Experiment No: **2** Date: 06/08/24

Experiment Name: Verification of Sampling Theorem

Aim:

To verify Sampling Theorem.

Theory:

The Sampling Theorem, also known as the Nyquist-Shannon Sampling Theorem, states that a continuous signal can be completely reconstructed from its samples if the sampling frequency is greater than twice the highest frequency present in the signal. This critical frequency is known as the Nyquist rate.

$$-fs \geq 2 \cdot fmax$$

Where:

- fs is the sampling frequency (rate at which the signal is sampled),
- fmax is the highest frequency present in the signal.

Applications:

- Digital audio and video processing
- Communication systems
- Image processing
- Medical imaging

Program:

```
clc;

clear all;

close all;


subplot(2,2,1);

t = 0:0.01:1;

f=10;
```

```
y = sin(2*pi*f*t);
plot(t,y);
grid(true);
xlabel("Time");
ylabel("Amplitude");
title("Continuous Signal");

 subplot(2,2,2);
 fs= 0.5*f; Undersampled
 t1 = 0:1/fs:1;
 y1 = sin(2*pi*f*t1);
 stem(t1,y1);
 hold on;
 plot(t1,y1);
 grid(true);
 xlabel("Time");
 ylabel("Amplitude");
 title("Under Sampled Signal");

 subplot(2,2,3);
 fs2= 3*f; Nyquist sampled
 t3 = 0:1/fs2:1;
 y2 = sin(2*pi*f*t3);
 stem(t3,y2);
 hold on;
 plot(t3,y2);
 xgrid(true);
 xlabel("Time");
 ylabel("Amplitude");
 legend("Discrete","Continuous")
```

```
title("Nyquist Sampled Signal");

subplot(2,2,4);

fs2= 100*f; Oversampled
t3 = 0:1/fs2:1;

y2 = sin(2*pi*f*t3);

stem(t3,y2);

hold on;

plot(t3,y2);

grid(true);

xlabel("Time");

ylabel("Amplitude");

legend("Discrete","Continuous")

title("Over Sampled Signal");
```

Result

Verified Sampling Theorem using MATLAB.

Observation