

```

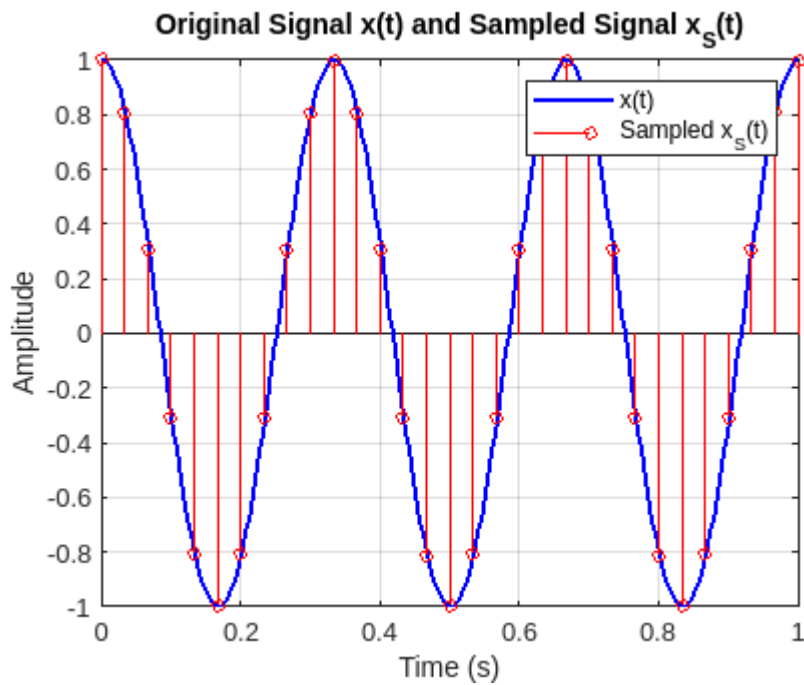
%dsp lab 3

clc; clear; close all;
A = 1;
f0 = 3;
K = 10;
fs = K * f0;
Ts = 1/fs;
M = 10;
C = 100;
T0 = 1/f0;
Tmax = C * T0;
TDelta = Ts / M;
t = linspace(0, Tmax, round(Tmax / TDelta));
xt = A * cos(2 * pi * f0 * t);

data_points = length(xt);
xSt = zeros(1, data_points);
xSt(1:M:end) = xt(1:M:end);

figure;
plot(t, xt, 'b', 'LineWidth', 1.5); hold on;
stem(t(1:M:end), xSt(1:M:end), 'r', 'MarkerSize', 4);
xlabel('Time (s)'); ylabel('Amplitude');
title('Original Signal x(t) and Sampled Signal x_S(t)');
legend('x(t)', 'Sampled x_S(t)');
grid on;
xlim([0, 3*T0]);

```



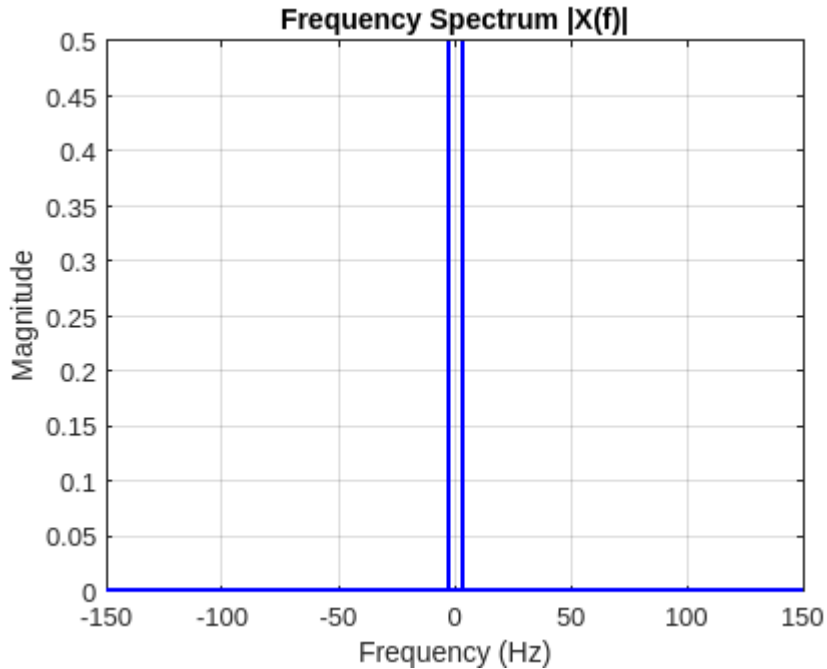
```

X_f = (TDelta/Tmax) * fftshift(fft(xt));
XS_f = (1/Tmax) * fftshift(fft(xSt));

f_max = M * fs / 2;
f_axis = linspace(-f_max, f_max, length(X_f));

figure;
