IIT Bhilai
Communications Systems - I

Chapter 3: Amplitude Modulations
Simulations

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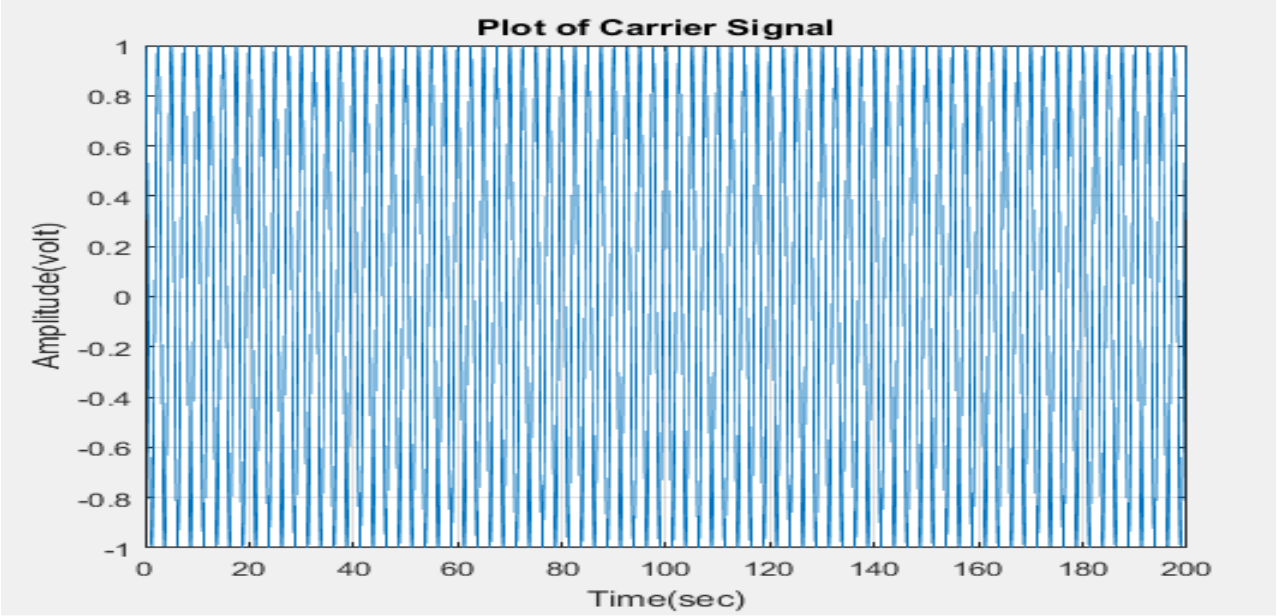
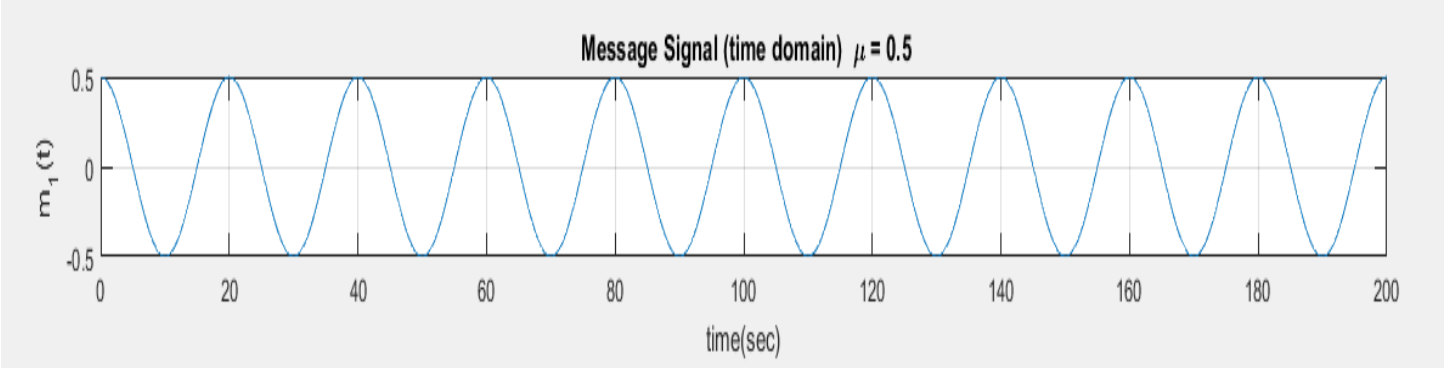
(1) Single-tone Modulation

