AMERICAN INTERNATIONAL UNIVERSITY BANGLADESH
Faculty of Engineering

Laboratory Report Cover Sheet
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Lab Title: Message Passing and Receiving Using Modulator (part 1: Transmitter Side)

Experiment Number: **08** Due Date: **03 /05/2024** Semester: **Spring 2023-2024**

Subject Code: **COE3103** Subject Name: **DATA COMMUNICATION** Section: **E**

Course Instructor: **NOWSHIN ALAM** Degree Program: **B.Sc. CSE**

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Group Number (if applicable): 08 Individual Submission ☐ Group Submission ☐

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Introduction:

This laboratory experiment investigates the complexity of message transmission and reception within the realm of data communication. The primary objective is to clarify the process through which a text message undergoes encoding, serialization, modulation, transmission over a communication channel, and subsequent decoding back into its orginal from at the reciver end. Central to this exploration is the simulation of transmitting the message "Data Comm" across a communication channel, which could encompass both wired mediums like twisted pair cables and wireless alternatives such as radio frequency links. The experiment strictly outlines the essential stages in this journey, commencing with the encoding phase wherein the character of the text message are translated into a digital representation leveraging a character encoding scheme, typically ASCII. Subsequently the encoded message undergoes serialization, converting into a sequential stream of bits for efficient transmission. The porital modulation step follows, wherin the carier signal is modulated with the serialized data to enable its transmission through the communication channel effectively.

Theory:

The process commences with the encoding of textual information into a format suitable for transmission. Each character, numeral, or symbol undergoes encoding, assigning binary representations. for instance, the ASCII encoding scheme maps characters into unique binary codes.

Following encoding, the data is serialized, converting the binary information into a sequential stream of bits. This steps streamlines the transmission process, facilitating the transfer of information bit by bit

With the data serialized, modulation comes into play, where the serial data stream modulate carrier waveform. Various modulation theenique exist, each altering different aspects of the carrier signal. In the presented scenario, Amplitud Shif Keying (ASK) modulation is employed. ASK involves varying the amplitude of the carrier signal represent different signal elements, Alining with the binary data stream.

At the recivers end, the transmitted signal encounters noise and distortions as it travelses the communication channel. The reciver must demodulate the recived waveform to extract the digital data. However, before delving into demodulation, the impact of noise is considered. Additive White Gaussian Noise (AWGN) is introduced as a common model for channel noise, reflecting real-world transmission scenarios.

Demodulation entails reversing the modulation process, recovering the orginal binary data from the recived signal. Despite noise-induced distortions, demodulation aims to accurately discern the transmitted information. In the presented example, Binary ASK demodulation is employed, involving the comparison of recived signal amplitude against predefined thresholds.

After successfully demodulation, the binary data is converted back into its original textual form. This inverse process of encoding involves segmenting the binary data stream into 8-bits segment and converting into ASCII characters. Through this conversion, the transmitted message is reconstructed.

Simulated Results:

Main Code:

```
clc;
clear all;
close all;

% ID = 22-46013-1

Transmitted_Message= 'Data Comm'
%Converting Information Message to bit%

x = asc2bn(Transmitted_Message); % Binary Information
bp=.000001;         % bit period
disp('Binary information at Trans mitter :');
disp(x);

%XX representation of transmitting binary information as digital
signal XXX
bit=[];
for n=1:1:length(x)
if x(n)==1;
se=5*ones(1,100);
else x(n)==0;
se=zeros(1,100);
end
bit=[bit se];
end
t1=bp/100:bp/100:100*length(x)*(bp/100);
subplot(4,1,1);
plot(t1,bit,'lineWidth',2.5);grid on;
axis([ 0 bp*length(x) -.5 6]);
ylabel('amplitude(volt)');
xlabel(' time(sec)');
title('Transmitting information as digital signal');


%XXXXXXXXXXXXXXXXXXXXXXX Binary-ASK modulation
XXXXXXXXXXXXXXXXXXXXXXXXXXX%
A1=5;                       % Amplitude of carrier signal for
information 1
A2=0;                       % Amplitude of carrier signal for
information 0
br=1/bp;                    % bit rate
f=br*10;                    % carrier frequency
t2=bp/99:bp/99:bp;
ss=length(t2);
m=[];
for (i=1:1:length(x))
    if (x(i)==1)
```

```
        y=A1*cos(2*pi*f*t2);
    else
        y=A2*cos(2*pi*f*t2);
    end
    m=[m y];
end
t3=bp/99:bp/99:bp*length(x);
subplot(4,1,2);
plot(t3,m);
axis([ 0 bp*length(x) -6 6]);
xlabel('time(sec)');
ylabel('amplitude(volt)');
title('Modulated Analog Signal at Transmitter');



disp('**********')
disp(' Message transmitted through a Transmission medium');
disp('**********')

%Channel Noise%
t4=bp/99:bp/99:bp*length(x);
Rec=awgn(m,30);   % snr = 30
subplot(4,1,3);
plot(t4,Rec);
axis([ 0 bp*length(x) -6 6]);
xlabel('time(sec)');
ylabel('amplitude(volt)');
title('Received signal at Receiver');


%XXXXXXXXXXXXXXXXXXXX Binary ASK demodulation
XXXXXXXXXXXXXXXXXXXXXXXXXXXX
mn=[];
for n=ss:ss:length(Rec)
  t=bp/99:bp/99:bp;
  y=cos(2*pi*f*t);           % carrier siignal
  mm=y.*Rec((n-(ss-1)):n);
  t5=bp/99:bp/99:bp;
  z=trapz(t5,mm) ;          % intregation
  zz=round((2*z/bp));
  if(zz>2.5)                % logic level = (A1+A2)/2=7.5
    a=1;
  else
    a=0;
  end
  mn=[mn a];
end
disp(' Binary information at Reciver :');
disp(mn);
```

```
%XXXXX Representation of binary information as digital signal which
achived
%after ASK demodulation
bit=[];
for n=1:length(mn);
    if mn(n)==1;
       se=5*ones(1,100);
    else mn(n)==0;
        se=zeros(1,100);
    end
     bit=[bit se];
end
t5=bp/100:bp/100:100*length(mn)*(bp/100);
subplot(4,1,4)
plot(t5,bit,'LineWidth',2.5);grid on;
axis([ 0 bp*length(mn) -.5 6]);
ylabel('amplitude(volt)');
xlabel(' time(sec)');
title('Demodulated signal at receiver');


%Converting Information bit to Message%
Received_Message=bin2asc(mn)
%>>>>>>>>> end of program >>>>>>>>>>>>>>>>>%
```

