discrete Fourier transform? Find the Fourier transforms of the following functions :

   (i) signum function : sgn(t)

   (ii) the double-sided exponential: $e^{-a|t|}$.

   (b) State the two methods used for filtering long data sequences.

   (c) Write a short note on Fast Fourier Transform. 2+2+1+5

6. (a) Explain the design principle of an FIR Low Pass Filter.

   (b) Compare between FIR and IIR Filters. 6+4

7. (a) Obtain Z-transform for :

   (i) $y(n) = x(n+3)u(n)$.

   (ii) sequence : {1, 0, 2, 0, 3}.

   (b) State any six properties of Z transforms. (3+1)+6