## 6<sup>TH</sup> SEM./APP ELEC & INSTRU ENGG/ECE/EEE/ ELECTRICAL(INST & CTRL)/ETE/2022(S) TH3 DIGITAL SIGNAL PROCESSING

Full Marks: 80

Answer any FIVE Questions including Q No.1& 2

Figures in the right hand margin indicates marks

- 1. Answer **All** questions
  - a. Write any two examples of (i) Random signal (ii) Even Signal
  - b. Draw the following type of signals. (i) Continuous periodic signal (ii) Discrete aperiodic signal
  - c. Determine if x(n) = u(n+2) is a causal signal or non-causal signal.
  - d. Check if the below given signal x(n) is periodic or not. Determine its fundamental Period if it's a periodic signal.

$$\mathbf{x}(\mathbf{n}) = \cos\left(\frac{2\pi n}{5}\right)$$

e. Represent below given signals graphically.

$$\underbrace{(i)s_1(n) = \{0, 2, 1, 4, 5, 1, 2\}, (ii) s_2(n) = \{\dots, -1, 0, 1, 0, 5, 1, -2, \dots, \}}_{\uparrow}$$

f. Determine z-transform & ROC of signal y (n) =  $\delta$  (n - k), k > 0

g. Find the inverse z-transform of X (Z) =  $\left(\frac{3Z}{Z-6}\right)$  (ROC: |Z| > 6).

- h. Write any two properties of convolution.
- i. Represent the given signal as sum of shifted impulses.  $x (n) = \{2, 4, 0, 3\}$
- j. Mention the formula to find the total number of complex addition and complex multiplication in N-point FFT algorithm.

2.

## Answer Any SIX Questions

6 x 5

[2]

- a. Sketch the following discrete signals along with mathematical representation. [1]
  - (i) Unit Impulse signal [2]
  - (ii) Unit Step Signal
  - (iii) Unit Ramp signal
- b. Sketch x(n), x(n+2), x(-n), x(-n+2),  $x^2(n)$  if x(n) is defined as below  $x(n) = \{1, 0, 1, 2\}$
- c. Compute poles, zeros and system response of the following:

$$y(n) = 2 y(n - 1) + 3x(n)$$

d. State any 5 properties of z-transform

Time- 3 Hrs

2 x 10

e. Find Linear and Circular convolution of the following signals.

 $x_1(n) = \{1, 2, 0, 1\} \& x_2(n) = \{1, 2, 3, 4\}$ 

10[5+5]

- f. Determine the signal  $x(n) = \left(\frac{2}{3}\right)^n u(n)$  is an energy or power or neither energy nor power signal.
- g Find 4-point DFT of  $x(n) = \{1, 0, 0, 1\}$
- 3 (i) State and explain sampling theorem.
  - (ii) Determine the Nyquist rate of the below given analog signal.

$$m(t) = 2 Sin(100\pi t) Cos(200\pi t) + Cos(50\pi t)$$

4 (i) Define LTI system. 10[2+8]

(ii)Determine whether the following systems are linear time invariant.

(a) y(n) = x(n-4), (b)  $y(n) = nx^{2}(n)$ ,

- 5 Find Inverse Z-Transform of casual system  $X(Z) = \left(\frac{1+5z^{-1}}{1+3z^{-1}+2z^{-2}}\right)$  (ROC: |Z|>2) 10
- 6 Compute a 4 point IDFT of a sequence  $X(K) = \{3, (2+j), 1, (2-j)\}$  10
- 7 Find the DFT of a sequence  $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$  using DIT-FFT radix-2 10 algorithm.