asc2bn Code:

```
function dn = asc2bn(txt)
dec=double(txt)  %Text to ASCII (decimal)
p2=2.^(0:-1:-7)  % 2^0,2^-1,.......,2^-7
B=mod(floor(p2'*dec),2) %Decimal to binary conversion
%Columns of B are bits of chars
dn=reshape(B,1,numel(B));%Bytes to serial conbversion
end
```

bin2asc Code:

```
function txt = bin2asc(dn)
%bin2asc    Serial binary to ASCII to text conversion
%           8 bits per char , LSB first
%           >> txt= bin2asc(dn) <<
%           where dn is binary input sequence
%                 txt is output text string
L=length(dn); %Length of input string
L8=8*floor(L/8); %Multiple of 8 Length
B=reshape(dn(1:L8),8,L8/8); %Cols of B are bits of chars
p2=2.^(0:7); %power of 2
dec=p2*B;  %Binary to decimal conversion
txt=char(dec); %ASCII (decimal) to txt
end
```

When, SNR = 30

Command Window

```
Transmitted_Message =

    'Data Comm'


dec =

    68    97   116    97    32    67   111   109   109


p2 =

    1.0000    0.5000    0.2500    0.1250    0.0625    0.0313    0.0156    0.0078


B =

     0     1     0     1     0     1     1     1     1
     0     0     0     0     0     1     1     0     0
     1     0     1     0     0     0     1     1     1
     0     0     0     0     0     0     1     1     1
     0     0     1     0     0     0     0     0     0
     0     1     1     1     1     0     1     1     1
     1     1     1     1     0     1     1     1     1
     0     0     0     0     0     0     0     0     0
```

```
Binary information at Trans mitter :
  Columns 1 through 17

     0     0     1     0     0     0     1     0     1     0     0     0     0     1     1     0     0

  Columns 18 through 34

     0     1     0     1     1     1     0     1     0     0     0     0     1     1     0     0     0

  Columns 35 through 51

     0     0     0     1     0     0     1     1     0     0     0     0     1     0     1     1     1

  Columns 52 through 68

     1     0     1     1     0     1     0     1     1     0     1     1     0     1     0     1     1

  Columns 69 through 72

     0     1     1     0
```

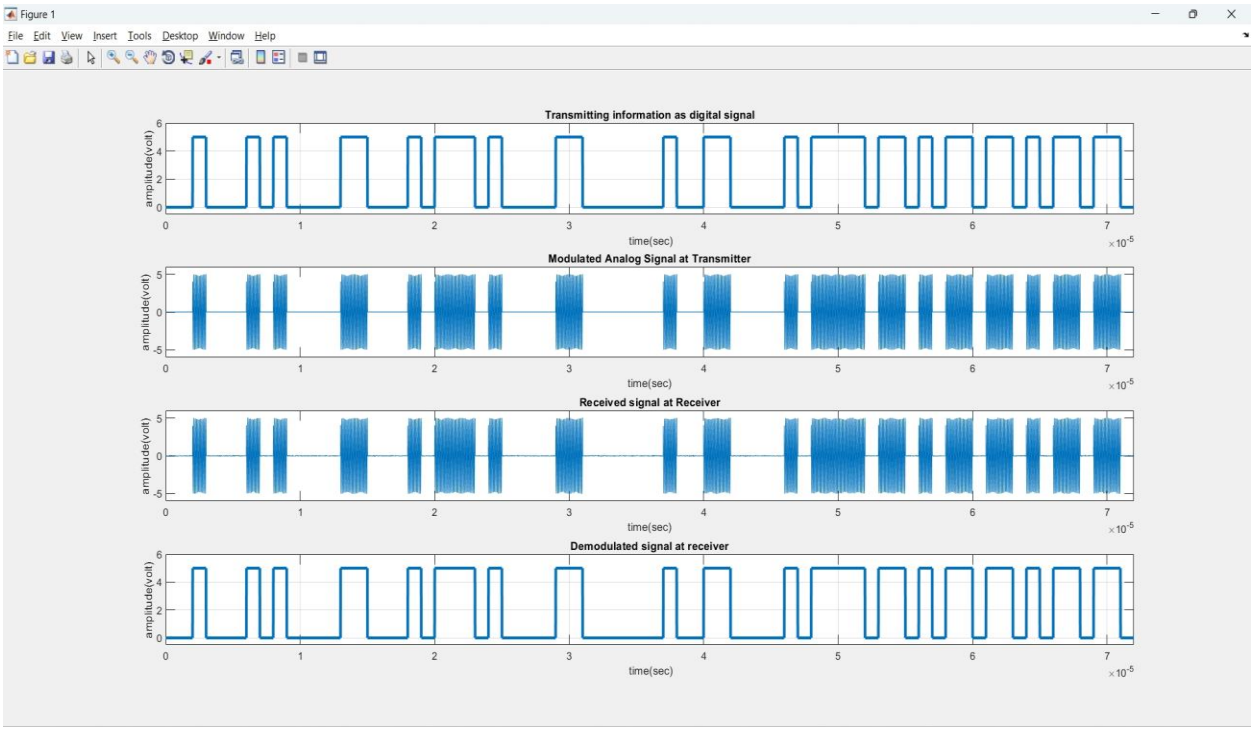
```
**********
 Message transmitted through a Transmission medium
**********
 Binary information at Reciver :
  Columns 1 through 17

     0     0     1     0     0     0     1     0     1     0     0     0     0     1     1     0     0

  Columns 18 through 34

     0     1     0     1     1     1     0     1     0     0     0     0     1     1     0     0     0

  Columns 35 through 51

     0     0     0     1     0     0     1     1     0     0     0     0     1     0     1     1     1

  Columns 52 through 68

     1     0     1     1     0     1     0     1     1     0     1     1     0     1     0     1     1

  Columns 69 through 72

     0     1     1     0


Received_Message =

    'Data Comm'

>>
```