plot(f_axis, abs(X_f), 'b', 'LineWidth', 1.5);
xlabel('Frequency (Hz)'); ylabel('Magnitude');
title('Frequency Spectrum |X(f)|');
grid on;

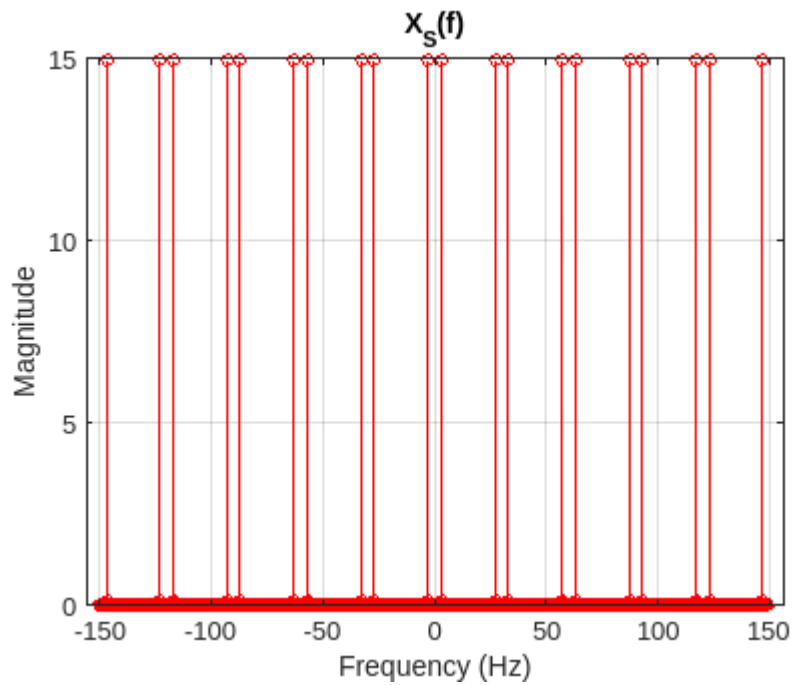
```



```

figure;
stem(f_axis, abs(XS_f), 'r', 'MarkerSize', 4);
xlabel('Frequency (Hz)'); ylabel('Magnitude');
title('X_S(f)');
grid on;

```



```
%task 2
```

```
clc; clear; close all;
```

```
A = 1;
f0 = 3;
K = 10;
fs = K * f0;
Ts = 1/fs;
```

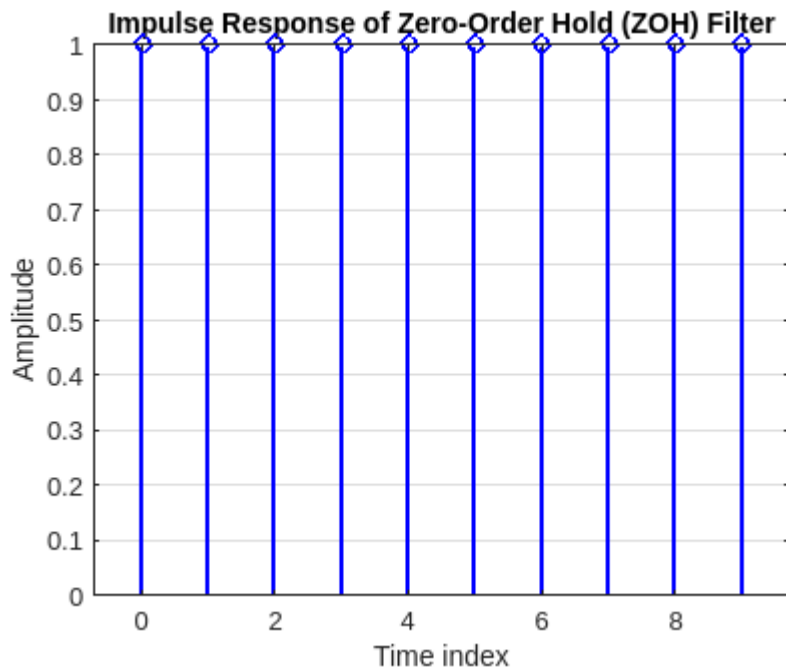
```
M = 10;
C = 100;

T0 = 1/f0;
Tmax = C * T0;
TDelta = Ts / M;
t = linspace(0, Tmax, round(Tmax / TDelta));
```

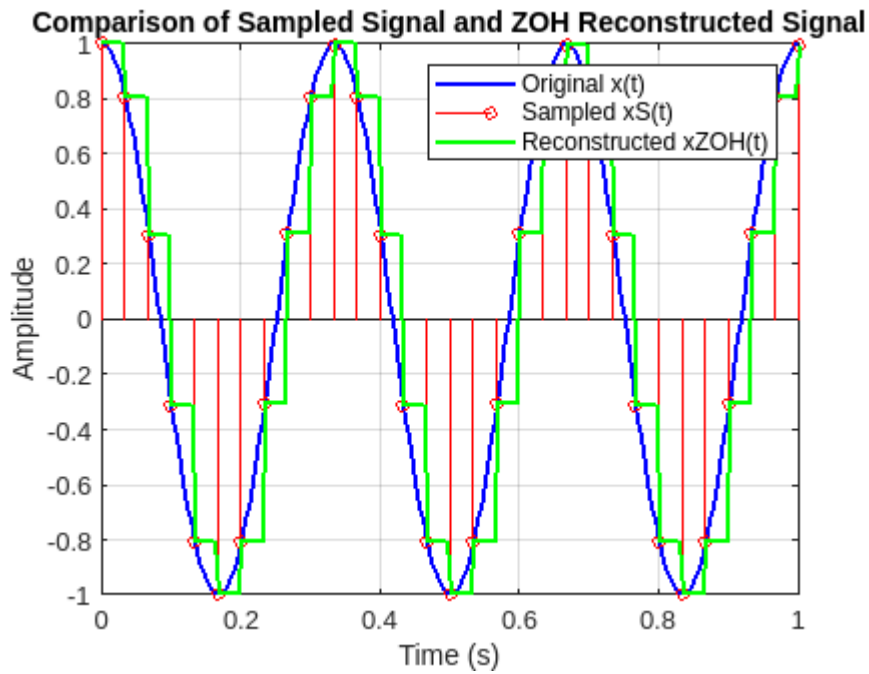
```
xt = A * cos(2 * pi * f0 * t);
```

```
data_points = length(xt);
xSt = zeros(1, data_points);
xSt(1:M:end) = xt(1:M:end);
hzoh_t = ones(1, M);
figure;
stem(0:M-1, hzoh_t, 'b', 'LineWidth', 1.5);
