# $6^{\text {TH }}$ SEM./APP ELEC \& INSTRU ENGG/ECE/EEE/ ELECTRICAL(INST \& CTRL)/ETE/2022(S) TH3 DIGITAL SIGNAL PROCESSING 

Full Marks: 80
Time- 3 Hrs
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 $\mathrm{x}(\mathrm{n})$ is periodic or not. Determine its fundamental Period if it's a periodic signal.

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

e. Represent below given signals graphically.

$$
\text { (i) } s_{1}(n)=\{0,2,1,4,5,1,2\}, \text { (ii) } s_{2}(n)=\{\ldots \ldots . .-1,0,1,0,5,1,-2, \ldots \ldots \ldots\}
$$

f. Determine z-transform \& ROC of signal $\mathrm{y}(\mathrm{n})=\delta(\mathrm{n}-\mathrm{k}), \mathrm{k}>0$
g. Find the inverse z -transform of $\mathrm{X}(\mathrm{Z})=\left(\frac{3 Z}{z-6}\right)($ ROC: $|\mathrm{Z}|>6)$.
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
a. Sketch the following discrete signals along with mathematical representation.
(i) Unit Impulse signal
(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:

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

d. State any 5 properties of z-transform
e. Find Linear and Circular convolution of the following signals.

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

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

(i) Define LTI system.
(ii)Determine whether the following systems are linear time invariant.
(a) $y(n)=x(n-4)$,
(b) $y(n)=n x^{2}(n)$,

Find Inverse Z-Transform of casual system $X(Z)=\left(\frac{1+5 z^{-1}}{1+3 z^{-1}+2 z^{-2}}\right)($ ROC: $|Z|>2)$
Compute a 4 point IDFT of a sequence $\mathrm{X}(\mathrm{K})=\{3,(2+\mathrm{j}), 1,(2-\mathrm{j})\}$ 10

Find the DFT of a sequence $\mathrm{x}(\mathrm{n})=\{1,2,3,4,4,3,2,1\}$ using DIT-FFT radix-2 10 algorithm.