Workspace

Workspace

Name	Value
a	0
A1	5
A2	0
ans	1
bit	*1x7200 double*
bp	1.0000e-06
br	1000000
f	10000000
i	72
m	*1x7128 double*
mm	*1x99 double*
mn	*1x72 double*
n	72
Rec	*1x7128 double*
Received_Mes...	'Data Comm'
se	*1x100 double*
ss	99
t	*1x99 double*
t1	*1x7200 double*
t2	*1x99 double*
t3	*1x7128 double*
t4	*1x7128 double*
t5	*1x7200 double*
Transmitted_...	'Data Comm'
x	*1x72 double*
y	*1x99 double*
z	2.1263e-09
zz	0

Plots



When, SNR = −30

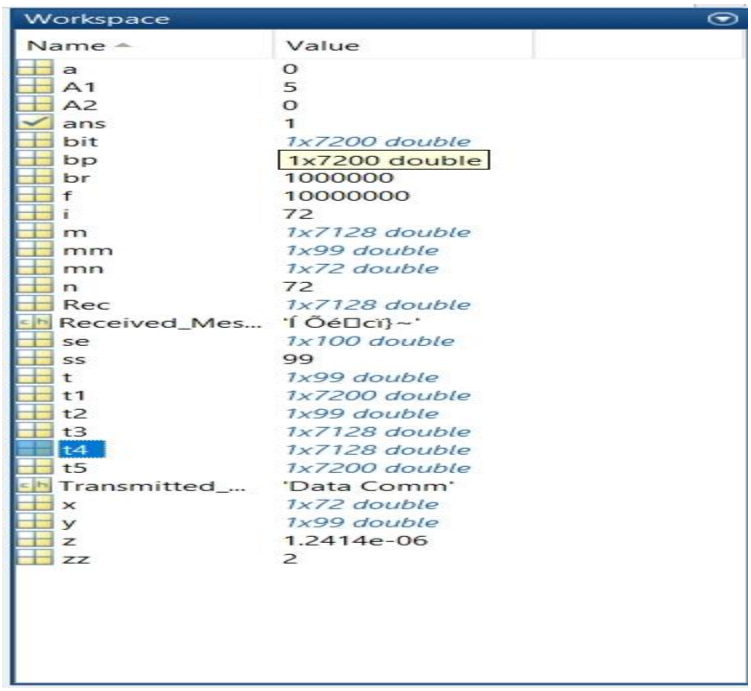
Command Window

```
Transmitted_Message =

    'Data Comm'


dec =

    68    97   116    97    32    67   111   109   109


p2 =

    1.0000    0.5000    0.2500    0.1250    0.0625    0.0313    0.0156    0.0078


B =

     0     1     0     1     0     1     1     1     1
     0     0     0     0     0     1     1     0     0
     1     0     1     0     0     0     1     1     1
     0     0     0     0     0     0     1     1     1
     0     0     1     0     0     0     0     0     0
     0     1     1     1     1     0     1     1     1
     1     1     1     1     0     1     1     1     1
     0     0     0     0     0     0     0     0     0
```

