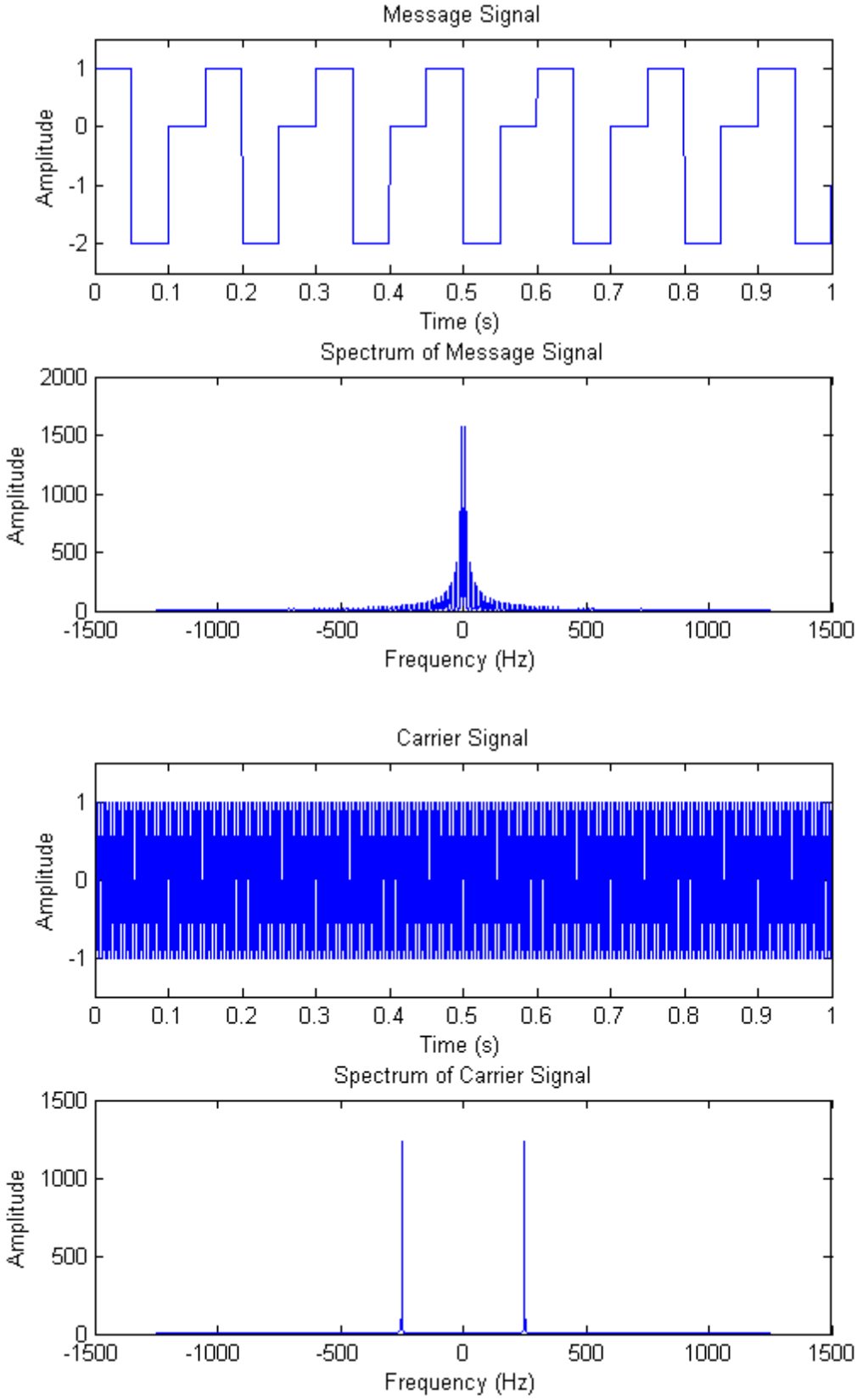
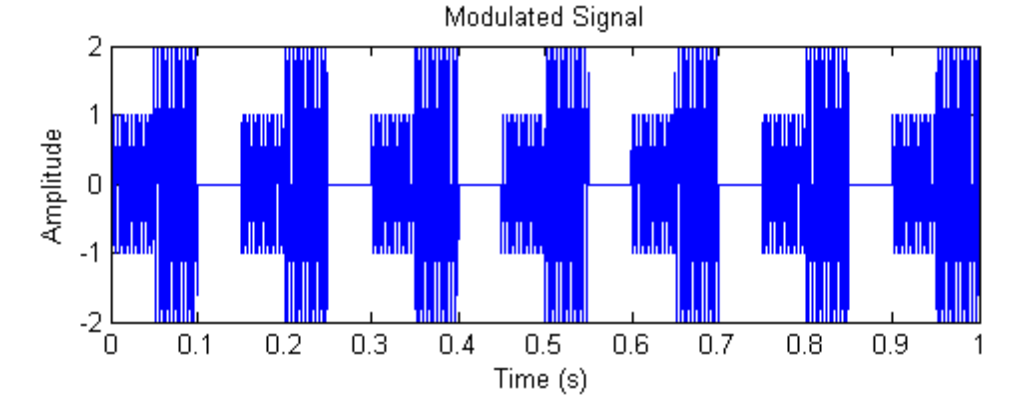
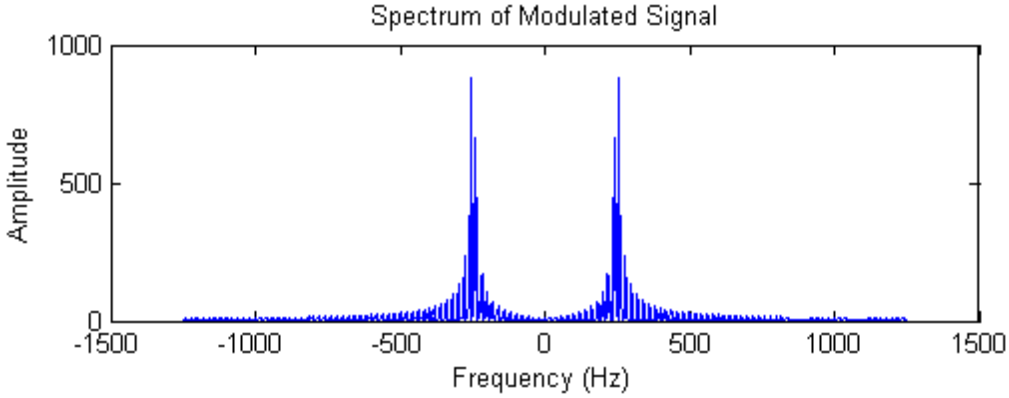
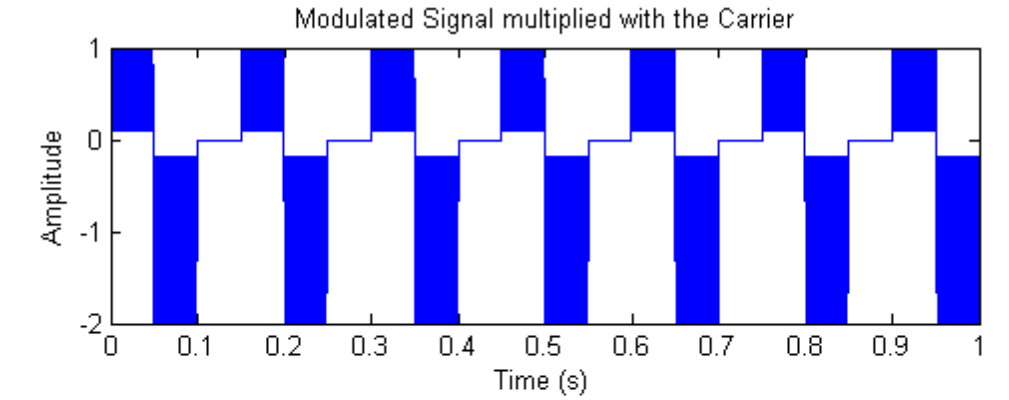
```
% Illustrative Problem 3.5
% ------------------------
clc;
clear all;
close all;

% Details given in the question
lpf_Fc = 250;
t0 = 0.15;

% Assumed values
Tstart = 0;
Tstop = 1;
Fs = 2.5 * 10^3;

% Generating time
Ts = 1 / Fs;
t = Tstart : Ts : Tstop;
N = length(t);

% Generating the message signal
tk = mod(t, t0);
m_t = (tk <= (1/3)*t0) - 2*((tk > (1/3)*t0) .* (tk <= (2/3)*t0));
figure;
subplot(2,1,1);
plot(t, m_t);
ylim([-2.5 1.5]);
title('Message Signal');
xlabel('Time (s)');
ylabel('Amplitude');
subplot(2,1,2);
plot(linspace(-Fs/2, Fs/2, N), abs(fftshift(fft(m_t))));
title('Spectrum of Message Signal');
xlabel('Frequency (Hz)');
ylabel('Amplitude');

% Generating the carrier signal
c_t = cos(2*pi*lpf_Fc*t);
figure;
subplot(2,1,1);
plot(t, c_t);
title('Carrier Signal');
xlabel('Time (s)');
ylabel('Amplitude');
ylim([-1.5 1.5]);
subplot(2,1,2);
plot(linspace(-Fs/2, Fs/2, N), abs(fftshift(fft(c_t))));
title('Spectrum of Carrier Signal');
xlabel('Frequency (Hz)');
ylabel('Amplitude');

% Generating the modulated signal
```

