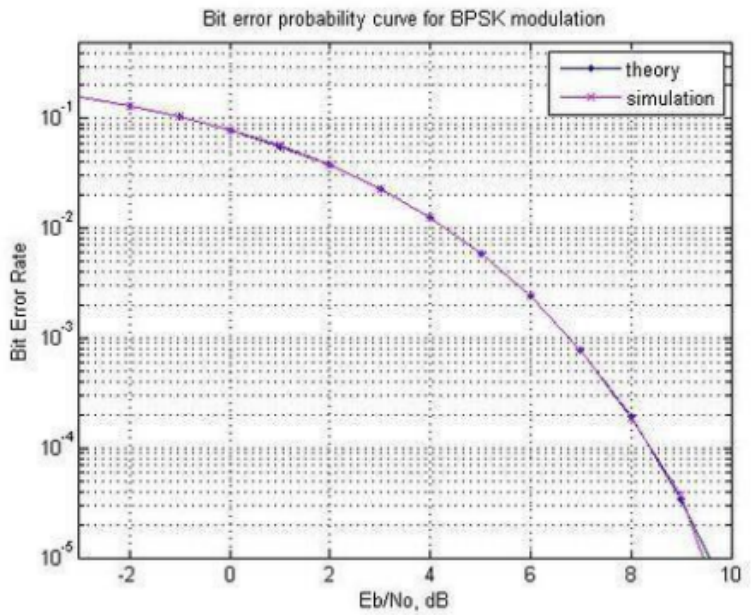
EXP-4 Part 1
Bit error probability curve for BPSK Modulation

```
clear
N = 10^6; % number of bits or symbols
rand('state',100); % initializing the rand() function
randn('state',200); % initializing the randn() function
% Transmitter
ip = rand(1,N)>0.5; % generating 0,1 with equal probability
s = 2*ip-1; % BPSK modulation 0 -> -1; 1 -> 1
n = 1/sqrt(2)*(randn(1,N) + 1i*randn(1,N)); % white gaussian noise, 0dB variance
Eb_N0_dB = [-3:10]; % multiple Eb/N0 values
Eb_N0_dB = -3:12;
for ii=1:length(Eb_N0_dB)
% Noise addition
y = s + 10^(-Eb_N0_dB(ii)/20)*n; % additive white gaussian noise
% receiver - hard decision decoding
ipHat = real(y)>0;
% counting the errors
nErr(ii) = size(find(ip- ipHat),2);
end
simBer = nErr/N; % simulated ber
theoryBer = 0.5*erfc(sqrt(10.^(Eb_N0_dB/10))); % theoretical ber
% plot
close all
figure
semilogy(Eb_N0_dB,theoryBer,'b.-');
hold on
semilogy(Eb_N0_dB,simBer,'mx-');
axis([-3 10 10^-5 0.5])
grid on
legend('theory', 'simulation');
xlabel('Eb/No, dB');
ylabel('Bit Error Rate');
title('Bit error probability curve for BPSK modulation');
```

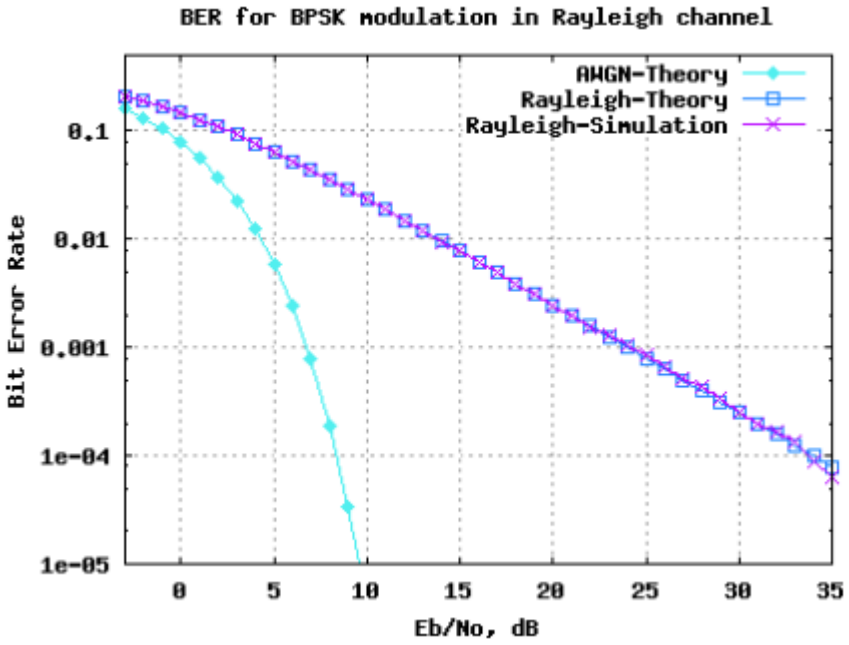
OUTPUT:



EXP-4 Part 2
BER for BPSK modulation in Rayleigh Channel

```
clear
N = 10^6 % number of bits or symbols
% Transmitter
ip = rand(1,N)>0.5; % generating 0,1 with equal probability
s = 2*ip-1; % BPSK modulation 0 -> -1; 1 -> 0
Eb_N0_dB = [-3:35]; % multiple Eb/N0 values
for ii = 1:length(Eb_N0_dB)
   n = 1/sqrt(2)*[randn(1,N) + j*randn(1,N)]; % white gaussian noise, 0dB variance
   h = 1/sqrt(2)*[randn(1,N) + j*randn(1,N)]; % Rayleigh channel
   % Channel and noise Noise addition
   y = h.*s + 10^(-Eb_N0_dB(ii)/20)*n;
   % equalization
   yHat = y./h;
   % receiver - hard decision decoding
   ipHat = real(yHat)>0;
   % counting the errors
   nErr(ii) = size(find([ip- ipHat]),2);
end
simBer = nErr/N; % simulated ber
theoryBerAWGN = 0.5*erfc(sqrt(10.^(Eb_N0_dB/10))); % theoretical ber
EbN0Lin = 10.^(Eb_N0_dB/10);
theoryBer = 0.5.*(1-sqrt(EbN0Lin./(EbN0Lin+1)));
% plot
close all
figure
semilogy(Eb_N0_dB,theoryBerAWGN,'cd-','LineWidth',2);
hold on
semilogy(Eb_N0_dB,theoryBer,'bp-','LineWidth',2);
semilogy(Eb_N0_dB,simBer,'mx-','LineWidth',2);
axis([-3 35 10^-5 0.5])
grid on
legend('AWGN-Theory','Rayleigh-Theory', 'Rayleigh-Simulation');
xlabel('Eb/No, dB');
ylabel('Bit Error Rate');
title('BER for BPSK modulation in Rayleigh channel');
```

OUTPUT:


BER for BPSK modulation in Rayleigh channel
AWGN-Theory
Rayleigh-Theory
Rayleigh-Simulation
Bit Error Rate
0.1
0.01
0.001
1e-04
1e-05
0
5
10
15
20
25
30
35
Eb/No, dB