Aim of the Experiment:

Simulation of Frequency Modulation using Matlab script, Matlab Communications toolbox and communications block set using Simulink

Apparatus Required:

PC Loaded with Matlab

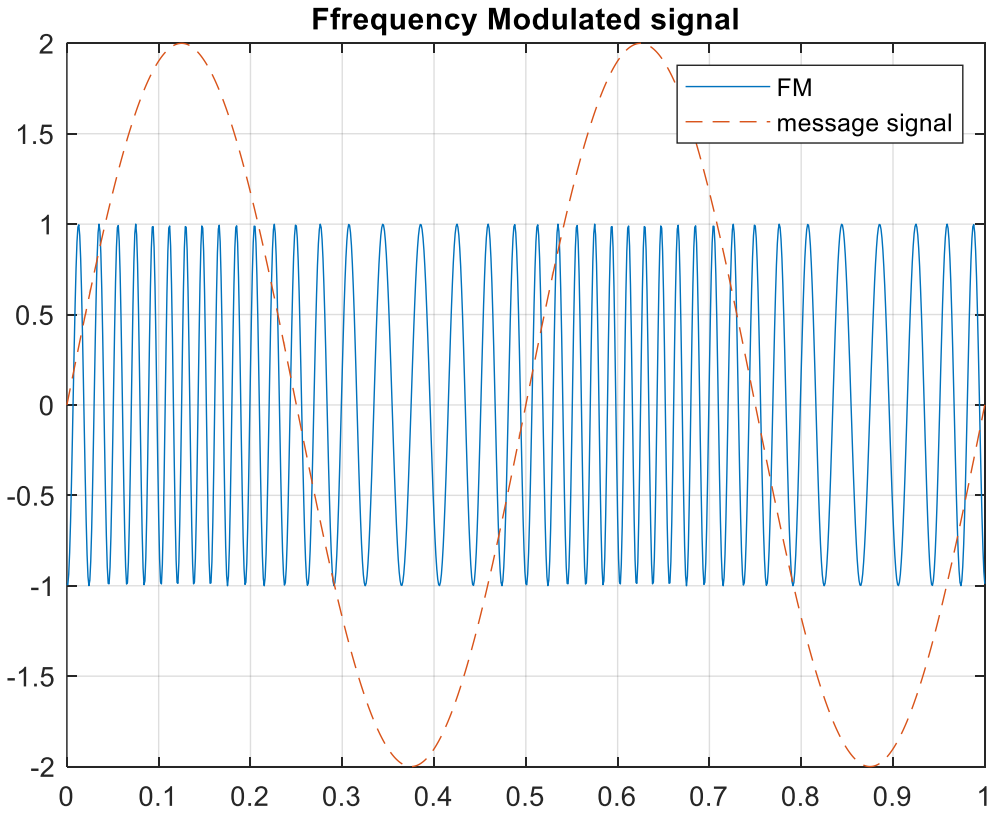
I. FM Modulation with Matlab Script

Procedure:

1. Define starting and ending time with time interval
2. Define Amplitude Frequency of message, carrier
3. Define the frequency deviation
4. Generate the message signal, carrier signal, integrated message
5. Generate the FM with reference to FM equation.
6. Plot the message, carrier and AM DSB-C signal using Subplot option

```
%Matlab program for the simulation of FM
clc;
clear all;
close all;
t = 0:0.001:1;
am = 4; %message amplitude
fm = 2; %message frequency
ac = 1; %carrier amplitude
fc = 40; %carrier frequency
b = 4;%frequency deveation
m = am*sin(2*pi*fm*t); %message
c = ac*sin(2*pi*fc*t); %carrier
m1 = -am*cos(2*pi*fm*t); % integrated message
s = ac*sin(2*pi*fc*t + b*m1);
plot(t,s,t,m,'--');
```

Matlab Output



II. DSB-C Amplitude Modulation with Matlab Script using communications tool box

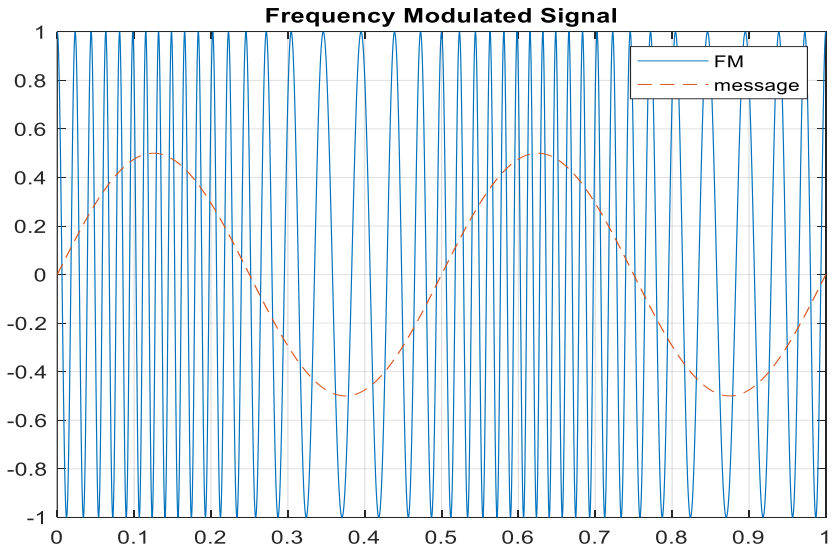
Procedure:

1. Define sampling frequency
2. Define the starting and ending time with sampling time based on sampling frequency definition
3. Define frequencies and amplitudes of message and carrier
4. Define initial phase as 'zero'
5. Define the frequency deviation
6. Generate the message signal with a variable name 'x'
7. Generate the frequency modulated signal using matlab communications tool box command 'fmmod'
8. Plot the message and fm modulated signal using plot command, use legend and grid for the plot.

Matlab Code using Communications Toolbox script

```
clc;
clear all;
close all;
Fs = 10000; % Sampling Frequency
t = 0:1/Fs:1;
mesamp = 2; % message amplitude
Fm = 2; % message frequency
Fc = 40; % carrier frequency
ini_phase = 0; %initial phase
freqdev = 10; % frequency deveation
x = mesamp*sin(2*pi*Fm*t); % message signal
y = fmmod(x,Fc,Fs,freqdev,ini_phase); % FM signal
plot(t,y,t,x/4,'--');legend('FM','message');
title('Frequency Modulated Signal');
grid;
```

Matlab Output



III. Frequency Modulation with Simulink

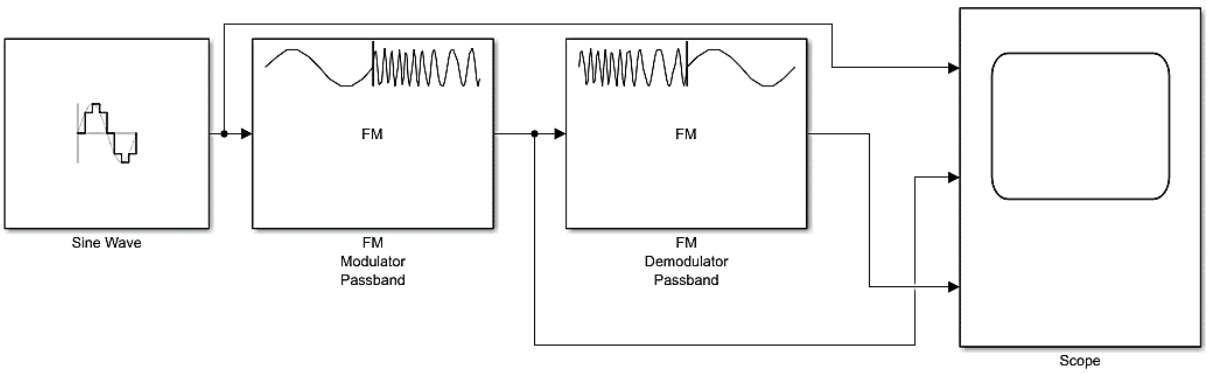
Procedure:

1. Open Simulink from Home tab, or type 'simulink' in command window
2. Once the Simulink environment is opened, click on 'blank model'
3. Using Simulink library browser drag and drop the following blocks and make settings as follows:

