ASK, FSK, PSK COMPARITIVE STUDY

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Contents:

First we will know about types of signals, then what is digital signals, types of digital modulation techniques , what are ask, fsk, psk and their modulated, demodulated waveforms(and also implementation in matlab) and at last we will compare **ASK, FSK, PSK.**

Objective:

An electromagnetic or electrical current that transports data from one system or network to another is known as a signal. In electronics, a signal is often a time-varying voltage that also serves as an information-carrying electromagnetic wave, however it can also be current. Analog and digital signals are the two primary forms of signals used in electronics. In addition, we shall discuss digital signals in greater depth in this project.

A digital signal is one in which data is represented as a series of discrete numbers. At any one time, a digital signal can only take on one value from a finite set of possible values. The physical amount representing the information in digital signals can be any of the following: Electric current or voltage that varies.

More information capacity, superior data security, faster system availability, and high-quality transmission are all benefits of digital modulation. As a result, digital modulation techniques are in higher demand than analog modulation techniques due to their ability to transmit bigger amounts of data. There are 3 types of digital modulation techniques and also their combinations, depending upon the need we will use them

And there are 3 types of digital modulation techniques:

- Amplitude Shift Keying(Ask)
- Frequency Shift Keying(Fsk)
- Phase Shift Keying(Psk)

Block diagram and description:

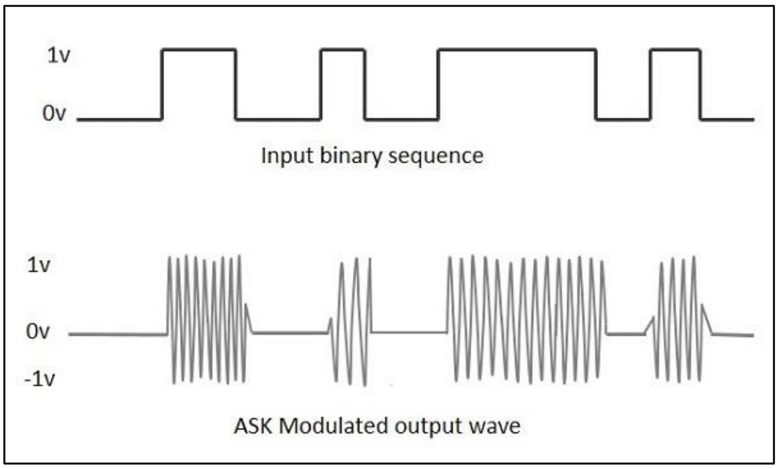
Ask:

ASK stands for Amplitude Shift Keying

ASK modulation:

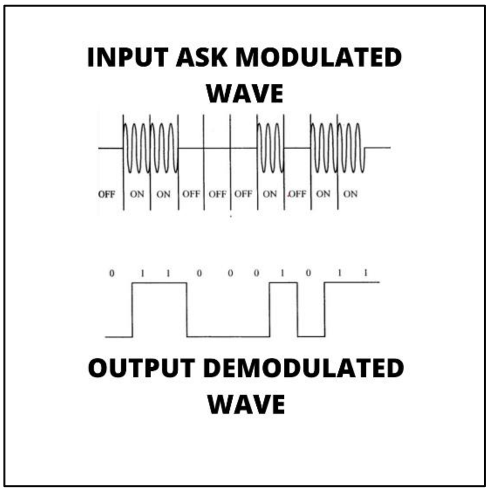
• ASK is a digital modulation technique using an analog carrier and digital data to be modified. Analog output is modulated.

• The carrier signal's strength or amplitude is adjusted to represent binary 1 and binary 0 data inputs, while the carrier signal's frequency and phase remain constant. The modulation system's voltage values are left to the designers.



ASK Demodulation:

At the receiver level, demodulation is the process of recreating the original signal. It's defined as whatever amplitude modulated signal is received from the channel at the receiver side, using correct amplitude demodulation techniques to recover/reproduce the original input signal at the receiver's output stage. The input amplitude varied modulated will be the input and the output is the noise free digital signal

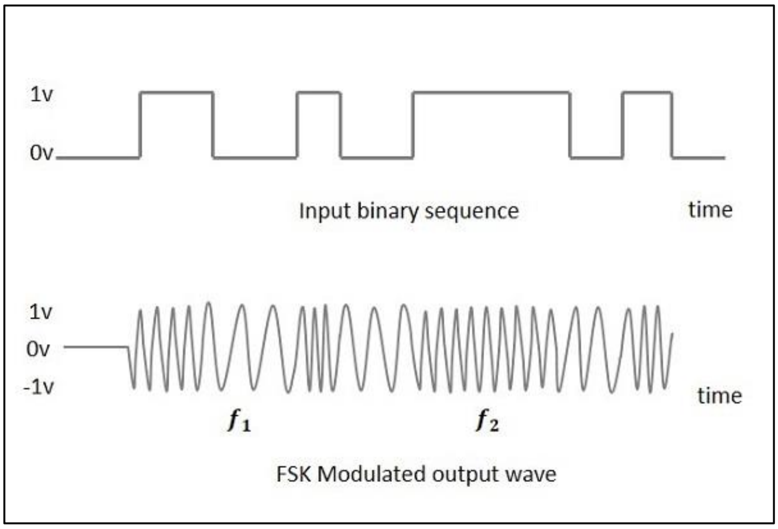


Fsk:

FSK stands for frequency-shift keying

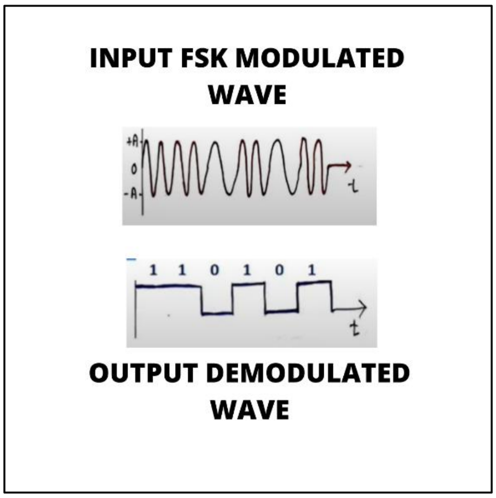
FSK modulation:

FSK is a frequency modulation technology in which digital data is transferred by changing the frequency of a carrier wave in a discrete manner. Amateur radio, caller ID, and emergency broadcasts are all examples of communication systems that utilize the technology. FSK transmits binary (0s and 1s) data using a pair of discrete frequencies. The "1" is referred to as the mark frequency, and the "0" is referred to as the space frequency in this system.



FSK demodulation:

At the receiver level, demodulation is the process of recreating the original signal. It's defined as whatever frequency modulated signal is received from the channel at the receiver side, using correct frequency demodulation techniques to recover/reproduce the original input signal at the receiver's output stage. The input frequency varied modulated will be the input and the output is the noise free digital signal.



Psk:

PSK stands for phase shift keying

The digital modulation technique (PSK) changes the phase of the carrier signal by altering the sine and cosine inputs at a specific period.

There are two varieties of PSK:

BPSK stands for Binary Phase-Shift Keying.

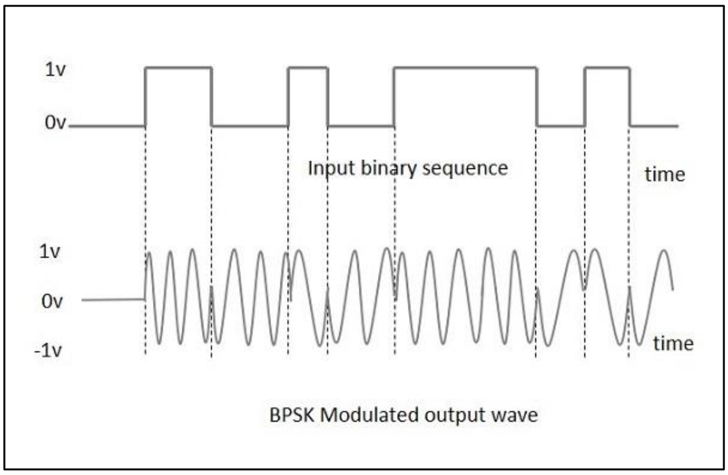
QPSK stands for Quadrature Phase Shift Keying.

