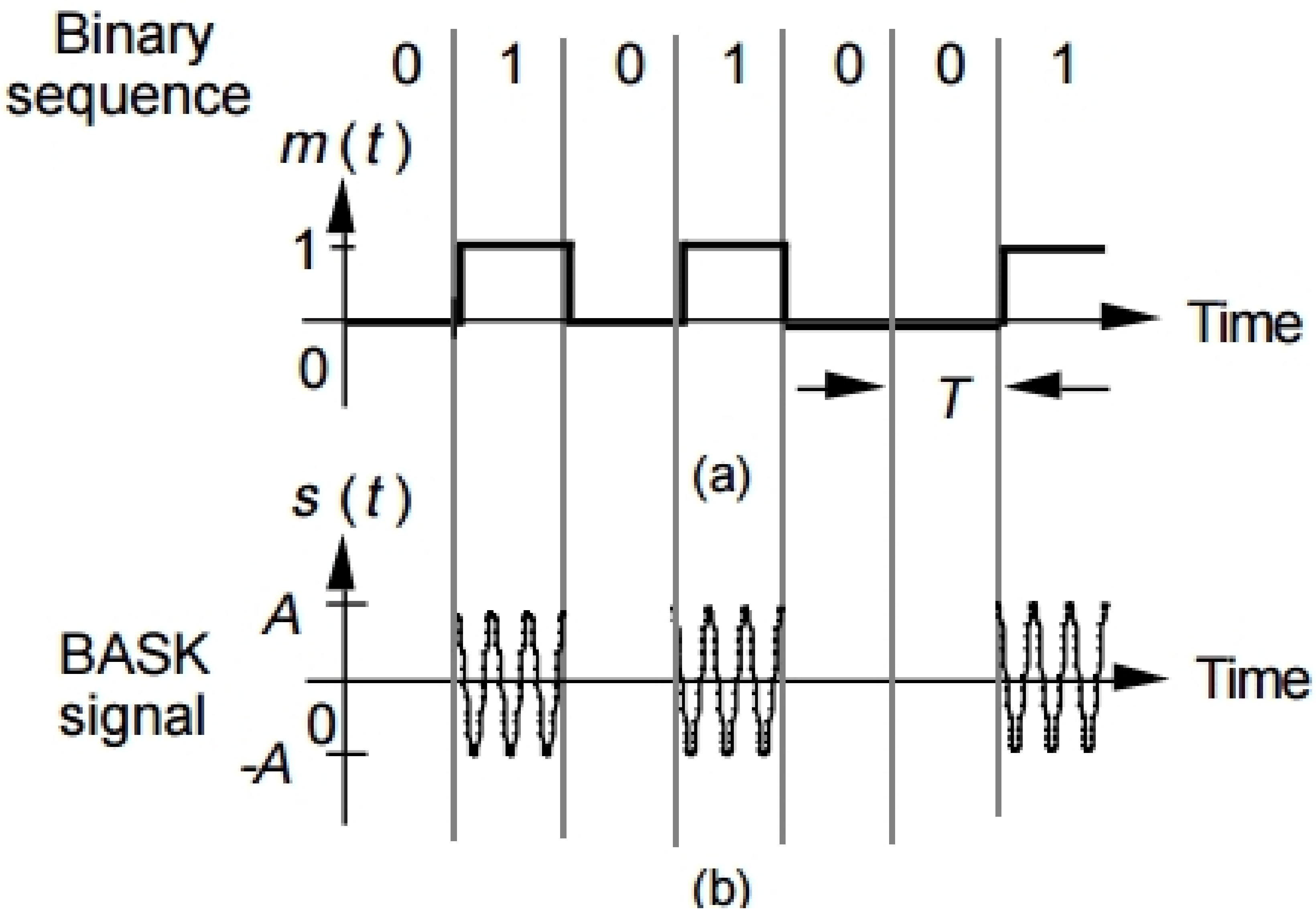
Experiment No.4

To Understand the various bandpass signalling scheme
BASK,BPSK and BFSK

BASK signal:


Binary sequence
0
1
0
1
0
0
1
m (t)
1
0
Time
T
(a)
s (t)
A
BASK signal
0
-A
Time
(b)

BASK:

1. Generate message signal by square function with Amplitude and frequency =5
2. Generate the 2 different amplitude of the signal AC1 and AC2 = 10,0 (Amplitude of carrier signal with Bit 1 and 0)
3. Use the for loop and if else condition and display the output

For loop ____1 to n

If condition

Bask_out1=Ac1*cos(2*pi*fc*t2);%modulation signal with carrier signal 1

else

Similarly calculate for Ac2

BPSK:

BPSK stands for **Binary Phase Shift Keying**.

