Experiment No: 7

ERROR PERFORMANCE OF BPSK

AIM:

1.To Generate a string of message bits.

2. Encode using BPSK with energy per bit Eb and represent it using points in a signal-space.

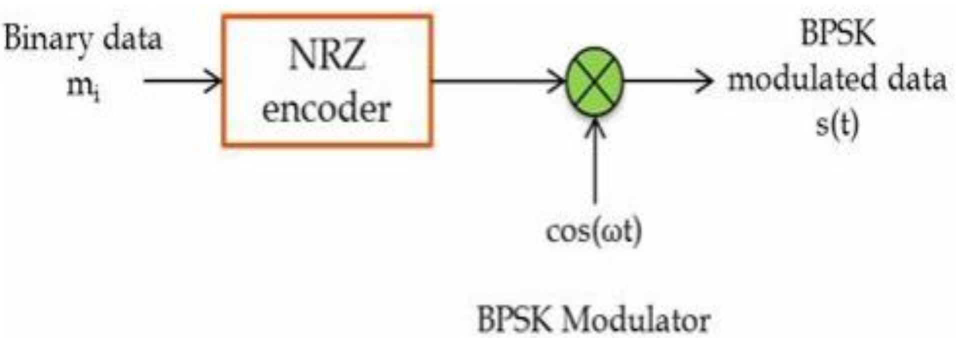
3. Simulate transmission of the BPSK modulated signal via an AWGN channel with variance N0/2.

4. Detect using an ML decoder and plot the probability of error as a function of SNR per bit Eb/N0.

THEORY:

In Binary Phase Shift Keying (BPSK) only one sinusoid is taken as basis function modulation. Modulation is achieved by varying the phase of the basis function depending on the message bits.

A BPSK modulator can be implemented by coding the message bits using NRZ coding (1 represented by positive voltage and 0 represented by negative voltage) and multiplying the output by a reference oscillator running at carrier frequency ω.



BPSK Modulator

In the demodulator the received signal is multiplied by a reference frequency generator (assuming the PLL/Costas loop is present). The multiplied output is integrated over one bit period using an integrator. A threshold detector makes a decision on each integrated bit based on a threshold. Since an NRZ signaling format is used with equal amplitudes in positive and negative direction, the threshold for this casewould be ’0′.

MATLAB CODE:

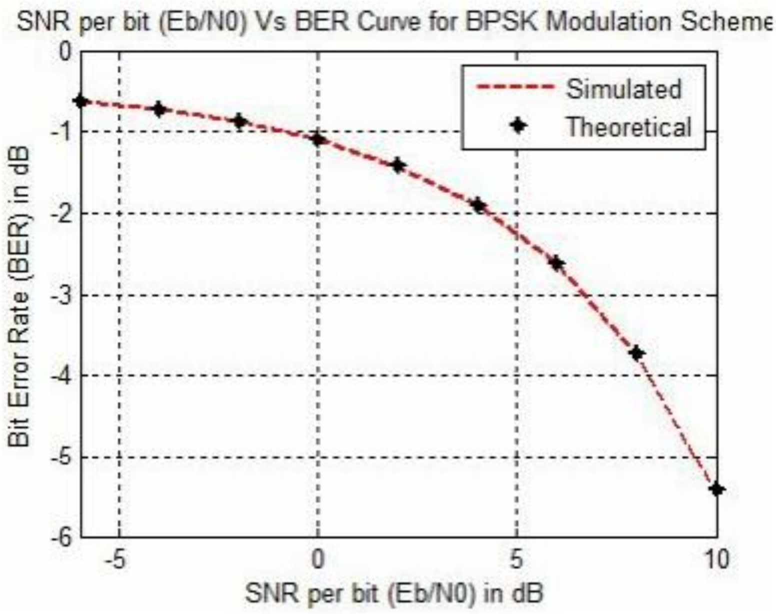
```
clc;
clear all;
d=randi(1,1000); % 1000 data bits
L=length(d);
t=0:(2*pi)/99:2*pi;
c1=sin(t);
s=c1*c1'; % energy of the carrier1
s1=c1/sqrt(s); % normalizing the carrier
c2=cos(t);
s=c2*c2'; % energy of the carrier2
s2=c2/sqrt(s); % normalizing the carrier
%BPSK modulation
BPSK=[];
for i=1:L
    if d(i)==1
        a=s2;
    else
        a=-1.*s2;
    end
BPSK=[BPSK,a];
end

%BPSK demodulation with AWGN
N=length(BPSK);
snr=[0:10];
ber=zeros(0,11);
thber=zeros(0,11);
for i=1:length(snr)
    N0= 1/(10^(snr(i)/10));
    stddev=sqrt(N0/2);
    thber(i)=qfunc(sqrt(2/N0)); % theoretical BER calculation
```

```
    GN=stddev*randn(1,N); % noise generation
    Rcv=BPSK+GN; % Adding noise to the BPSK signal
    Rcv1=reshape(Rcv,length(c2),L);
    % demodulation
    dX=s2*Rcv1;
    dY=s1*Rcv1;
    r=zeros(1,L);
for k=1:L
    if dX(k)>0
        r(k)=1;
    end
end
%error calculation
E=0;
for j=1:L
    if (r(j)~=d(j))
        E=E+1;
    end
end
    ber(i)=E/L;
end
figure(1)
semilogy(snr,ber,'*',snr,thber);
title('BER Vs SNR plot');
xlabel('SNR in dB');
ylabel('BER');
legend('Practical BER','theoetical BER')
figure(2)
plot(dX,dY,'*');
grid on;
title('CONSTELLATION OF BPSK');
xlabel('Normalised basis function1');
```

```
ylabel('Normalised basis function2');
xlim([-3,3]);
ylim([-3,3]);
```

OUTPUT



Result

Studied and verified error performance of BPSK