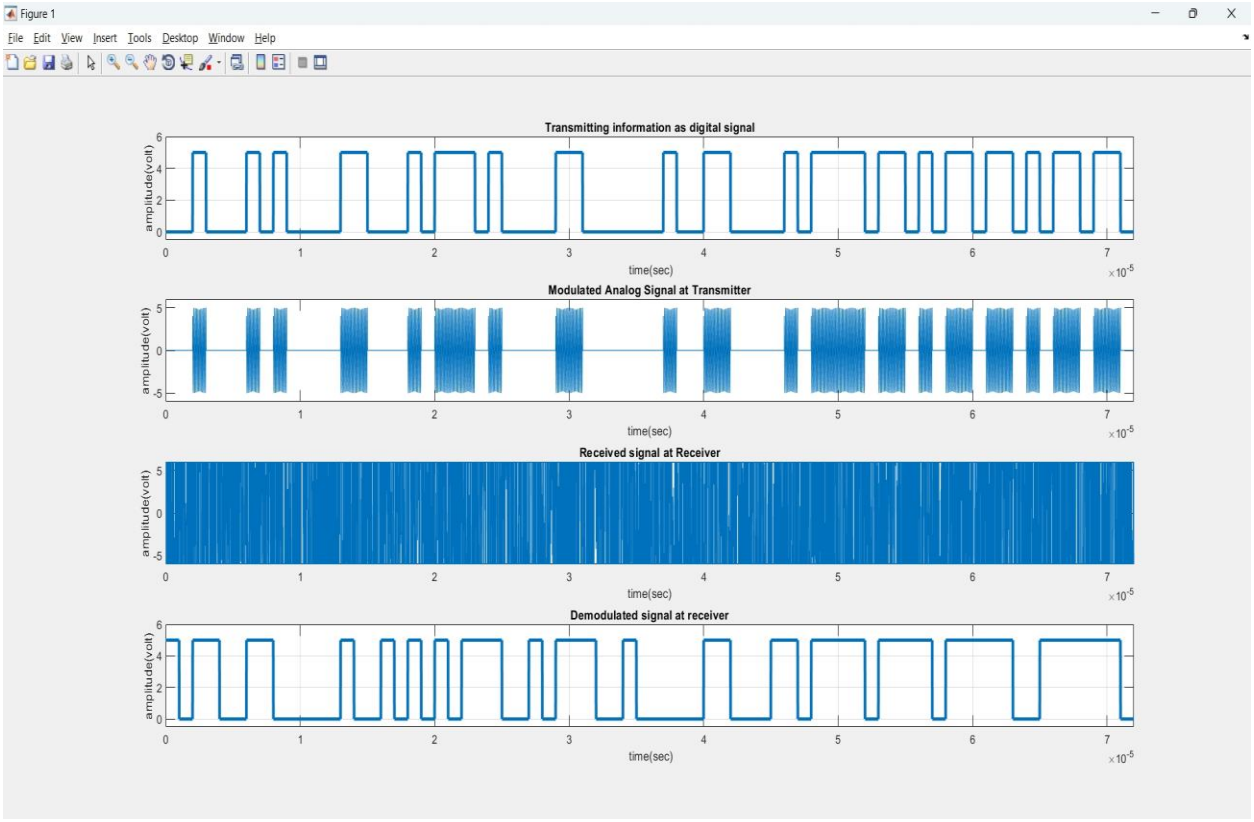
```
Binary information at Trans mitter :
  Columns 1 through 18

     0     0     1     0     0     0     1     0     1     0     0     0     0     1     1     0     0

  Columns 19 through 36

     1     0     1     1     1     0     1     0     0     0     0     1     1     0     0     0     0

  Columns 37 through 54

     0     1     0     0     1     1     0     0     0     0     1     0     1     1     1     1     0

  Columns 55 through 72

     1     0     1     0     1     1     0     1     1     0     1     0     1     1     0     1     1
```

```
**********
 Message transmitted through a Transmission medium
**********
 Binary information at Reciver :
  Columns 1 through 17

     1     0     1     1     0     0     1     1     0     0     0     0     0     1     0     0     1

  Columns 18 through 34

     0     1     0     1     0     1     1     1     0     0     1     0     1     1     1     0     0

  Columns 35 through 51

     1     0     0     0     0     0     1     1     0     0     0     1     1     0     1     1     1

  Columns 52 through 68

     1     0     1     1     1     1     0     1     1     1     1     1     0     0     1     1     1

  Columns 69 through 72

     1     1     1     0


Received_Message =

    'í õé□c1}~'
```

Workspace



Plots



When SNR = 10

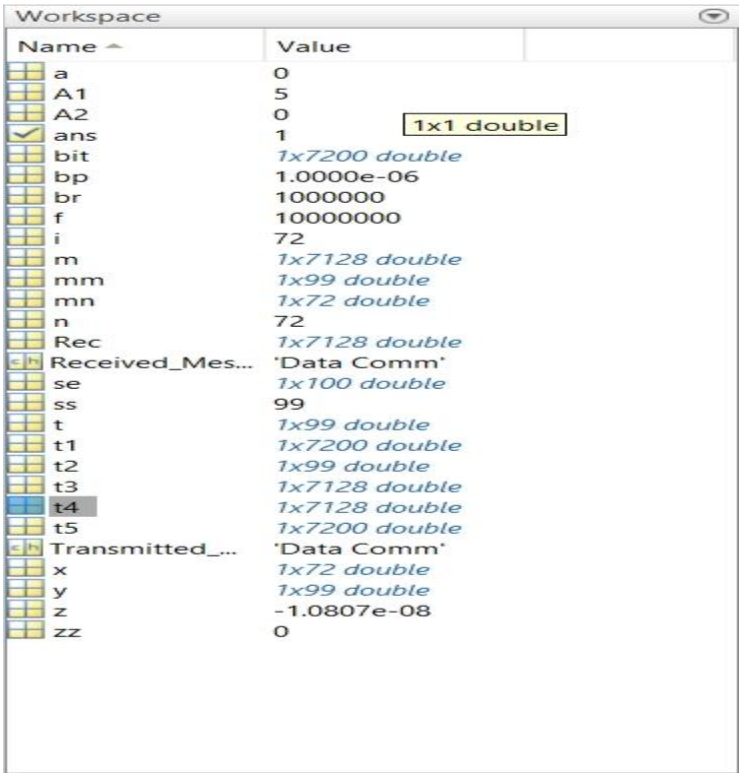
Command Window

```
Command Window

Transmitted_Message =

    'Data Comm'


dec =

    68    97   116    97    32    67   111   109   109


p2 =

    1.0000    0.5000    0.2500    0.1250    0.0625    0.0313    0.0156    0.0078


B =

     0     1     0     1     0     1     1     1     1
     0     0     0     0     0     1     1     0     0
     1     0     1     0     0     0     1     1     1
     0     0     0     0     0     0     1     1     1
     0     0     1     0     0     0     0     0     0
     0     1     1     1     1     0     1     1     1
     1     1     1     1     0     1     1     1     1
     0     0     0     0     0     0     0     0     0
```

