Project Digital Communications

```
clear all;
close all;
clc;

warning('off','all');
warning;
```

```
All warnings have the state 'off'.
```

Message Signal Generation

```
Noit=1e4;
%Generate 1 and 0s
x = randi([0 1],Noit,1);   % Message signal in binary form

figure(1);
subplot(2,2,1);
stairs(x(1:8),'Linewidth',2);      %Message signal plot
title('Message signal');
ylabel('Amplitude');
```

Carrier Signal Generation

```
Tb = 0.002;      % symbol duration in sec
br = 1/Tb;       % Bit rate

fs = 1000;       % Sampling Frequency

fc0 = 3000;      % Carrier frequency for binary input '0'
fc1 = fc0 + br;  % Carrier frequency for binary input '1'

%time window, the duration between two samples is 1/(100*fs)
t1=0:1/(100*fs):Tb;

%Signal Generation Carrier Waveform
s1 = cos(2*pi*fc0*t1);
s2 = cos(2*pi*fc1*t1);

% Signal Generation for Quadrature Implementation
s3 = sin(2*pi*fc0*t1);
s4 = sin(2*pi*fc1*t1);

% Carrier Signal Plot
subplot(2,2,2);
plot(t1,s1);
```

```
title('Carrier Signal Fc0 3Khz');
xlabel('Time');
ylabel('Amplitude');

subplot(2,2,3);
plot(t1,s2);
title('Carrier Signal Fc1 3.5 Khz');
xlabel('Time');
ylabel('Amplitude');
```

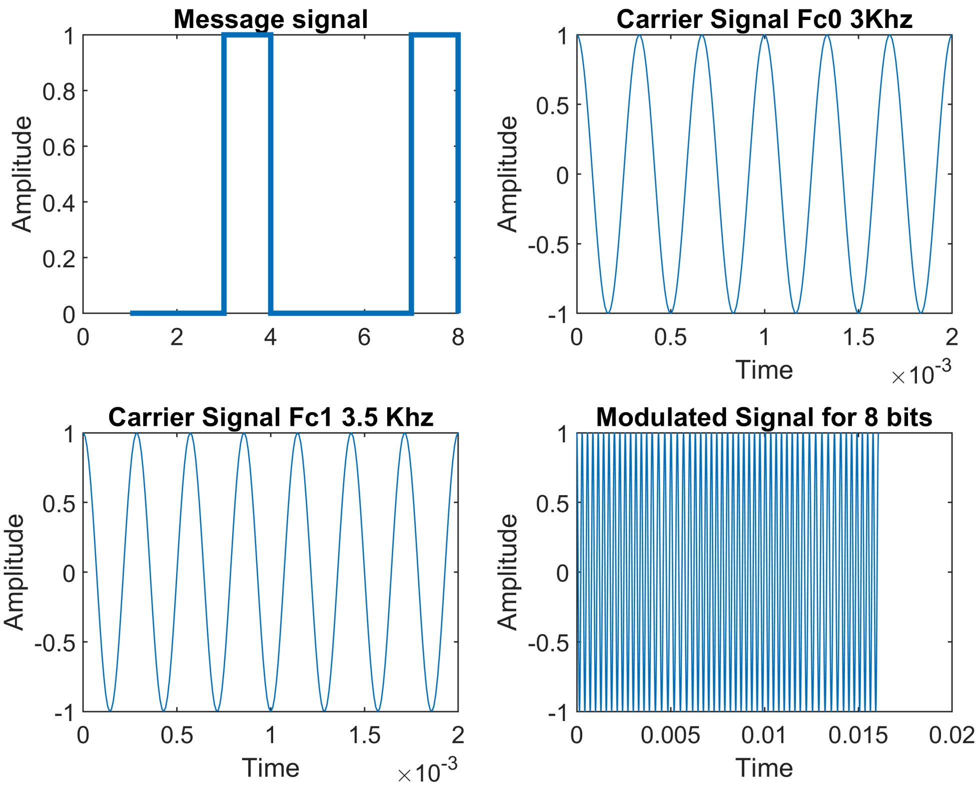
Signal Modulation

```
mod_Signal = [];
for (i = 1:1:Noit)
    if (x(i) == 1)
        y = cos(2*pi*fc0*t1);   % Modulation signal with carrier signal 1
    else
        y = cos(2*pi*fc1*t1);   % Modulation signal with carrier signal 2
    end
    mod_Signal = [mod_Signal y];
end

% Total Signal Duration
t2 = 0:1/(100*fs):Tb*Noit;
```

