Verification of Sampling Theorem

Aim

To Verify the Sampling Theorem using MATLAB

Theory

Sampling Theorem: A band limited signal can be reconstructed exactly if it is sampled at a rate atleast twice the maximum frequency component in it. The maximum frequency component of g(t) is fm. To recover the signal g(t) exactly from its samples it has to be sampled at a rate fs=2fm. The minimum required sampling rate fs = 2fm is called Nyquist rate

Program

```
clc;
clear;
close all;

t = 0:0.01:1;
fm = 10;

y = sin(2*pi*fm*t);
subplot(2,2,1);
plot(t,y,'r');
hold on;
stem(t,y,'b');
hold off
legend('Continuous', 'Discrete');
xlabel('Time Index');
ylabel('Amplitude');
title('Signal')

fs1 = fm;
t1 = 0:1/fs1:1;
y1 = sin(2*pi*fs1*t1);
subplot(2,2,2);
plot(t1,y1,'r');
hold on;
stem(t1,y1,'b');
hold off;
legend('Continuous','Discrete')
title('Undersampling');
```

```matlab
fs2 = 2*fm;
t2 = 0:1/fs2:1;
y2 = sin(2*pi*fs2*t2);
subplot(2,2,3);
plot(t2,y2,'r');
hold on;
stem(t2,y2,'b');
hold off;
legend('Continuous','Discrete')
title('Nyquist Sampling');

fs3 = 10*fm;
t3 = 0:1/fs3:1;
y3 = sin(2*pi*fs3*t3);
subplot(2,2,4);
plot(t3,y3,'r');
hold on;
stem(t3,y3,'b');
hold off;
legend('Continuous','Discrete')
title('Over Sampling');
```

Result

Verified Sampling theorem using MATLAB

Observation