xlabel('Time index'); ylabel('Amplitude');
title('Impulse Response of Zero-Order Hold (ZOH) Filter');
```

```
grid on;
```



```
xZOH_t = filter(hzoh_t, 1, xSt);  
  
xZOH_t = xZOH_t / max(abs(xZOH_t)) * max(abs(xSt));  
  
figure;  
plot(t, xt, 'b', 'LineWidth', 1.5); hold on;  
stem(t(1:M:end), xSt(1:M:end), 'r', 'MarkerSize', 4);  
plot(t, xZOH_t, 'g', 'LineWidth', 1.5);  
  
xlabel('Time (s)'); ylabel('Amplitude');  
title('Comparison of Sampled Signal and ZOH Reconstructed Signal');  
legend('Original x(t)', 'Sampled xS(t)', 'Reconstructed xZOH(t)');  
grid on;  
xlim([0, 3*T0]);
```



```







X_ZOH_f = (1/Tmax) * fftshift(fft(xZOH_t));

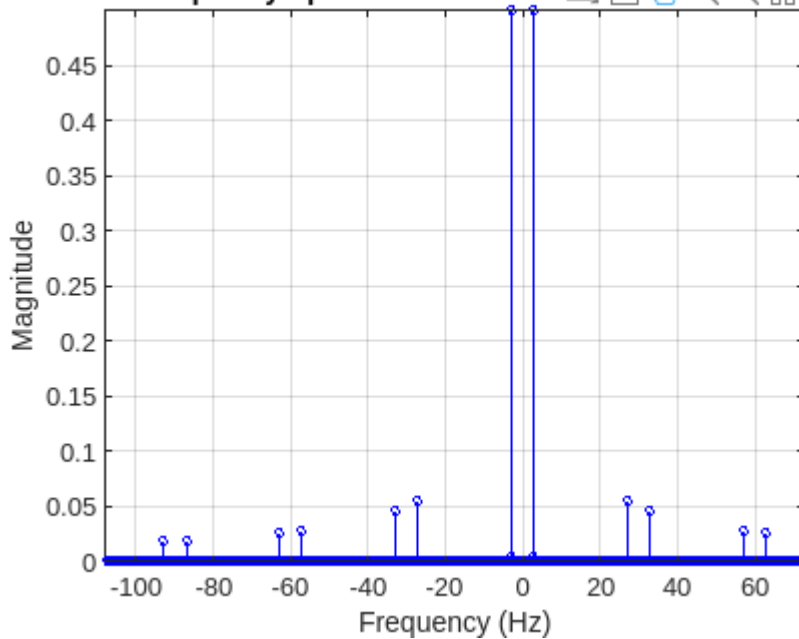
N = length(X_ZOH_f);
df = 1/Tmax;
f_axis = (-N/2:N/2-1) * df;

X_ZOH_f = X_ZOH_f / max(abs(X_ZOH_f)) * (A/2);

figure;