Modulated Signal Plot

```
subplot(2,2,4);
plot(t2(1:8*length(t1)),mod_Signal(1:8*length(t1)));
title('Modulated Signal for 8 bits');
xlabel('Time');
ylabel('Amplitude');
```



Recieved Signal Generation

```
rx_Signal = [];
```

AWGN Addition

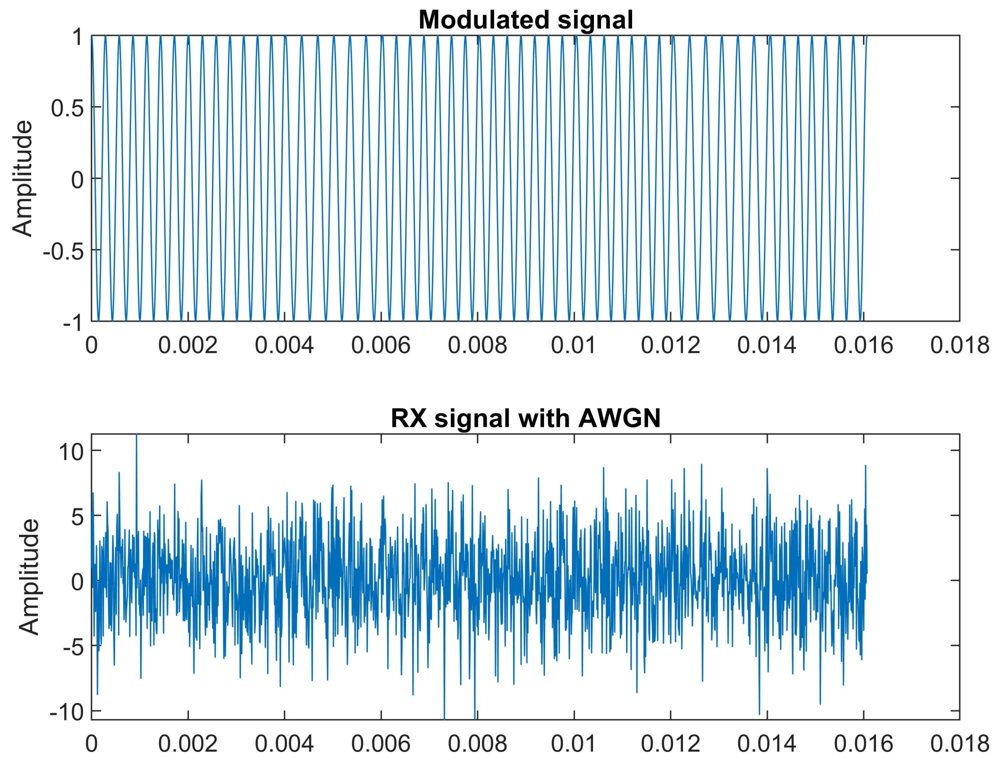
Modulated Signals vs Signal with AWGN (8 Bits)

```
step1 = length(mod_Signal)/11;
snrdB = -10;
for n1 = step1:step1:length(mod_Signal) %define SNR in terms of dB
    rx_Signal = [rx_Signal awgn(mod_Signal(n1-(step1-1):n1),snrdB)];
    snrdB = snrdB + 2;
end



figure(2);
subplot(2,1,1);
plot(t2(1:8*length(t1)),mod_Signal(1:8*length(t1)));      %Modulated Signal Plot
title('Modulated signal');
ylabel('Amplitude');
```

```
subplot(2,1,2);
plot(t2(1:8*length(t1)),rx_Signal(1:8*length(t1)));      %RX Signal Plot with Noise
title('RX signal with AWGN');
ylabel('Amplitude');
```