We shall concentrate on BPSK in this project.

Bpsk modulation:

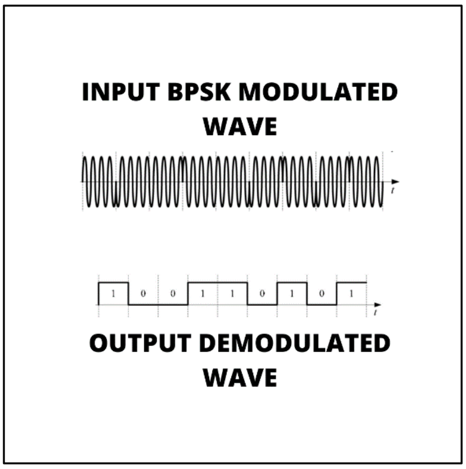
Phase reversal keying, or 2PSK, is another name for BPSK. PSK in this form is the most basic. The two phases are separated by 180 degrees and are symbolised by the numbers 0 and 1, where 0 represents 0 degrees and 1 represents 180 degrees.

Along with its input, the output wave is BPSK modulated



BPSK demodulation:

At the receiver level, demodulation is the process of recreating the original signal. It's defined as whatever phase modulated signal is received from the channel at the receiver side, using correct phase demodulation techniques to recover/reproduce the original input signal at the receiver's output stage. The input phase varied modulated will be the input and the output is the noise free digital signal.



Simulation results (Plots /Graphs):

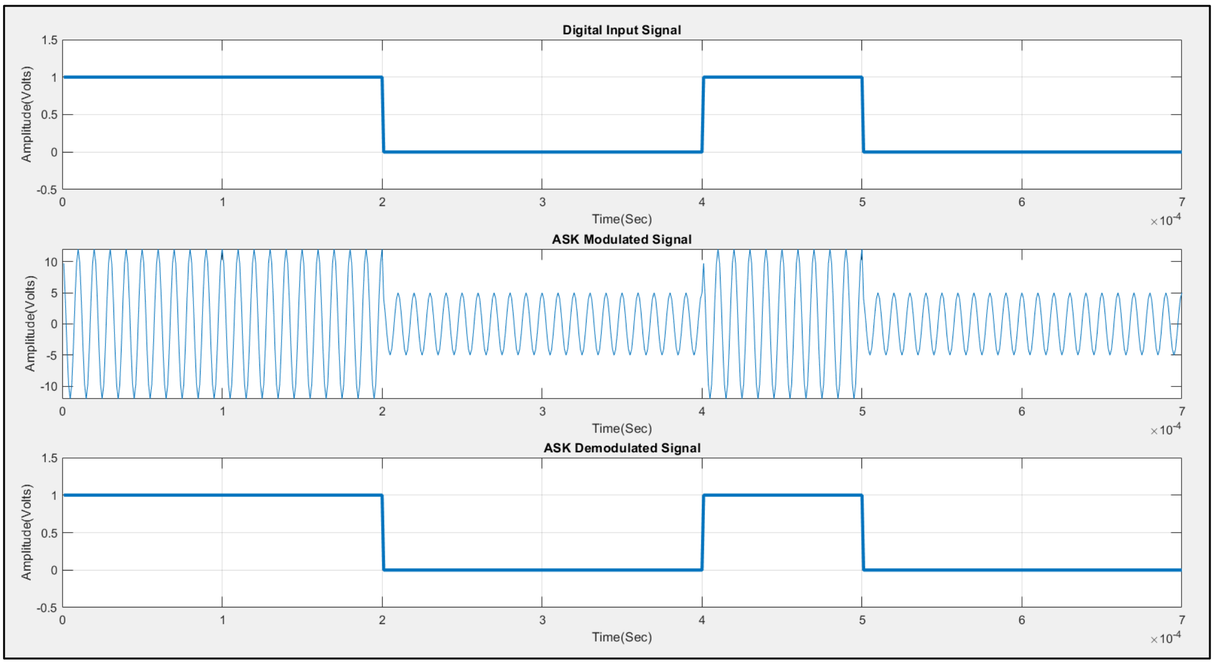
Ask Modulation, demodulation:

INPUTING THE BINARY DIGITAL INFORMATION:

```
Enter Digital Input Information = [1 1 0 0 1 0 0]
Binary Input Information at Transmitter:
     1     1     0     0     1     0     0

Demodulated Binary Information at Receiver:
     1     1     0     0     1     0     0
```

GRAPH:



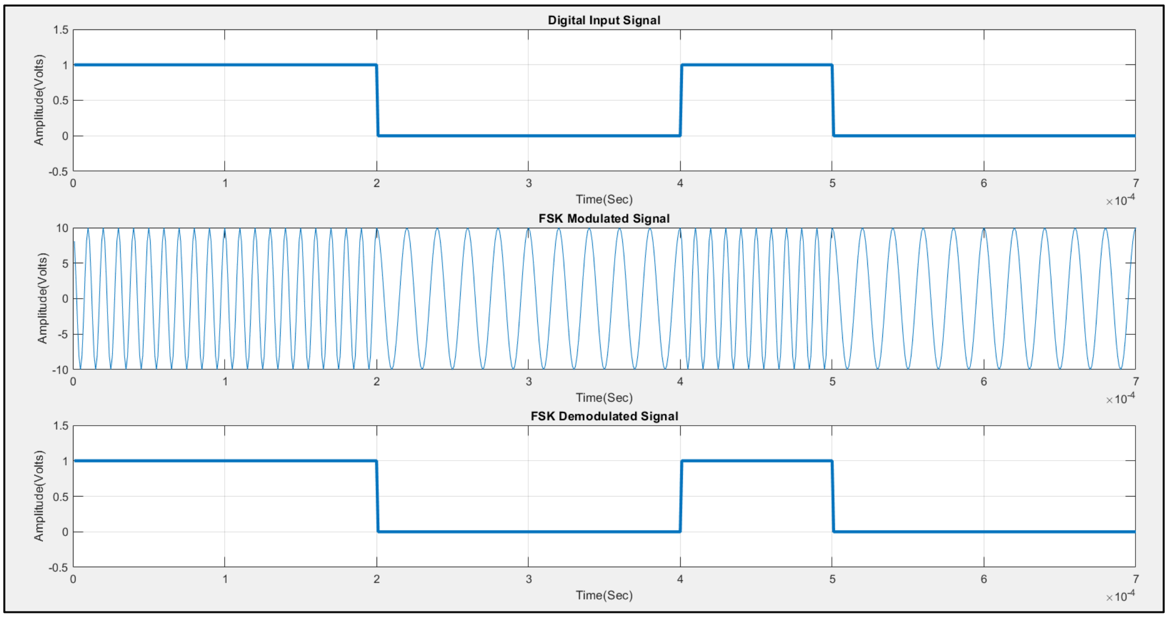
Fsk Modulation, demodulation:

INPUTING THE BINARY DIGITAL INFORMATION:

```
Enter Digital Input Information = [1 1 0 0 1 0 0]
Binary Input Information at Transmitter:
     1     1     0     0     1     0     0

Demodulated Binary Information at Receiver:
     1     1     0     0     1     0     0
```

GRAPH:



