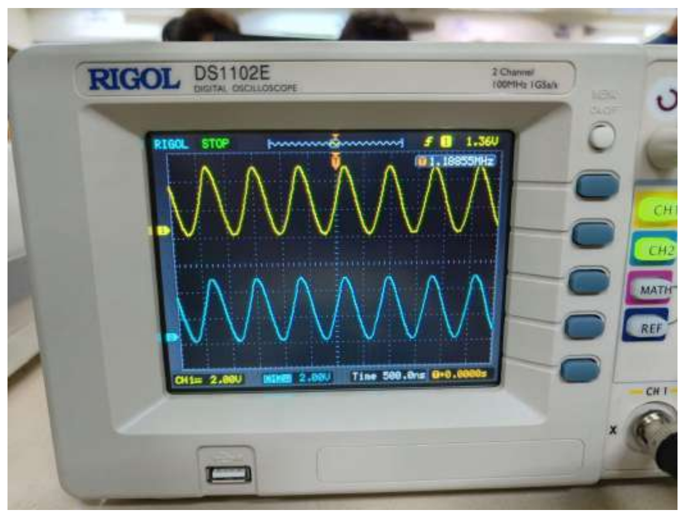
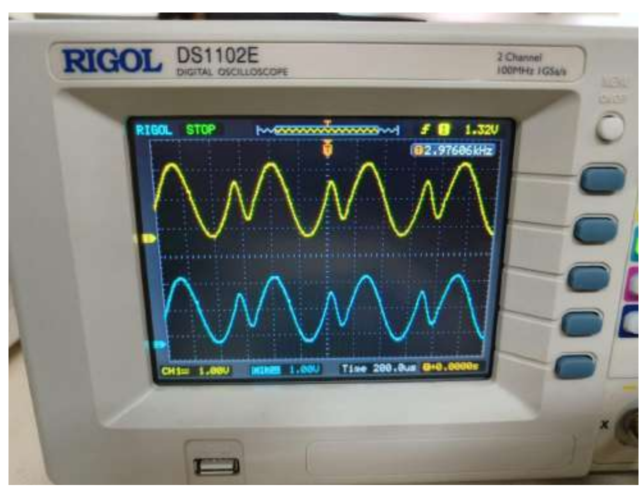
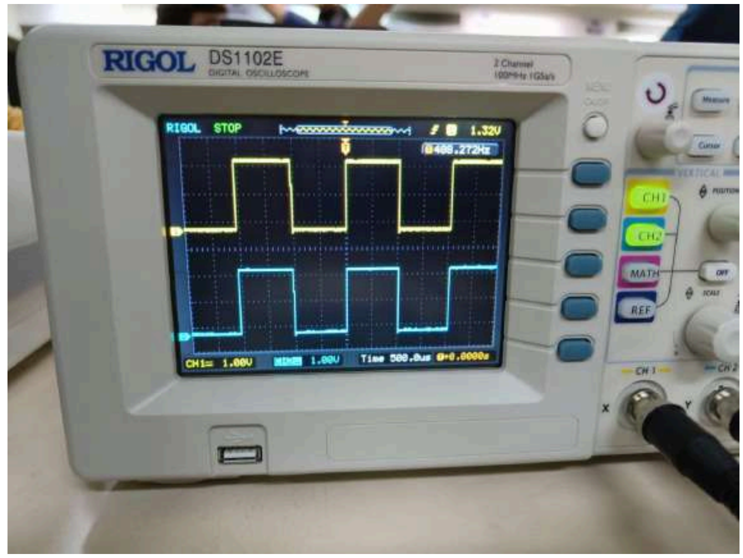
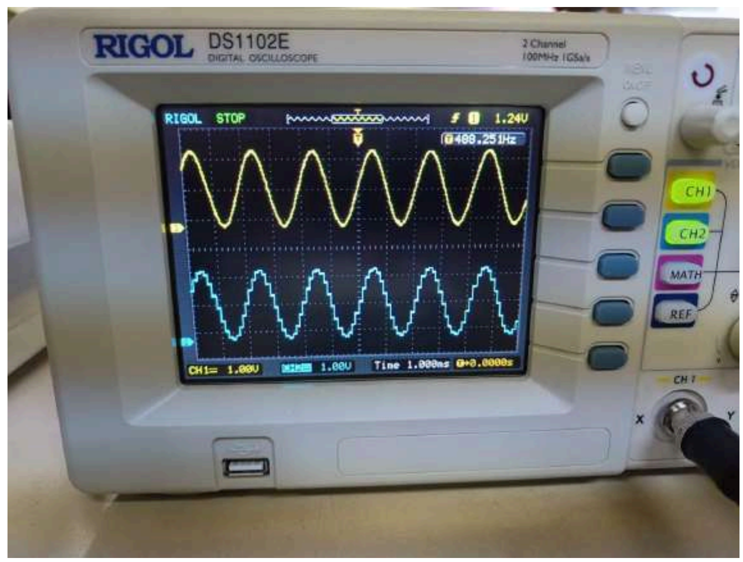
Lab-3

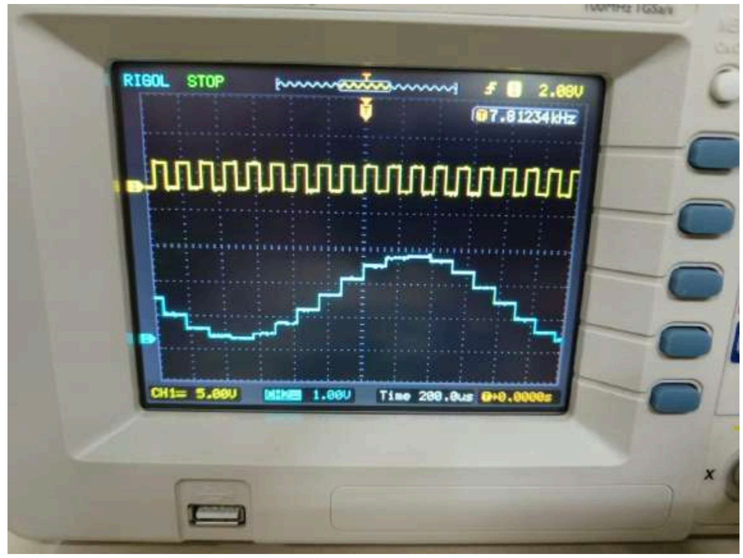
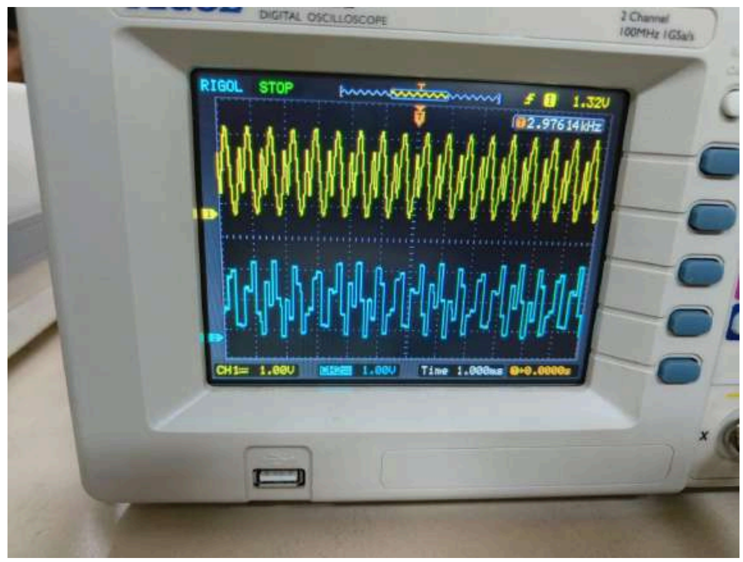
Raj-202201403, Bhoomish-202201414

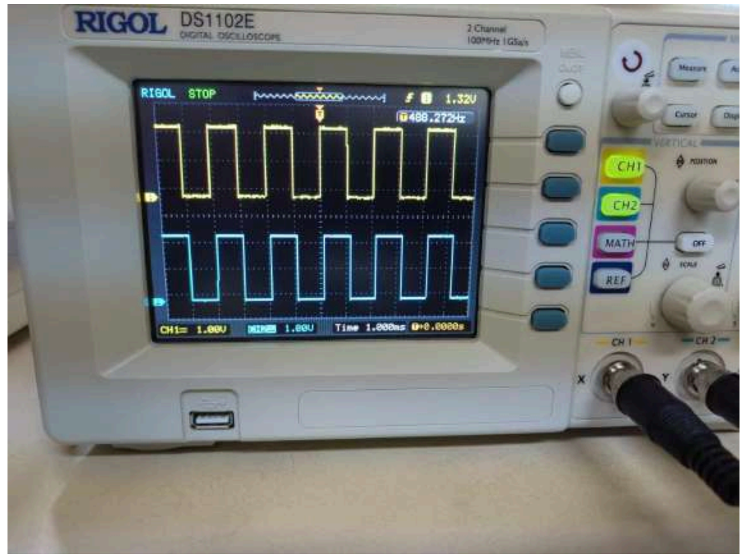
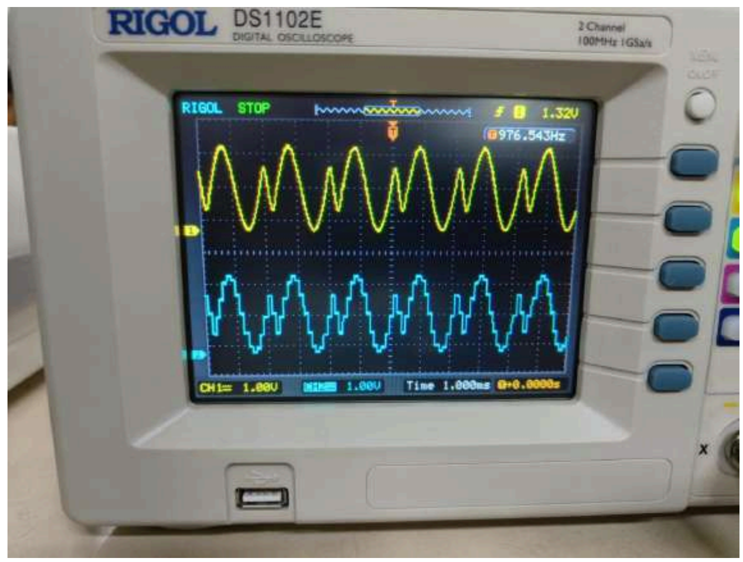
Manthan-202201416, Rakshit-202201426

Experiment 8

I/P Signal Type/Freq	Channel	Sampling Freq	Sampled Outputs
Sine/ 500 Hz	Channel 1	-	
Arbitrary /1.5 KHz	Channel 2	-	

Square /500 Hz	Channel 3	-	
Sine/ 500 Hz	Channel 1	8 KHz	

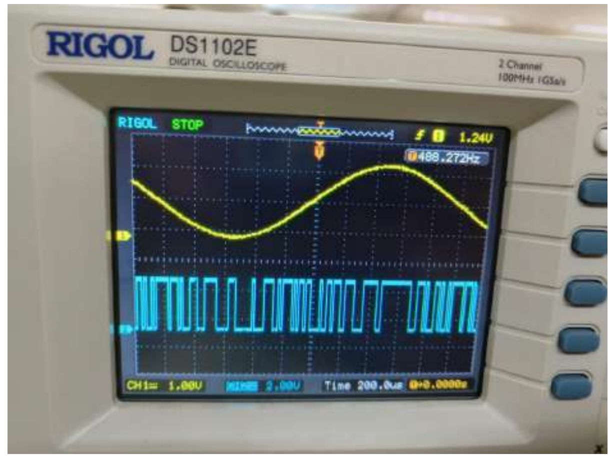
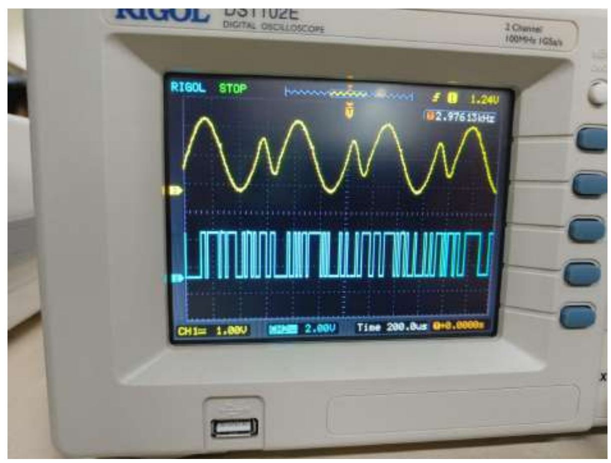
Sine/ 500 Hz	Channel 1	8 KHz	
Arbitrary /1.5KHz	Channel 2	16 KHz	

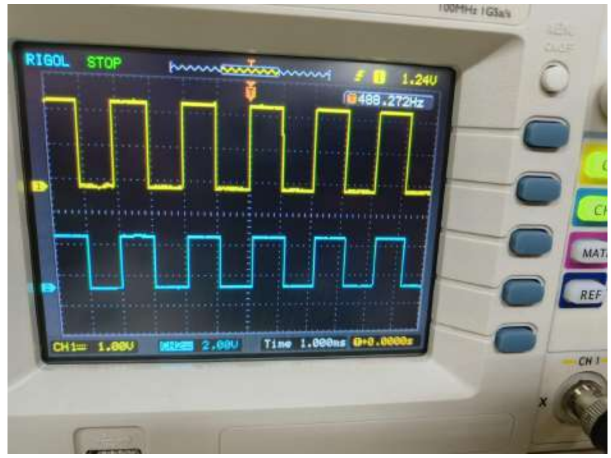
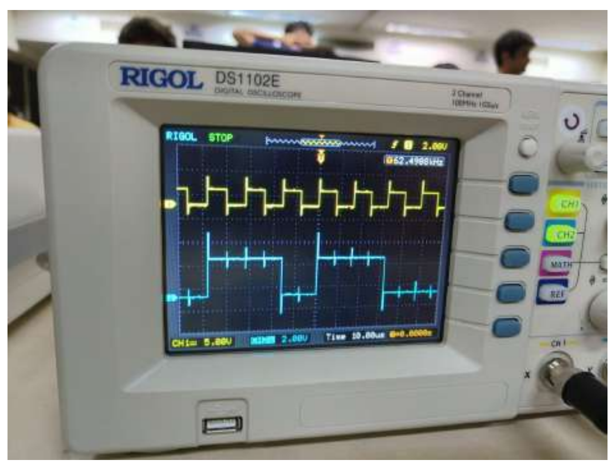
Square/ 500 Hz	Channel 3	8 KHz	
Arbitrary /1.5KHz	Channel 4	8 KHz	

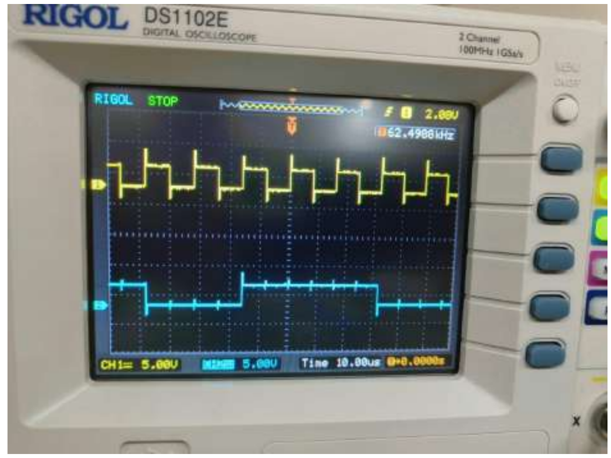
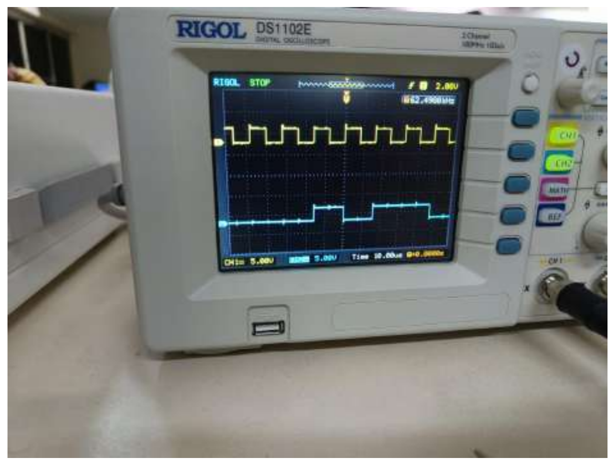
Conclusion:

- Through this experiment, we learned how by varying the input signal frequencies, we see the effect on waveforms at each channel.
- By changing the sampling clock frequencies, we see sample-and-hold signals affect the quality of signal sampling.
- The more the samples, the better the signal integrity is maintained.

Experiment 9

I/P Signal Type/Freq	Channel	Sampling Freq.	Sampled Output
Sine/ 500 Hz	Channel1	8 KHz	
Arbitrary/ 500Hz	Channel2	8 KHz	

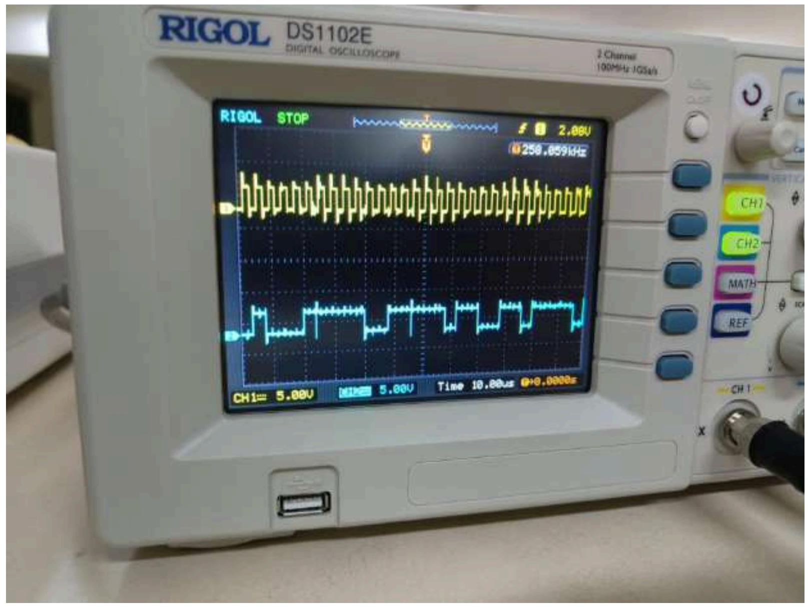
Square/ 500 Hz	Channel3	8 KHz	
Arbitrary /1.0KHz	Channel4	16 KHz	
Sine/ 500 Hz	Channel1	8 KHz	

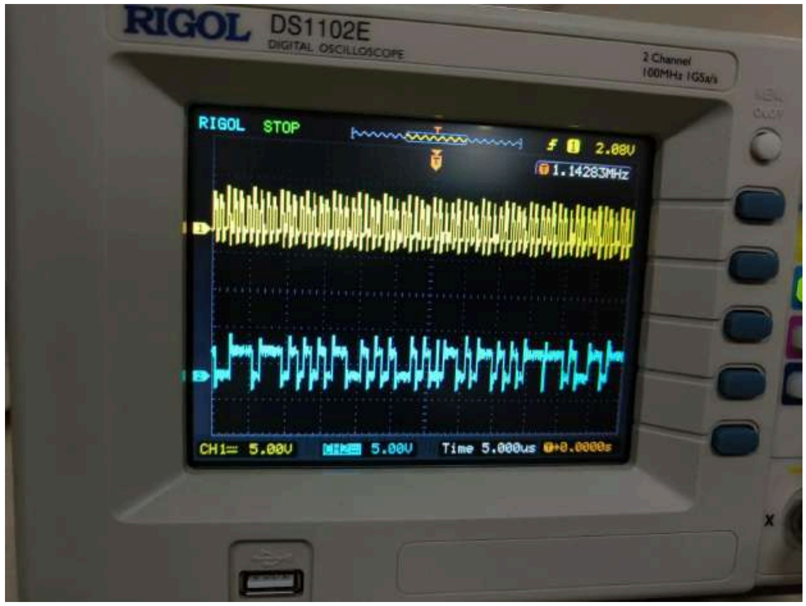
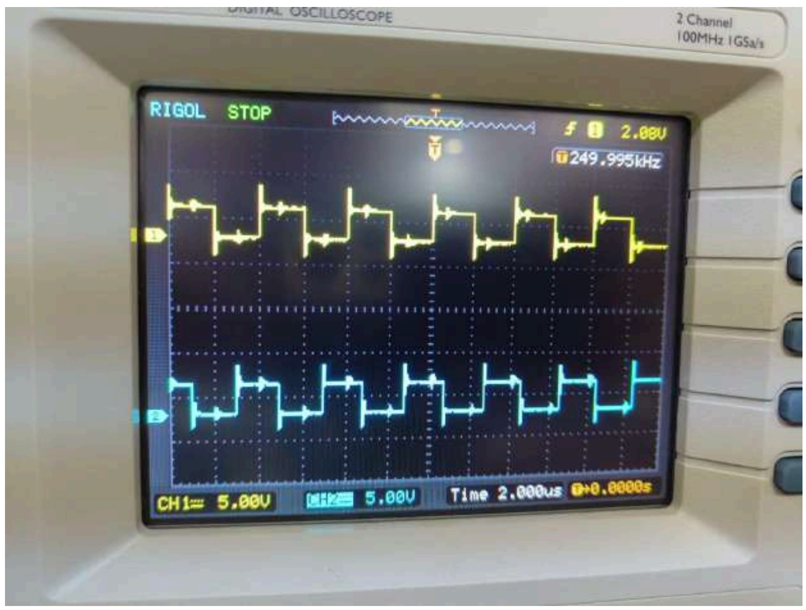
Sine/1.5 KHz	Channel2	8 KHz	
Sine/500 Hz	Channel3	8 KHz	

Conclusion:

- Through this experiment, we learned how varying the line speed frequencies impacted the PCM clock and output signals.
- By adjusting line speed, we note changes in PCM output which demonstrates how line speed affects signal transmission in PCM.

Experiment 10

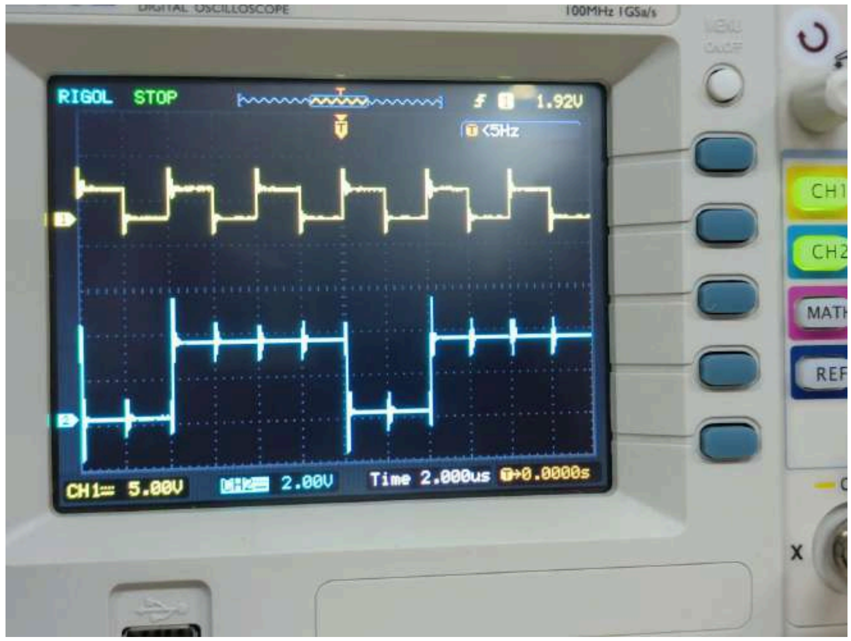
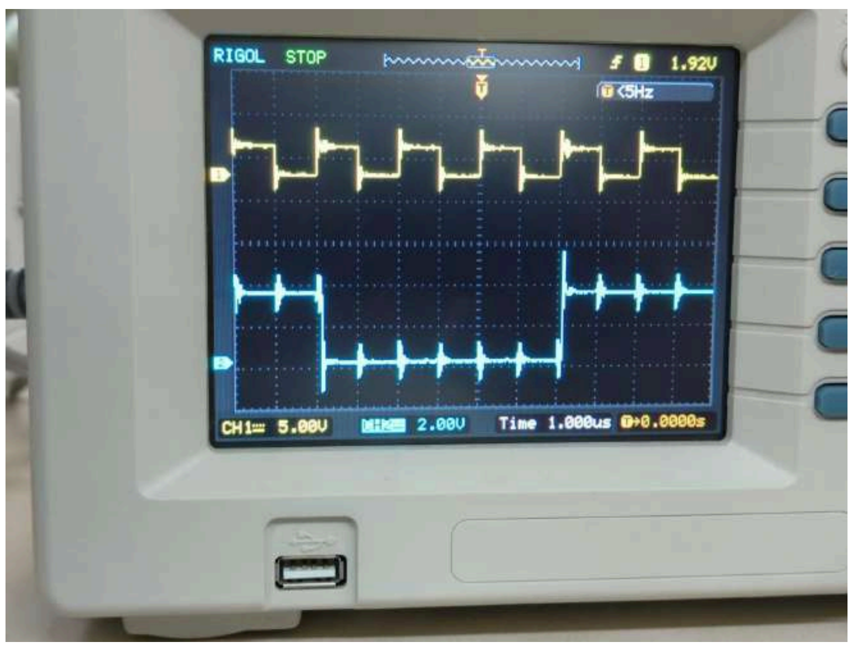
I/P Signal Type/Freq	Sampling Freq.	Sampled Output
Sine/500 Hz	8 KHz	
Sine/500 Hz	16 KHz	