FSK Demodulation

```
s = length(t1);

step = rx_Signal / s;

demod = [];
demod2 = [];
```

Correlation

```
for n = s:s:length(rx_Signal)
```

```
  cor1 = corrcoef(sqrt(2/Tb).*s1,rx_Signal(n-(s-1):n));
```

```
  cor2 = corrcoef(sqrt(2/Tb).*s2,rx_Signal(n-(s-1):n));
  cor3 = corrcoef(sqrt(2/Tb).*s3,rx_Signal(n-(s-1):n));
  cor4 = corrcoef(sqrt(2/Tb).*s4,rx_Signal(n-(s-1):n));
```

Squaring and IQ EnergySummation

```
  IQ1 = cor1.^2 + cor3.^2;
  IQ2 = cor2.^2 + cor4.^2;

  IQ = IQ1-IQ2;
```

Test Statistics and Decision

```
  if(IQ(2) > 0);
      a = 1;
  else;
     a = 0;
  end

  demod2 = [demod2 a];

end

demod2 = transpose(demod2);

BER_theory=[];
BER_sim=[];

step1 = length(demod2)/11;
i1 = 1;
i2 = step1;
```

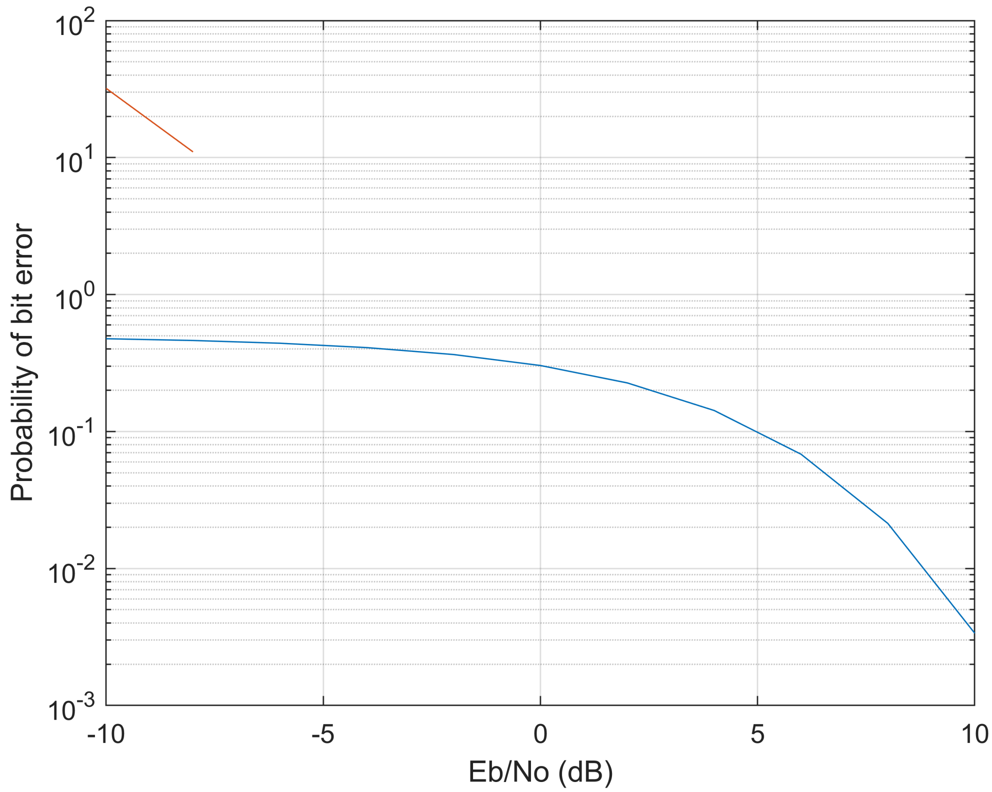
Error Probabilty

```
for (snrdB=-10:2:10) %define SNR in terms of dB
    BER_theory = [BER_theory berawgn(snrdB,'fsk',2,'noncoherent')];
    BER_sim = [BER_sim biterr(x(i1:i2),demod2(i1:i2))];
    i1 = i2 + 1;
    i2 = i2 + step1;
end
```

