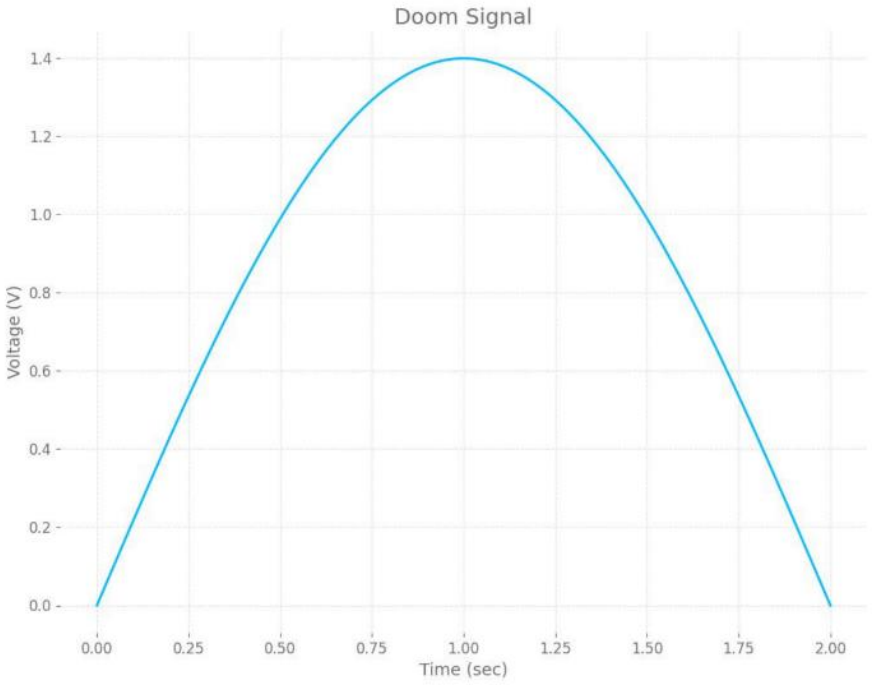


Requirements

if we need to convert this analog to digital signal what is the

digital sequence if we use ADC with:

- 3-bit encoder with Sampling Time = 0.25sec,
- 3-bit encoder with Sampling Time = 0.5sec,
- 3-bit encoder with Sampling Time = 1sec,
- 2-bit encoder with Sampling Time = 0.25sec,

at each point draw the discrete signal also (the step after time

sampling and quantization)

what is your conclusion from this problem

code:

```
t = linspace(0, 2, 1000);
y = 1.4 * sin(pi * t / 2);
V_max = 1.4;
sampling_times = [0.25, 0.5, 1];
bit_depths = [3, 2];
for i = 1:length(bit_depths)
    n = bit_depths(i);
    q = V_max / (2^n - 1);
    for j = 1:length(sampling_times)
        Ts = sampling_times(j);
        t_samples = 0:Ts:2;
        y_samples = 1.4 * sin(pi * t_samples / 2);
        a = fix(y_samples / q);
        yq = a * q;
        if (n == 3 && (Ts == 0.5 || Ts == 1 || Ts == 0.25)) || (n == 2 && Ts == 0.25)
            figure;
            % Original signal plot
            subplot(2, 2, 1);
            plot(t, y, 'r');
            title(['Original Signal (n=', num2str(n), ', Ts=', num2str(Ts), ')']);
            xlabel('Time (sec)');
            ylabel('Voltage (V)');
            axis([0 2 0 V_max]);
            grid on;
            % Sampled signal plot
            subplot(2, 2, 2);
            stem(t_samples, y_samples, 'b');
```

```
        title(['Sampled Signal (n=', num2str(n), ', Ts=', num2str(Ts), ')']);
        xlabel('Time (sec)');
        ylabel('Voltage (V)');
        axis([0 2 0 V_max]);
        grid on;
        % Reconstructed signal plot with binary y-axis labels
        subplot(2, 2, 3:4);
        stairs(t_samples, yq, 'black');
        title(['Reconstructed Signal (n=', num2str(n), ', Ts=', num2str(Ts), ')']);
        xlabel('Time (sec)');
        ylabel('Binary Code');
        yticks((0:2^n-1) * q);
        yticklabels(dec2bin(0:2^n-1, n));
        axis([0 2 -q V_max+q]);
        grid on;
    end
  end
end
```