Carrier Signal

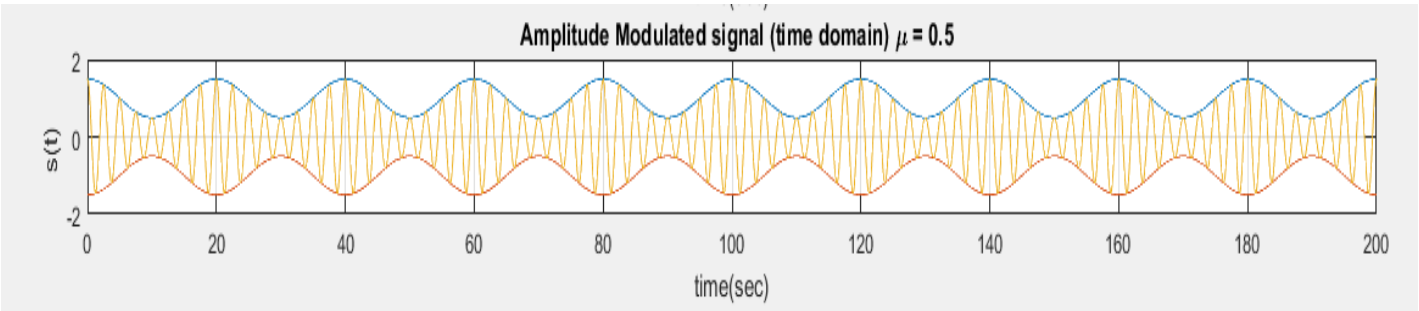


$\mu = 0.5(\ undermodulation)$

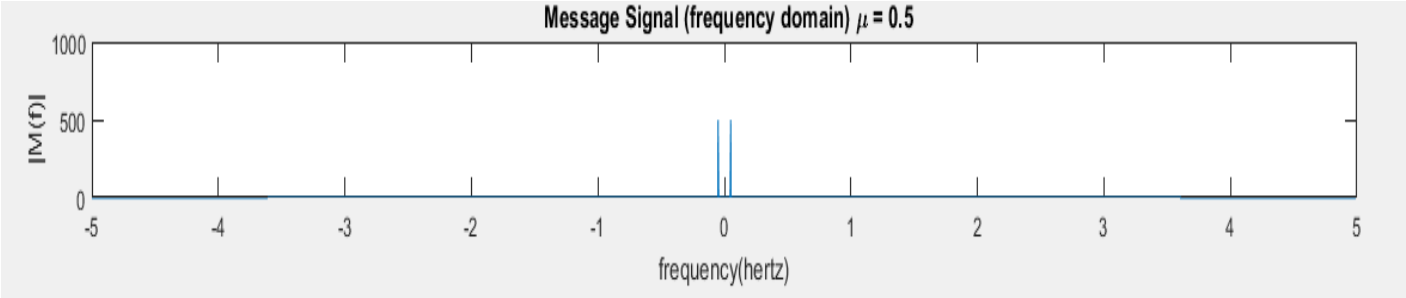
Message Signal



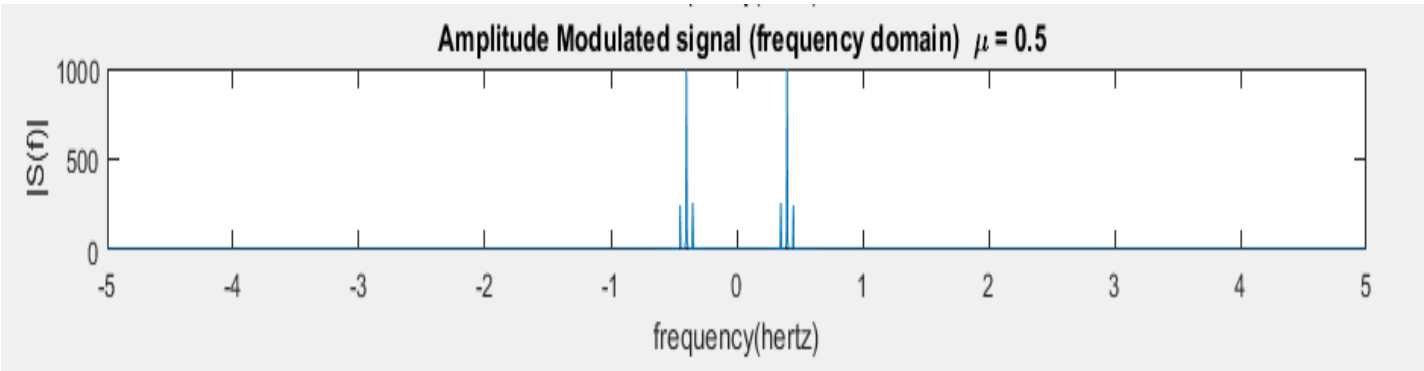
AM Modulation



Fourier Transform of Message Signal



Fourier Transform of Modulated Signal

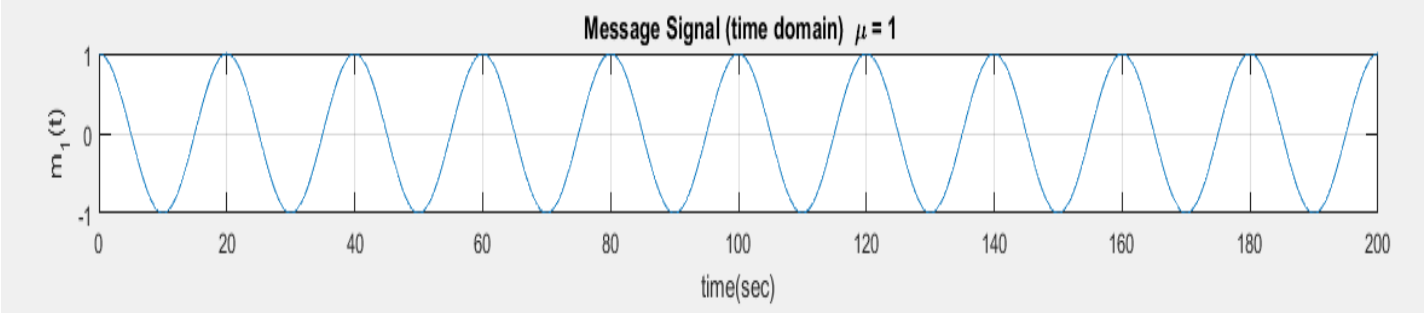


Observation:μ=0.5

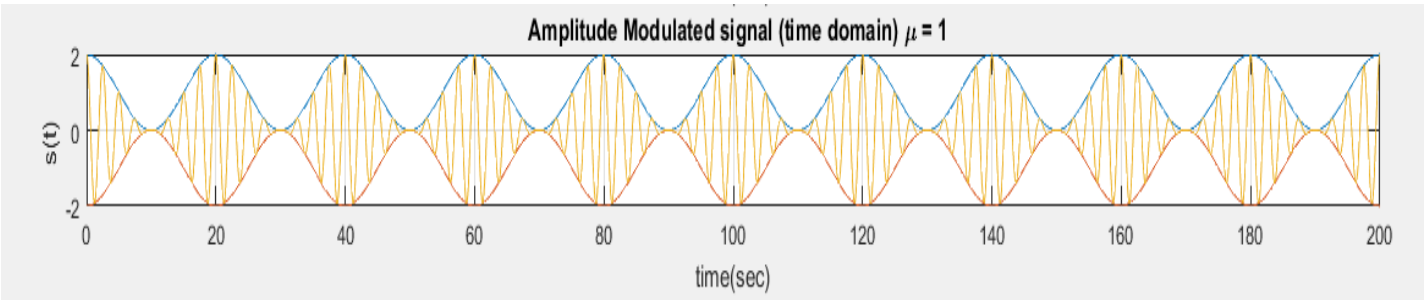
1. The upper side band and lower side band is not overlapping in the amplitude modulated signal.
2. There are high peaked impulses in the amplitude modulated signal in frequency domain at 0.4 Hz and -0.4Hz.
3. A_{max} = 1.5 ; A_{min} = 0.5 in modulated signal.
4. Message signal can be recovered completely