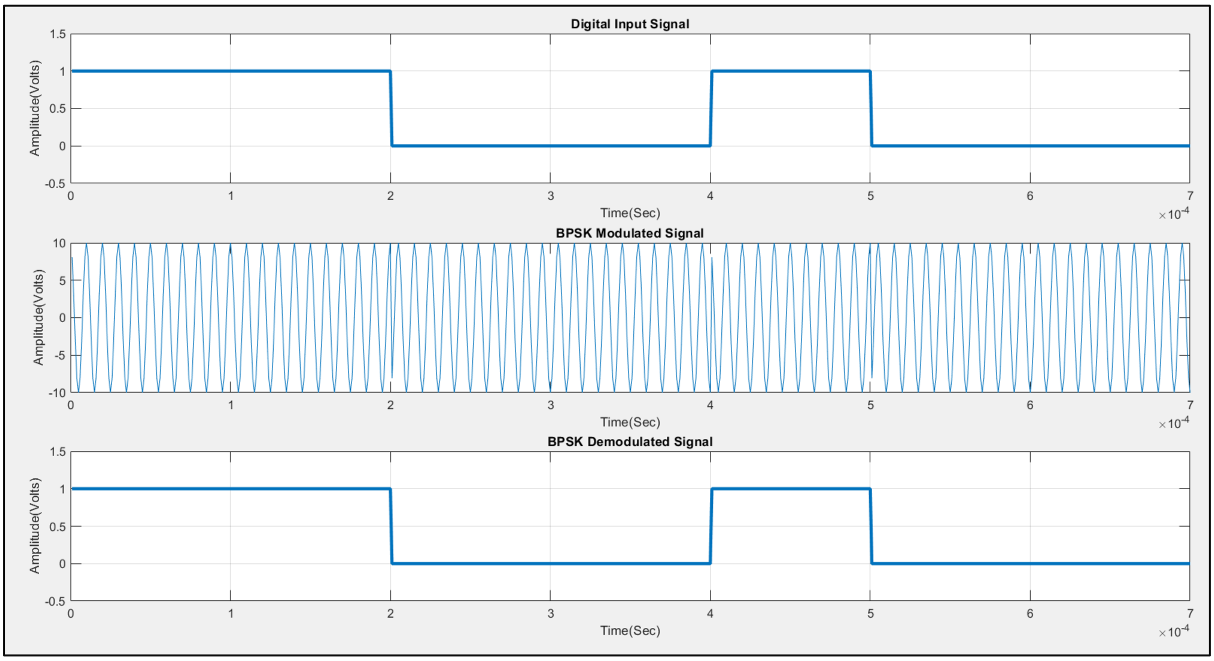
Bpsk Modulation, demodulation:

INPUTING THE BINARY DIGITAL INFORMATION:

```
Enter Digital Input Information = [1 1 0 0 1 0 0]
Binary Input Information at Transmitter:
     1     1     0     0     1     0     0

Demodulated Binary Information at Receiver:
     1     1     0     0     1     0     0
```

GRAPH:



Inferences:

Ask Modulation, demodulation:

In the corresponding graphical representation we can see that when the input binary is '0' then there will be less amplitude varied analog type of waveform and when the input binary is '1' then there will be more amplitude varied analog type of waveforms are produced and as we know from **ASK** theory that the binary signal when ASK modulated, gives a zero value for low input while it gives the carrier output for high input. Our graphical representation is satisfied for the above theory. So, our implementation is accurate.

And after getting the modulated wave from modulation now we will demodulate it and after amplitude demodulation if we get same input digital waveform then our implementation is accurate. As we can see the graph both input, amplitude demodulated graphs are similar so our implementation is accurate.

Fsk Modulation, demodulation:

In the corresponding graphical representation we can see that when the input binary is '0' then there will be less frequency varied analog type of waveform and when the input binary is '1' then there will be more frequency varied analog type of waveforms are produced and as we know from **FSK** theory that 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. Our graphical representation is satisfied for the above theory. So, our implementation is accurate.

And after getting the modulated wave from modulation now we will demodulate it and after frequency demodulation if we get same input digital waveform then our implementation is accurate. As we can see the graph both input, frequency demodulated graphs are similar so our implementation is accurate.

Bpsk Modulation, demodulation:

In the corresponding graphical representation we can see that when the input binary is '0' then there will be 0 degree phase angle varied analog type of waveform and when the input binary is '1' then there will be 180 degree phase angle varied analog type of waveforms are produced and as we know from **BPSK** theory that For a zero binary input, the phase will be 0° and for a high input, the phase reversal is of 180°.Our graphical representation is satisfied for the above theory. So, our implementation is accurate.