Output:

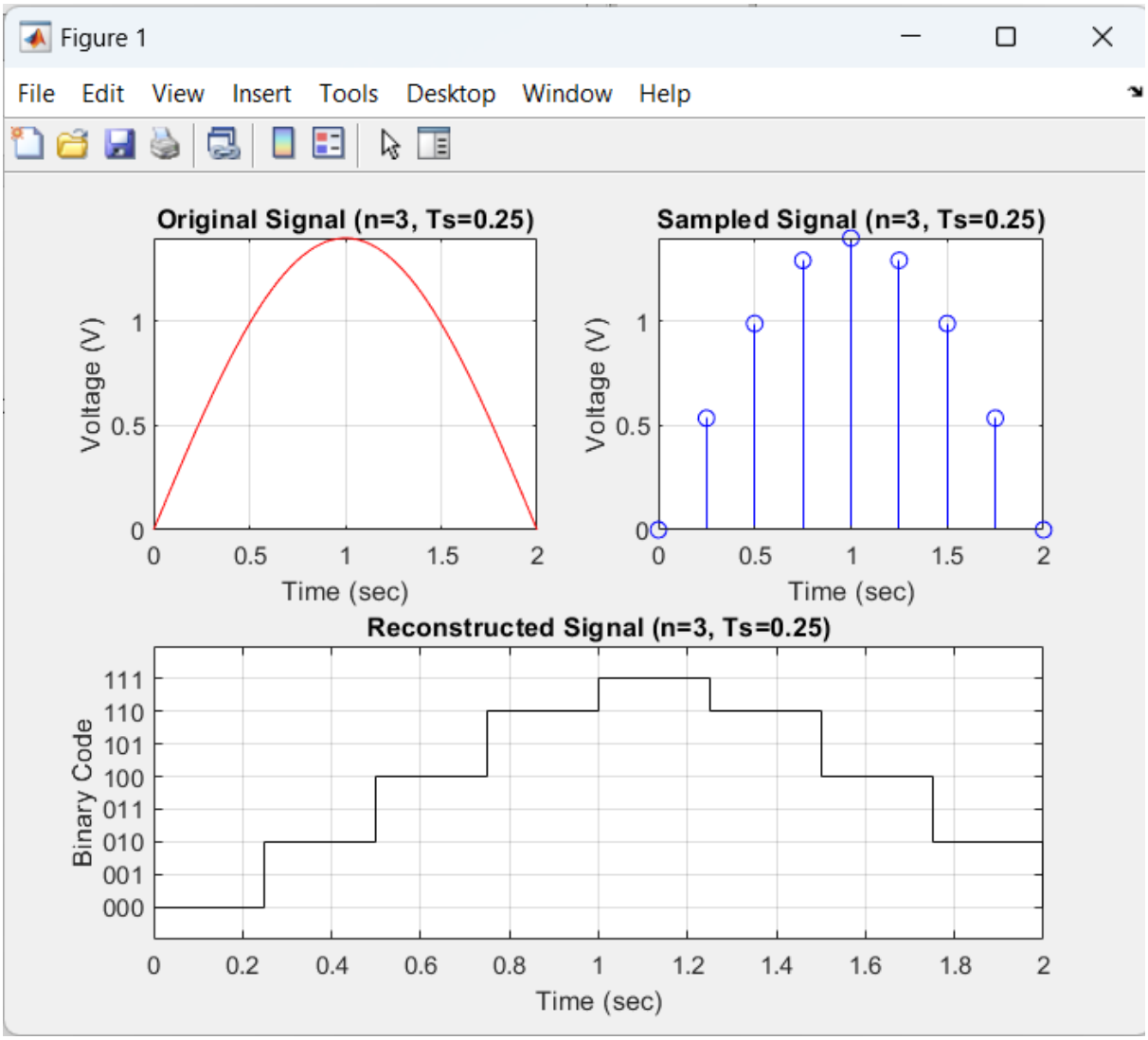


Figure 1
File Edit View Insert Tools Desktop Window Help
Original Signal (n=3, Ts=0.25)
Voltage (V)
Time (sec)
Sampled Signal (n=3, Ts=0.25)
Voltage (V)
Time (sec)
Reconstructed Signal (n=3, Ts=0.25)
Binary Code
111
110
101
100
011
010
001
000
Time (sec)