$\mu = 1\ (100\%modulation)$

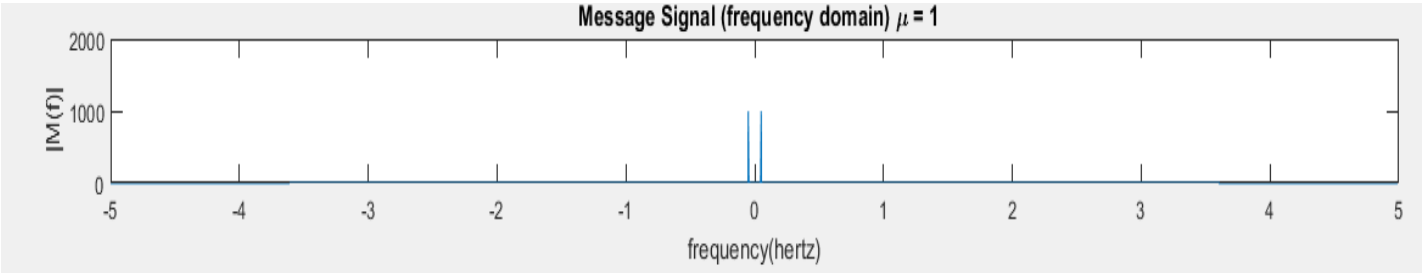
Message Signal



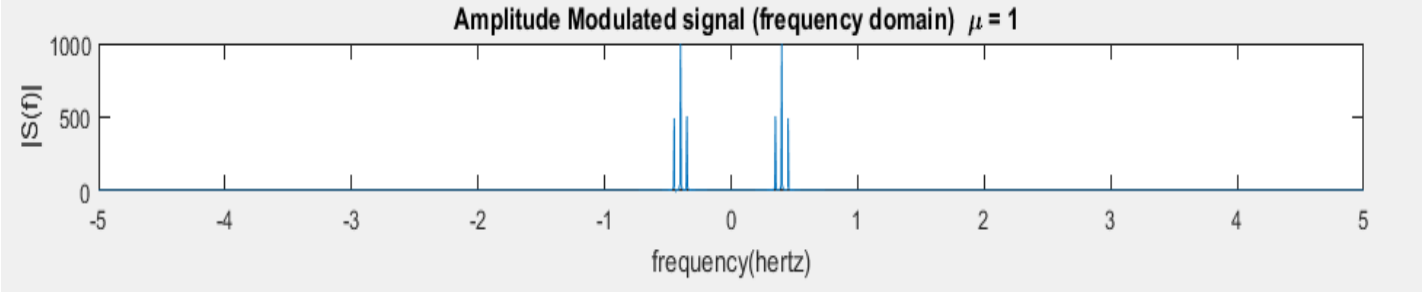
AM Modulation



Fourier transform of message signal



Fourier transform of amplitude modulated Signal

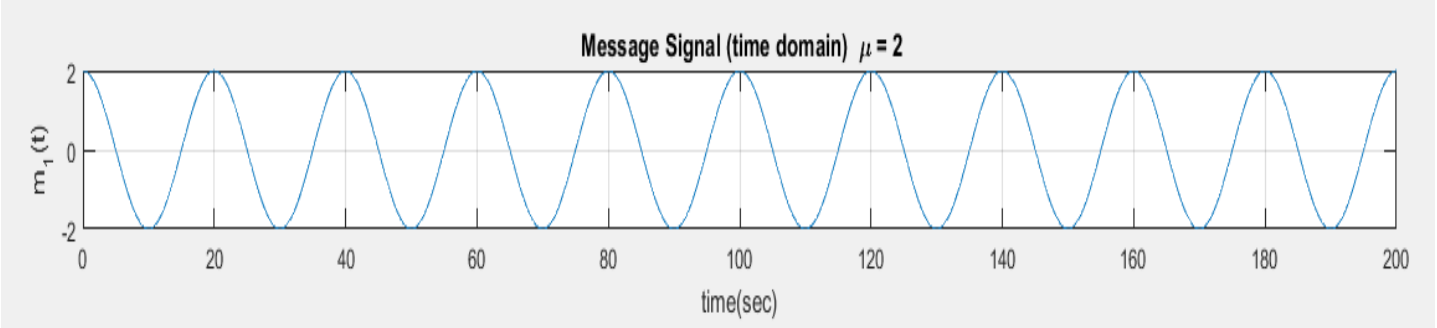


Observation: μ=1

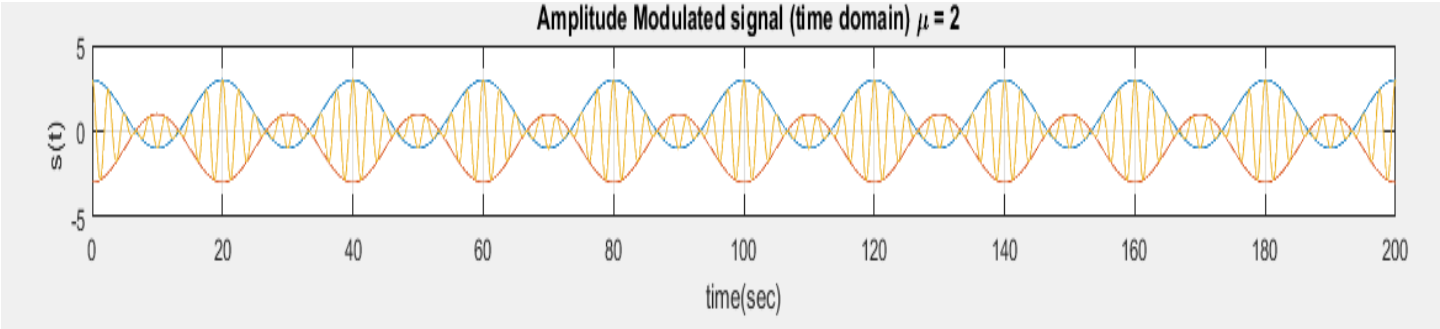
1. Upper side band and lower side band is just overlapping in modulated signal.
2. There is spikes at -0.4 Hz and 0.4 Hz in amplitude modulated signal.
3. A_{max}= 2 and A_{min} =0 in modulated signal.
4. Message signal can be recovered completely

