FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEER
Department of Electronics and Computer Science

Expt2: To study Amplitude Modulation and Demodulation

1. Course, Subject & Experiment Details

Timeline (3)	Understanding (3)	Self Efforts (4)	Total (10)

Student's Name	Hardik Prajapati	Roll No.	9152
Academic Year	2021 – 22	Estimated Time	2 Hours
Course & Semester	T.E. (ECS) Sem. V	Subject Name	Communication Engineering Laboratory
Unit No.	2	Chapter Title	Analog modulation Systems
Experiment Type	Software Performance	Subject Code	ECL 501

2. Aim of the Experiment:

To Study the amplitude modulation and demodulation.

3. Apparatus:

Name of the Component/Equipment	Values	Quantity
Transistor	BC 107	1
Diode	0A79 (or equivalent)	1
Resistors	1K, 2K, 6.8K, 10K	1 each
Capacitor	0.01μF	1
Inductor	130mH	1
CRO	20MHz	1
Function Generator	1MHz	2
Regulated power supply	0-30V, 1A	1

4. Expected Outcome of Experiment

Students will be able to measure the modulation index from the waveform observed on the CRO and identify over modulation and its effect on the demodulated audio frequency signal.

5. Theoretical Description

In amplitude modulation (AM) the amplitude of carrier signal is varied according to the amplitude of the modulating signal, whose frequency is invariably less than that of the carrier. Thus, AM is the system of modulation in which the amplitude of the carrier is made proportional to the instantaneous amplitude of the modulating voltage. The standard form of AM is defined by

$$v_{AM}(t) = V_c(1 + msin\omega_m t)sin\omega_c t$$

where V_c is the amplitude of the carrier, m is modulation index, ω_m is the modulating frequency, and ω_c is the carrier frequency.

Depth of Modulation: The Amount by which the amplitude of the carrier wave increases or decreases depends on the amplitude of the information signal and is called the depth of modulation.

The depth of modulation can be quoted as a fraction or as a percentage.

$$Percentage\ modulation = \left(\frac{Vmax - Vmin}{Vmax + Vmin}\right) \times 100\% \quad (1)$$

where V_{max} and V_{min} are the maximum and minimum amplitudes of the Am envelope.

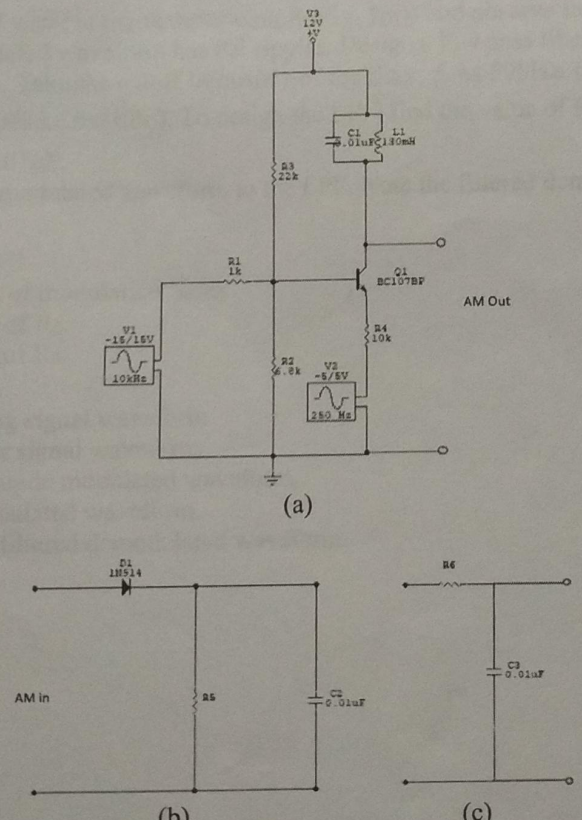


Figure 1: (a) AM Modulator, (d) demodulator (Diode Detector), (c) Low pass filter

Diode Detector:

The function of the diode detector is to extract the audio signal from the signal at the output of the IF Amplifiers.

The Result is an output which contains three components.

1. The Wanted audio information signal.
2. RF ripple
3. A positive DC voltage level signifying the strength of the carrier.

The demodulated signal with RF ripples is passed through a low pass filter, which removes the RF ripples from the demodulated signal, and amplified.

