School of Engineering and Applied Science (SEAS)
Ahmedabad University

BTech(ICT) Semester V: Wireless Communication (ECE311)

Laboratory Assignment-1

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1. Solution Problem-1

   (a) Matlab Script:

```
close all;
clear all;
clc;
SNR_dB = 0:15;                    %Generating values of SNR in dB
SNR_lin = 10.^(SNR_dB./10);       %SNR value in linear scale for computation

%Simulation code for BPSK
N = 150000;                       %No. of bits to transmit

%BPSK Modulated signal for transmission
m = rand(1,N)>0.5;                %Generating bit 0 and 1 with equal probability
%formating with BPSK modulation signals i.e. 0 => -1 and 1 => 1
s = 2*m-1;
%generating additive white gaussian noise to add in channel
n = 1/sqrt(2)*[randn(1,N) + 1i*randn(1,N)];
Error = zeros(length(SNR_dB)); %initializing the Error array with zeros

for i=1:length(SNR_dB)          %for loop for error count on each SNR_dB value
    % Signal + Noise addition
    z = s + (10^(-SNR_dB(i)./20)).*n;  %h=1 for wired channel
    epHat = real(z)>0;                 %decoding at receiver side
    Error(i) = sum(m~=epHat);          %count the errors
end

bpsk_simBer = Error/N;

% Simulation code of BER calculation for QPSK
yy = [];

%%pi/4 shifted so 45 ,135,315 ,225 degree
for j=1:2:length(m)
    if(m(j)==0 && m(j+1)==0)
        y = cosd(225) + 1j*sind(225);
    elseif(m(j)==0 && m(j+1)==1)
        y = cosd(135) + 1j*sind(135);
    elseif(m(j)==1 && m(j+1)==0)
        y = cosd(315) + 1j*sind(315);
    elseif(m(j)==1 && m(j+1)==1)
        y = cosd(45) + 1j*sind(45);
    end

    yy = [yy y];
end

qpsk_simBer = zeros(1,length(SNR_lin));

%AWGN noise adding
for ii=1:length(SNR_lin)
    awgnNoise = (1/sqrt(2))*[randn(1,length(yy)) + 1j*randn(1,length(yy))];
    r = yy + (10^(-SNR_dB(ii)./20)).*awgnNoise;
```

```
51
52      %Error Dtection in I-Q part
53      I_part = (real(r)>0);
54      Q_part = (imag(r)>0);
55      m_cap = [];
56      for k=1:length(r)
57          m_cap = [m_cap I_part(k) Q_part(k)];
58      end
59
60      %error counting
61      qBER = sum(m ~= m_cap)/N;
62      qpsk_simBer(ii) = qBER;
63  end
64
65  close all
66  figure
67  plt1 = semilogy(SNR_dB, bpsk_simBer,'r*-','linewidth',4);
68  %plotting BER of Simulated BPSK
69  hold on
70  plt2 = semilogy(SNR_dB,qpsk_simBer,'b+-','linewidth',4); %
71  plotting BER of Simulated
72  axis([0 15 10^-5 0.5]);
73  grid on
74  legend([plt1(1),plt2(1)],'BPSK SIMULATION','QPSK SIMULATION');
75  xlabel('Eb/No (dB)');
76  ylabel('BER');
77  title('Bit Error Rate Simulation ');
78
79
```

(b) Simulation Output:

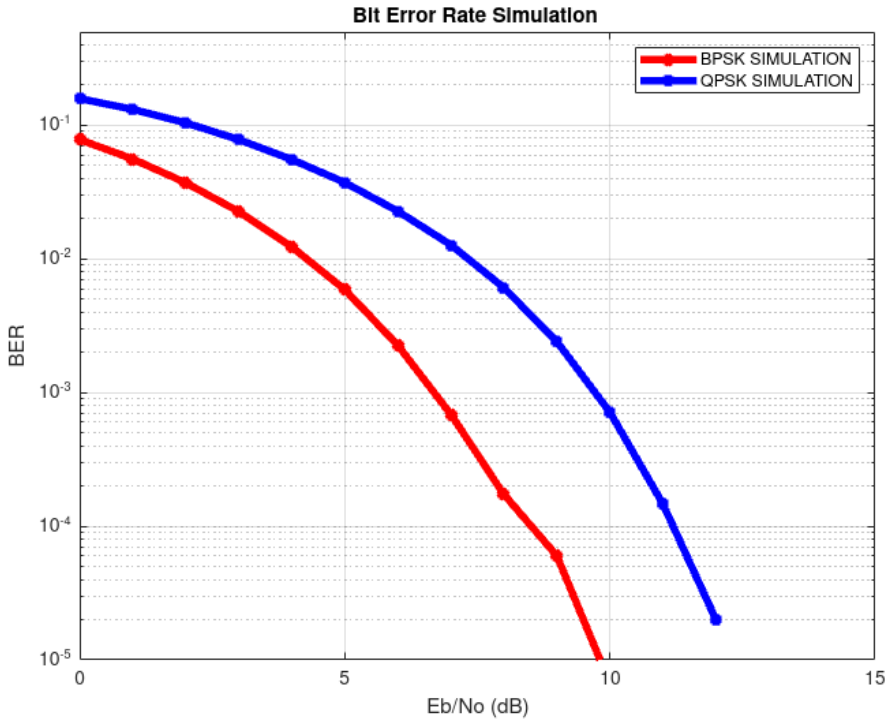

Fig : Comparison Between BPSK and QPSK over AWGN channel (BER vs SNR)

(c) Inference:

1) Since the bit error rate for BPSK and QPSK is similar thus it by using QPSK we can transmit twice amount of data on the same channel with the same bandwidth. If we extend the modulation using 4 QPSK, 8QPSK then we can achieve higher data rate on little increase in Bit error rate as compare to BPSK.

2) On the other hand, The BER vs SNR plot for various modulation techniques shows that for higher order modulation schemes the BER increases with increasing SNR. On the other hand, the lower order modulation schemes (BPSK and QPSK) experience less BER at receiver thus lower order modulations improve the system performance in terms of BER and SNR

3) The key inferences that BER is the key parameter for indicating the system performance of any data link. The BER vs SNR plot for various modulation techniques shows that for higher order modulation schemes the BER increases with increasing SNR.