And after getting the modulated wave from modulation now we will demodulate it and after phase demodulation if we get same input digital waveform then our implementation is accurate. As we can see the graph both input, phase demodulated graphs are similar. So our implementation is accurate.

Conclusions:

Applications of Ask:

- Low-frequency radio frequency (RF) applications
- Devices for home automation
- Devices for industrial networks
- Base stations for wireless networks

Applications of Fsk:

- Telephone Systems with Caller ID
- Radio Amateur
- Early Modems for Telephone Lines
- Systems for Emergency Broadcasting
- Modems

Applications of Psk:

- LANs that are wireless
- Bio-metric
- Contactless operations
- Communication using Bluetooth

COMPARISON BETWEEN ASK, FSK, PSK:

Parameters	**ASK**	**FSK**	**PSK**
Variable characteristics	Amplitude	Frequency	Phase
Bandwidth	Low	High	Low
Noise immunity	low	High	High
Complexity	Simple	Moderately complex	Very complex

Parameters	ASK	FSK	PSK
Error probability	High	Low	Low
Performance in presence of noise	Poor	Better than ASK	Better than FSK
Bit rate	Suitable upto 100 bits/sec	Suitable upto about 1200 bits/sec	Suitable for high bit rates
Signal to noise ratio	Low	High	High

Appendix:

Ask Modulation, demodulation:

```
% ASK Modulation and Demodulation
clc, clear all, close all;

%Digital/Binary input information
x = input('Enter Digital Input Information = ');   % Binary information
as stream of bits (binary signal 0 or 1)
N = length(x);
Tb = 0.0001;   %Data rate = 1MHz i.e., bit period (second)
disp('Binary Input Information at Transmitter: ');
disp(x);


%Represent input information as digital signal
nb = 100;   % Digital signal per bit
digit = [];
for n = 1:1:N
    if x(n) == 1;
       sig = ones(1,nb);
    else x(n) == 0;
        sig = zeros(1,nb);
    end
```

```
    digit = [digit sig];
end

t1 = Tb/nb:Tb/nb:nb*N*(Tb/nb);   % Time period
figure('Name','ASK Modulation and Demodulation','NumberTitle','off');
subplot(3,1,1);
plot(t1,digit,'LineWidth',2.5);
grid on;
axis([0 Tb*N -0.5 1.5]);
xlabel('Time(Sec)');
ylabel('Amplitude(Volts)');
title('Digital Input Signal');


%ASK Modulation
Ac1 = 12;      % Carrier amplitude for binary input '1'
Ac2 = 5;       % Carrier amplitude for binary input '0'
br = 1/Tb;     % Bit rate
Fc = br*10;    % Carrier frequency
t2 = Tb/nb:Tb/nb:Tb;   % Signal time

mod = [];
for (i = 1:1:N)
    if (x(i) == 1)
        y = Ac1*cos(2*pi*Fc*t2);   % Modulation signal with carrier
signal 1
    else
        y = Ac2*cos(2*pi*Fc*t2);   % Modulation signal with carrier
signal 2
    end
    mod = [mod y];
end

t3 = Tb/nb:Tb/nb:Tb*N;   % Time period
subplot(3,1,2);
plot(t3,mod);
xlabel('Time(Sec)');
ylabel('Amplitude(Volts)');
title('ASK Modulated Signal');


%Transmitted signal x

x = mod;

%Channel model h and w
h = 1;   % Signal fading
w = 0;   % Noise

%Received signal y
y = h.*x + w;   % Convolution

%ASK Demodulation
s = length(t2);
demod = [];
for n = s:s:length(y)
  t4 = Tb/nb:Tb/nb:Tb;     % Time period
  c = cos(2*pi*Fc*t4);     % Carrier signal
  mm = c.*y((n-(s-1)):n); % Convolution
  t5 = Tb/nb:Tb/nb:Tb;
```

```
  z = trapz(t5,mm);        % Intregation
  rz = round((2*z/Tb));
  Ac = ((Ac1 + Ac2)/2);    % Average of carrier amplitudes
  if(rz > Ac)              % Logical condition
    a = 1;
  else
    a = 0;
  end
  demod = [demod a];
end

disp('Demodulated Binary Information at Receiver: ');
disp(demod);

%Represent demodulated information as digital signal
digit = [];
for n = 1:length(demod);
    if demod(n) == 1;
       sig = ones(1,nb);
    else demod(n) == 0;
        sig = zeros(1,nb);
    end
     digit = [digit sig];
end

t5 = Tb/nb:Tb/nb:nb*length(demod)*(Tb/nb);   % Time period
subplot(3,1,3)
plot(t5,digit,'LineWidth',2.5);grid on;
axis([0 Tb*length(demod) -0.5 1.5]);
xlabel('Time(Sec)');
ylabel('Amplitude(Volts)');
title('ASK Demodulated Signal');
```