stem(f_axis, abs(X_ZOH_f), 'b', 'MarkerSize', 3);
xlabel('Frequency (Hz)'); ylabel('Magnitude');
title('Final Fixed Frequency Spectrum of ZOH-Filtered Reconstructed Signal');
grid on;

```

Final Fixed Frequency Spectrum of ZOH-Fil       ed Sign



```
%task3:

clc; clear; close all;

A = 1;
f0 = 3;
K = 10;
fs = K * f0;
Ts = 1/fs;

M = 10;
C = 100;

T0 = 1/f0;
Tmax = C * T0;
TDelta = Ts / M;
t = linspace(0, Tmax, round(Tmax / TDelta));

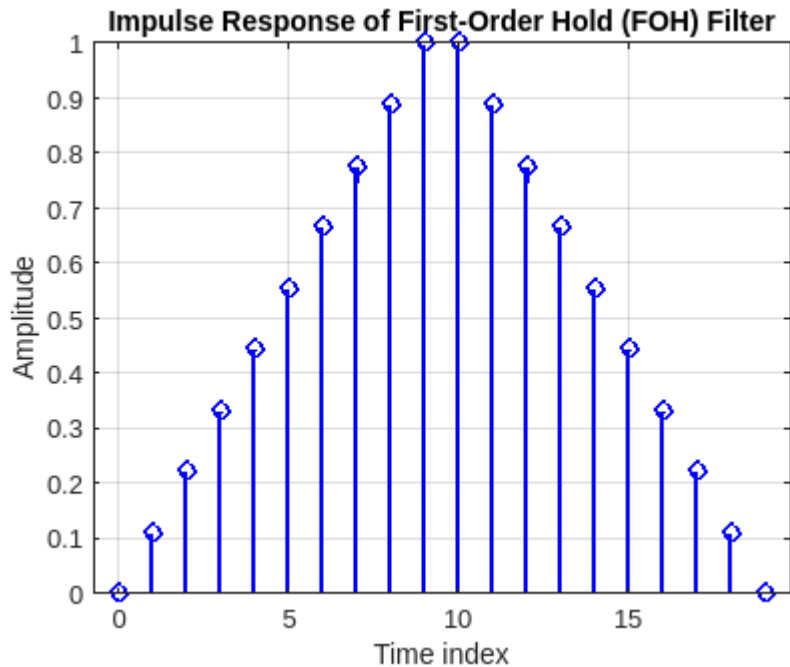
xt = A * cos(2 * pi * f0 * t);

data_points = length(xt);
xSt = zeros(1, data_points);
xSt(1:M:end) = xt(1:M:end);

hfoh_t = [linspace(0, 1, M), linspace(1, 0, M)];

figure;
stem(0:length(hfoh_t)-1, hfoh_t, 'b', 'LineWidth', 1.5);
xlabel('Time index'); ylabel('Amplitude');
```

```
title('Impulse Response of First-Order Hold (FOH) Filter');