6. Procedure:

1. Connect the circuit using Circuit Maker as per the circuit diagram shown in Fig.1(a).
2. Switch on + 12 volts V_{cc} supply.
3. Apply sinusoidal signal of 250 Hz frequency and amplitude 5 Vp as modulating signal, and carrier signal of frequency 10 kHz and amplitude 15 Vp.
4. Note down values of V_{max} and V_{min}.
5. Calculate modulation index using equation (1).
6. To design the diode detector, find the value of R_5 from $f_m = \frac{1}{2\pi R_5 C_2}$, taking $C_2 = 0.01\mu F$.
7. Feed the AM wave to the detector circuit (Fig. 1(b)) and observe the output.
9. The demodulated waveform has RF ripples. Design a low pass filter (Fig. 1(c)) to remove these ripples. Take the cutoff frequency of the filter, f_c as 500Hz. (Resistor R_6 and capacitor C_3 make the LPF). To design the LPF, find the value of R_6 from $f_c = \frac{1}{2\pi R_6 C_3}$, taking C_3=0.01μF.
10. Feed the demodulated waveform to the LPF. Note the filtered demodulated waveform.

7. Calculations:

a. Calculation of modulation index
b. Calculation of R_5.
c. Calculation of R_6.

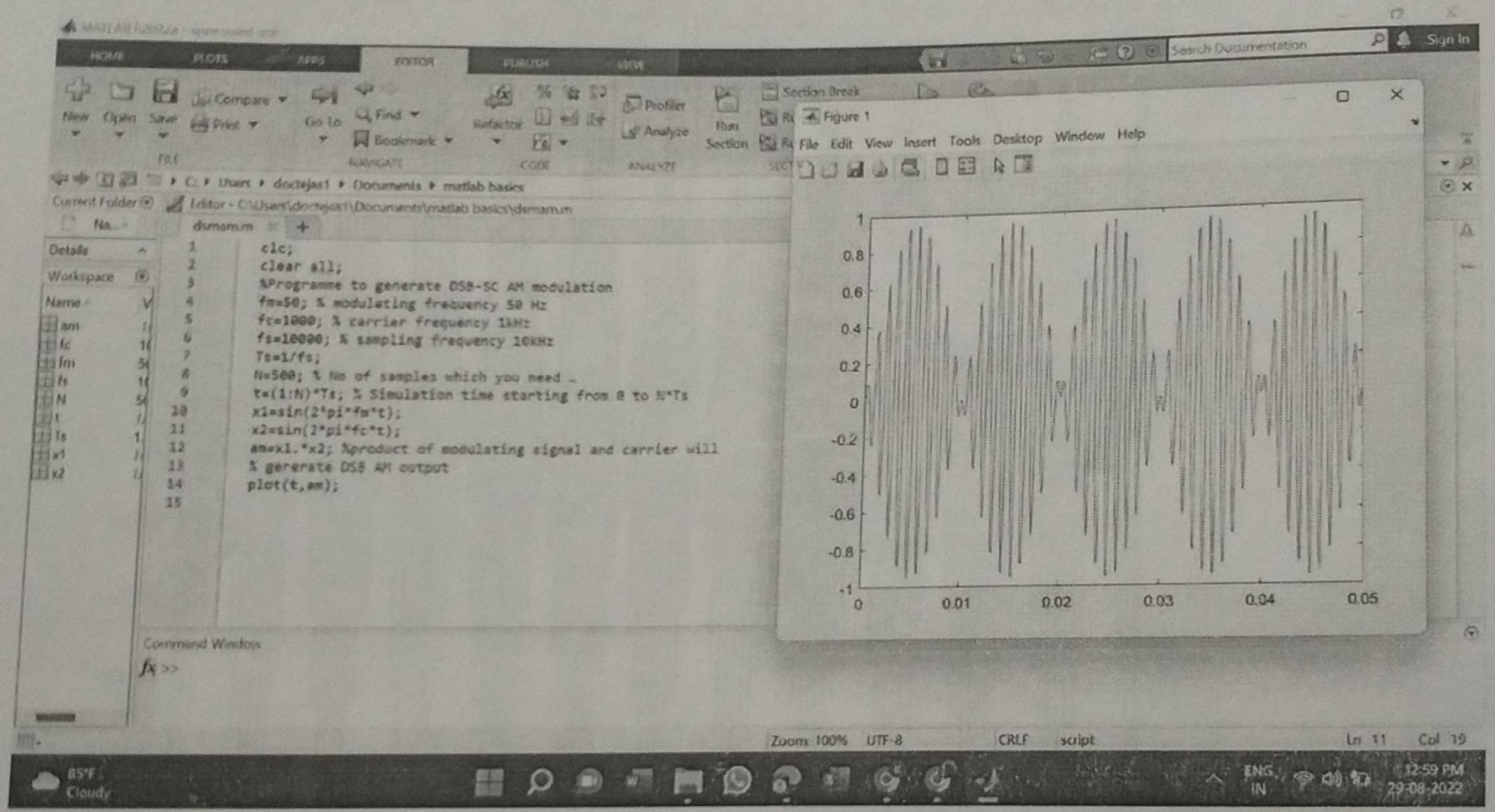
8. GRAPHS:

1. Modulating signal waveform
2. The carrier signal waveform
3. The Amplitude modulated waveform.
4. The demodulated waveform.
5. Low pass filtered demodulated waveform.

9. Conclusion

Hardik Prajapati 9152

DSB-SC AM Modulation



SSB-SC AM Modulation

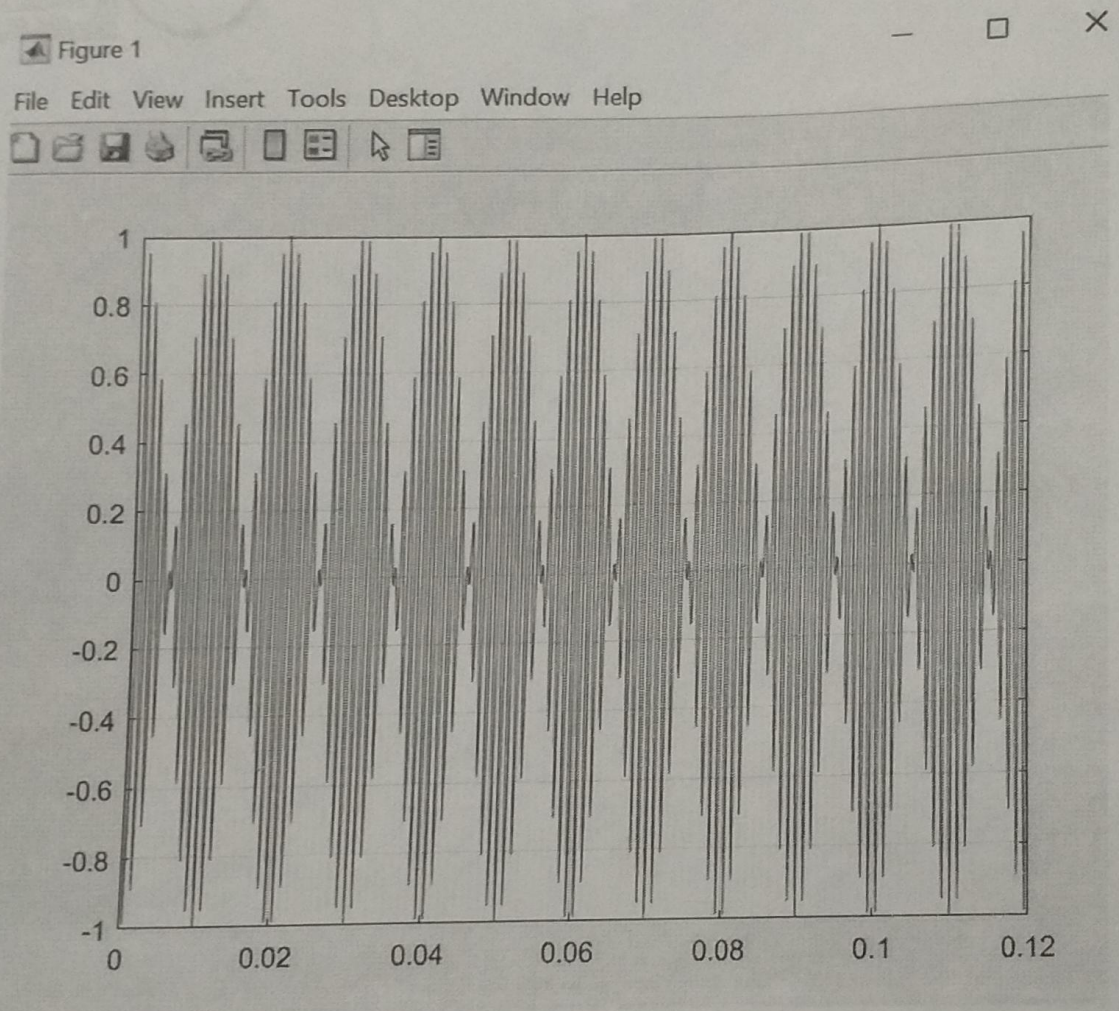


Figure 1
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1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.02
0.04
0.06
0.08
0.1
0.12

