```
M = 4 % Number of Bits per Symbol
```

```
M = 4
```

```
BAUD_RATE = 1 % Symbols transmitted per second
```

```
BAUD_RATE = 1
```

```
L = 50 % Number of Symbols to be transmitted
```

```
L = 50
```

```
SAMPLING_RATE = 20 % Samples per second in Khz
```

```
SAMPLING_RATE = 20
```

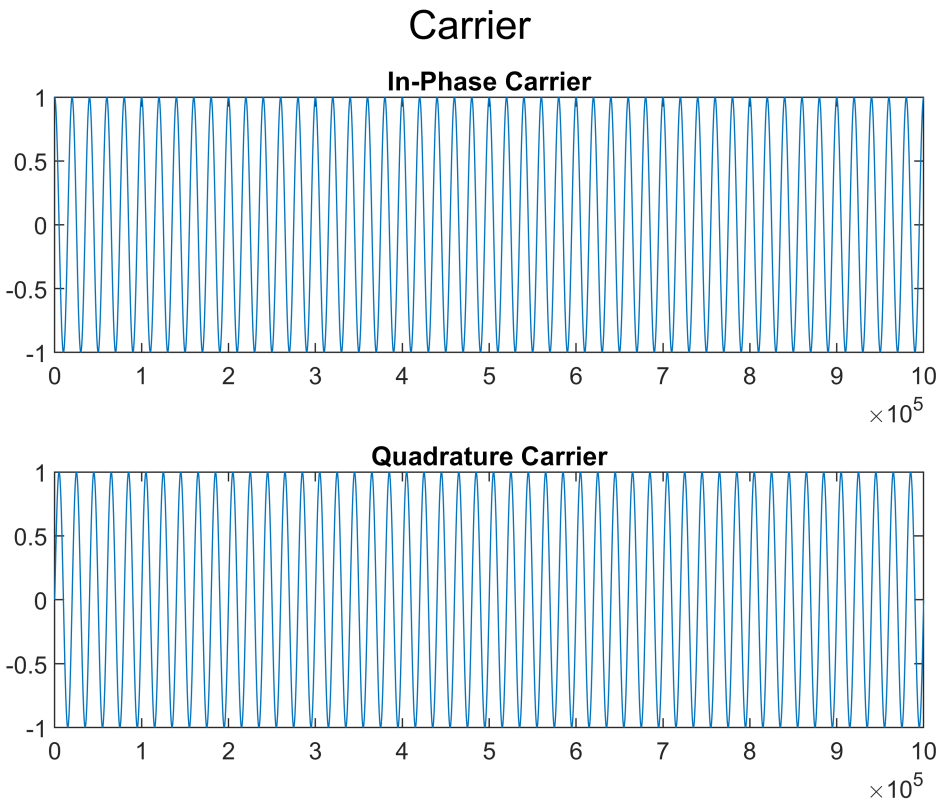
```
Fc = 1 % Carrier Frequency in Khz
```

```
Fc = 1
```

