EEE 435:

Homework 6 **Due 28th Oct**

Simulate **the BER of QPSK** for two branch diversity receiver under independent Rayleigh fading.

Apply

i) Equal gain combining
ii) Selection combining
iii) Maximal ratio combining

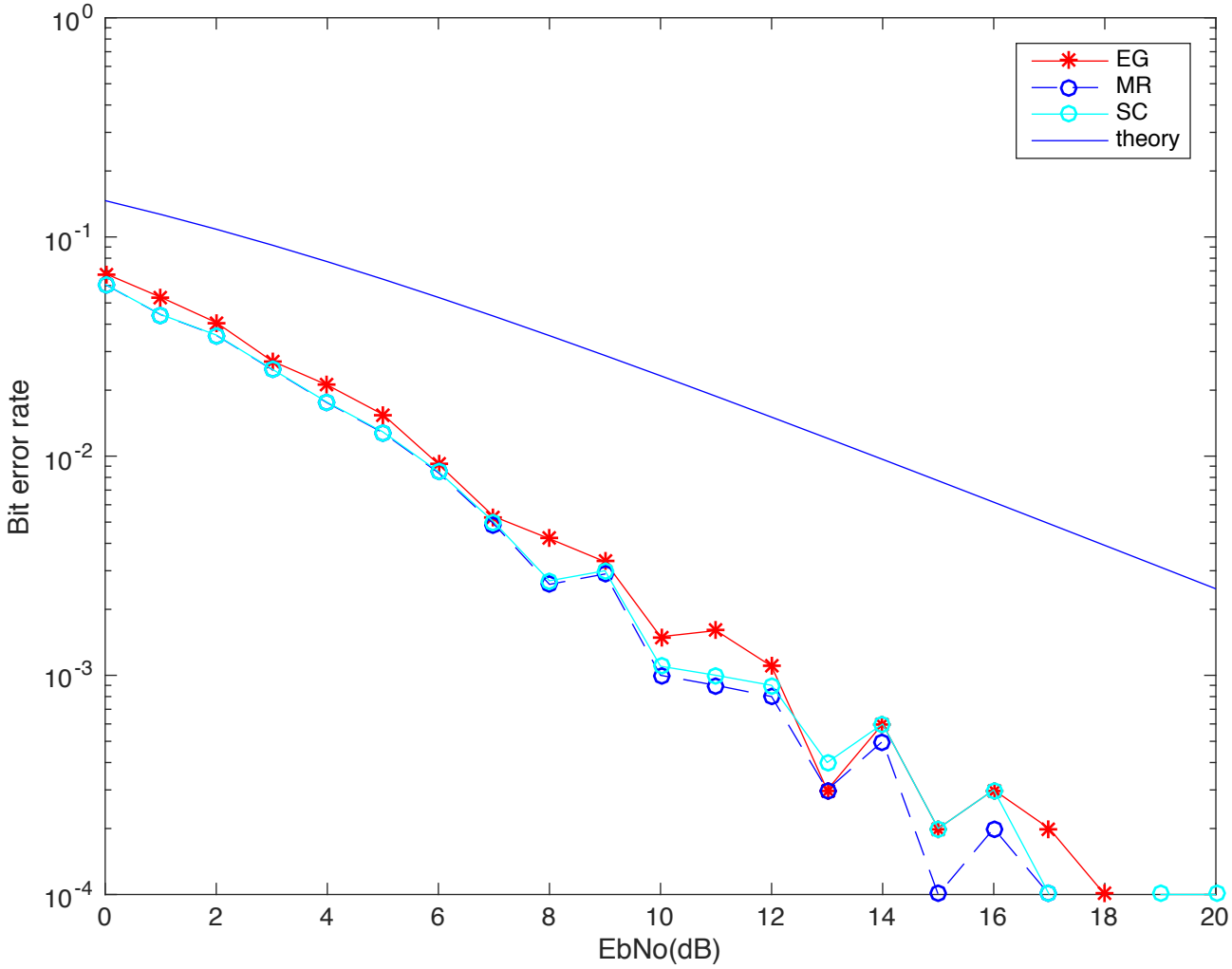
Provide the MATLAB code and a figure with three BER curves.

Homework 6.

i) Equal gain combining

ii) Maximal ratio combining

iii) Selection combining



Code Part

```
x = 1; % signal to transmit Eb = 1
TRIAL = 10000; %number of simulation runs per EbN0 %50000
for EbN0 = 0:1:20 %dB
   linear_EbN0 = 10^(EbN0/10);
   nvar = 1/(linear_EbN0); %calculation of N0, remember Eb = 1
   error1 = 0;  %set error counter to 0
   error2 = 0;  %set error counter to 0
   error3 = 0;  %set error counter to 0
     for trial = 1:TRIAL % monte carlo trials.. count the errors
        n1 = sqrt(nvar/2)*randn; %noise for the first
        n2 = sqrt(nvar/2)*randn; %noise for the first
        h1 = sqrt(0.5)*abs(randn + j*randn);  %rayleigh amplitude 1
        h2 = sqrt(0.5)*abs(randn + j*randn);  %rayleigh amplitude 1

        %Equal Gain combining
        y1 = x*h1+n1;    % Signal 1
        y2 = x*h2+n2;    % Signal 2
        y_equal = 0.5*(y1+y2);

        %Maximal Ratio combining
        a1 = (abs(h1))^2;
        a2 = (abs(h2))^2;
        y_maximal = x*(a1*h1+a2*h2)+a1*n1+a2*n2;

        %Selection combining
        P1 = chi2rnd(4);
        P2 = chi2rnd(4);
        as1 = P1*(abs(h1))^2;
        as2 = P2*(abs(h2))^2;
        if as1 >= as2
            y_selection = x*(as1*h1)+as1*n1;
        end
        if as1 < as2
            y_selection = x*(as2*h2)+as2*n2;
        end

        if y_equal < 0 %define decision region as 0
           error1 = error1 + 1;
        end
        if y_maximal < 0
           error2 = error2 + 1;
        end
        if y_selection < 0
           error3 = error2 + 1;
        end
     end
   BER1(EbN0+1) = error1/(TRIAL);
   BER2(EbN0+1) = error2/(TRIAL);
   BER3(EbN0+1) = error3/(TRIAL);
end

% plot simulations
figure
EbNo=0:1:20; %changed from 10
mu = 10.^(EbNo./10);
ber_theory = (1/2)*(1 - sqrt(mu ./ (mu + 1)));
semilogy(EbNo,BER1,'r*-',EbNo,BER2,'b--o',EbNo,BER3,'c-o',EbNo,ber_theory,'b');    % plot EG BER vs EbNo
legend('EG','MR','SC','theory');
xlabel('EbNo(dB)')  %Label for x-axis
ylabel('Bit error rate') %Label for y-axis
```