It is digital modulation technique.

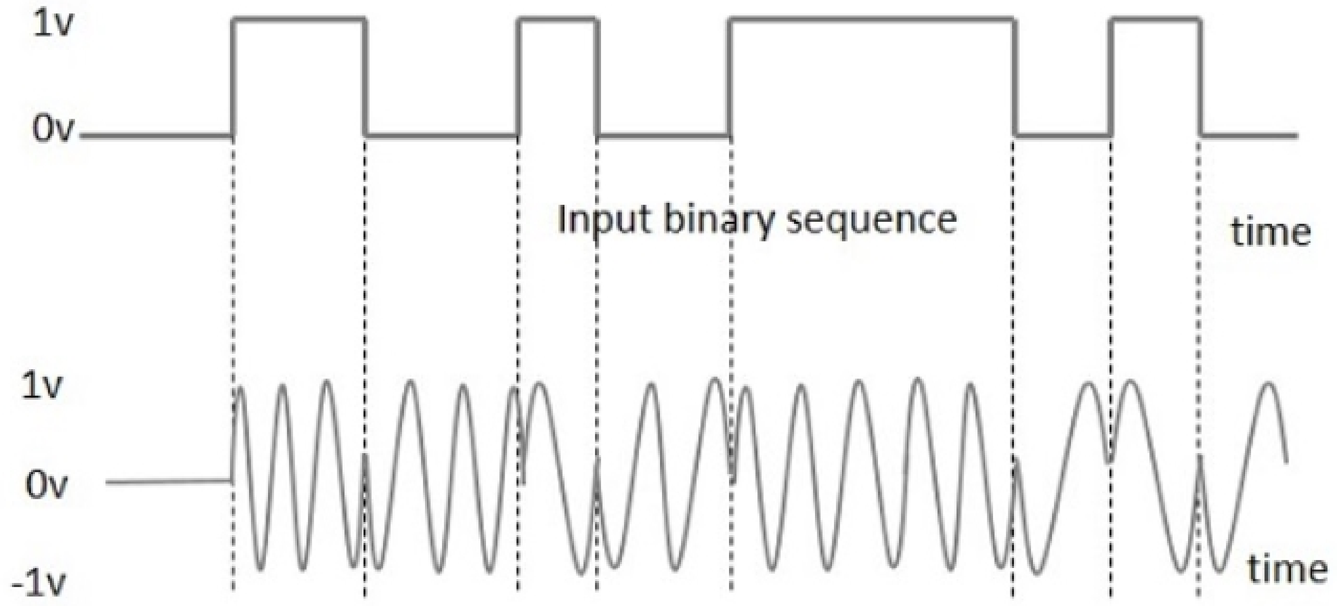
As per the constellation diagram binary 1 and binary 0 are represented by different carrier phases each is 180 degree apart.

The simplest BPSK scheme uses two phases to represent the two binary digits and is known as binary phase-shift keying. The resulting transmitted single for one bit time is

S (t) =A* cos (2*pi*fc*t) for binary 1

S (t) =A *cos (2*pi*fc*t+pi) for binary 0

BPSK Modulated output wave:



BPSK Modulated output wave

For given Data Bits Waveform Generation:

```
n=[1,1,1,0,1];
for k = 1:length(n)
    if n(k)==1
    amplitude=4;
    else
    amplitude=-4;
    end
end

i=1;
t=0:0.01:length(n);
for j=1:length(t)
   if t(j)<=i
    y(j)=n(i);
    else
    y(j)=n(i);
    i=i+1;
    end
end
plot(t,y,'r-');
```