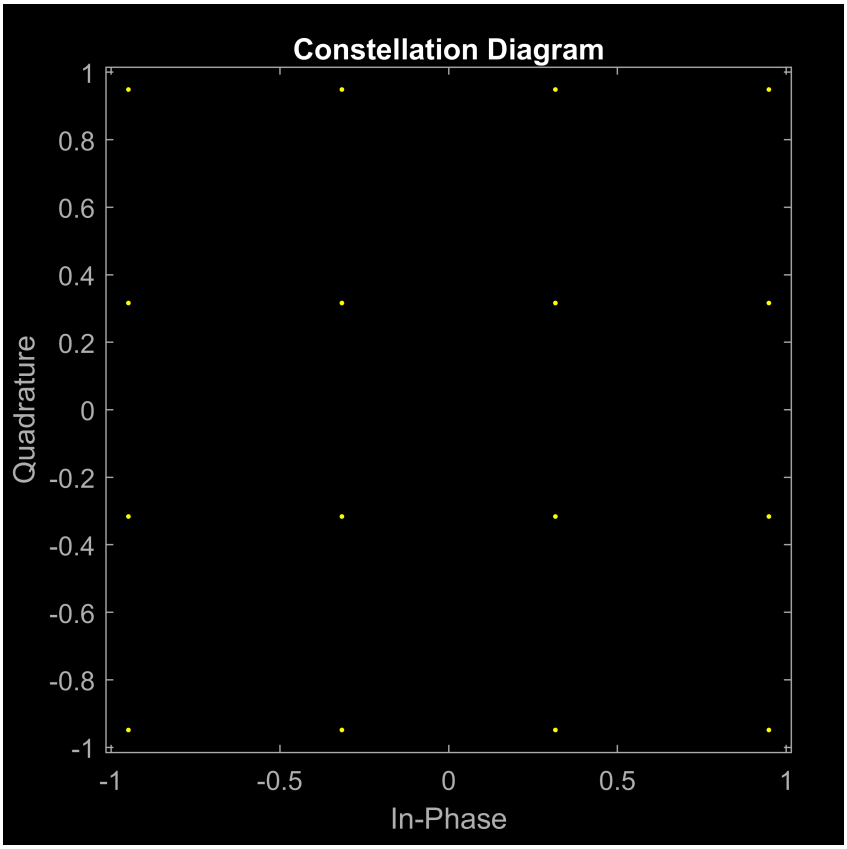
```
Ac = 1 % Carrier Amplitude
```

```
Ac = 1
```

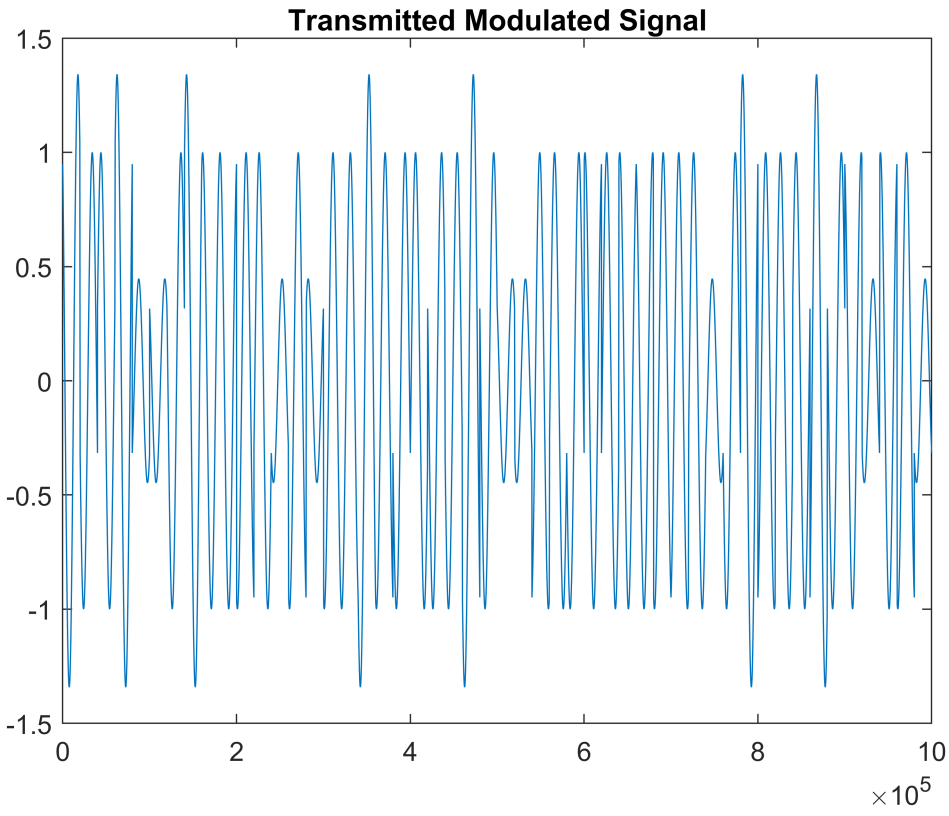
```
T = L / BAUD_RATE; % tx signal length in seconds
N = SAMPLING_RATE * T * 1000; % Number of samples required
samples_per_symbol = N/L;
n = 0:N-1;

% Carrier Signals
in_phase = Ac*cos(2*pi*Fc*n/N*T);
quadrature = Ac*sin(2*pi*Fc*n/N*T);

figure
subplot(2,1,1)
plot(in_phase)
title("In-Phase Carrier")
subplot(2,1,2)
plot(quadrature)
title("Quadrature Carrier")
sgtitle("Carrier")
```




```
symbols = qammod(0:2^M-1,2^M,"UnitAveragePower",true);

% Generating a random input message signal
message_signal = randi([0 2^M-1],L,1);
encoded_message_signal = zeros(L,1);

tx_signal = zeros(N,1);

for i = 1:L
   encoded_message_signal(i) = symbols(message_signal(i)+1);
   for j = 1:samples_per_symbol
       k = (i-1)*samples_per_symbol + j; % Index of the tx sample
       tx_signal(k) = real(encoded_message_signal(i)) * in_phase(k) + ...
           imag(encoded_message_signal(i)) * quadrature(k);
   end
end


figure
scatterplot(symbols)
title("Constellation Diagram")
```