$\mu = 2$ *(overmodulation)*

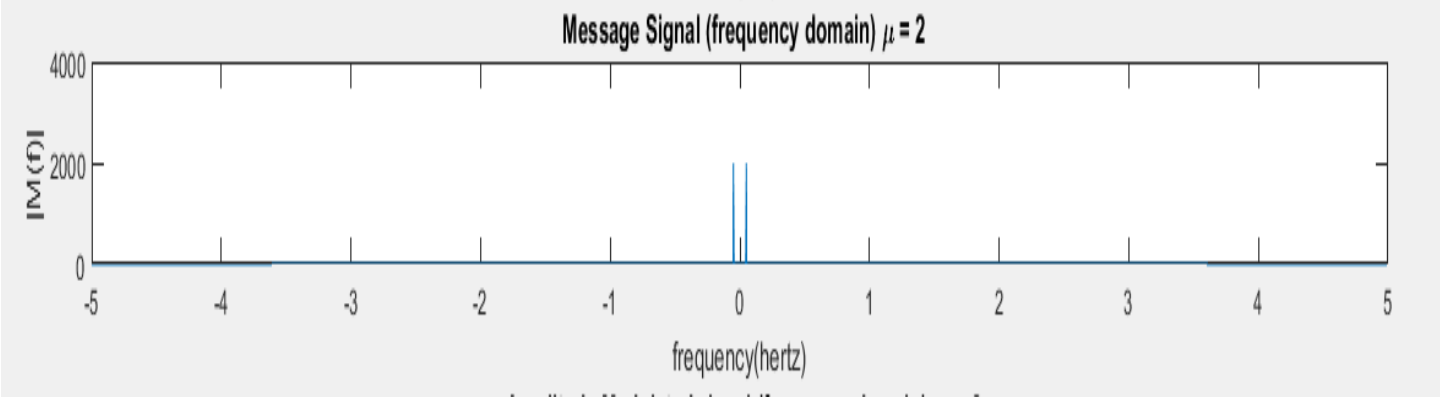
Message Signal



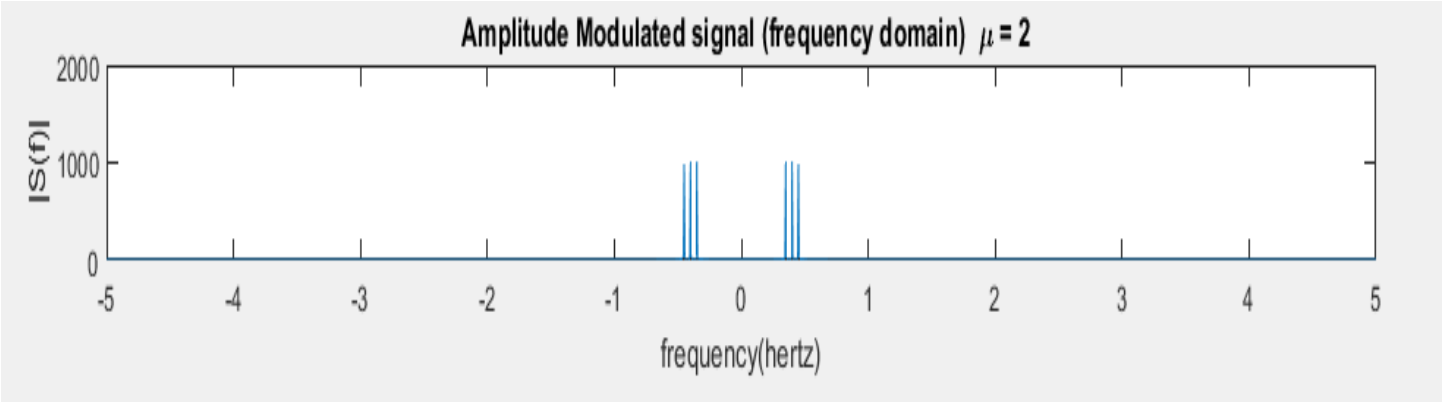
AM Modulation



Fourier transform of message signal



Fourier transform of amplitude modulated signal

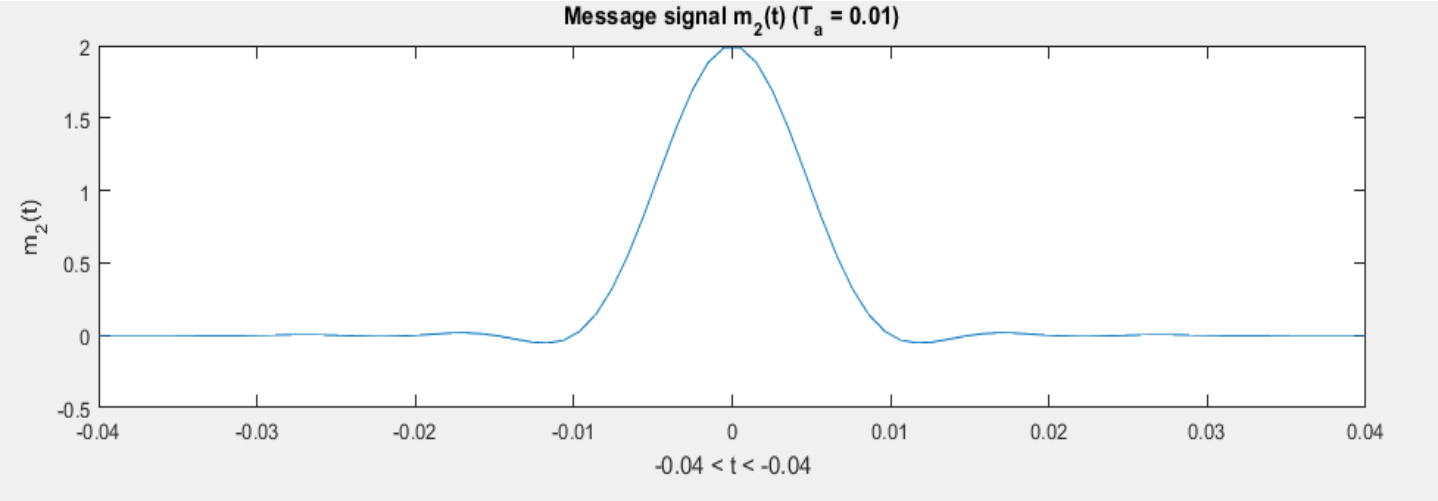


Observation: μ=2

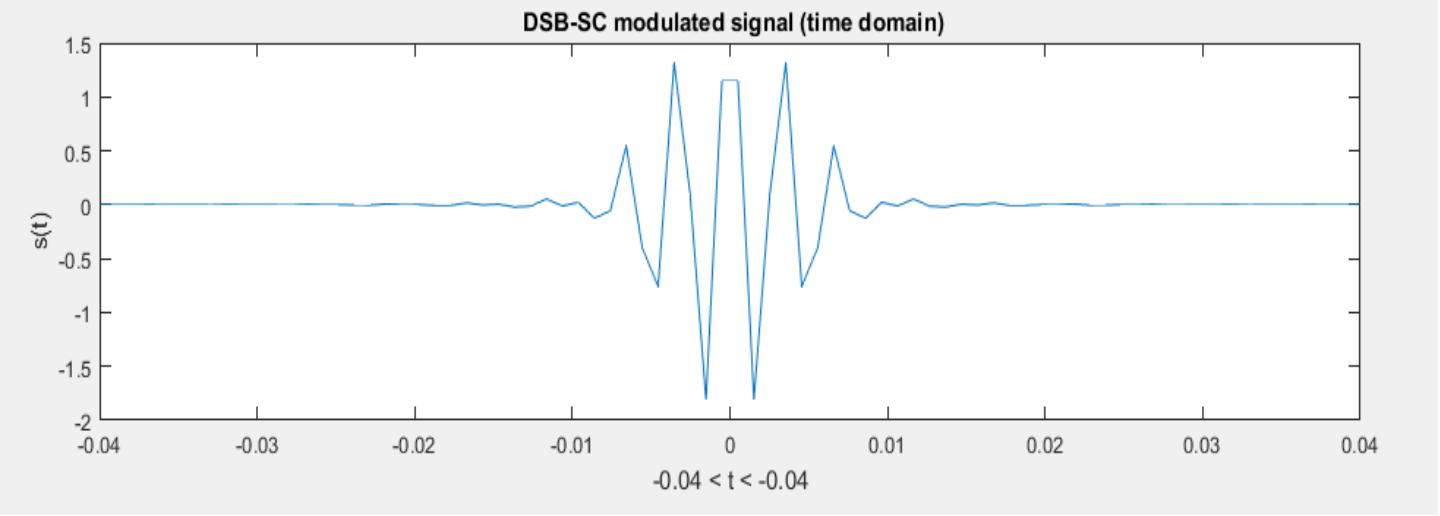
1. The upper band and lower band of amplitude modulated signal in time domain is overlapping.
2. There is no spikes at -0.4 Hz and 0.4 Hz as found when μ=0.5 and μ= 1
3. So it will lead to distortion in demodulated signal
4. Message signal cannot be recovered.