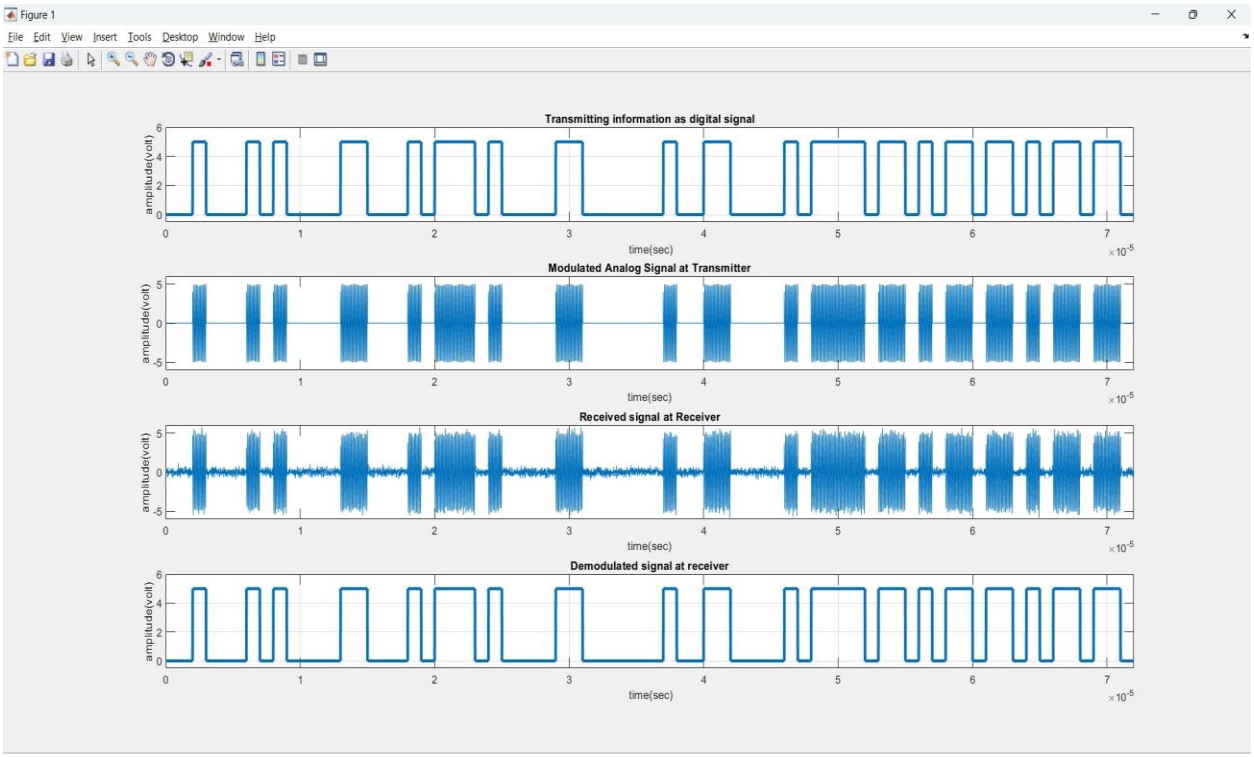
```
Command Window

Binary information at Trans mitter :
  Columns 1 through 18

     0     0     1     0     0     0     1     0     1     0     0     0     0     1     1     0     0

  Columns 19 through 36

     1     0     1     1     1     0     1     0     0     0     0     1     1     0     0     0     0

  Columns 37 through 54

     0     1     0     0     1     1     0     0     0     0     1     0     1     1     1     1     0

  Columns 55 through 72

     1     0     1     0     1     1     0     1     1     0     1     0     1     1     0     1     1
```

```
Command Window

**********
 Message transmitted through a Transmission medium
**********
 Binary information at Reciver :
  Columns 1 through 17

     0     0     1     0     0     0     1     0     1     0     0     0     0     1     1     0     0

  Columns 18 through 34

     0     1     0     1     1     1     0     1     0     0     0     0     1     1     0     0     0

  Columns 35 through 51

     0     0     0     1     0     0     1     1     0     0     0     0     1     0     1     1     1

  Columns 52 through 68

     1     0     1     1     0     1     0     1     1     0     1     1     0     1     0     1     1

  Columns 69 through 72

     0     1     1     0


Received_Message =

    'Data Comm'
```