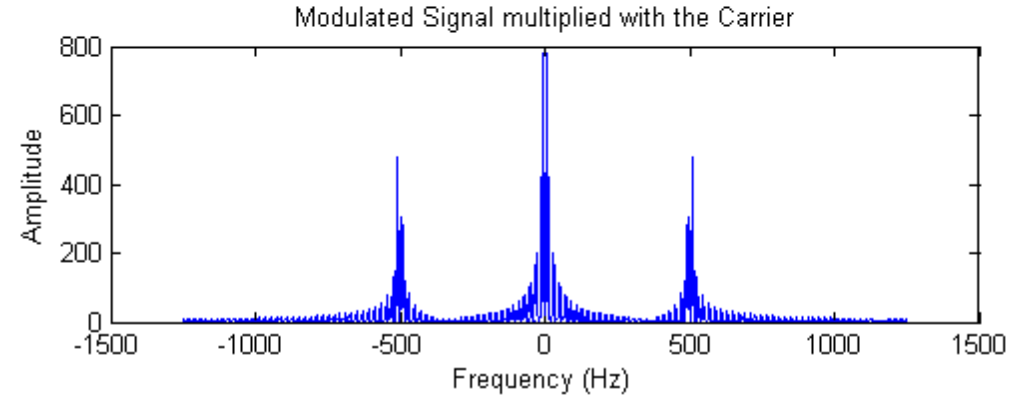
```
u_t = m_t .* c_t;
figure;
subplot(2,1,1);
plot(t, u_t);
title('Modulated Signal');
xlabel('Time (s)');
ylabel('Amplitude');
subplot(2,1,2);
plot(linspace(-Fs/2, Fs/2, N), abs(fftshift(fft(u_t))));
title('Spectrum of Modulated Signal');
xlabel('Frequency (Hz)');
ylabel('Amplitude');

% Create a Low Pass Filter
lpf_N    = 128;      % Order
lpf_Fc   = 250;      % Cutoff Frequency
lpf_flag = 'scale';  % Sampling Flag
lpf_h    = fir1(lpf_N, lpf_Fc/(Fs/2), 'low', blackman(lpf_N+1), lpf_flag);
lpf_sz   = length(lpf_h);
lpf_sz2  = floor(lpf_sz / 2);

% Demodulate the modulated signal
md1_t = u_t .* c_t;
md2_t = conv(md1_t, lpf_h);
md_t = 2 * md2_t(1, (1 + lpf_sz2) : (length(md2_t) - (lpf_sz - lpf_sz2 - 1)));

% Plot the demodulated signal
figure;
subplot(2,1,1);
plot(t, md1_t);
title('Modulated Signal multiplied with the Carrier');
xlabel('Time (s)');
ylabel('Amplitude');
subplot(2,1,2);
plot(linspace(-Fs/2, Fs/2, N), abs(fftshift(fft(md1_t))));
title('Modulated Signal multiplied with the Carrier');
xlabel('Frequency (Hz)');
ylabel('Amplitude');
figure;
subplot(2,1,1);
plot(t, md_t);
title('Demodulated Signal (after passing through LPF)');
xlabel('Time (s)');
ylabel('Amplitude');
subplot(2,1,2);
plot(linspace(-Fs/2, Fs/2, N), abs(fftshift(fft(md_t))));
title('Spectrum of Demodulated Signal (after passing through LPF)');
xlabel('Frequency (Hz)');
ylabel('Amplitude');
```