% Plotting

- subplot(4,1,1);
- plot(t,y,'k-');
- xlabel('Time');
- ylabel('Amplitude');
- title('NRZ Polar signal');

% Carrier signal

- c= cos(2*pi*2*t);
- subplot(4,1,2);
- plot(t,c,'k-');
- xlabel('Time');
- ylabel('Amplitude');
- title('carrier signal');

- % BPSK Modulation
- x=y.*c;
- subplot(4,1,3);
- plot(t,x,'k-');
- xlabel('Time');
- ylabel('Amplitude');
- title('BPSK signal');
-
- % Coherent detection and reproduction
- y2=x;
- y1=y2.*c;   % product modulator
- subplot(4,1,4);
- plot(t,y1,'k-');

```
% Integrator output
int_op=[];
for ii=0:S:length(y1)-S
    int_o=(1/S)*trapz(y1(ii+1:ii+S));
    int_op=[int_op int_o];
end

% Hard decision decoding
disp('Detected bits:')
det=(round(int_op,1)>=0)
% BER computation
ber=sum(n~=det)/N
```

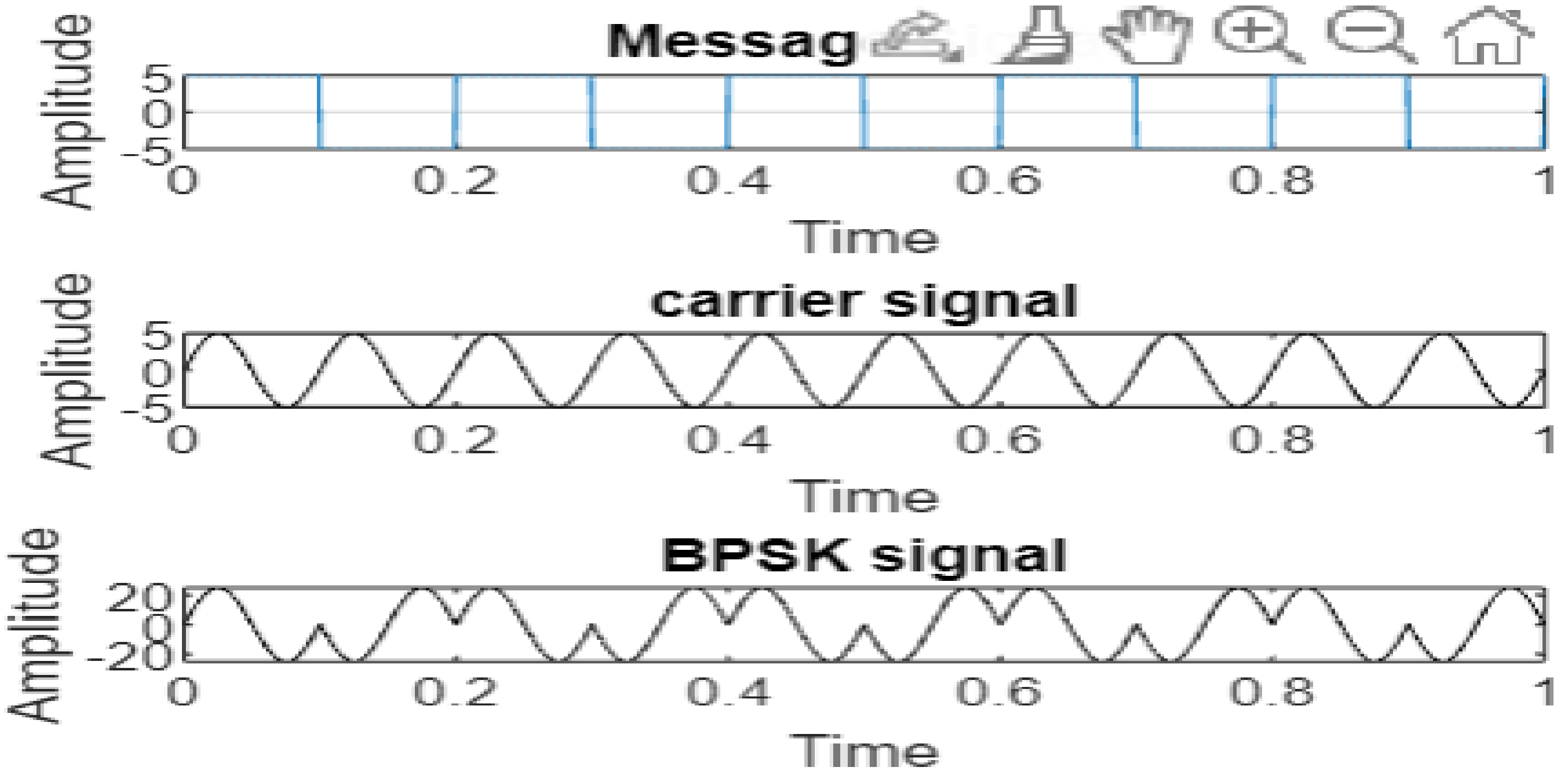
MATLAB code:

```
clc;
clear all;
fm=5; % frequency of signal needed for message signal
t = 0:0.001:1; % Time axis( 0.001 is the step size)
a=5; % Amplitude of a signal both the signal carrier and message
m = a*square(2*pi*fm*t); % Representation of message bits[1,0,1,0,1,0,1,0,10]
subplot(3,1,1); % 3 rows, 1 column first diagram
plot(t,m); % plot the message signal
grid on;
title("Message Signal")
xlabel("Time");
ylabel("Amplitude");


c= a*sin(2*pi*10*t); % representation of carrier signal
subplot(3,1,2); % 3 rows, 1 column second diagram
plot(t,c,'k-'); % plot the carrier signal
xlabel('Time');
ylabel('Amplitude');
title('carrier signal');


x=m.*c; % Calculation of BPSK signal
subplot(3,1,3); % 3 rows, 1 column second diagram
plot(t,x,'k-'); % plot the carrier signal
xlabel('Time');
ylabel('Amplitude');
title('BPSK signal');
```

