Experiment No: 2 Date: 06/08/24

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.

$$f_s \geq 2 \cdot f_{max}$$

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; %undersampled
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; %undersampled
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: