INSTITUTE OF ENGINEERING
CENTRAL CAMPUS,PULCHOWK

COMMUNICATION SYSTEM II

LAB #1

Amplitude Modulation & Demodulation

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August 8, 2021

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Amplitude Modulation & Demodulation

2 Objective

- To view amplitude modulation for DSB-TC, DSB-SC, SSB and Amplitude demodulation.

3 Theory

3.1 Amplitude modulaton

If amplitude of carrier wave varies in accordance with the amplitude of the signal, then the signal is called amplitude modulation.

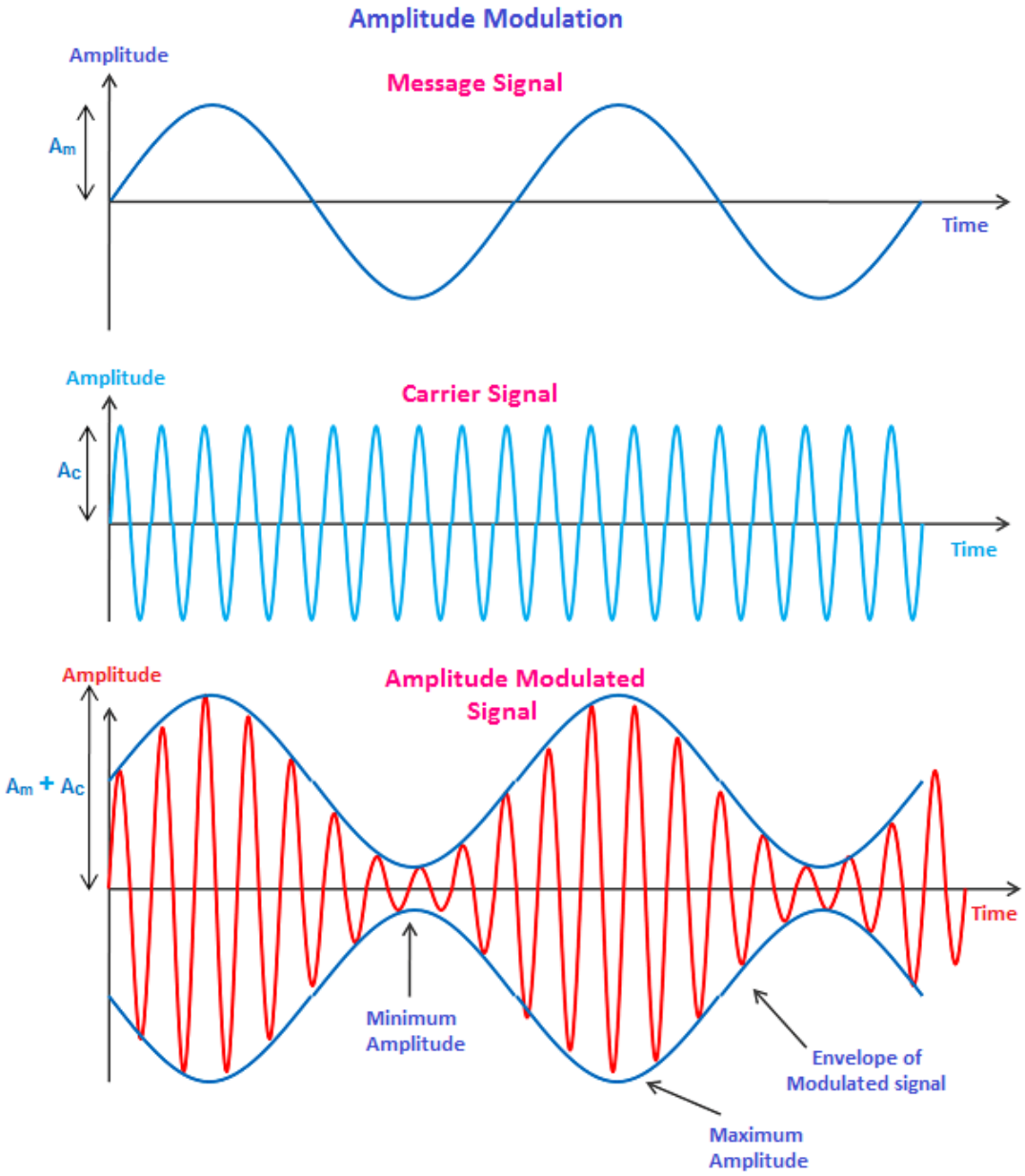

Figure 1: Amplitude modulation

3.1.1 DSB-TC

Double Sideband Transmitted carrier (DSB-TC) is a type of amplitude modulation where modulated signal has full carrier representation.For DSB-FC modulated signal $y(t)$ of a message signal $m(t)$ having carrier signal of frequency f_c :

$$y(t) = (1 + \mu m(t))cos(2\pi f_c t) \tag{1}$$

where, μ is the **modulation index**.

- $\mu < 1$: Under modulation
- $\mu = 1$: Perfect modulation
- $\mu > 1$: Over modulation

3.1.2 DSB-SC

Double Sideband-Suppressed Carrier (DSB-SC) is a type of amplitude modulation where modulated signal has reduced carrier representation in order to save power. For DSB-SC modulated signal $y(t)$ of a message signal $m(t)$ having carrier signal of frequency f_c :

$$y(t) = A_c m(t)cos(2\pi f_c t) \tag{2}$$

3.1.3 SSB

Single Sideband is a type of amplitude modulation where modulated signal has reduced carrier representation in order to save power and additionally Suppressing one of the side band.. For SSB modulated signal $y(t)$ of a message signal $m(t)$ having carrier signal of frequency f_c :

$$y(t) = m(t)cos(2\pi f_c t) - \hat{m}(t)sin(2\pi f_c t) \tag{3}$$

where $\hat{m}(t)$ is the **Hilbert transform** of the message signal.

3.2 Amplitude Demodulation

Amplitude Demodulation is the process of demodulating the received signal to recover the original message.

4 Problems

4.1 DSB-TC(Under,Normal,Over)

```
fm=100;
fc=1000;
fs=10000;
t=0:(1/fs):((4/fm)-(1/fs));
x=cos(2*pi*fm*t);
y_u=modulate(x, fc, fs, 'amdsb-tc', -1/0.5);
y_n=modulate(x, fc, fs, 'amdsb-tc', -1/1);
y_o=modulate(x, fc, fs, 'amdsb-tc', -1/2);
%Plot
subplot(2,3,[1 2 3]);
plot(t,x);
title('Message signal');
xlabel('Time (s)');
ylabel('Amplitude');
subplot(2,3,4)
plot(t,y_u);
title('Under modulated signal','m<1');
```

```
xlabel('Time (s)');
ylabel('Amplitude');
subplot(2,3,5)
plot(t,y_n);
title('Normal modulated signal','m=1');
xlabel('Time (s)');
ylabel('Amplitude');
subplot(2,3,6)
plot(t,y_o);
title('Over modulated signal','m>1');
xlabel('Time (s)');
ylabel('Amplitude');
sgtitle('(PUL074BEX004) AMDSB-TC')
```

Code 1: MATLAB code DSB-TC

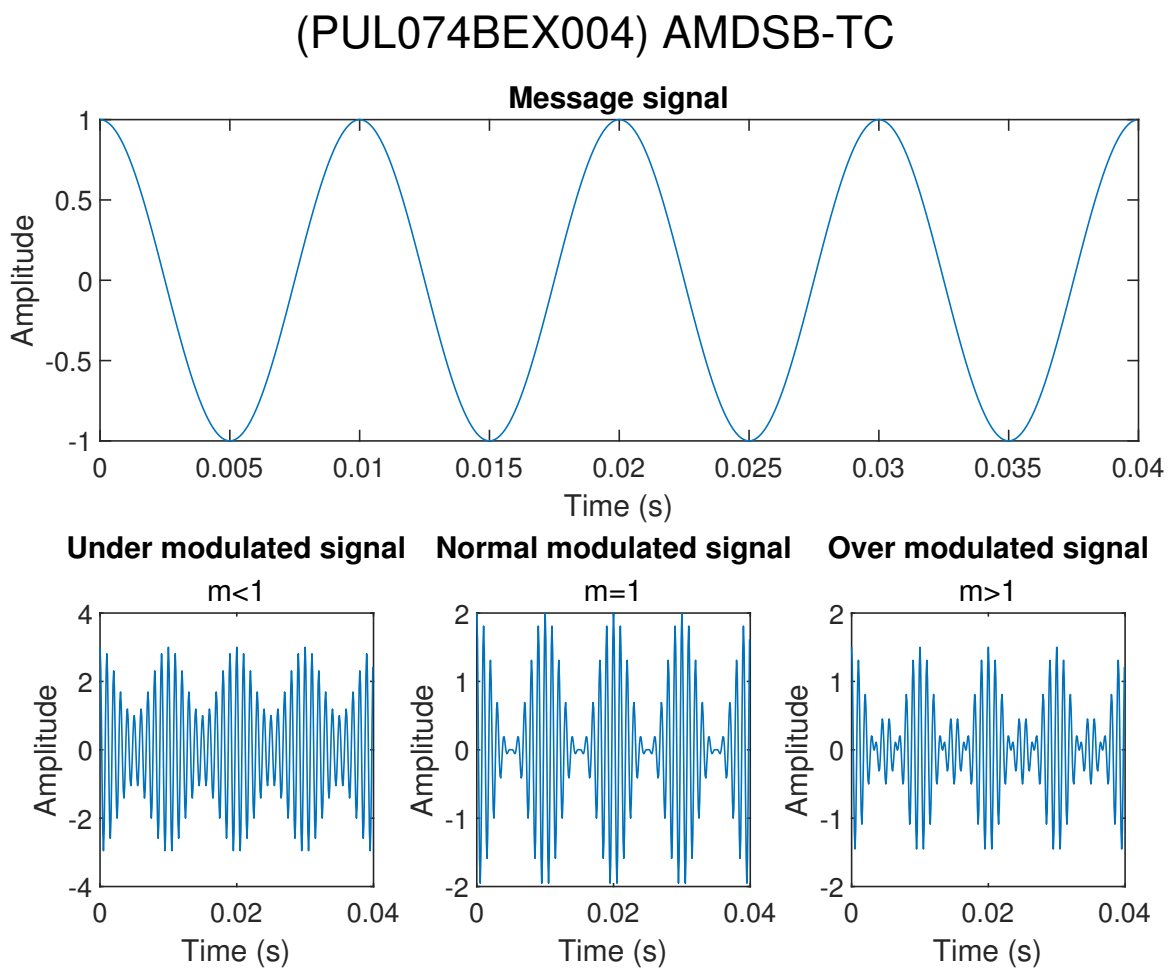

Figure 2: DSB-TC(Under,Normal,Over)

4.2 DSB-SC (Time & Frequency Domain)

```
fm=100;
fc=1000;
fs=10000;
t=0:(1/fs):((4/fm)-(1/fs));
x=cos(2*pi*fm*t);
y=modulate(x, fc, fs, 'amdsb-sc');
z=abs(fft(y,1024));
f= (-511*fs/1024):(fs/1024):(512*fs/1024);
%Plot
```

```
subplot(2,2,[1 2]);
plot(t,x);
title('Message signal');
xlabel('Time (s)');
ylabel('Amplitude');
subplot(2,2,3);
plot(t,y);
title('Modulated signal','Time Domain');
xlabel('Time (s)');
ylabel('Amplitude');
subplot(2,2,4);
plot(f,z);
title('Modulated signal','Frequency Domain');
xlabel('Frequency (Hz)');
ylabel('Spectrum amplitude');
sgtitle('(PUL074BEX004) AMDSB-SC')
```

Code 2: MATLAB code DSB-SC

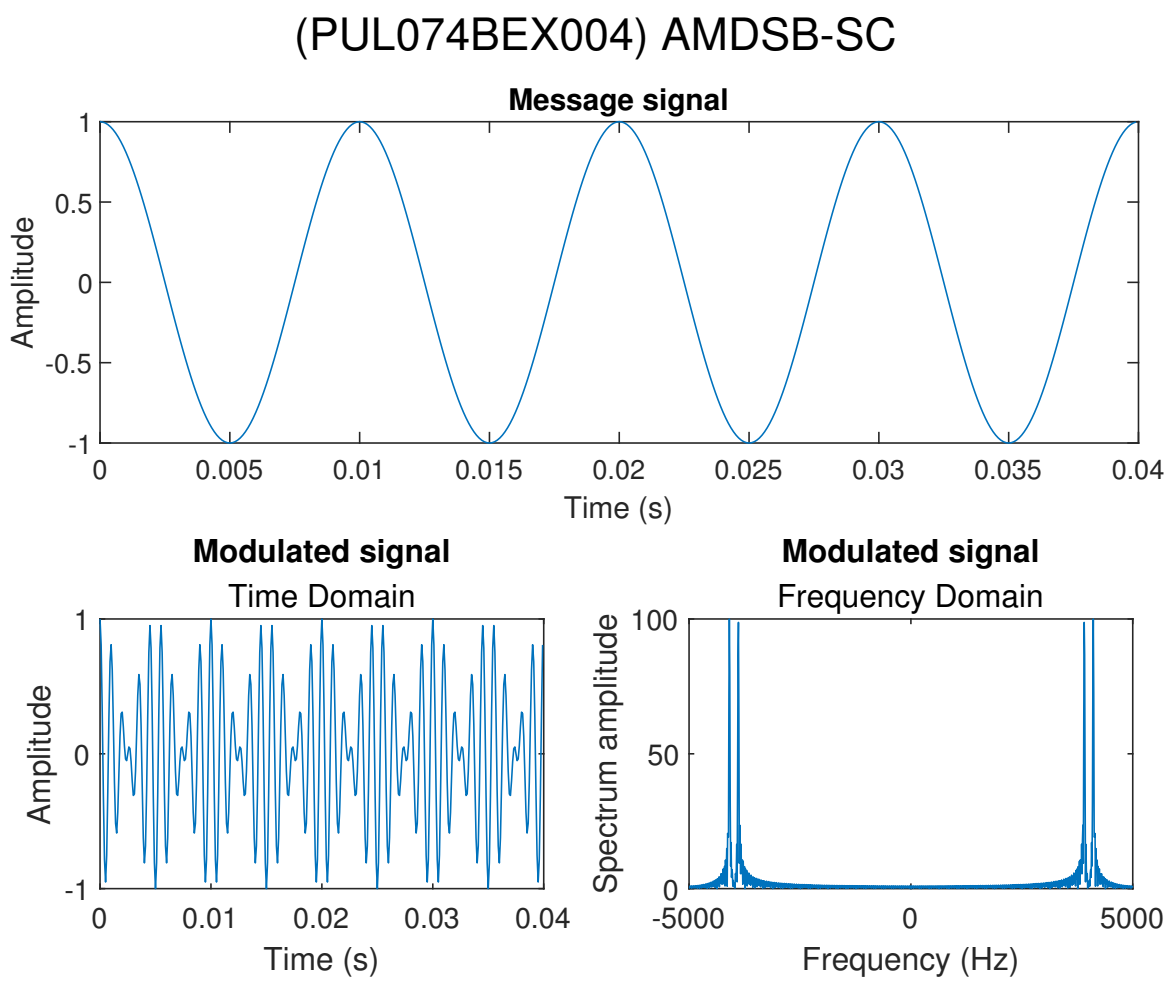

Figure 3: DSB-SC (Time & Frequency Domain)

4.3 SSB (Time & Frequency Domain)

```
fm=100;
fc=1000;
fs=10000;
t=0:(1/fs):((4/fm)-(1/fs));
x=cos(2*pi*fm*t);
y=modulate(x, fc, fs, 'amssb');
z=abs(fft(y,1024));
f= (-511*fs/1024):(fs/1024):(512*fs/1024);
%Plot
subplot(2,2,[1 2]);
plot(t,x);
title('Message signal');
xlabel('Time (s)');
ylabel('Amplitude');
subplot(2,2,3);
plot(t,y);
title('Modulated signal','Time Domain');
xlabel('Time (s)');
ylabel('Amplitude');
subplot(2,2,4);
plot(f,z);
title('Modulated signal','Frequency Domain');
xlabel('Frequency (Hz)');
ylabel('Spectrum amplitude');
sgtitle('(PUL074BEX004) AMSSB')
```

