Samaa Hany Seif Elyazal %% %%%%%%%%%%%%%%%

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Wireless Communication, Intake 42 %%%%%% %%%%%%%%%%%

LTE, LAB 1 %%%%%%%%%%%%%%%%%

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Initializtion

```
clc
clear all

% System Paramters
EbNo_range=0:20;
N_OFDMsymbols=1e4;
ModulationOrder=64;
N_Subcarriers=512;
N_DataSubcarriers=300;     % 300 Subcarriers corresponding to 5MHz BW
SamplingRate=7.68e6;
CP_length=4.7e-6;          %normal CP=4.7us, extended=16.67us
N_ofCPbits = int64(SamplingRate*CP_length);


%Derived Paramters
N_Bits=N_DataSubcarriers*log2(ModulationOrder);
N_Bits=N_Bits*N_OFDMsymbols;
```

Transmitter Side

Bit Stream Generation

```
T_Bits = randi([0 1],N_Bits,1);
```

```
% Symbol Mapper
Symbols=qammod(T_Bits,ModulationOrder,'InputType','Bit');

% Series to Parallel
SymbolsParallel=reshape(Symbols,N_DataSubcarriers,N_OFDMsymbols);

% Guard add
GuardSide=(N_Subcarriers-N_DataSubcarriers)/2;
InputIFFT=[zeros(GuardSide,N_OFDMsymbols);SymbolsParallel;zeros(GuardSide,N_OFDMsy

% IFFT
OutputIFFT=ifft(InputIFFT);

% CP Insertion
[NoOfRows NoOfCols] = size(OutputIFFT);
OFDMsymbols=[OutputIFFT((NoOfRows-N_ofCPbits+1):NoOfRows,:);
 OutputIFFT];

% Parallel to Series
txSig=reshape(OFDMsymbols,548*1e4,1);
[r c] = size(txSig);
```

AWGN

```
Noise = randn(r,1)+1i*randn(r,1);

BER = [];
for EbNo=EbNo_range

    Eb = ((ModulationOrder-1)*2^2)/
(6*log2(ModulationOrder)*N_Subcarriers);
    No = Eb/(10^(EbNo/10));
```

Receiver Side

```
    Rceived_Sig=txSig+(sqrt(No/2)*Noise);

    R_Sig_Parallel = reshape(Rceived_Sig,N_Subcarriers
+N_ofCPbits,N_OFDMsymbols);

    % CP Removement
    CP_removement=R_Sig_Parallel(N_ofCPbits+1:NoOfRows+N_ofCPbits,:);

    % FFT
    FFT_Output=fft(CP_removement);

    % Guard removement
    zeros_removement=FFT_Output(GuardSide+1:NoOfRows-GuardSide,:);
    R_Symbols =
 reshape(zeros_removement,N_DataSubcarriers*N_OFDMsymbols,1);

    % Symbol Demapper
    R_Bits = qamdemod(R_Symbols,ModulationOrder,'OutputType','Bit');
```

```
    % Bit Error Rate
    [ber berRatio] = biterr(R_Bits,T_Bits);

    BER = [BER berRatio];

end

semilogy(EbNo_range,BER)
title('Bit Error Rate of OFDM')
xlabel('SNR')
ylabel('BER')
```

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