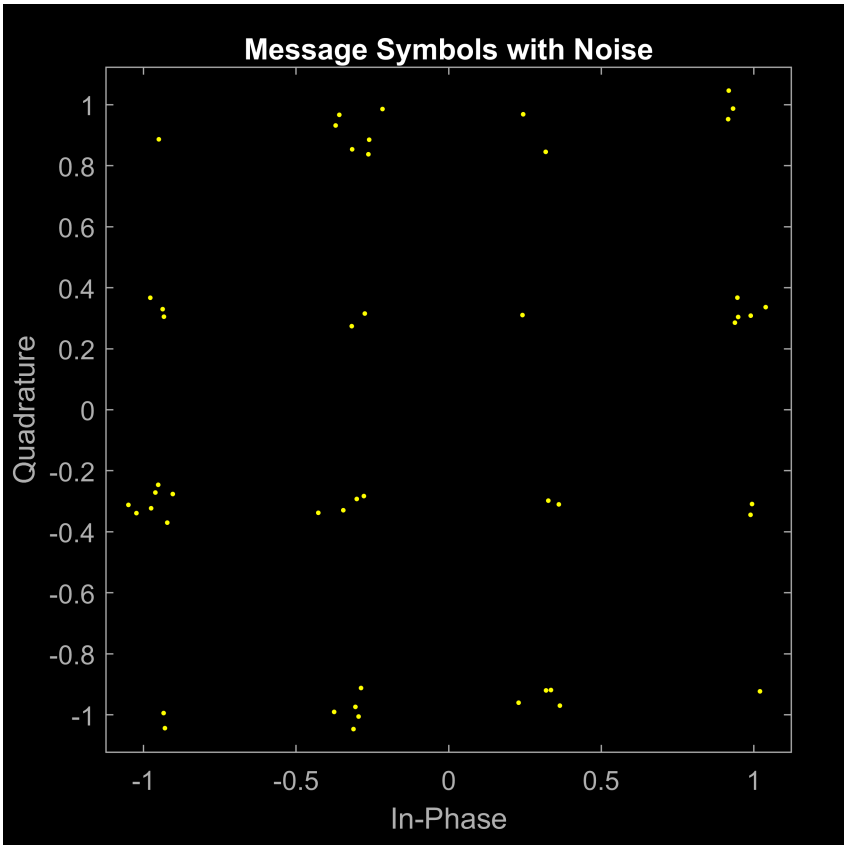

```
figure
plot(tx_signal)
title("Transmitted Modulated Signal")
```




```
% Passing through AWGN Channel
SNR = 25 % Db
```

```
SNR = 25
```

```
encoded_message_signal_with_noise = AWGN_Custom(encoded_message_signal,SNR);
figure
scatterplot(encoded_message_signal_with_noise)
title("Message Symbols with Noise")
```


Message Symbols with Noise
Quadrature
In-Phase
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1
-0.5
0
0.5
1