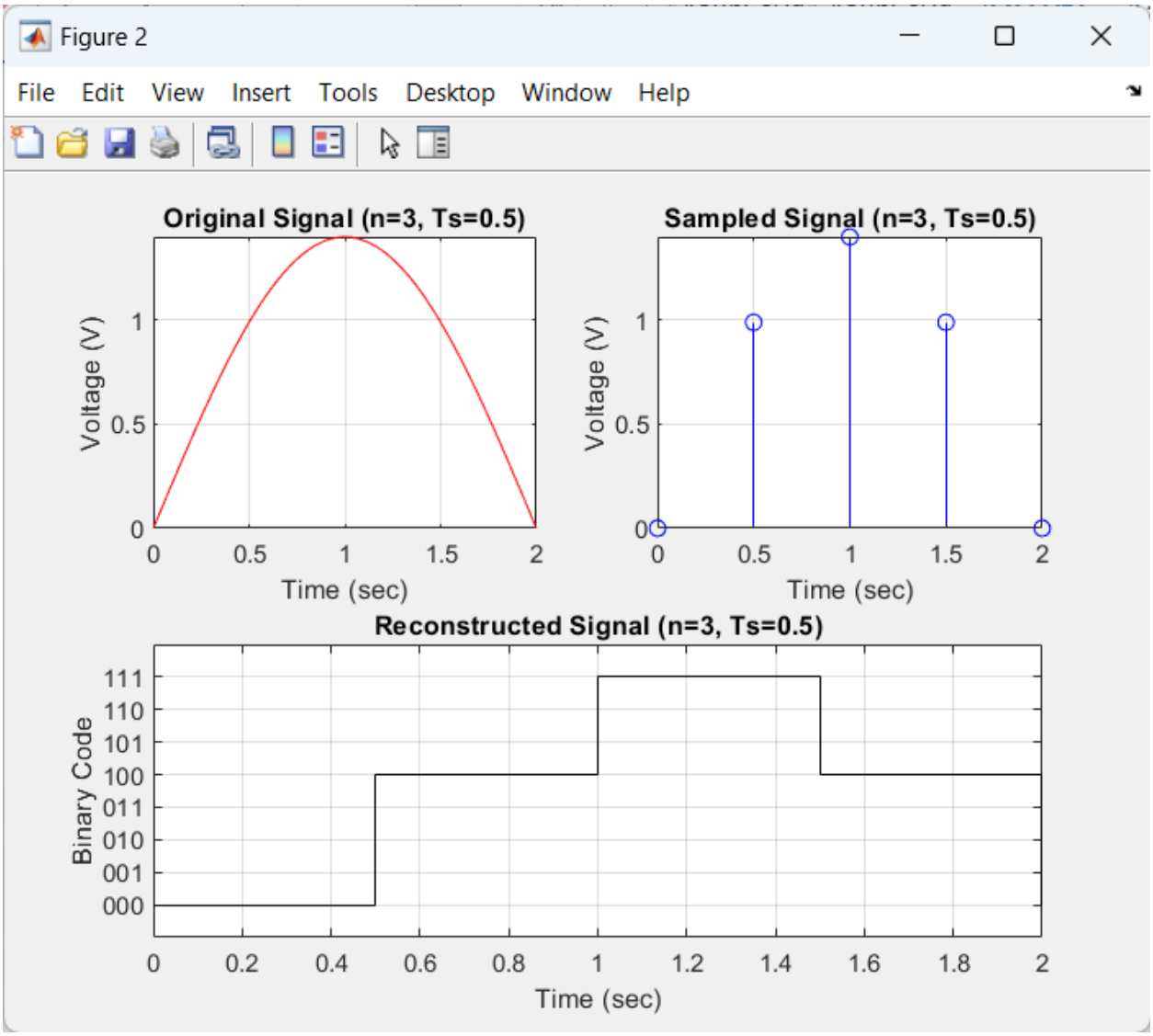


Figure 2
File Edit View Insert Tools Desktop Window Help
Original Signal (n=3, Ts=0.5)
Voltage (V)
Time (sec)
Sampled Signal (n=3, Ts=0.5)
Voltage (V)
Time (sec)
Reconstructed Signal (n=3, Ts=0.5)
Binary Code
111
110
101
100
011
010
001
000
Time (sec)