Workspace

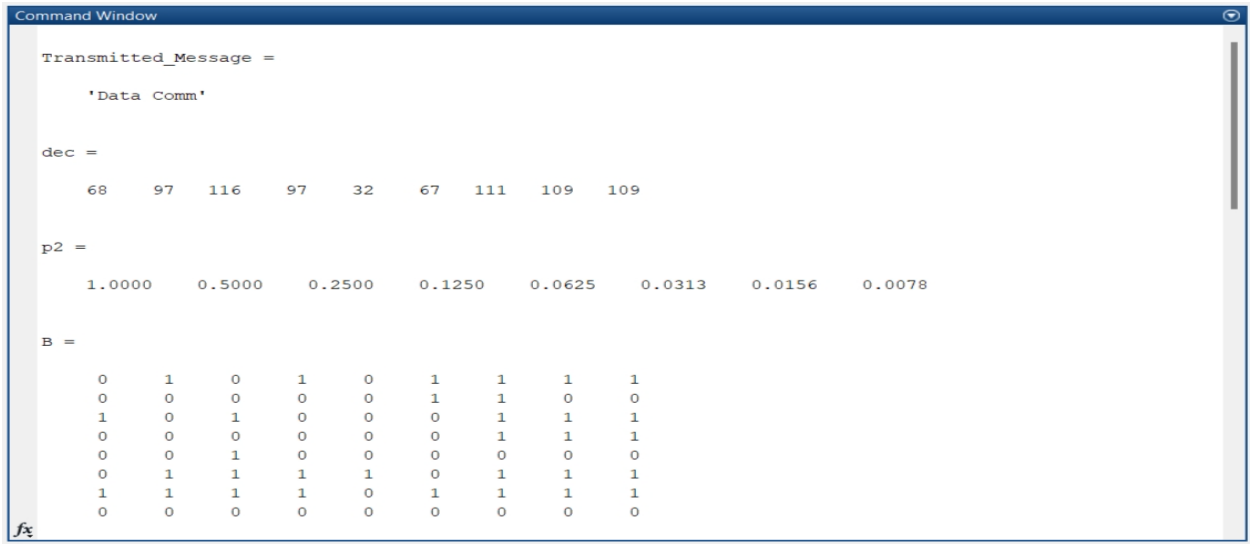


Plots

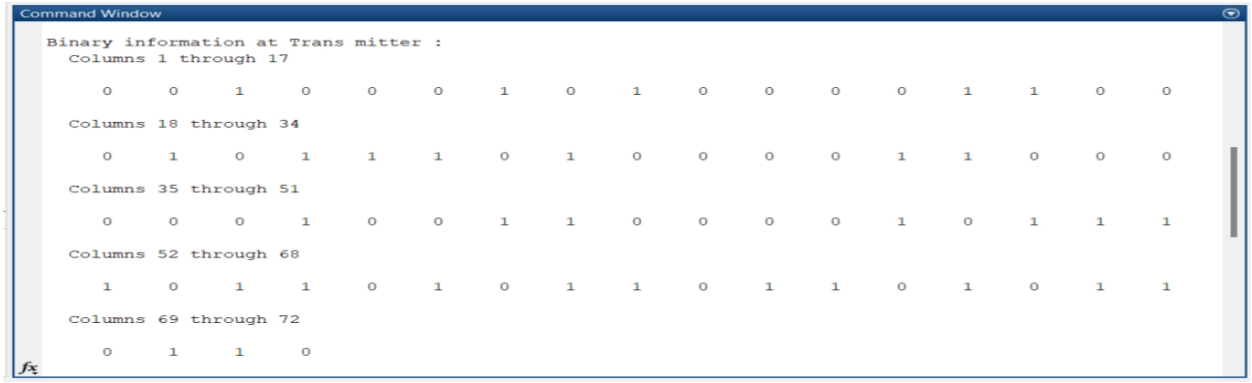


When, SNR = −10

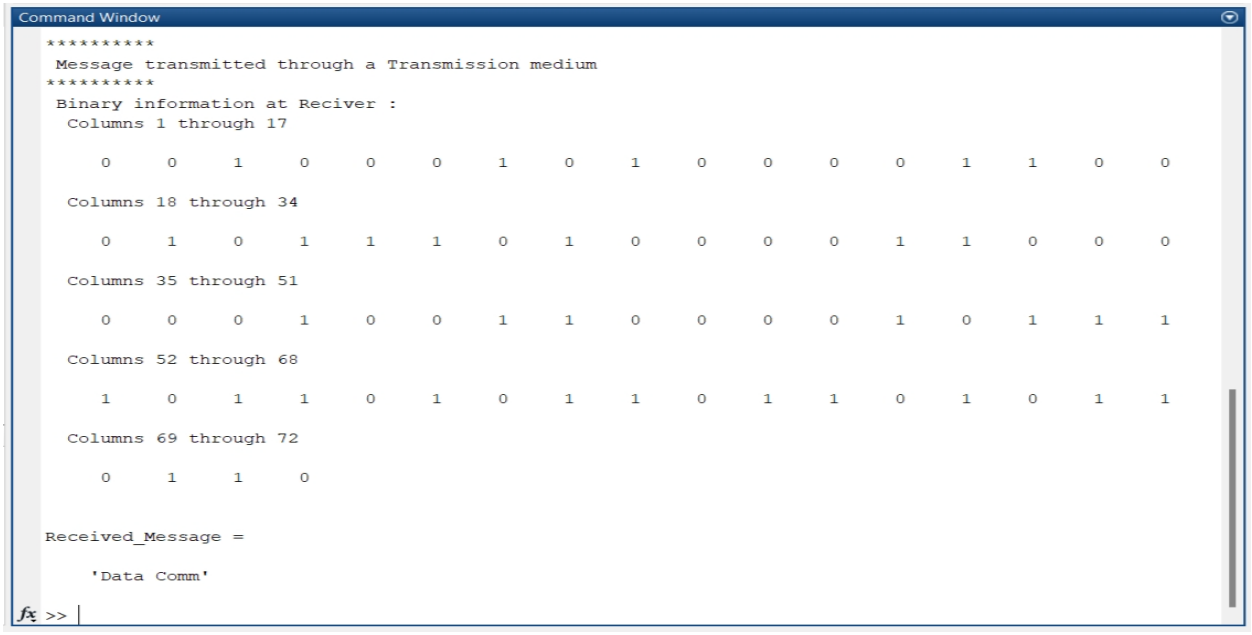
Command Window



```
Command Window

Transmitted_Message =

    'Data Comm'


dec =

    68    97   116    97    32    67   111   109   109


p2 =

    1.0000    0.5000    0.2500    0.1250    0.0625    0.0313    0.0156    0.0078


B =

     0     1     0     1     0     1     1     1     1
     0     0     0     0     0     1     1     0     0
     1     0     1     0     0     0     1     1     1
     0     0     0     0     0     0     1     1     1
     0     0     1     0     0     0     0     0     0
     0     1     1     1     1     0     1     1     1
     1     1     1     1     0     1     1     1     1
     0     0     0     0     0     0     0     0     0
```

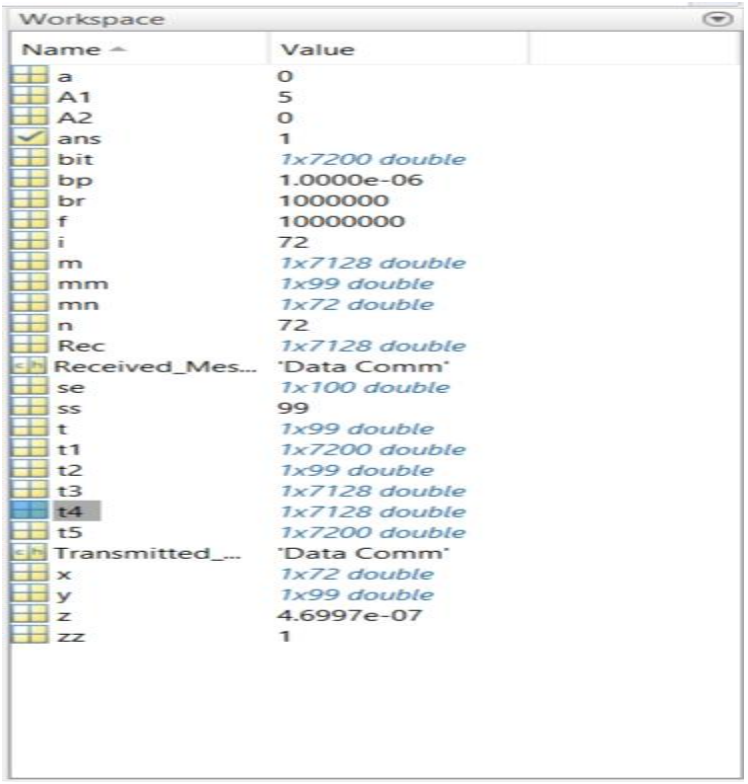


```
Command Window

Binary information at Trans mitter :
  Columns 1 through 17

     0     0     1     0     0     0     1     0     1     0     0     0     0     1     1     0     0

  Columns 18 through 34

     0     1     0     1     1     1     0     1     0     0     0     0     1     1     0     0     0

  Columns 35 through 51

     0     0     0     1     0     0     1     1     0     0     0     0     1     0     1     1     1

  Columns 52 through 68

     1     0     1     1     0     1     0     1     1     0     1     1     0     1     0     1     1

  Columns 69 through 72

     0     1     1     0
```