Fsk Modulation, demodulation:

```
%FSK Modulation and Demodulation
clc, clear all, close all;

%Digital/Binary input information
x = input('Enter Digital Input Information = ');   % Binary information
as stream of bits (binary signal 0 or 1)
N = length(x);
Tb = 0.0001;   %Data rate = 1MHz i.e., bit period (second)
disp('Binary Input Information at Transmitter: ');
disp(x);

%Represent input information as digital signal
nb = 100;   % Digital signal per bit
digit = [];
for n = 1:1:N
    if x(n) == 1;
       sig = ones(1,nb);
    else x(n) == 0;
        sig = zeros(1,nb);
    end
```

```
    digit = [digit sig];
end

t1 = Tb/nb:Tb/nb:nb*N*(Tb/nb);   % Time period
figure('Name','FSK Modulation and Demodulation','NumberTitle','off');
subplot(3,1,1);
plot(t1,digit,'LineWidth',2.5);
grid on;
axis([0 Tb*N -0.5 1.5]);
xlabel('Time(Sec)');
ylabel('Amplitude(Volts)');
title('Digital Input Signal');

%FSK Modulation
Ac = 10;         % Carrier amplitude for binary input
br = 1/Tb;       % Bit rate
Fc1 = br*10;     % Carrier frequency for binary input '1'
Fc2 = br*5;      % Carrier frequency for binary input '0'
t2 = Tb/nb:Tb/nb:Tb;   % Signal time

mod = [];
for (i = 1:1:N)
    if (x(i) == 1)
        y = Ac*cos(2*pi*Fc1*t2);   % Modulation signal with carrier
signal 1
    else
        y = Ac*cos(2*pi*Fc2*t2);   % Modulation signal with carrier
signal 2
    end
    mod = [mod y];
end

t3 = Tb/nb:Tb/nb:Tb*N;   % Time period
subplot(3,1,2);
plot(t3,mod);
xlabel('Time(Sec)');
ylabel('Amplitude(Volts)');
title('FSK Modulated Signal');

%Transmitted signal x
x = mod;

%Channel model h and w
h = 1;   % Signal fading
w = 0;   % Noise

%Received signal y
y = h.*x + w;   % Convolution

%FSK Demodulation
s = length(t2);
demod = [];
for n = s:s:length(y)
  t4 = Tb/nb:Tb/nb:Tb;          % Time period
  c1 = cos(2*pi*Fc1*t4);        % carrier signal for binary value '1'
  c2 = cos(2*pi*Fc2*t4);        % carrier siignal for binary value '0'
  mc1 = c1.*y((n-(s-1)):n);     % Convolution
  mc2 = c2.*y((n-(s-1)):n);     % Convolution
  t5 = Tb/nb:Tb/nb:Tb;
  z1 = trapz(t5,mc1);           % Intregation
```

```
  z2 = trapz(t5,mc2);          % Intregation
  rz1 = round(2*z1/Tb);
  rz2 = round(2*z2/Tb);
  if(rz1 > Ac/2)               % Logical condition
    a = 1;
  else(rz2 > Ac/2)
    a = 0;
  end
  demod = [demod a];
end
disp('Demodulated Binary Information at Receiver: ');
disp(demod);

%Represent demodulated information as digital signal
digit = [];
for n = 1:length(demod);
    if demod(n) == 1;
       sig = ones(1,nb);
    else demod(n) == 0;
        sig = zeros(1,nb);
    end
     digit = [digit sig];
end

t5 = Tb/nb:Tb/nb:nb*length(demod)*(Tb/nb);   % Time period
subplot(3,1,3)
plot(t5,digit,'LineWidth',2.5);grid on;
axis([0 Tb*length(demod) -0.5 1.5]);
xlabel('Time(Sec)');
ylabel('Amplitude(Volts)');
title('FSK Demodulated Signal');
```