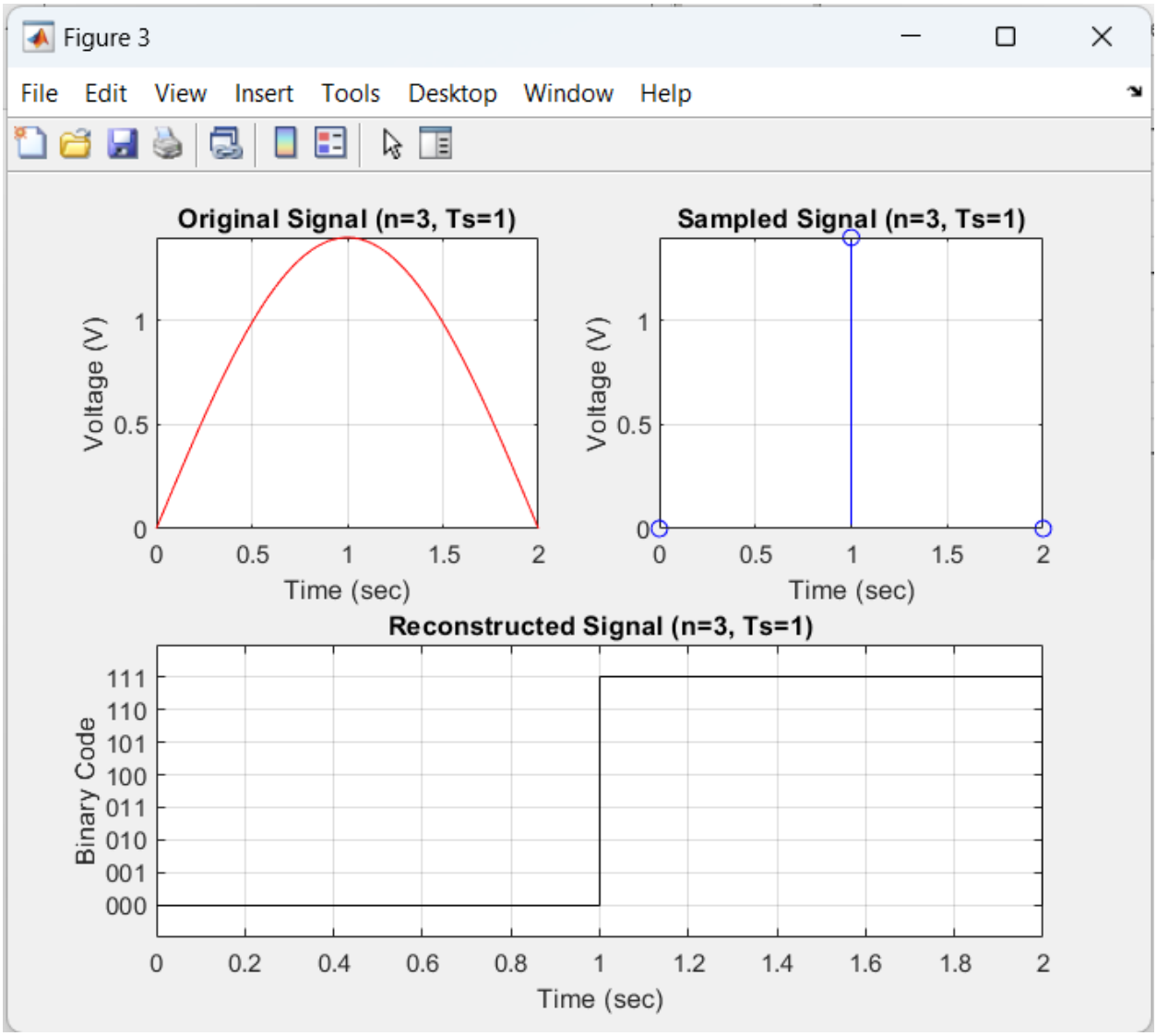


Figure 3
File Edit View Insert Tools Desktop Window Help
Original Signal (n=3, Ts=1)
Voltage (V)
Time (sec)
Sampled Signal (n=3, Ts=1)
Voltage (V)
Time (sec)
Reconstructed Signal (n=3, Ts=1)
Binary Code
111
110
101
100
011
010
001
000
Time (sec)