(2) Modulation of a bandlimited signal

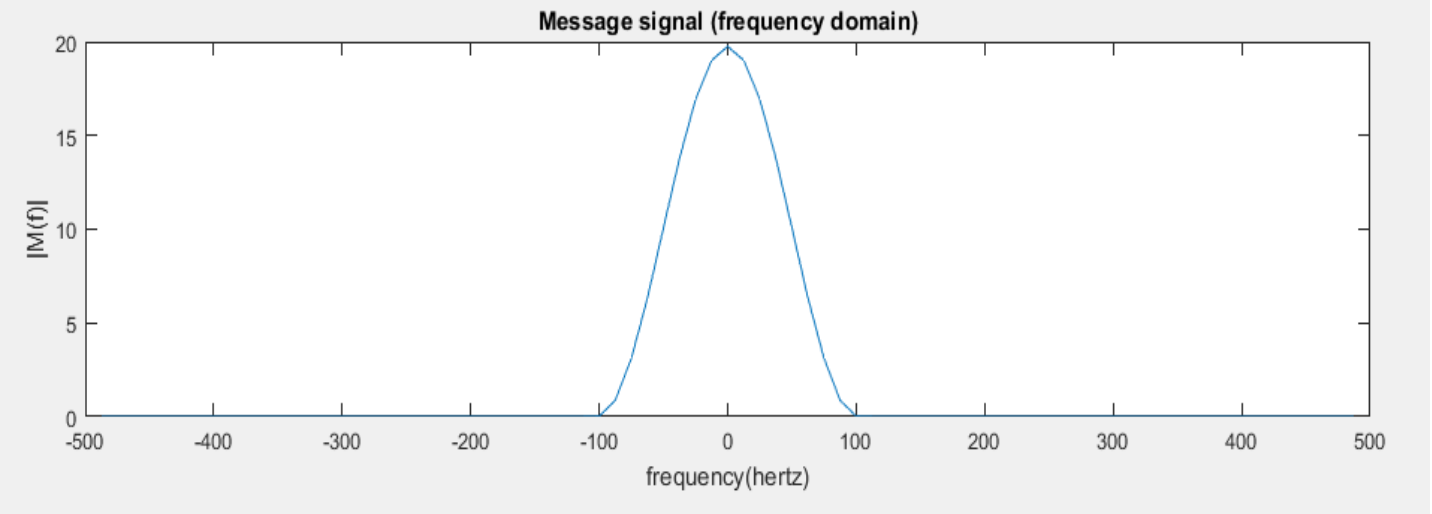
Message Signal



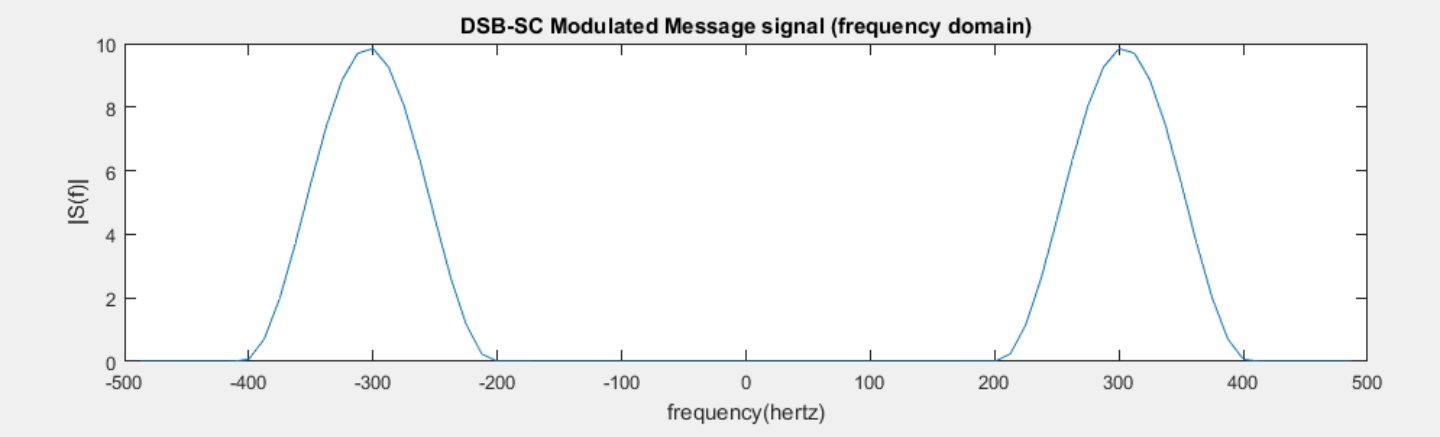
DSB-SC modulated signal (time domain)



Fourier Transform of message signal



Fourier Transform of DSB-SC Modulated signal

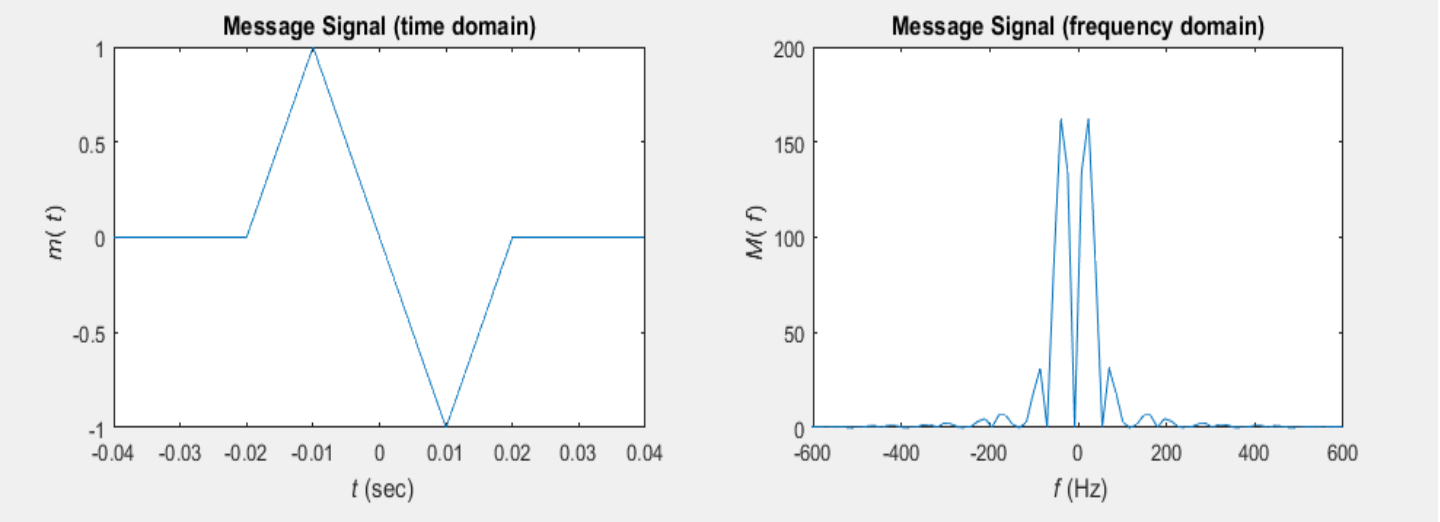