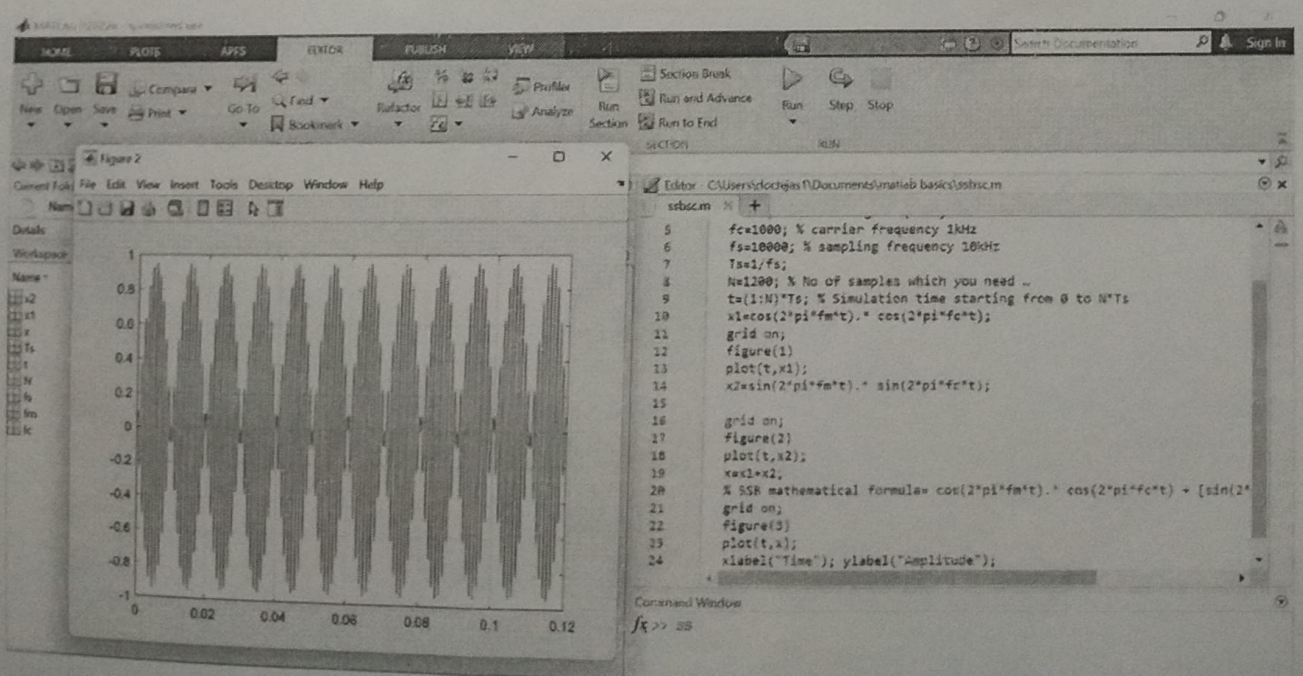
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Figure 2
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ssbsc.m
fc=1000; % carrier frequency 1kHz
fs=10000; % sampling frequency 10kHz
Ts=1/fs;
N=1200; % No of samples which you need
t=(1:N)*Ts; % Simulation time starting from 0 to N*Ts
x1=cos(2*pi*fm*t).* cos(2*pi*fc*t);
grid on;
figure(1)
plot(t,x1);
x2=sin(2*pi*fm*t).* sin(2*pi*fc*t);
grid on;
figure(2)
plot(t,x2);
x=x1+x2;
% SSB mathematical formula= cos(2*pi*fm*t).* cos(2*pi*fc*t) + [sin(2*
grid on;
figure(3)
plot(t,x);
xlabel("Time"); ylabel("Amplitude");
Command Window

Figure 3

File Edit View Insert Tools Desktop Window Help