Code 3: MATLAB code SSB

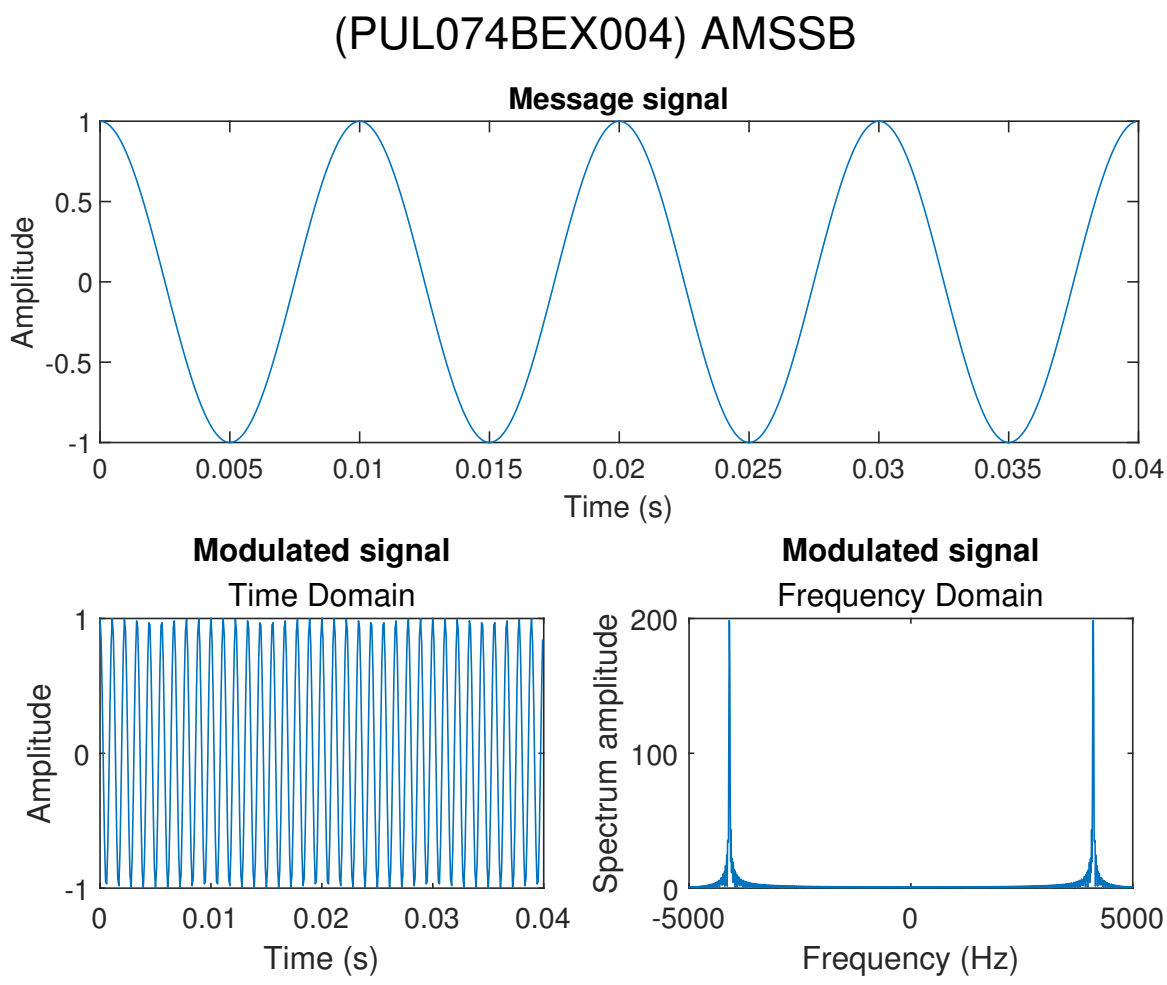

Figure 4: SSB (Time & Frequency Domain)

4.4 Demodulation

```
fm =100;
fc =1000;
fs =10000;
t =0:(1/ fs ) :((4/ fm ) -(1/ fs ) ) ;
x =cos (2* pi* fm * t ) ;
y = modulate (x , fc , fs , 'amdsb -sc ') ;
z = demod (y , fc , fs ,'amdsb -sc ') ;
% Plot
subplot (3 ,1 ,1)
plot (t , x ) ;
title ('Message signal ') ;
xlabel ('Time (s)') ;
ylabel ('Amplitude ') ;
subplot (3 ,1 ,2)
plot (t , y ) ;
title ('Modulated signal ') ;
xlabel ('Time (s)') ;
ylabel ('Amplitude ') ;
subplot (3 ,1 ,3)
plot (t , z ) ;
title (' Demodulated signal ') ;
xlabel ('Time (s)') ;
ylabel ('Amplitude ') ;
sgtitle ('( PUL074BEX004 ) Demodulation ')
```