[Modulation of Bandlimited signal]
Observation:

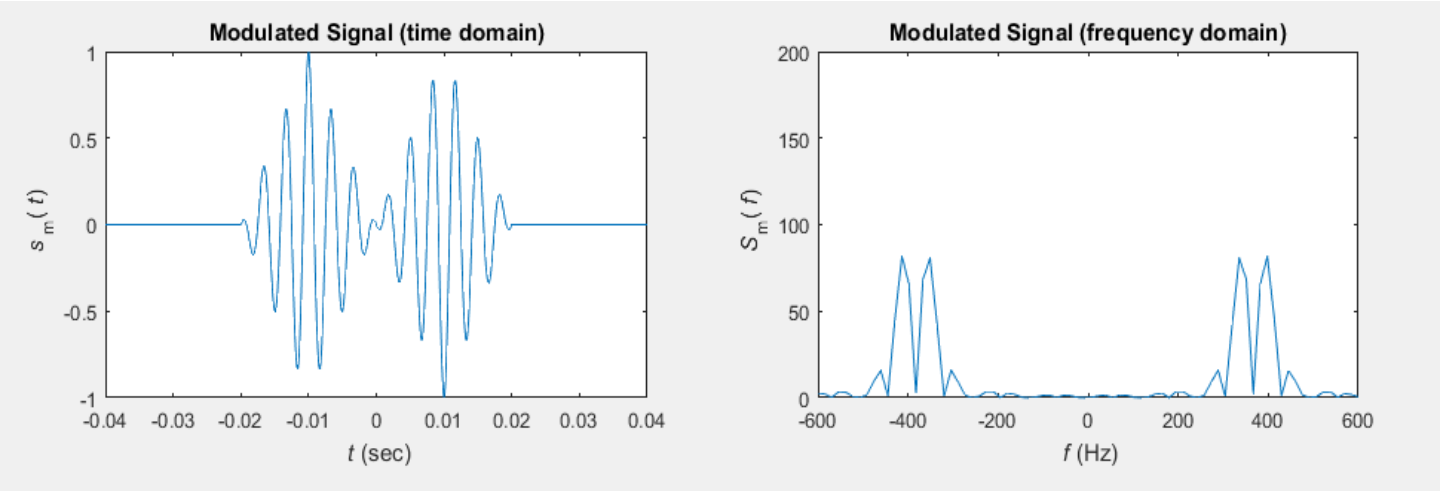
1. DSB-SC modulated signal is shifted to 300 Hz and -300 Hz.
2. Bandwidth of message signal is 100 Hz .
3. Bandwidth of DSB-SC signal is 200 Hz.
4. Approximately 90% of energy is concentrated in central part of the graph