Bpsk Modulation, demodulation:

```
%BPSK Modulation and Demodulation
clc, clear all, close all;

%Digital/Binary input information
x = input('Enter Digital Input Information = ');   % Binary information
as stream of bits (binary signal 0 or 1)
N = length(x);
Tb = 0.0001;   %Data rate = 1MHz i.e., bit period (second)
disp('Binary Input Information at Transmitter: ');
disp(x);

%Represent input information as digital signal
nb = 100;   % Digital signal per bit
digit = [];
for n = 1:1:N
    if x(n) == 1;
       sig = ones(1,nb);
    else x(n) == 0;
        sig = zeros(1,nb);
    end
     digit = [digit sig];
end
```

```
t1=Tb/nb:Tb/nb:nb*N*(Tb/nb);    % Time period
figure('Name','BPSK Modulation and Demodulation','NumberTitle','off');
subplot(3,1,1);
plot(t1,digit,'lineWidth',2.5);
grid on;
axis([0 Tb*N -0.5 1.5]);
xlabel('Time(Sec)');
ylabel('Amplitude(Volts)');
title('Digital Input Signal');

%BPSK Modulation
Ac = 10;      % Carrier amplitude for binary input
br = 1/Tb;    % Bit rate
Fc = br*10;   % Carrier frequency
Pc1 = 0;      % Carrier phase for binary input '1'
Pc2 = pi;     % Carrier phase for binary input '0'
t2 = Tb/nb:Tb/nb:Tb;    % Signal time

mod = [];
for (i = 1:1:N)
    if (x(i)==1)
        y = Ac*cos(2*pi*Fc*t2+Pc1);    % Modulation signal with carrier
signal 1
    else
        y = Ac*cos(2*pi*Fc*t2+Pc2);    % Modulation signal with carrier
signal 2
    end
    mod=[mod y];
end

t3=Tb/nb:Tb/nb:Tb*N;    % Time period
subplot(3,1,2);
plot(t3,mod);
xlabel('Time(Sec)');
ylabel('Amplitude(Volts)');
title('BPSK Modulated Signal');

%Transmitted signal x
x = mod;

%Channel model h and w
h = 1;    % Signal fading
w = 0;    % Noise

%Received signal y
y = h.*x + w;    % Convolution

%BPSK Demodulation
s = length(t2);
demod = [];
for n = s:s:length(y)
  t4 = Tb/nb:Tb/nb:Tb;
  c = cos(2*pi*Fc*t4);       % carrier siignal
  mm = c.*y((n-(s-1)):n);    % Convolution
  t5 = Tb/nb:Tb/nb:Tb;
  z = trapz(t5,mm);          % intregation
  rz = round((2*z/Tb));
  if(rz > Ac/2)              % Logical condition
    a = 1;
```

```
  else
    a = 0;
  end
  demod = [demod a];
end
disp('Demodulated Binary Information at Receiver: ');
disp(demod);

%Represent demodulated information as digital signal
digit = [];
for n = 1:length(demod);
    if demod(n) == 1;
       sig = ones(1,nb);
    else demod(n) == 0;
        sig = zeros(1,nb);
    end
     digit = [digit sig];

end

t5=Tb/nb:Tb/nb:nb*length(demod)*(Tb/nb);    % Time period
subplot(3,1,3)
plot(t5,digit,'LineWidth',2.5);grid on;
axis([0 Tb*length(demod) -0.5 1.5]);
xlabel('Time(Sec)');
ylabel('Amplitude(Volts)');
title('BPSK Demodulated Signal');
```

THANKING YOU GROUP 15.