grid on;
```

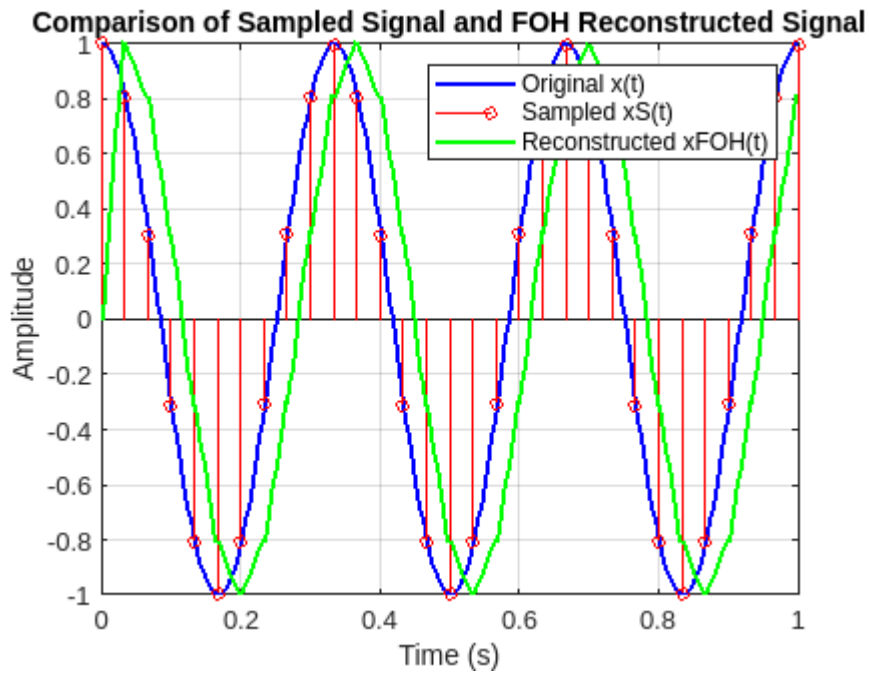


```
xFOH_t = filter(hfoh_t, 1, xSt);

xFOH_t = xFOH_t / max(abs(xFOH_t)) * max(abs(xSt));

figure;
plot(t, xt, 'b', 'LineWidth', 1.5); hold on;
stem(t(1:M:end), xSt(1:M:end), 'r', 'MarkerSize', 4);
plot(t, xFOH_t, 'g', 'LineWidth', 1.5);

xlabel('Time (s)'); ylabel('Amplitude');
title('Comparison of Sampled Signal and FOH Reconstructed Signal');
legend('Original x(t)', 'Sampled xS(t)', 'Reconstructed xFOH(t)');
grid on;
xlim([0, 3*T0]);
```



```

X_FOH_f = (1/Tmax) * fftshift(fft(xFOH_t));

N = length(X_FOH_f);
df = 1/Tmax;
f_axis = (-N/2:N/2-1) * df;

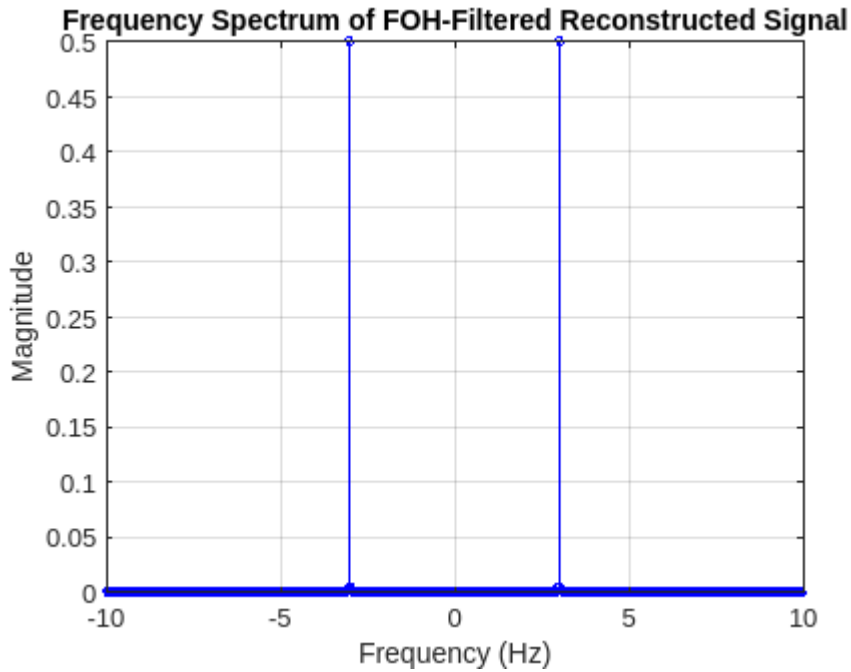
X_FOH_f = X_FOH_f / max(abs(X_FOH_f)) * (A/2);

figure;
stem(f_axis, abs(X_FOH_f), 'b', 'MarkerSize', 3);
xlabel('Frequency (Hz)'); ylabel('Magnitude');