(3) AM demodulation

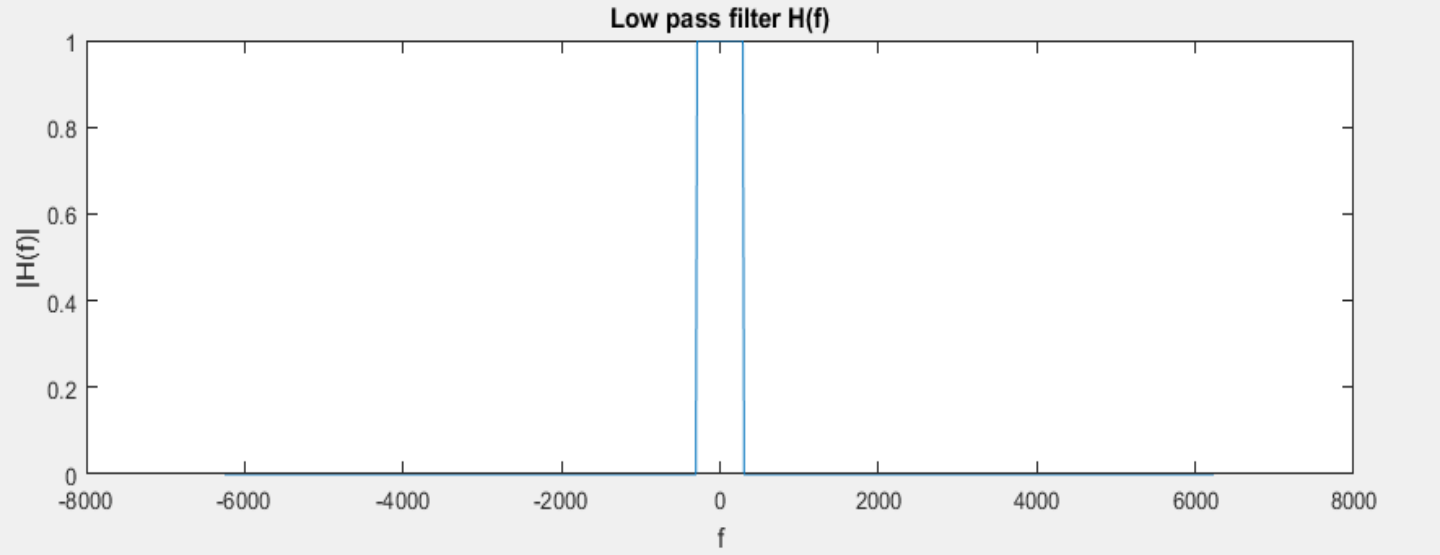
Message signal in time and frequency domain



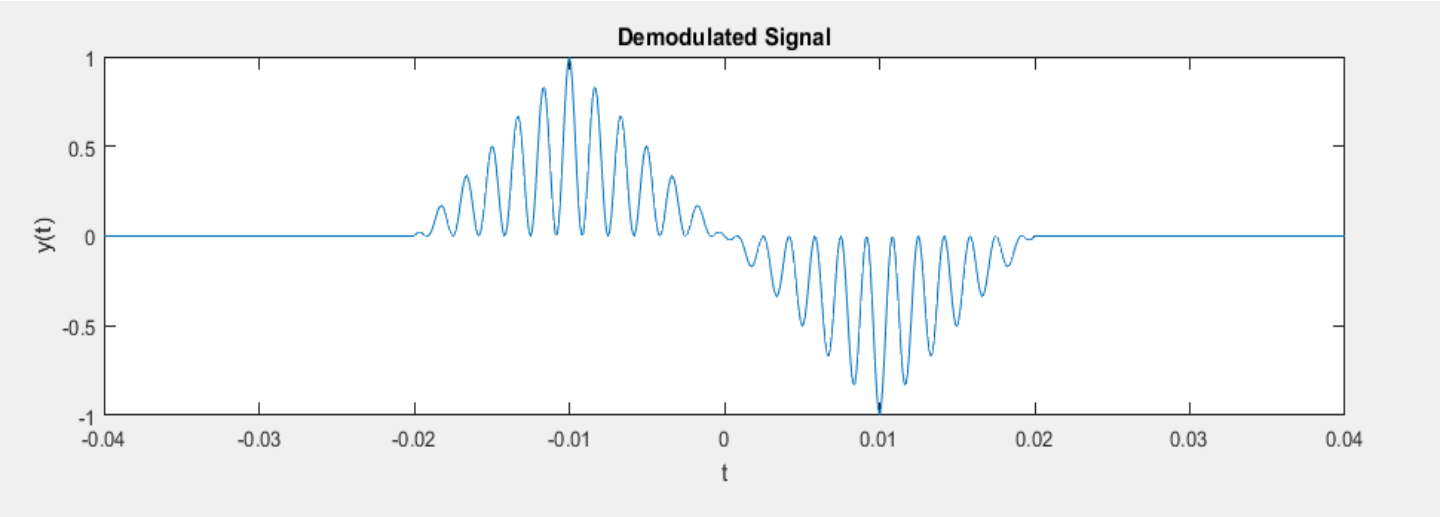
Modulated signal in time and frequency domain



