School of Engineering and Applied Science (SEAS)
Ahmedabad University

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

Laboratory Assignment-2

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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
N = 200000;                                  %No. of bits to transmit

% Generating BPSK Modulated signal for transmission
m = rand(1,N)>0.5; %                         generating bit 0 and 1 with equal probability

% Simulation code of BER calculation for QPSK
%pi/4 shifted QPSK
yy = [];
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

%for AWGN channel
QPSK_simBer = zeros(1,length(SNR_lin));

for ii=1:length(SNR_lin)
    awgn_noise = (1/sqrt(2))*[randn(1,length(yy)) + 1j*randn(1,length(yy))];
    r = yy + (10^(-SNR_dB(ii)./20)).*awgn_noise;
    %detection
    I_part = (real(r)>0);
    Q_part = (imag(r)>0);
    m_cap = [];
    for k=1:length(r)
        m_cap = [m_cap I_part(k) Q_part(k)];
    end
    qBER = sum(m ~= m_cap)/N;
    QPSK_simBer(ii) = qBER;
end

%for Rayleigh channel
QPSK_simBer_Ray = zeros(1,length(SNR_lin));

for ii=1:length(SNR_lin)
```

```
    awgn_noise = (1/sqrt(2))*[randn(1,length(yy)) + 1j*randn(1,length(yy))];
    h = (1/sqrt(2))*[randn(1,length(yy)) + 1j*randn(1,length(yy))]; % h is rayleigh Channel
    rr = h.*yy + (10^(-SNR_dB(ii)./20)).*awgn_noise; % y = hx+n
    %equalization
    r=rr./h;
    %detection
    I_part = (real(r)>0);
    Q_part = (imag(r)>0);
    m_cap = [];
    for k=1:length(r)
        m_cap = [m_cap I_part(k) Q_part(k)];
    end
    qBER = sum(m ~= m_cap)/N;
    QPSK_simBer_Ray(ii) = qBER;
end

% QPSK theoryBer ove AWGN erfc(sqrt(SNR_lin)) - (1/4)*((erfc(sqrt(SNR_lin))).^2);
% QPSK theoryBer over Rayleigh 0.5.*(1-sqrt(SNR_lin./(SNR_lin+1)));

close all
figure
plt1 = semilogy(SNR_dB,QPSK_simBer_Ray ,'mx-','linewidth',3); %plotting BER of Simulated over Rayleigh
hold on
plt2 = semilogy(SNR_dB,QPSK_simBer,'b+-','linewidth',3); %plotting BER of Simulated over AWGN

axis([0 15 10^-5 0.5]);
grid on
legend([plt1(1),plt2(1)],'QPSK Simulation over Rayleigh','QPSK Simulation over AWGN');
xlabel('Eb/No (dB)');
ylabel('BER');
title('Bit Error Rate  for  QPSK modulation over Rayleigh Channel' );

```

(b) Simulation Output:

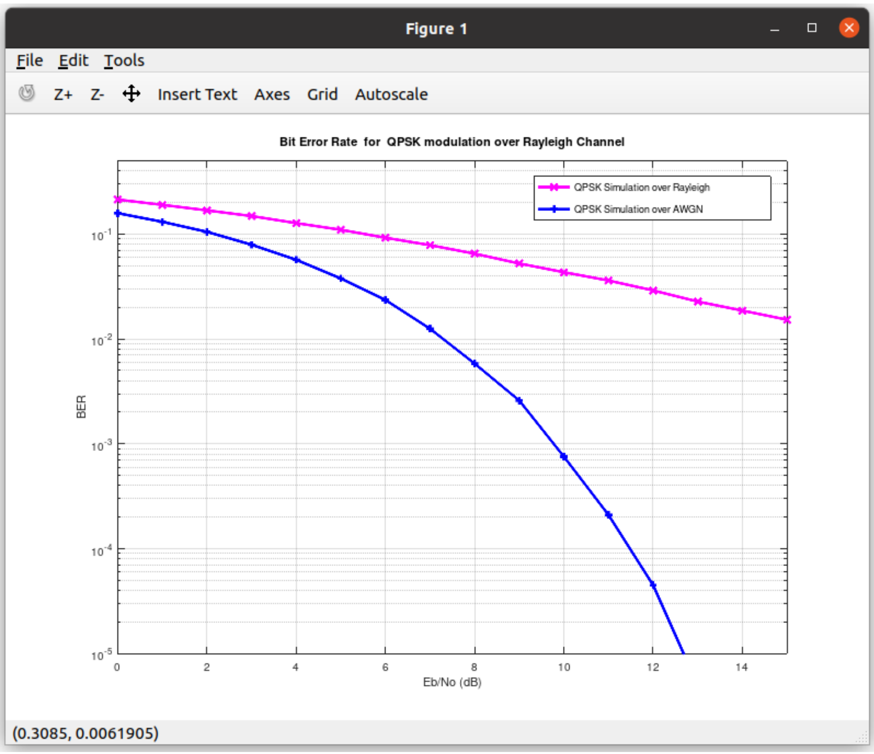

Fig : Comparison Between QPSK over Rayleigh channel (BER vs SNR)

(c) Inference:

1) Rayleigh fading channel which is a more realistic representation of a wireless communication channel.In fact, for Rayleigh fading, the statistics has a steady slope in its BER curve. With increasing the Signal power, the Bit error in received signal reduces steadily . In Simulation over AWGN in QPSK , BER rate is much higher for Small value of SNR .other hand ,In simulation over Rayleigh channel SNR value is very large for same BER rate .It was observed that the BER performance of AWGN channel improves rapidly and offers a better performance than Rayleigh fading channel also low bit error rate (BER) and low SNR.. This is because Rayleigh fading channel is characterized by multipath signal and it is computed by average BER .The average BER is dominated by poor BER of individual path and variations in instantaneous BER.So that It offers a poorer BER performance.

2) The receiver is receiving data with high data rate, so that necessary for reducing errors and delimit from BER value to give the best performance of the system with less noise. Therefore, necessary to choose the better channel with better BER performance when building the transceiver in order to produce less noise and high performance.

3)The comparison of the theoretical and simulated Bit error rate of QPSK signal in a Rayleigh fading channel over an increasing signal power shows that the result are closely related especially at a low signal power but the simulated result tends to deviate as the signal power increases. The deviation can be assumed as a result of the randomness of large numbers of iterated value employed in the program, since the model is taking into account infinite arrival paths .