

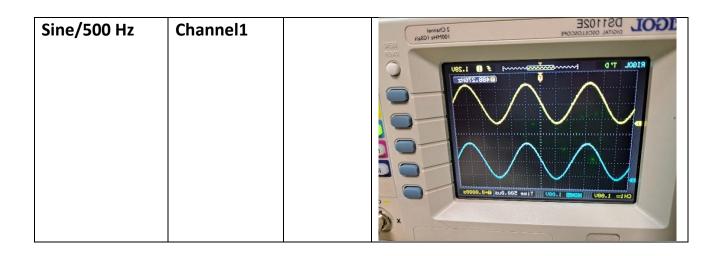
Digital Communication Lab3

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Task 1: From [1], perform experiments 8 to 14, which pertain to TDM. The page numbers for the same are given in the table of contents. You need to follow the procedures given in the manual and observe the output as suggested in the observations. (Note: Time-division multiplexing (TDM) is one very useful application of PCM which allows multiple users to use a common channel. For section A, it will be soon covered in the lectures.)

Experiment 8::



Arbitrary /1.5 KHz	Channel2		R190L STOP 1.28U (92.976 IGHZ) (H1== 1.00U MINES 1.00U Time 500.0us 0+0.0000s
Square /500 Hz	Channel3		RIGOL T'D
Sine/500 Hz	Channel1	8 KHz	RIGOL T'D
Sine/500 Hz	Channel1	8 KHz	RIGOL STOP 1.28U

Arbitrary/1.5 KHz	Channel2	16 KHz	RIGOL STOP
Square/500 Hz	Channel3	8 KHz	RIGOL STOP (3 CHZ 1.000 CHZ 1.000 Time 1.000ms (0-0.0000s
Arbitrary/1.5 KHz	Channel4	8 KHz	RIGOL STOP

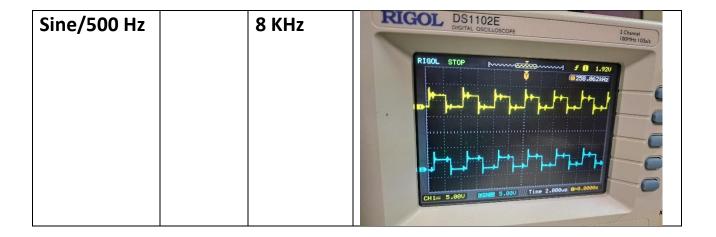
Experiment 9 ::

Sine/500 HZ	Channel1	8 KHz	RIGOL STOP (District Filter) (District Filter) (H1= 1.06U Milles 2.06U Time 200.0us (D704.0us)
Arbitrary/ 500Hz	Channel1	8 KHz	RIGOL STOP (82.63962H2) (82.63962H2) CHI= 1.690 (82.63962H2)
Square/500 Hz	Channel1	8 KHz	RIGOL STOP 1.28U Time 1.000mm (3+0.0000s)
Arbitrary /1.0KHz	Channel1	16 KHz	RIGOL STOP (03.684204H2) (03.684204H2) (14.10) (15.10) (15.10) (16.10)

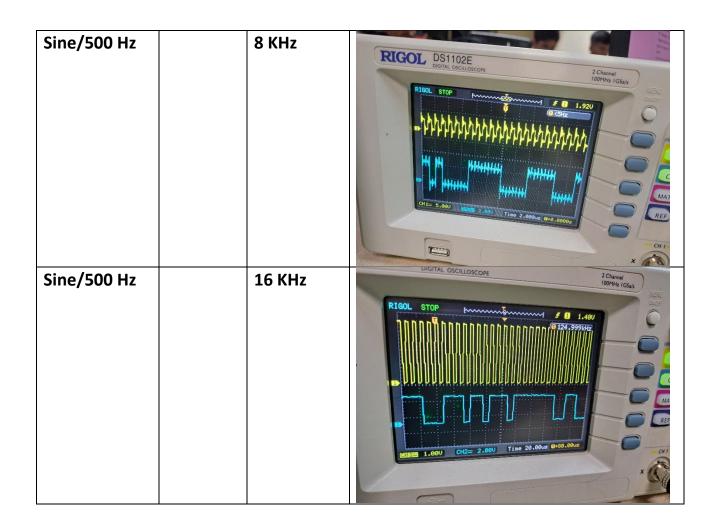
Sine/500 Hz	Channel1	8 KHz	RIGOL STOP # 1 1-400
Sine/1.5 KHz	Channel1	8 KHz	RIGOL STOP 1.480 1.48
Sine/500 Hz	Channel1	8 KHz	RIGOL STOP ### 1.460 CH2= 2.660 Time 20.60 m @ \$30.00 m

Experiment 10::

Sine/500 Hz	8 KHz	RIGOL STOP
Sine/500 Hz	16 KHz	RIGOL STOP (G.533.328)Hz Couping DC BW Limit Probe IX CH1:: 5.000 MINISTER 2.000 Time 5.000 GPO.00005
Sine/500 Hz	32 KHz	RIGOL 8TOP (6 1.1920) (6 1.142257962



Experiment 11::



Sine/500 Hz	32 KHz	RIGOL STOP 1.480 1.48
Sine/500 Hz	8 KHz	RIGOL STOP 1.28U CH2= 1.000ms 219.00003
Sine/500 Hz	8 KHz	RIGOL DS1102E DIGITAL OSCILLOSCOPE 2 Channel IOMHz IGSNS RIGOL STOP # 0 1.920 # 258.662Hz CH1= 5.000 Markett 5.000 Time 2.000us @v0.0000s

Experiment 12 ::

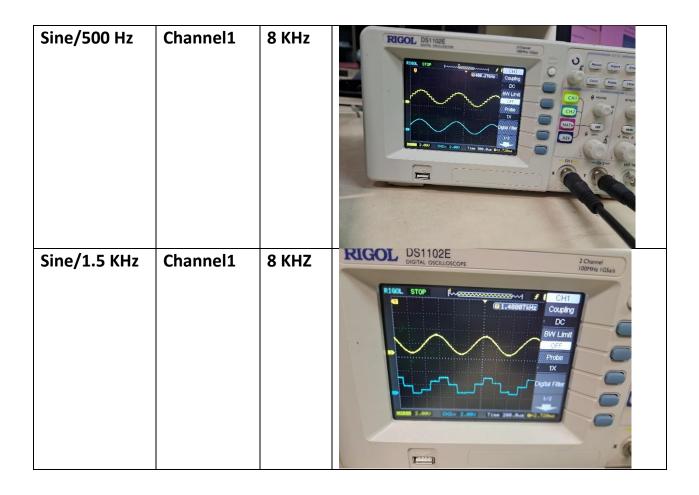
Sine/500 Hz	Channel1	8 KHz	RIGOL DS1102E DOTA OCCUPANT INDEPENDENT IN
Sine/500 Hz	Channel2	8 KHz	RIGOL DS1102E DG17A- DGCALDOCCAF 2 Channel 100/Har 103ay CH1 CH2 MATU REP CH2 X X
Sine/500 Hz	Channel3	8 KHZ	RIGOL STOP RIGOL

Experiment 13::

Sine/500 Hz	Channel1	8 KHz	RIGOL DS1102E SOUTH OKALOSCOPE RIGOL STOP GITTASPPORE COLUMN CFT DONE FTIM MATTER RED CH 1 RED
Sine/500 Hz	Channel1	8 KHz	RIGOL DS1102E DIGTAL OSCILLOSCOPE 2 Channel 100MHz 1GSa/s RIGOL TD G188,270Hz Cottaining DC DC DMLIntt CFF Cottaining DC DC DMLIntt CFF DC DC DC DC DC DC DC DC D
Arbitrary/500 Hz	Channel2	8 KHz	RIGOL DS1102E DIGITAL OSCILLOSCOPE 2 Channel 100NHz 1GSNS CH2 Country Ch2
Square/500 Hz	Channel3	8 KHz	RIGOL STOP GESS.276FR CH2 GESS.276FR Couping DC BW. Limit OFF Probe Probe Again Filer Couping DC DC DC DC DC DC DC DC DC D

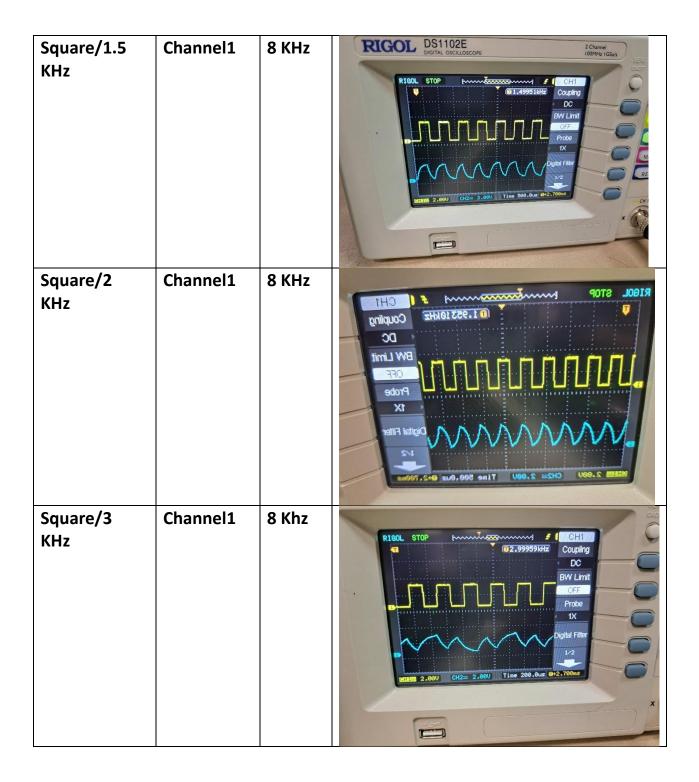
Arbitrary/500	Channel4	8 KHz	OL DS1102E DIGITAL OSCILLOSCOPE	2 Channel 100MHz 1GSa/s
Hz				LA CAL
			RISOL STOP COUP	ling
			BWL	mit
			Parala Transis	
			CH1= 2.000 MINE SOOMU Time 500.0us G+2.720ms	
			072.720as	

Experiment 14 ::



Sine/1.5 KHz	Channel2	8 KHz	RIGOL STOP TO 1.48854HF Coupling DC BW Limit OFF Probe 12 Misses 2.900 CH2= 2.000 Time 500.0us 0>2.700s
Sine/1.5 KHz	Channel2	16 KHz	DIGITAL OSCILLOSCOPE 100MHz IGSa/s
			RIGOL STOP (G) 1.48854RHz Coupling OC BW Limit OFF Probe 1X Digital Filter
Square/500	Channel3	8 KHz	100MHz 1GS.
Hz			RIGOL STOP (P488.276Hz) Coupling DC BW Limit OFF Probe 1X Digital Filter 1/2
Sine/1.5 KHz	Channel3	8 Khz	RIGOL STOP FIGURE 1000MHz 10 RIGOL STOP Frobe 12 Probe 13 Probe 14 Probe 15 Probe 16 Probe 17 Probe 18 P
			×.

Arbitrary/50 0 Hz	Channel4	8 KHz	RIGOL STOP COLLOSCOPE CHIP C
Square /500 Hz	Channel1	8 KHz	RIGOL DS1102E DIGITAL OSCILLOSCOPE RIGOL STOP RIGOL
Square/1 KHz	Channel1	8 KHz	RIGOL DS1102E CONNECTION OF THE SOLUTION OF T



- → Conclusion ::
- → In this part we performed different sampling of signals and reconstruction of them like sine , square etc.

Task 2 :: Go through section 7.6 and subsequently, section 7.10 from [2]. Thereafter, implement the _les \pnrz.m", \prz.m", \psine.m", \prcos.m",

\binary eye.m", and \Mary eye.m". Subsequently, with the understanding developed, solve problem 4.38 from [3]. The function \eyediagram" is a built-in M-function in MATLAB. (Note: The concept of eye-diagram is well explained in section 7.6. However, it will be covered in the lectures on \communication over band-limited channels, scheduled for the second week after In-sem 1.)

Code ::

```
% (pnrz.m)
% Generating a rectangular pulse of width T
% Usage: function pout = pnrz(T)
function pout = pnrz(T)
    % Generate a rectangular pulse of width T
    pout = ones(1, T);
end
% (prz.m)
% Generating a rectangular pulse of width T/2
% Usage: function pout = prz(T)
function pout = prz(T)
    % Generate a rectangular pulse of width T/2
    1 = 1; % Set the number of rows (for a single-row vector)
    pout = [zeros(1, T/4), ones(1, T/2), zeros(1, T/4)];
end
% (psine.m)
% Generating a sinusoidal pulse of width T
function pout = psine(T)
    % Generate a sinusoidal pulse of width T
    pout = sin(pi * (0:T-1) / T);
end
% (prcos.m)
function y = prcos(rollfac,length,T)
y = rcosdesign(rollfac,length,T);
end
clear; clc;
data= sign(randn(1, 400)); % Generate 400 random bits
Tau=64; % Define the symbol period
```

```
dataup= upsample(data, Tau); % Generate impulse train

yrz= conv(dataup, prz(Tau)); % Return to zero polar signal

yrz= yrz (1: end-Tau+1);

ynrz= conv(dataup, pnrz(Tau)); % Non-return to zero polar

ynrz= ynrz(1:end-Tau+1);

ysine=conv(dataup, psine (Tau)); % half sinusoid polar

ysine=ysine (1: end-Tau+1);

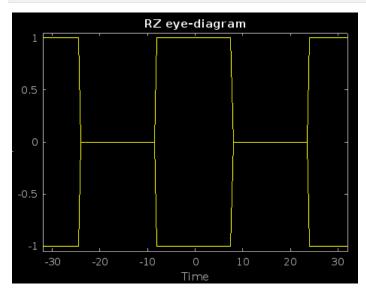
Td=4; % truncating raised cosine to 4 periods

yrcos= conv( dataup , prcos (0.5, Td, Tau)); % rolloff factor = 0.5

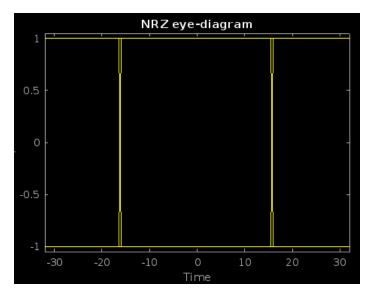
yrcos= yrcos(2*Td*Tau : end- 2*Td*Tau + 1); % generating RC pulse train

eyel= eyediagram(yrz, 2*Tau, Tau, Tau/2);

title('RZ eye-diagram');
```

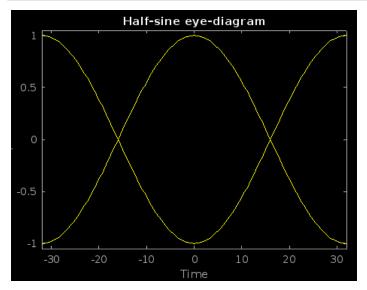


```
eye2= eyediagram(ynrz , 2*Tau, Tau, Tau/2);
title('NRZ eye-diagram');
```



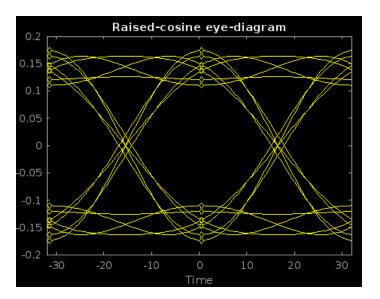
Execution of script eye as a function is not supported: /MATLAB Drive/eye.m

```
eye3= eyediagram(ysine, 2*Tau, Tau, Tau/2);
title('Half-sine eye-diagram');
```

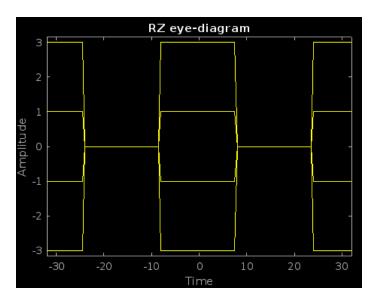


Warning: Error updating Legend.

```
eye4= eyediagram( yrcos, 2*Tau, Tau) ;
title('Raised-cosine eye-diagram');
```

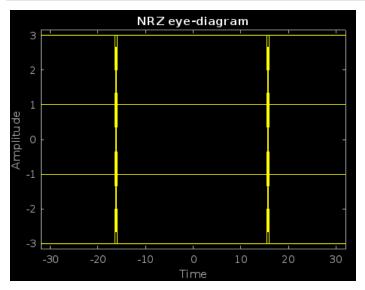


```
clear; clc;
data= sign(randn(1, 400)) + 2*sign(randn(1, 400)); % 400 PAM symbols
Tau=64; % Define the symbol period
dataup= upsample(data , Tau); % Generate impulse train
yrz =conv(dataup, prz(Tau)); % Return to zero polar signal
yrz =yrz (1: end-Tau+1);
ynrz =conv(dataup, pnrz (Tau)); % Non-return to zero polar
ynrz =ynrz(1:end-Tau+1);
ysine= conv(dataup, psine (Tau)); % half sinusoid polar
ysine= ysine (1 : end-Tau+1);
Td=4; % truncating raised cosine to 4 periods
yrcos= conv( dataup, prcos (0.5, Td, Tau)); % rolloff factor = 0.5
yrcos= yrcos(2*Td*Tau : end-2*Td*Tau+1); % generating RC pulse train
eye1=eyediagram (yrz , 2*Tau, Tau, Tau/2);
title ('RZ eye-diagram');
```



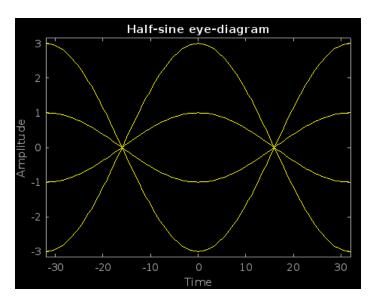
Execution of script eye as a function is not supported: /MATLAB Drive/eye.m

```
eye2=eyediagram ( ynrz , 2*Tau, Tau, Tau/2);
title ('NRZ eye-diagram');
```



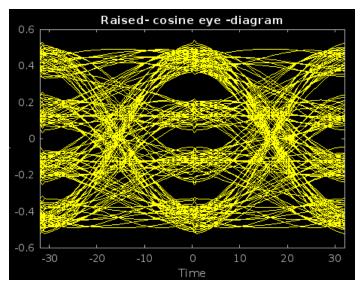
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```
eye3=eyediagram (ysine , 2*Tau, Tau, Tau/2);
title('Half-sine eye-diagram');
```



Execution of script eye as a function is not supported: /MATLAB Drive/eye.m

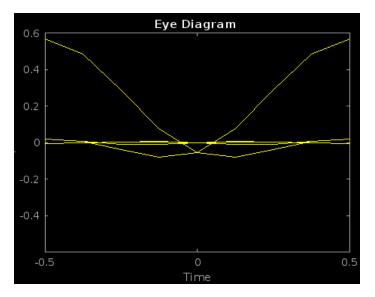
```
eye4=eyediagram ( yrcos , 2 * Tau, Tau);
title('Raised- cosine eye -diagram');
```



Warning: Error updating Legend.

```
clear all
%Define the M-ary number, calculation sample frequency
M=4; Fs=20;
```

```
%Define the number of points in the calculation
pd=500;
%Generate an integer message in range [0, m-1]
msg_d = exp_randint(pd,1,M);
%Use square constellation PAM method for modulation
msg_a = exp_modmap(msg_d,Fs,M);
%nonlinear channel
alpha=0.0;
msg_a=msg_a +alpha*msg_a.^2;
%raised cosine filtering
span = 10;
rolloff = 0.5;
sps = 4; % samples per symbol
rcv_a = rcosdesign(rolloff, span, sps, 'sqrt');
% rcv_a=rcosdesign(msg_a, Fs);
%eye pattern
eyediagram(rcv_a, 2 * sps);
```



```
function y= exp_modmap(x,Fs,M)
%PAM modulation
x=x-(M-1)/2;
x=2*x/(M-1);
y=zeros(length(x)*Fs,1);
p=0;
for k=1:Fs:length(y)
p=p+1;
y(k:(k+Fs-1))=x(p)*ones(Fs,1);
end
end
function out = exp_randint(p,q,r)
%random integer generator
```

```
r = [0, r-1];
r = sort(r);
r(1) = ceil(r(1));
r(2) = floor(r(2));
if r(1) == r(2)
out = ones(p,q) * r(1);
return;
end
d = r(2) - r(1);
r1 = rand(p,q);
out = ones(p,q)*r(1);
for i = 1:d
index = find(r1 >= i/(d+1));
out(index) = (r(1) +1) * index./index;
end
end
```

→ Conclusion ::

We plotted different eye diagrams of the different sampled signals like pulse , sinusoidal , cosine and etc .