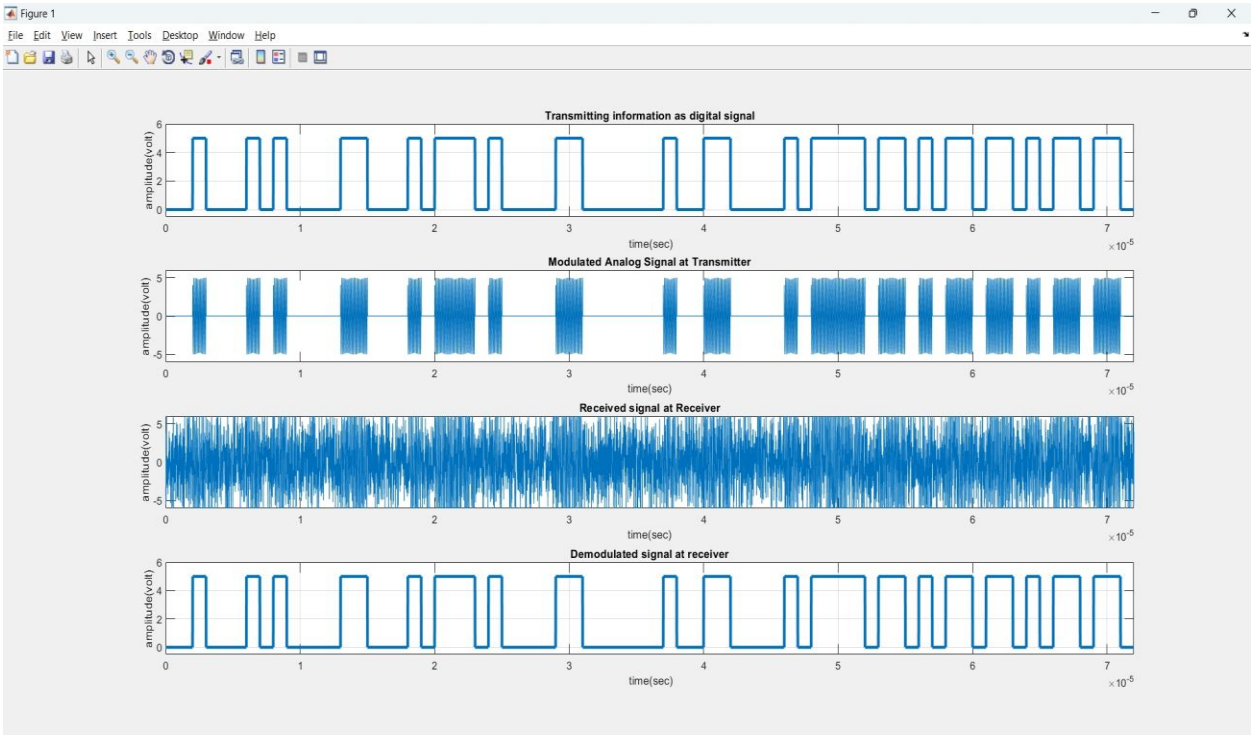


```
Command Window

**********
 Message transmitted through a Transmission medium
**********
 Binary information at Reciver :
  Columns 1 through 17

     0     0     1     0     0     0     1     0     1     0     0     0     0     1     1     0     0

  Columns 18 through 34

     0     1     0     1     1     1     0     1     0     0     0     0     1     1     0     0     0

  Columns 35 through 51

     0     0     0     1     0     0     1     1     0     0     0     0     1     0     1     1     1

  Columns 52 through 68

     1     0     1     1     0     1     0     1     1     0     1     1     0     1     0     1     1

  Columns 69 through 72

     0     1     1     0


Received_Message =

    'Data Comm'

>>
```