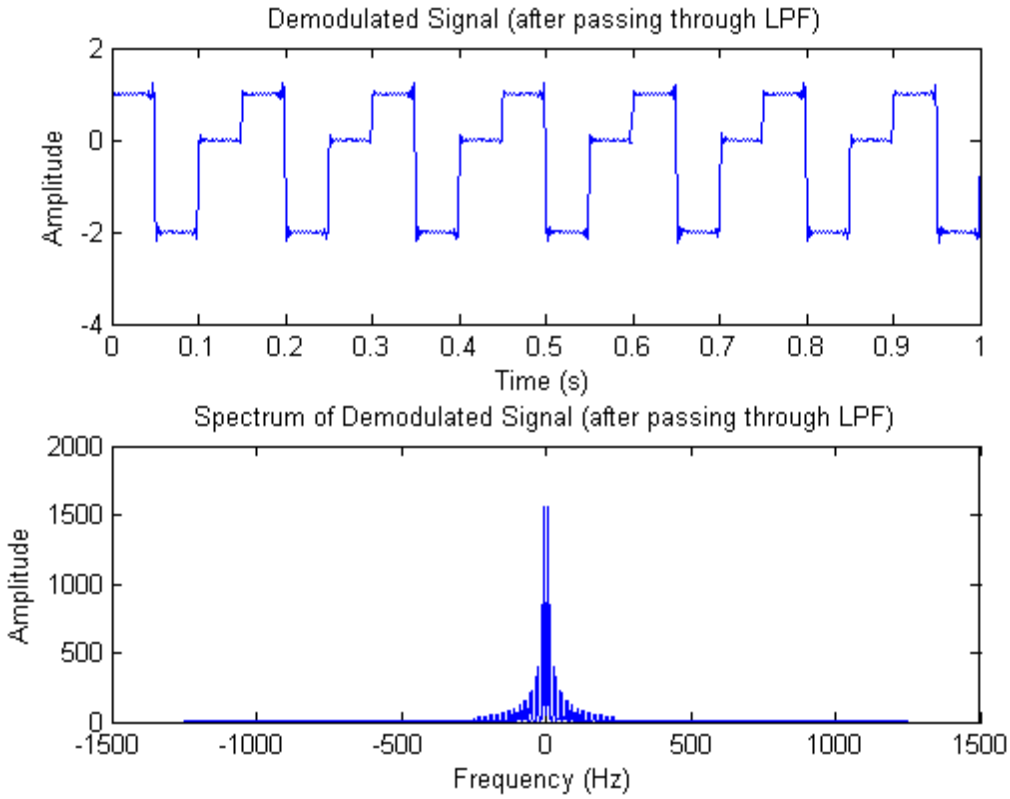

Message Signal
Amplitude
Time (s)
Spectrum of Message Signal
Amplitude
Frequency (Hz)
Carrier Signal
Amplitude
Time (s)
Spectrum of Carrier Signal
Amplitude
Frequency (Hz)


Modulated Signal
Amplitude
Time (s)


Spectrum of Modulated Signal
Amplitude
Frequency (Hz)


Modulated Signal multiplied with the Carrier
Amplitude
Time (s)


Modulated Signal multiplied with the Carrier
Amplitude
Frequency (Hz)



Published with MATLAB® 7.14