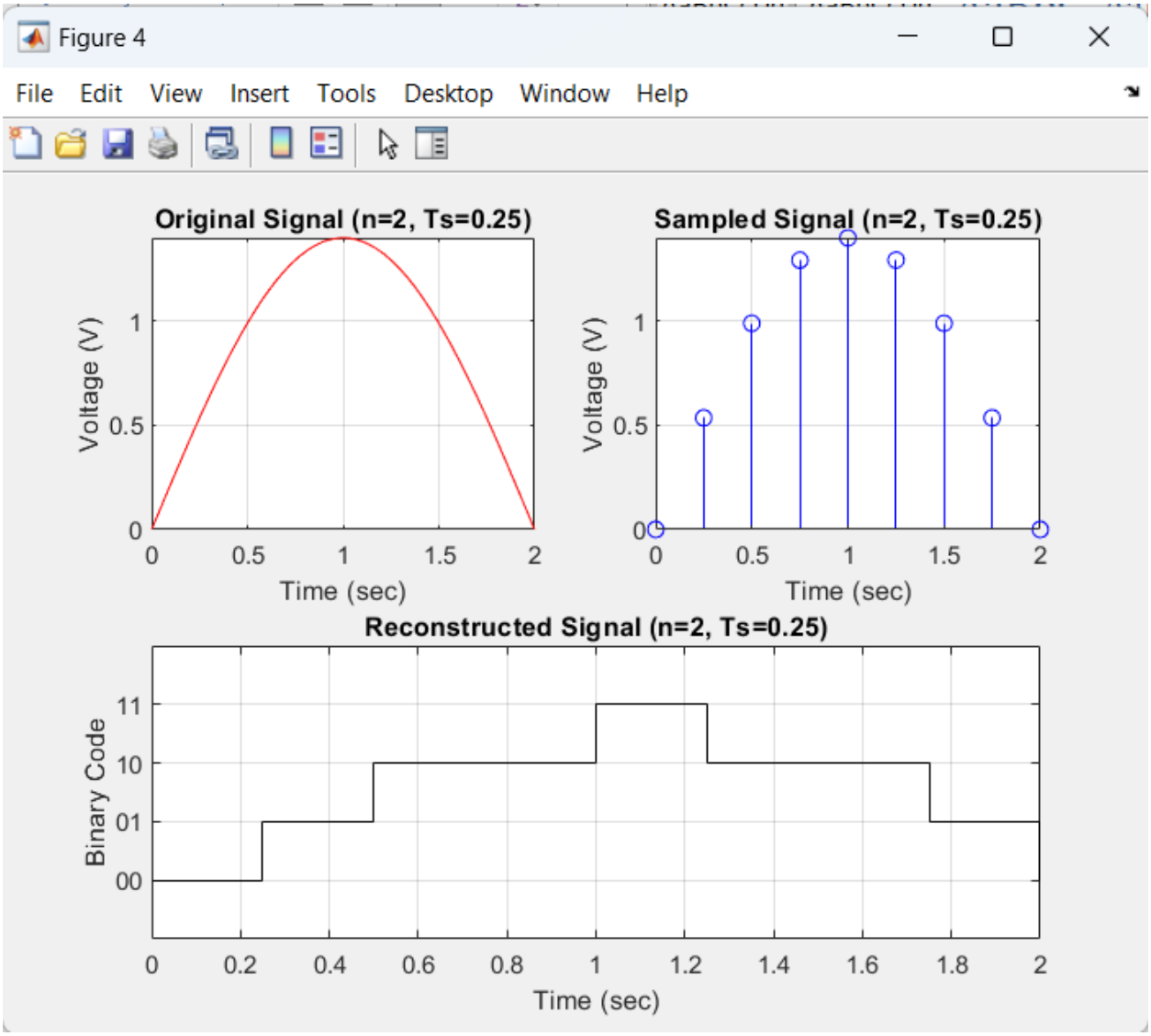
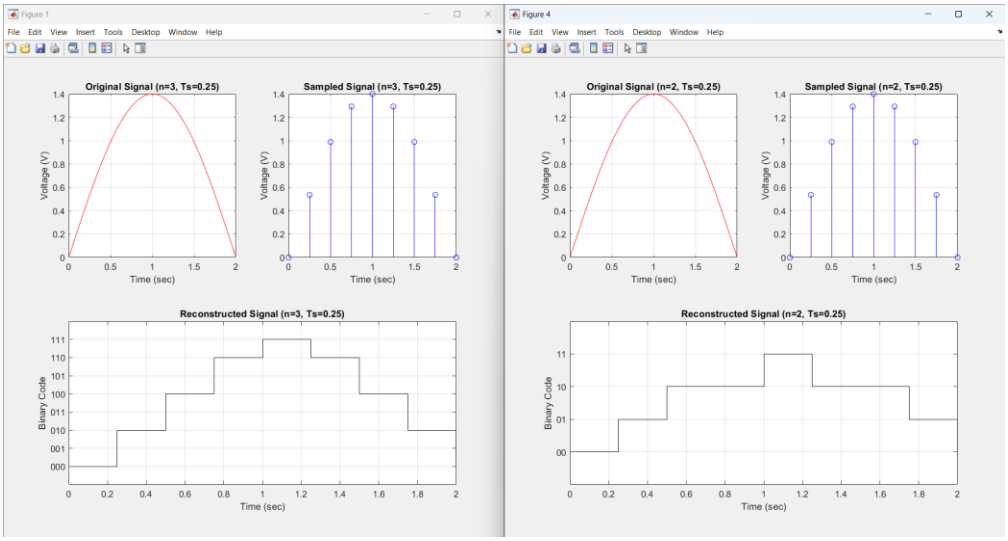


Figure 4
File Edit View Insert Tools Desktop Window Help
Original Signal (n=2, Ts=0.25)
Voltage (V)
Time (sec)
Sampled Signal (n=2, Ts=0.25)
Voltage (V)
Time (sec)
Reconstructed Signal (n=2, Ts=0.25)
Binary Code
11
10
01
00
Time (sec)

Conclusion:

1. In the comparison between 3-bit and 2-bit quantization, higher bit depth allows for more precise quantization of the analog signal, resulting in a digital representation that closely approximates the original signal.



2. Smaller sampling intervals provide a more detailed representation of the analog signal's changes over time. For instance, a 0.25-second sampling interval offers a discrete-time signal that more closely matches the continuous waveform compared to longer intervals, such as 0.5 or 1 second