MATLAB Waveform:



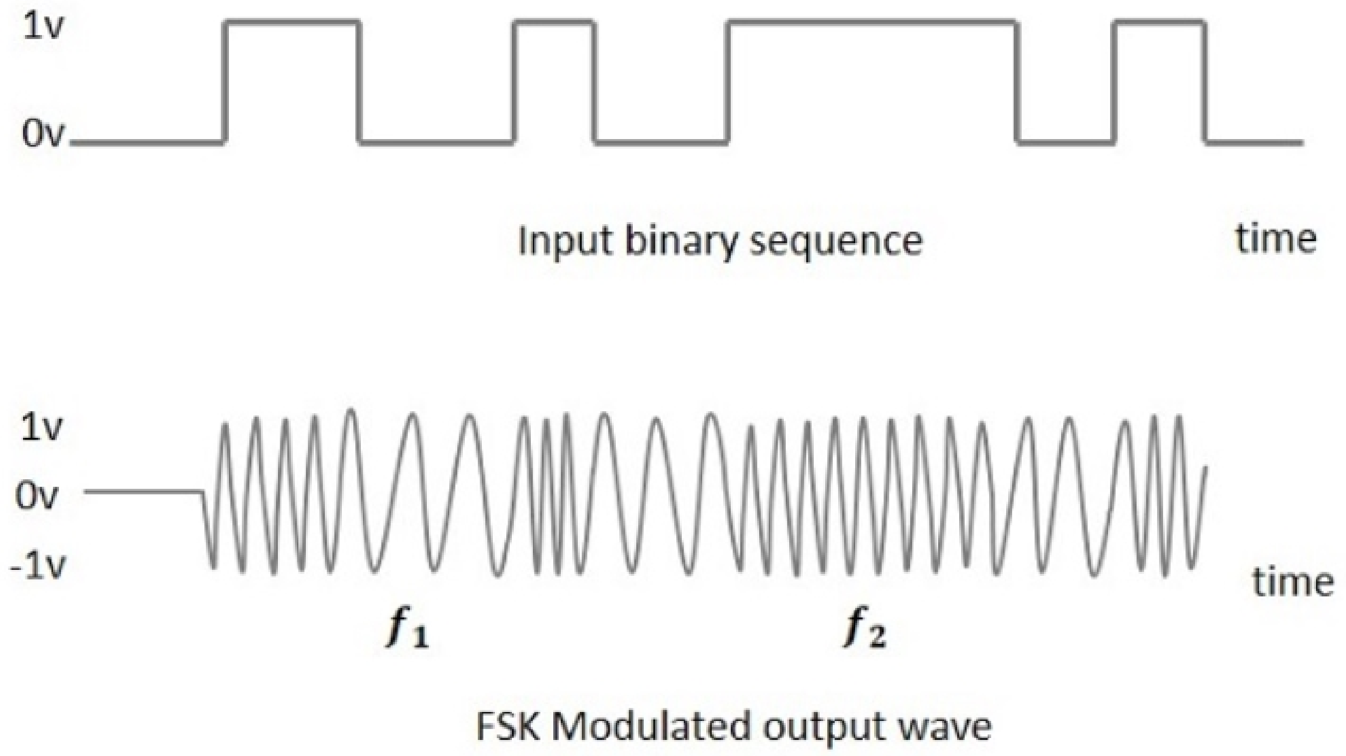
BPSK Applications:

- The **BPSK** modulation is a very basic technique used in various wireless standards such as CDMA, WiMAX (16d, 16e), WLAN 11a, 11b, 11g, 11n, Satellite, DVB, Cable modem etc.
- It is considered to be more robust among all the modulation types due to difference of 180 degree between two constellation points.
- Hence it can withstand severe amount of channel conditions or channel fading.
- It is used in OFDM and OFDMA to modulate the pilot subcarriers used for channel estimation and equalization.
- As we know different channels are used for specific data transmission in cellular systems.
- The channels used to transmit system related information's which are very essential are modulated using BPSK modulation.

BFSK:

- Frequency Shift Keying FSK is the digital modulation technique in which the frequency of the carrier signal varies according to the digital signal changes. FSK is a scheme of frequency modulation.
- The output of a FSK modulated wave is high in frequency for a binary High input and is low in frequency for a binary Low input. The binary 1s and 0s are called Mark and Space frequencies.
- The following image is the diagrammatic representation of FSK modulated waveform along with its input.

Waveform:

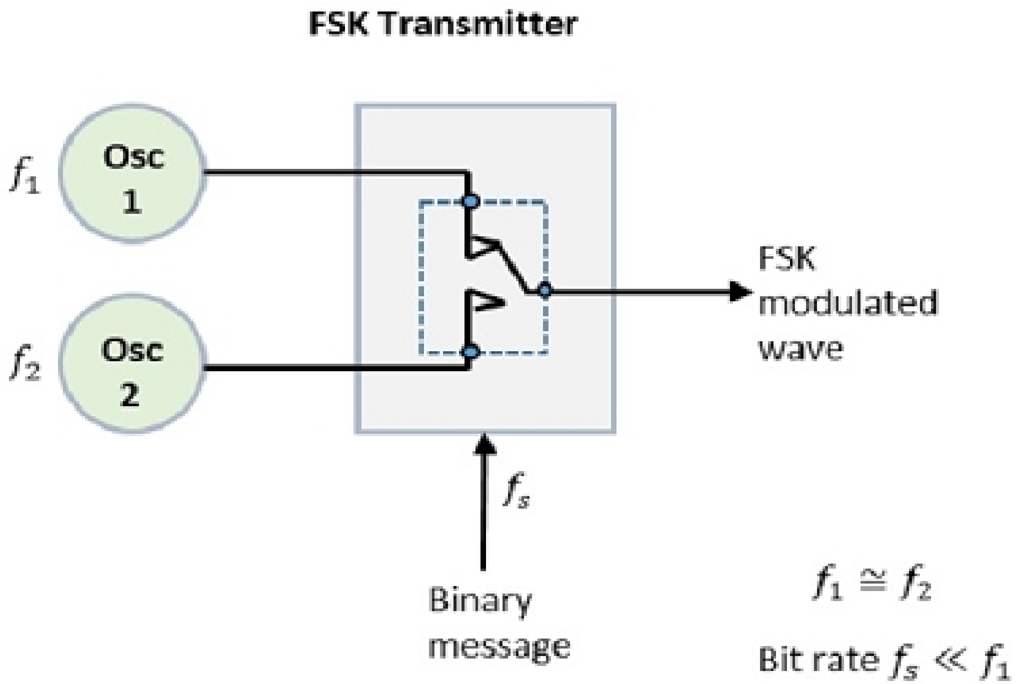


1v
0v
Input binary sequence
time
1v
0v
-1v
time
f_1
f_2
FSK Modulated output wave

FSK Modulator

- The FSK modulator block diagram comprises of two oscillators with a clock and the input binary sequence. Following is its block diagram.

- FSK Transmitter



FSK Modulator:

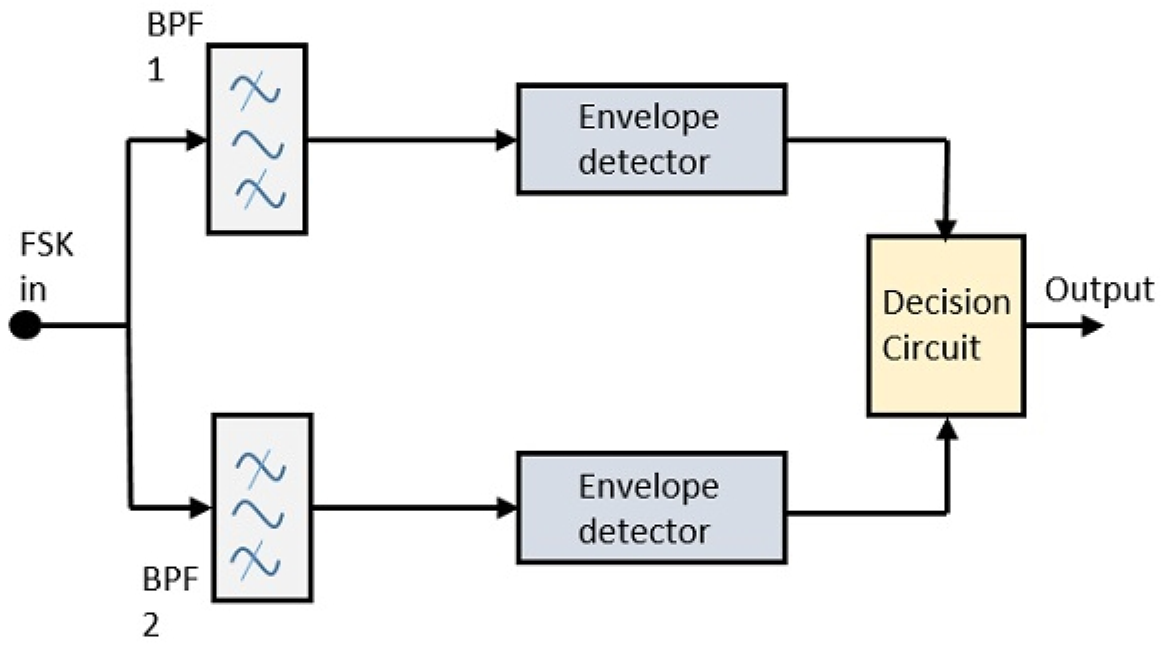
- The two oscillators, producing a higher and a lower frequency signals, are connected to a switch along with an internal clock.
- To avoid the abrupt phase discontinuities of the output waveform during the transmission of the message, a clock is applied to both the oscillators, internally.
- The binary input sequence is applied to the transmitter so as to choose the frequencies according to the binary input.

FSK Demodulator:

- There are different methods for demodulating a FSK wave. The main methods of FSK detection are asynchronous detector and synchronous detector. The synchronous detector is a coherent one, while asynchronous detector is a non-coherent one.

- Asynchronous FSK Detector
- The block diagram of Asynchronous FSK detector consists of two band pass filters, two envelope detectors, and a decision circuit. Following is the diagrammatic representation.

FSK Demodulator:



FSK Demodulator:

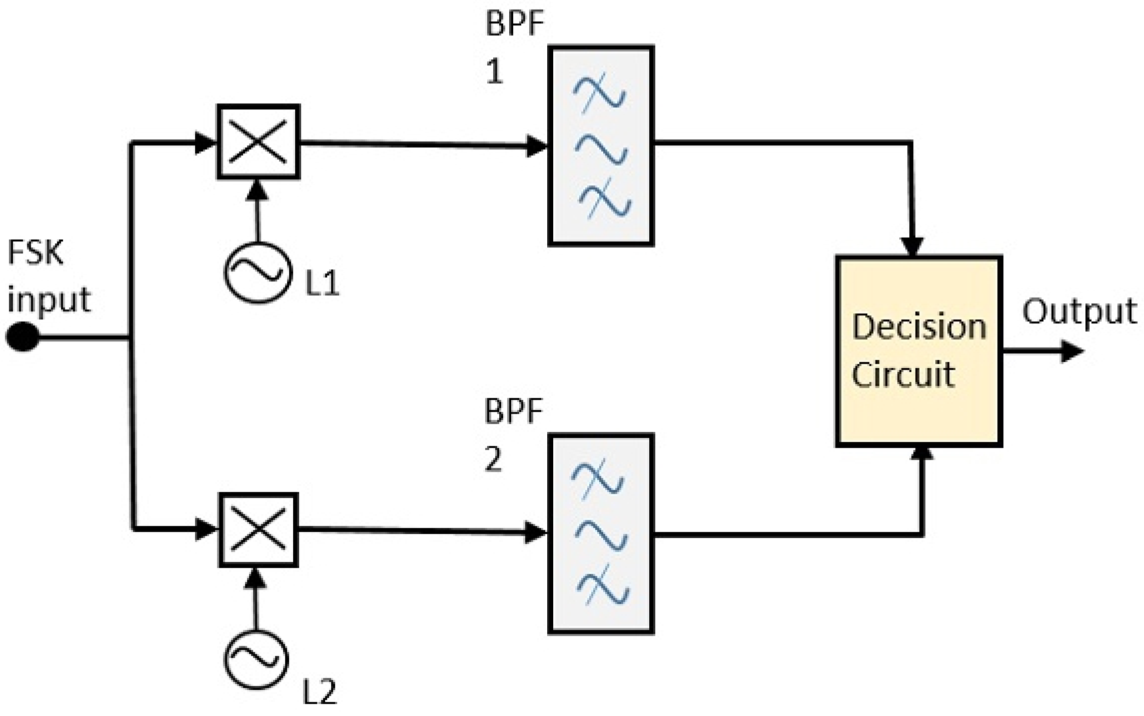
- The FSK signal is passed through the two Band Pass Filters BPFs, tuned to Space and Mark frequencies. The output from these two BPFs look like ASK signal, which is given to the envelope detector. The signal in each envelope detector is modulated asynchronously.

- The decision circuit chooses which output is more likely and selects it from any one of the envelope detectors. It also re-shapes the waveform to a rectangular one.

Synchronous FSK Detector

- The block diagram of Synchronous FSK detector consists of two mixers with local oscillator circuits, two band pass filters and a decision circuit. Following is the diagrammatic representation.

Synchronous FSK Detector



Synchronous FSK Detector

- The FSK signal input is given to the two mixers with local oscillator circuits. These two are connected to two band pass filters. These combinations act as demodulators and the decision circuit chooses which output is more likely and selects it from any one of the detectors. The two signals have a minimum frequency separation.

- For both of the demodulators, the bandwidth of each of them depends on their bit rate. This synchronous demodulator is a bit complex than asynchronous type demodulators.

