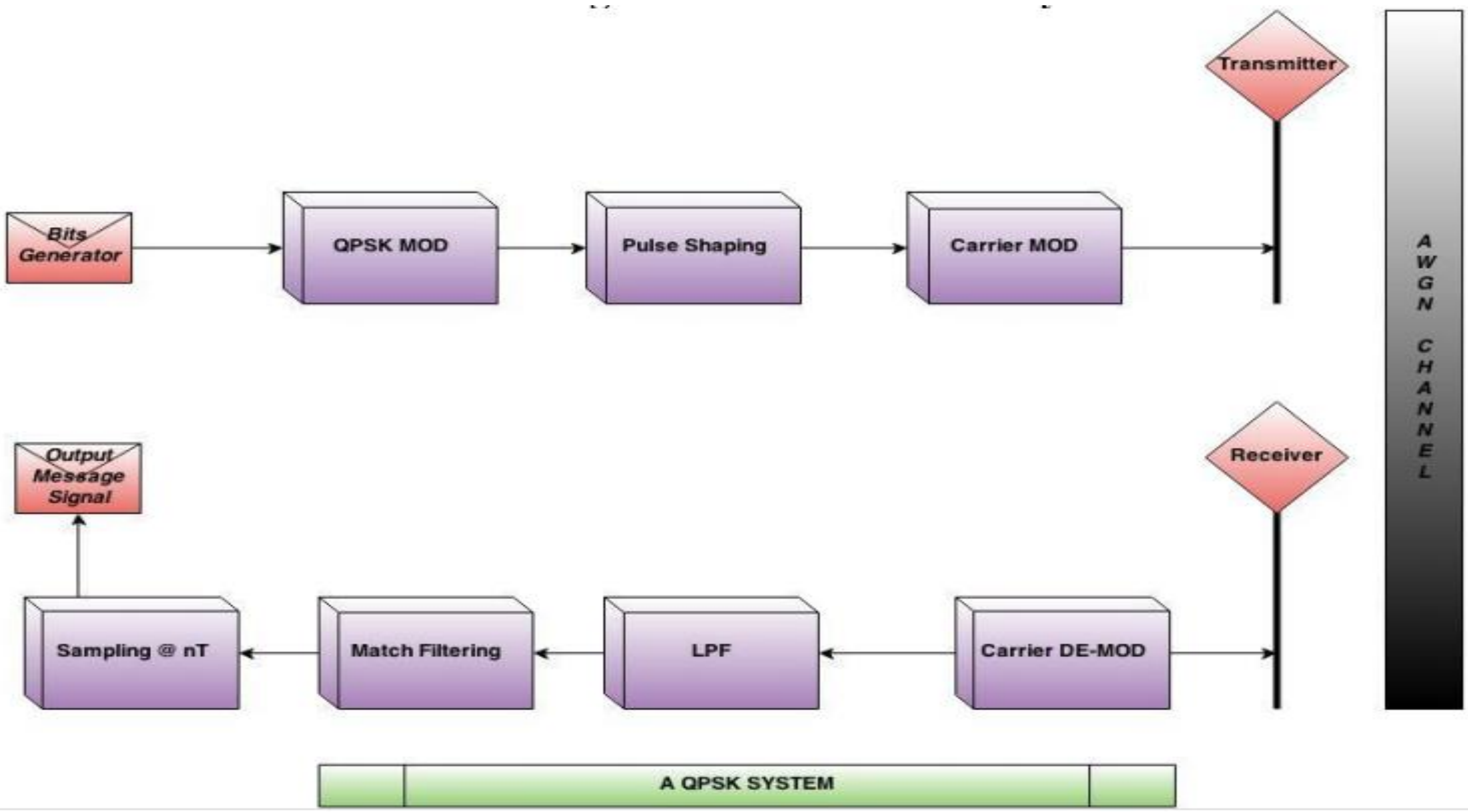
EXPERIMENT#12

TO DESIGN QPSK/4-QAM MODULATION SYSTEM

OBJECTIVE:

- The basic objective of this lab is to design the Qpsk modulation system and analyze the bit error rate.

