% Understand each line,

%briefly explain each line

% then write a summary of the whole %code

clc;  
clear all;  
close all;  
%..............................................................  
% Initiation  
%..............................................................  
no\_of\_data\_bits = 64;%Number of bits per channel extended to 128  
M =4; %Number of subcarrier channel  
n=256;%Total number of bits to be transmitted at the transmitter  
block\_size = 16; %Size of each OFDM block to add cyclic prefix  
cp\_len = floor(0.1 \* block\_size); %Length of the cyclic prefix  
%............................................................  
% Transmitter  
  
data = randsrc(1, no\_of\_data\_bits, 0:M-1);  
figure(1)

stem(data);

grid on;

xlabel('Data Points');

ylabel('Amplitude');  
title('Original Data ');

% Perform QPSK modulation on the input source data  
qpsk\_modulated\_data = pskmod(data, M);  
figure(2)

stem(qpsk\_modulated\_data);

title('QPSK Modulation ')  
%............................................................  
  
S2P = reshape(qpsk\_modulated\_data, no\_of\_data\_bits/M,M)  
Sub\_carrier1 = S2P(:,1)  
Sub\_carrier2 = S2P(:,2)  
Sub\_carrier3 = S2P(:,3)  
Sub\_carrier4 = S2P(:,4)  
figure(3)

subplot(4,1,1)

stem(Sub\_carrier1)

title('Subcarrier1')

grid on;  
subplot(4,1,2)

stem(Sub\_carrier2)

title('Subcarrier2')

grid on;  
subplot(4,1,3)

stem(Sub\_carrier3)

title('Subcarrier3')

grid on;  
subplot(4,1,4)

stem(Sub\_carrier4)

title('Subcarrier4')

grid on;  
%..................................................................  
%..................................................................  
% IFFT OF FOUR SUB\_CARRIERS  
%.................................................................  
%..............................................................  
number\_of\_subcarriers=4;  
cp\_start=block\_size-cp\_len;  
ifft\_Subcarrier1 = ifft(Sub\_carrier1)  
ifft\_Subcarrier2 = ifft(Sub\_carrier2)  
ifft\_Subcarrier3 = ifft(Sub\_carrier3)  
ifft\_Subcarrier4 = ifft(Sub\_carrier4)  
figure(4)

subplot(4,1,1)

plot(real(ifft\_Subcarrier1),'r')

title('IFFT on all the sub-carriers')

subplot(4,1,2)

plot(real(ifft\_Subcarrier2),'c')

subplot(4,1,3)

plot(real(ifft\_Subcarrier3),'b')

subplot(4,1,4)

plot(real(ifft\_Subcarrier4),'g')  
%...........................................................  
%...........................................................  
% ADD-CYCLIC PREFIX %..........................................................  
%............................................................  
for i=1:number\_of\_subcarriers,  
ifft\_Subcarrier(:,i) = ifft((S2P(:,i)),16);

for j=1:cp\_len,

cyclic\_prefix(j,i) = ifft\_Subcarrier(j+cp\_start,i)

end

Append\_prefix(:,i) = vertcat( cyclic\_prefix(:,i), ifft\_Subcarrier(:,i))

% Appends prefix to each subcarriers  
end

A1=Append\_prefix(:,1);  
A2=Append\_prefix(:,2);  
A3=Append\_prefix(:,3);  
A4=Append\_prefix(:,4);  
figure(5)

subplot(4,1,1)

plot(real(A1),'r')

title('Cyclic prefix added to all the sub-carriers')  
subplot(4,1,2)

plot(real(A2),'c')  
subplot(4,1,3)

plot(real(A3),'b')  
subplot(4,1,4)

plot(real(A4),'g')  
figure(11)

plot((real(A1)),'r')

title('Orthogonality')

hold on

plot((real(A2)),'c')

hold on ,  
plot((real(A3)),'b')

hold on ,plot((real(A4)),'g')

hold on ,grid on

%Convert to serial stream for transmission  
[rows\_Append\_prefix cols\_Append\_prefix]=size(Append\_prefix)  
len\_ofdm\_data = rows\_Append\_prefix\*cols\_Append\_prefix

% OFDM signal to be transmitted  
ofdm\_signal = reshape(Append\_prefix, 1, len\_ofdm\_data);  
figure(6)

plot(real(ofdm\_signal)); xlabel('Time'); ylabel('Amplitude');  
title('OFDM Signal');grid on;  
%...............................................................

**%Passing time domain data through channel and AWGN**

%.............................................................  
channel = randn(1,2) + sqrt(-1)\*randn(1,2);  
after\_channel = filter(channel, 1, ofdm\_signal);  
awgn\_noise = awgn(zeros(1,length(after\_channel)),0);  
recvd\_signal = awgn\_noise+after\_channel;   
figure(7)

plot(real(recvd\_signal))

xlabel('Time'); ylabel('Amplitude');  
title('OFDM Signal after passing through channel');grid on;  
%...........................................................

**%OFDM receiver part**

%..........................................................  
recvd\_signal\_paralleled = reshape(recvd\_signal,rows\_Append\_prefix, cols\_Append\_prefix);  
%........................................................  
%........................................................  
% Remove cyclic Prefix  
%.......................................................  
%......................................................  
recvd\_signal\_paralleled(1:cp\_len,:)=[];  
R1=recvd\_signal\_paralleled(:,1);  
R2=recvd\_signal\_paralleled(:,2);  
R3=recvd\_signal\_paralleled(:,3);  
R4=recvd\_signal\_paralleled(:,4);  
figure(8),plot((imag(R1)),'r'),subplot(4,1,1),plot(real(R1),'r'),  
title('Cyclic prefix removed from the four sub-carriers')  
subplot(4,1,2),plot(real(R2),'c')  
subplot(4,1,3),plot(real(R3),'b')  
subplot(4,1,4),plot(real(R4),'g')  
%...................................................  
%...................................................  
% FFT Of recievied signal  
for i=1:number\_of\_subcarriers,  
% FFT  
fft\_data(:,i) = fft(recvd\_signal\_paralleled(:,i),16);  
end  
F1=fft\_data(:,1);  
F2=fft\_data(:,2);  
F3=fft\_data(:,3);  
F4=fft\_data(:,4);  
figure(9)

subplot(4,1,1)

plot(real(F1),'r')

title('FFT of all the four sub-carriers')  
subplot(4,1,2)

plot(real(F2),'c')  
subplot(4,1,3)

plot(real(F3),'b')  
subplot(4,1,4)

plot(real(F4),'g')  
%................................  
%..............................  
% Signal Reconstructed  
%..................................  
%..................................  
% Conversion to serial and demodulationa  
recvd\_serial\_data = reshape(fft\_data, 1,(16\*4));  
qpsk\_demodulated\_data = pskdemod(recvd\_serial\_data,4);  
figure(10)  
stem(data)  
hold on  
stem(qpsk\_demodulated\_data,'rx');  
grid on;xlabel('Data Points');ylabel('Amplitude');  
title('Recieved Signal with error')