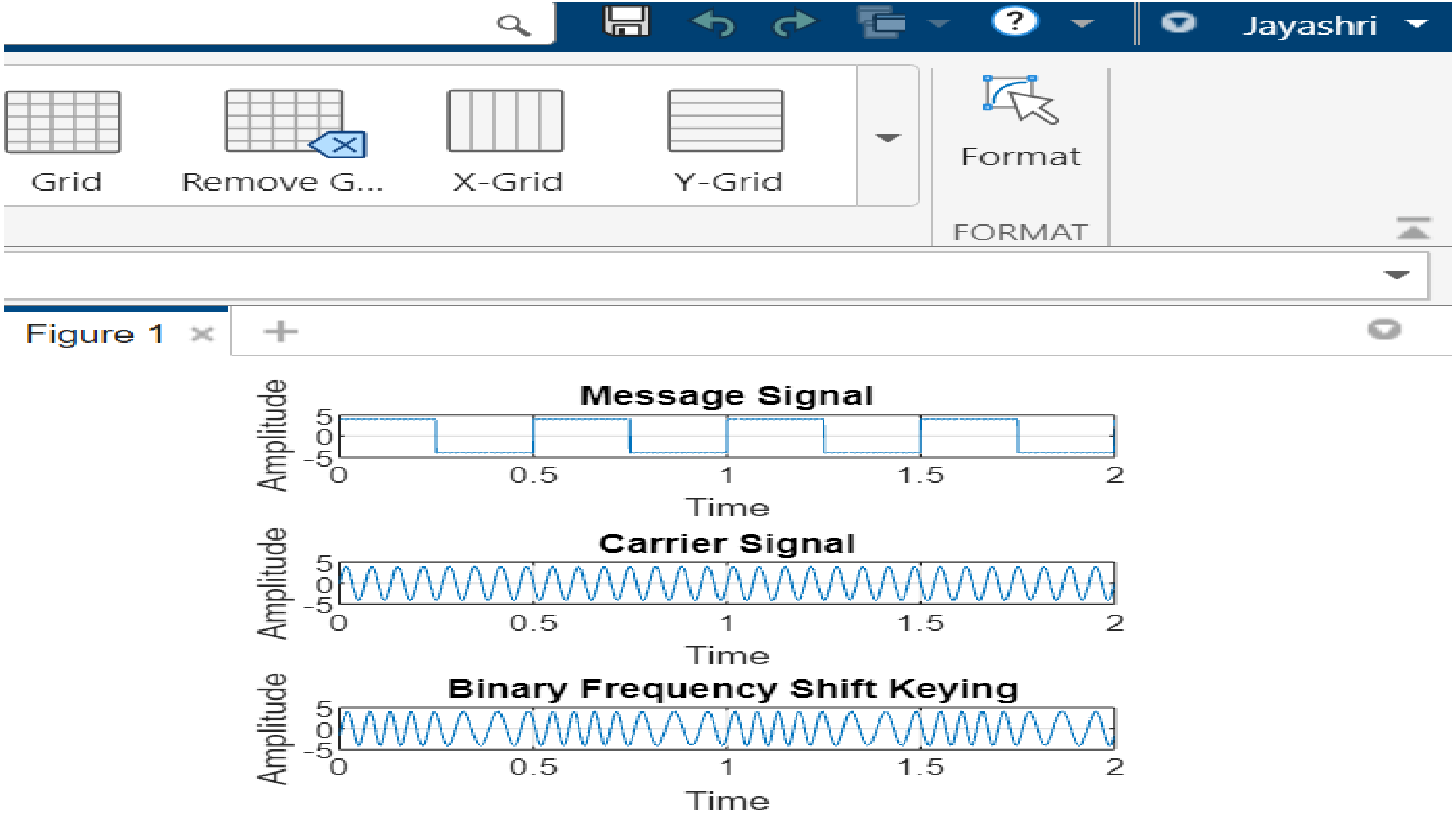
```
clc;
clear all;
close all;
am = 4;
ac = 4;
t = 0:0.001:2;
fc = 15;
fm = 2;
kf = 1;


m = am*square(2*pi*fm*t);
subplot(3,1,1);
plot(t,m);
grid on;
title("Message Signal")
xlabel("Time");
ylabel("Amplitude");
```

```
c = ac*sin(2*pi*fc*t)
subplot(3,1,2);
plot(t,c);
grid on;
xlabel("Time");
ylabel("Amplitude");
title("Carrier Signal")


beta = (kf*am)/fm;
st = ac*cos(2*pi*fc*t - beta*cos(2*pi*fm*t));
subplot(3,1,3)
plot(t,st);
grid on;
xlabel("Time");
ylabel("Amplitude");
title(" Binary Frequency Shift Keying")
```

Output Waveform:



Thank You