Code 4: MATLAB code Demodulation

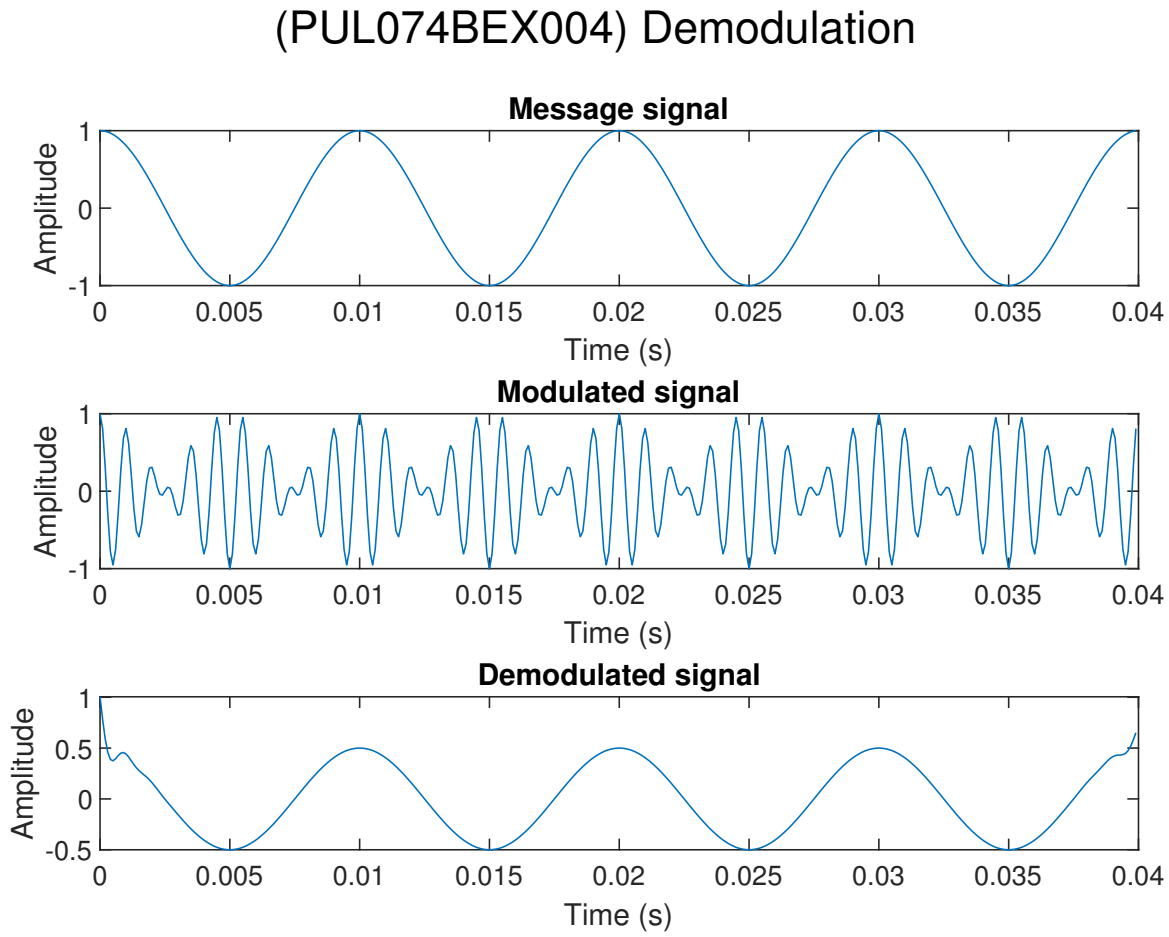

Figure 5: Demodulation Observation of DSB-SC

5 Discussion and Conclusion

In this lab we observed amplitude modulation of DSB-TC, DSB-SC, SSB and Demodulation of DSB-SC signal.We used MATLAB an its modules to implement the above mentioned process and generating plots.