title('Frequency Spectrum of FOH-Filtered Reconstructed Signal');
grid on;

xlim([-10 10]); % Ensure ±3 Hz is visible

```





```

clc; clear; close all;

A = 1;
f0 = 3;
K = 10;
fs = K * f0;
Ts = 1/fs;

M = 10;
C = 100;
beta = 0.25;
T0 = 1/f0;
Tmax = C * T0;
TDelta = Ts / M;
t = linspace(0, Tmax, round(Tmax / TDelta));

xt = A * cos(2 * pi * f0 * t);

data_points = length(xt);
xSt = zeros(1, data_points);
xSt(1:M:end) = xt(1:M:end);

rc_t = -5*Ts:TDelta:5*Ts;
h_rc = (sin(pi * rc_t / Ts) ./ (pi * rc_t / Ts)) .* (cos(pi * beta * rc_t / Ts) ./ (1 - (2 * beta * rc_t / Ts).^2));
h_rc(rc_t == 0) = 1;
h_rc(abs(2 * beta * rc_t / Ts) == 1) = (pi/4) * sin(pi/(2*beta));

```

```
figure;
stem(rc_t, h_rc, 'b', 'LineWidth', 1.5);
xlabel('Time index'); ylabel('Amplitude');
title('Impulse Response of Raised-Cosine (RC) Filter');
grid on;
```