Workspace



Plots



When, SNR = 0

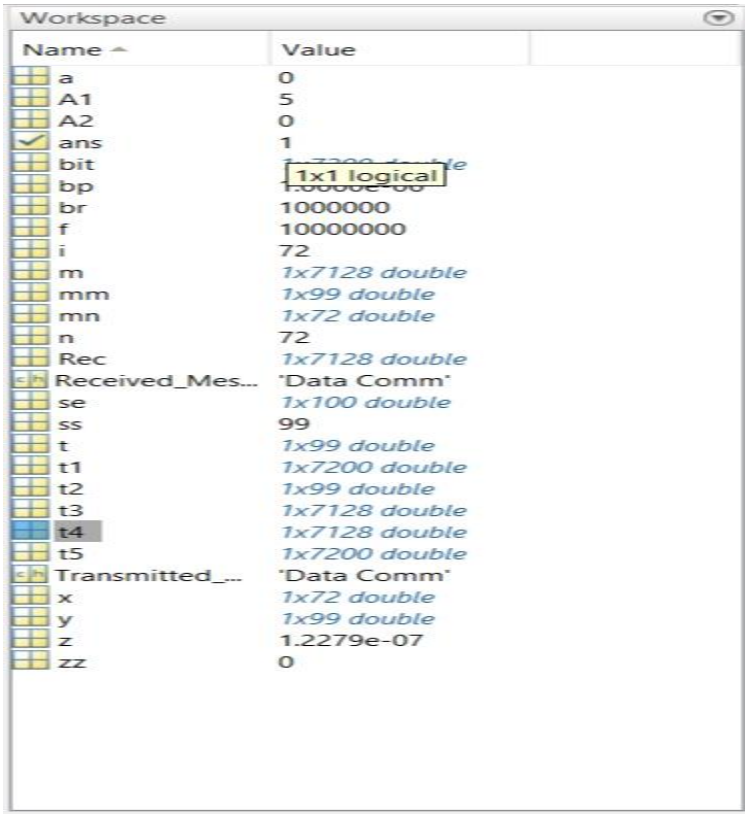
Command Window

```
Command Window

Transmitted_Message =

    'Data Comm'


dec =

    68    97   116    97    32    67   111   109   109


p2 =

    1.0000    0.5000    0.2500    0.1250    0.0625    0.0313    0.0156    0.0078


B =

     0     1     0     1     0     1     1     1     1
     0     0     0     0     0     1     1     0     0
     1     0     1     0     0     0     1     1     1
     0     0     0     0     0     0     1     1     1
     0     0     1     0     0     0     0     0     0
     0     1     1     1     1     0     1     1     1
     1     1     1     1     0     1     1     1     1
     0     0     0     0     0     0     0     0     0
```

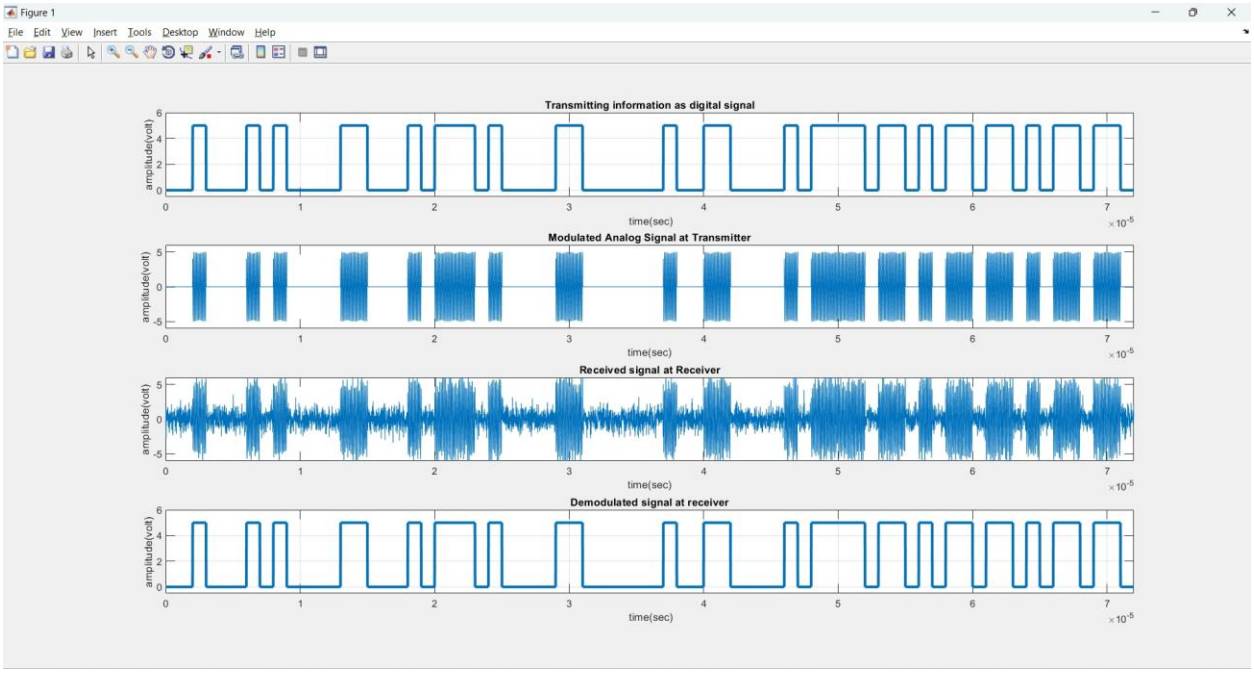
```
Command Window

Binary information at Trans mitter :
  Columns 1 through 17

     0     0     1     0     0     0     1     0     1     0     0     0     0     1     1     0     0

  Columns 18 through 34

     0     1     0     1     1     1     0     1     0     0     0     0     1     1     0     0     0

  Columns 35 through 51

     0     0     0     1     0     0     1     1     0     0     0     0     1     0     1     1     1

  Columns 52 through 68

     1     0     1     1     0     1     0     1     1     0     1     1     0     1     0     1     1

  Columns 69 through 72

     0     1     1     0
```

```
Command Window

**********
 Message transmitted through a Transmission medium
**********
 Binary information at Reciver :
  Columns 1 through 17

     0     0     1     0     0     0     1     0     1     0     0     0     0     1     1     0     0

  Columns 18 through 34

     0     1     0     1     1     1     0     1     0     0     0     0     1     1     0     0     0

  Columns 35 through 51

     0     0     0     1     0     0     1     1     0     0     0     0     1     0     1     1     1

  Columns 52 through 68

     1     0     1     1     0     1     0     1     1     0     1     1     0     1     0     1     1

  Columns 69 through 72

     0     1     1     0


Received_Message =

    'Data Comm'

>>
```

Workspace



Plots



Conclusion:

The experiment demonstrated the modulator in transmitting messages via message passing and receiving. We did our simulation using different SNR values like 30, 10, 0, -10 and -30. Most of the cases message signal or text recoven back at the receivers ends except of SNR value with -30. However, the performance of the modulator was affected by factors such as the modulation scheme used, and size of the message being transmitted. The results of the experiment can be used to optimize the performance of modulators in communication systems.