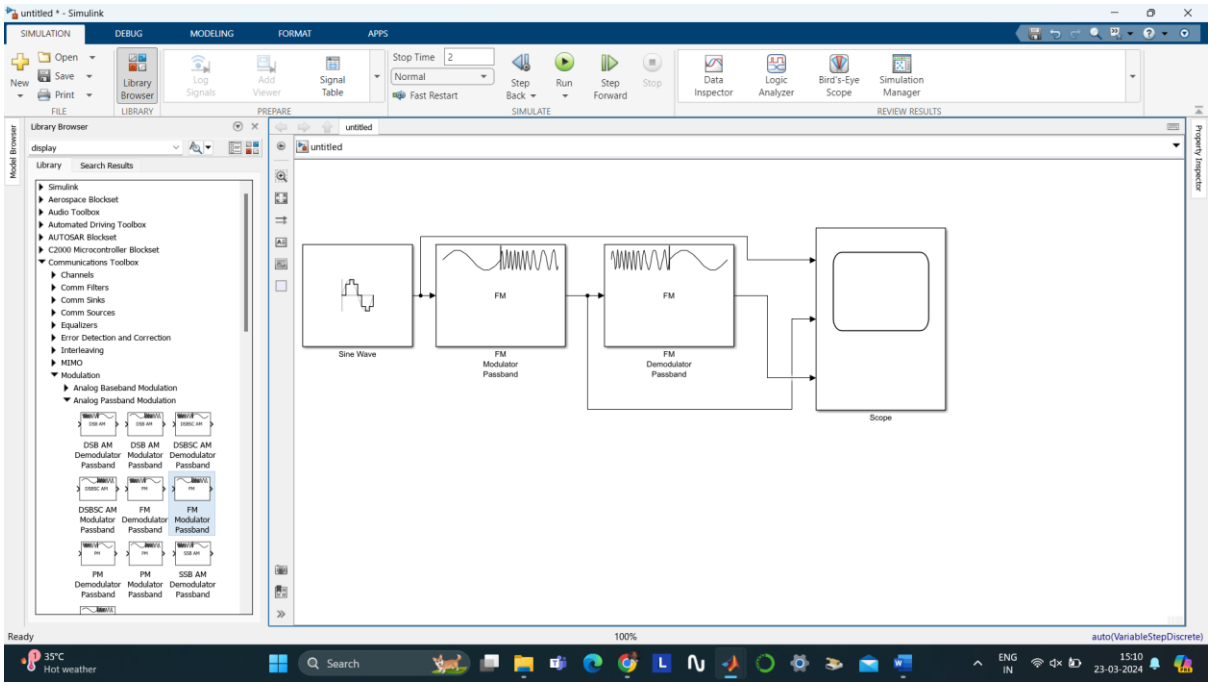
Block name	Simulink Library	Settings
Sine Wave	Simulink – Sources	Sine type : Time based Time(t) : use simulation time Amplitude : 4 Bias : 0 Frequency (rad/sec) : 2*pi*4 Sample time : 1/1000
FM Modulator pass band	Communications Toolbox-Modulation-Analog Passband Modulation	Carrier signal frequency : 40 Initial Phase : 0 Frequency deviation (Hz) : 5
FM Demodulator pass band	Communications Toolbox-Modulation-Analog Passband Modulation	Carrier signal frequency : 40 Initial Phase : 0 Frequency deviation (Hz) : 5 Hilbert transform filter order : 100
Scope	Simulink – Sinks	**Main tab:** Number of input ports : 3 with layout 3x1 Sample time : 1/1000

4. Connect all the blocks as per the given model
5. Make simulation time as '2 seconds'
6. Click on run simulation
7. Double click on scope to see the generated message, FM output, demodulated message.

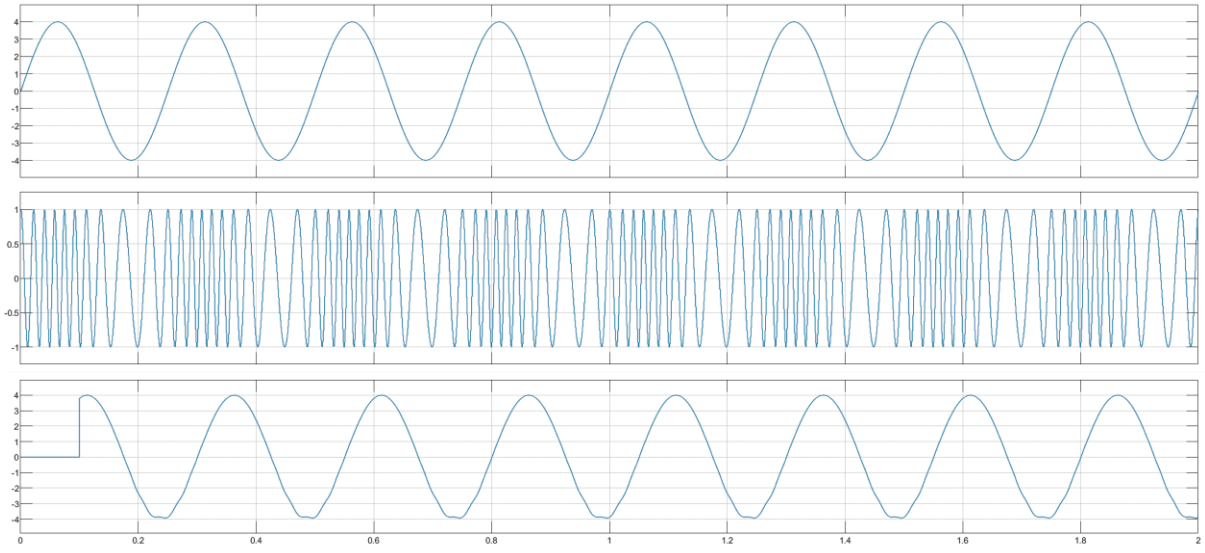
Simulink Model



Simulink window



Simulink Output



Result:

The process of Frequency modulated signal is successfully simulated, using Matlab script, matlab communications toolbox and Simulink.