Block Diagram



- **Bits Generator**
- This module of the digital communication system generates the message (signal) in bits.
- All the data here is in bits which are the input bits.
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- **QPSK MOD**
- In Quadrature Phase Shift Keying Modulation module, the modulator converts 1's into
- +1 and 0's into -1 given that it translates bits into complex bits pair which are then
- superimposed onto four different phases (0,90,180,270) degrees.
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- **Pulse Shaping**
- In this module, the modulated data is super imposed on a pulse (e.g. Manchester pulse,
- Raised Cosine, Gaussian pulse etc.) for channel synchronization.
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- **Carrier MOD**
- This is where the carrier modulation takes place i.e. the signal is multiplied with a sinus
- and cosinus carrier wave and then added up together. The frequency of the carrier wave is
- at least ten times the frequency of baseband (message) signal.
- **Transmitter**
- This module transmits the data in the form of electromagnetic waves.

QPSK Transmitter

```
N_Bits = 300;                              % # of Bits
Ts = 1;                                    % Symbol Duration
N_Pulses = 50;                             % # of Samples
t = linspace (0,1,50);
Tx_Signal = [];                            % Empty Matrix for Manipulations

BitG = randi([0,1],1,N_Bits);  % randint(1,N_Bits)
O_bits = BitG(1:2:end);          % pick up odd indices of the BitG
O_MOD = 2*O_bits - 1;
E_bits = BitG(2:2:end);           % pick up odd indices of the BitG
E_MOD = 2*E_bits - 1;
QPSK =  O_MOD + 1j*E_MOD;
scatterplot(QPSK);
```

Raised Cosine Wave

- RCos = 0.5 * (1 - cos ((2*pi*t)/Ts)); % RCos = [A/2 * (1-Cos(2*pi/Ts))]
- figure();
- stem (linspace(0,1,length(RCos)),RCos,'linewidth',1.5);
- axis ([0 1 0 1]);
- grid on;
- xlabel ('Ts');
- ylabel ('Amplitude');
- title ('Raised Cosine Wave')

RCos Waveform

- for a = 1:length(QPSK);
- Tx = QPSK(a) * RCos ;
- Tx_Signal = [Tx_Signal,Tx]; % Tx_Signal = BPSK_Mod * RCos
- end;
-
- figure();
- stem (linspace(0,N_Bits,length(Tx_Signal)),Tx_Signal,'linewidth',0.25);
- grid on; axis tight;
- xlabel ('nTs'); ylabel ('Amplitude');
- title ('Tx Signal using Raised Cosine Waveform');

Real Part of RCos Waveform

1. figure()
2. axis_set = linspace(0,length(QPSK),length(Tx_Signal));
3. stem (axis_set, real(Tx_Signal),'linewidth',0.25)
4. grid on; axis tight
5. xlabel ('nTs'); ylabel ('Amplitude')
6. title ('Real Part of Tx Signal using Raised Cosine Waveform')

Imaginary Part of RCos Waveform

1. figure()
2. stem (axis_set, imag(Tx_Signal),'linewidth',0.25)
3. grid on; axis tight
4. xlabel ('nTs'); ylabel ('Amplitude')
5. title ('Imaginary part of Tx Signal using Raised Cosine Waveform')

Carrier MOD

- fc = 300;
- Fs = 1000;
- t = 1:length(Tx_Signal);
- Ts = 1/Fs;
- tc = Ts*t;
-
- C_Cos = sqrt(2) .* cos(2*pi*fc*tc);
- C_Sin = -sqrt(2) .* sin(2*pi*fc*tc);
-
- R_Rcos = real(Tx_Signal) .*C_Cos;
- I_Rcos = imag(Tx_Signal) .*C_Sin;
-
- R_Tx = R_Rcos + I_Rcos;

Resultant Transmitter Signal

- figure()
- plot (linspace(0,length(QPSK),length(R_Tx)),R_Tx,'linewidth',0.25)
- grid on; axis tight
- xlabel ('nTs'); ylabel ('Amplitude')
- title ('Resultant Transmitter R_T_x Signal')