SNR vs Probabilty of Error Plot

```
figure(3);
semilogy((-10:2:10), BER_theory);
hold on;
```

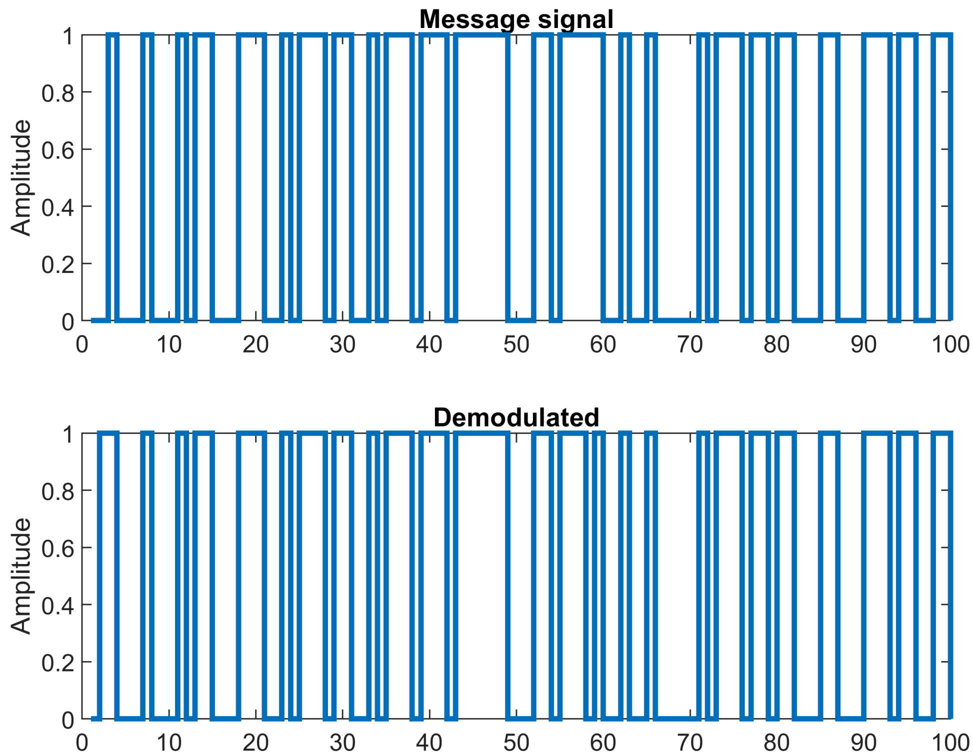
```
semilogy((-10:2:10), BER_sim);
ylabel('Probability of bit error');
xlabel('Eb/No (dB)')
grid on;
```



Recovered Signal Plot

```
figure(4);
subplot(2,1,1);
stairs(x(1:100),'Linewidth',2);      %Message signal plot
title('Message signal');
ylabel('Amplitude');

subplot(2,1,2);
stairs(demod2(1:100),'Linewidth',2);      %Message signal plot
title('Demodulated');
ylabel('Amplitude');
```


Message signal
Amplitude
1
0.8
0.6
0.4
0.2
0
0 10 20 30 40 50 60 70 80 90 100
Demodulated
Amplitude
1
0.8
0.6
0.4
0.2
0
0 10 20 30 40 50 60 70 80 90 100