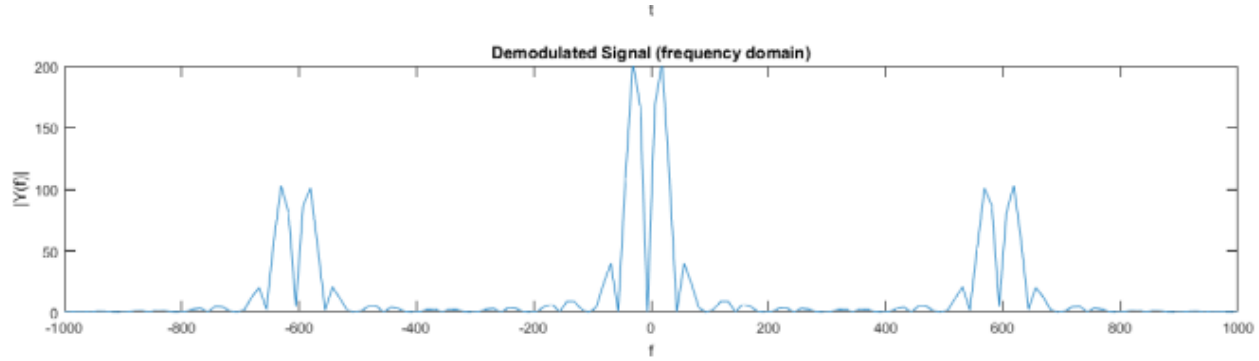
Lowpass filter



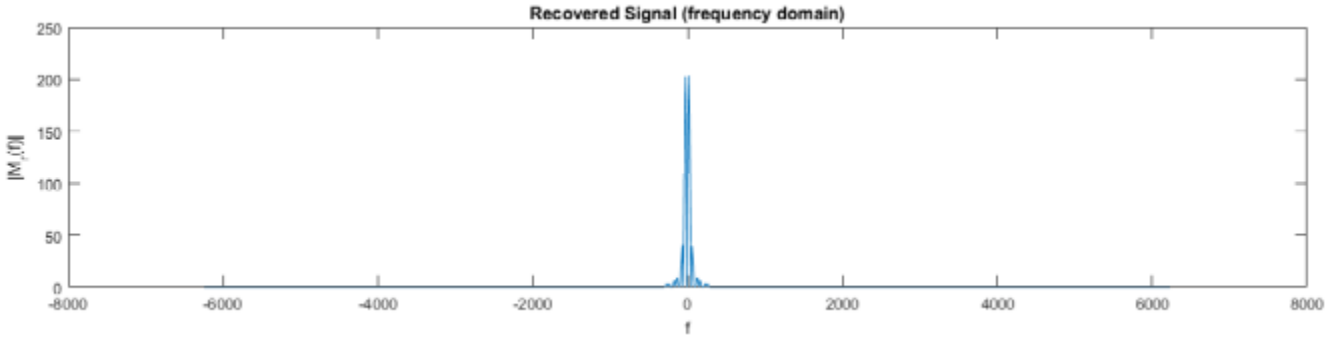
Demodulated Signal in time domain



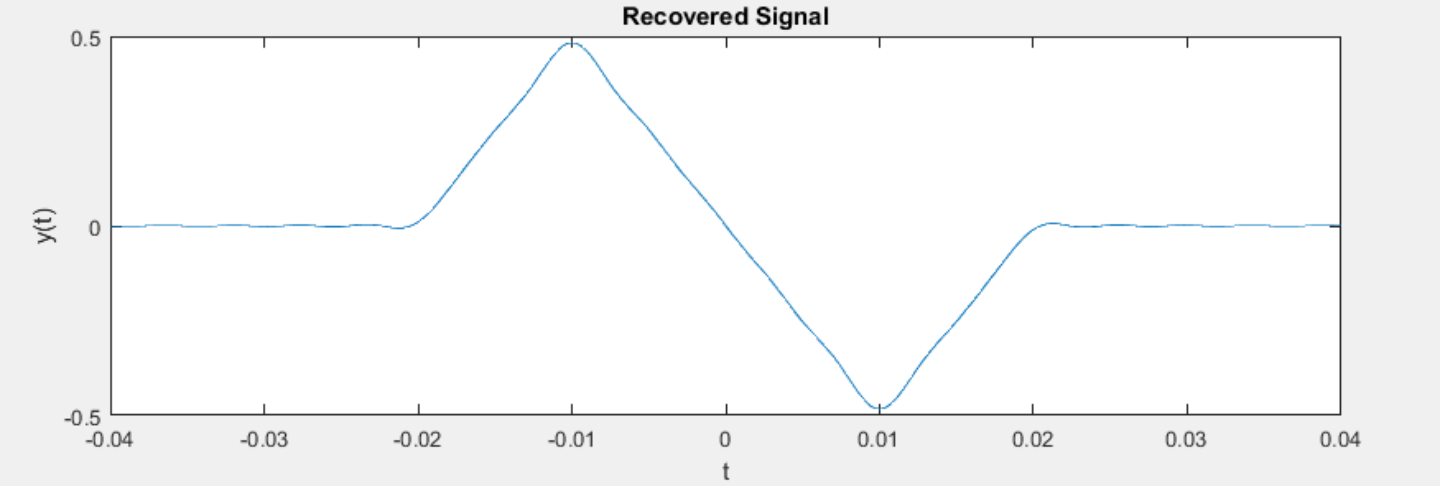
Demodulated signal in frequency domain



Recovered Signal (Frequency domain)



Recovered Signal (time domain)



[Amplitude Demodulation]
Observation:

1. Message signal is sum of two inverted triangular signal (both lying on different side of y-axis)
2. Modulated message signal is bandwidth is not strictly band-limited.
3. There is a large impulse in the modulated signal and demodulated signal (in time domain) at -0.01 sec and 0.01 sec.
4. Modulated Signal and demodulated signal in frequency domain is not very smooth.
5. Bandwidth of lowpass filter is 300 Hz.
6. Demodulation result **almost** shows no distortion.