Sine/500 Hz	32 KHz	
Sine/500 Hz	8 KHz	

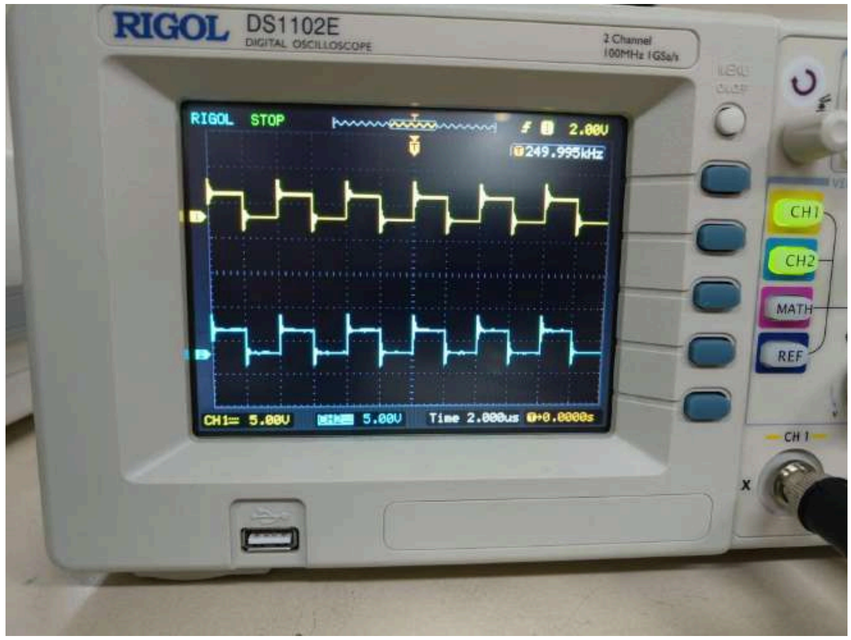
Conclusion:

- Through this experiment, we observed the multiplexed output of a 33 bit frame, one bit of framing pulse.
- The framing pulse helped synchronize the frame for accurate transmission and reception.

Experiment 11

I/P Signal Type/Freq	Sampling Freq.	Sampled Output
Sine/ 500 Hz	8 KHz	
Sine/ 500 Hz	16 KHz	

Sine/ 500 Hz	32 KHz	
Sine/ 500 Hz	8 KHz	

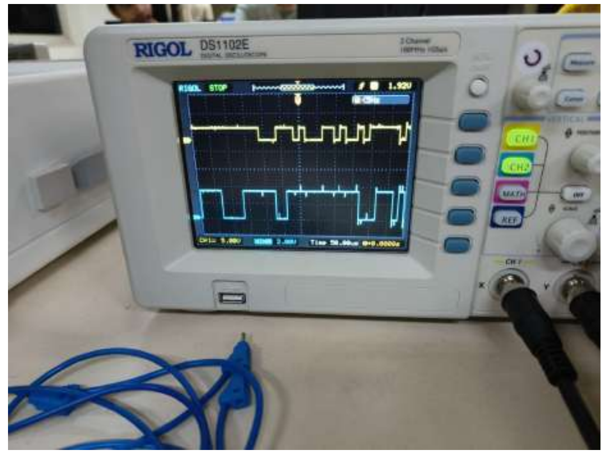
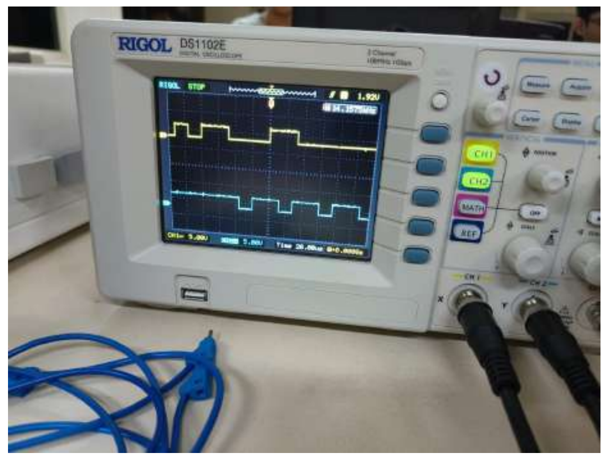
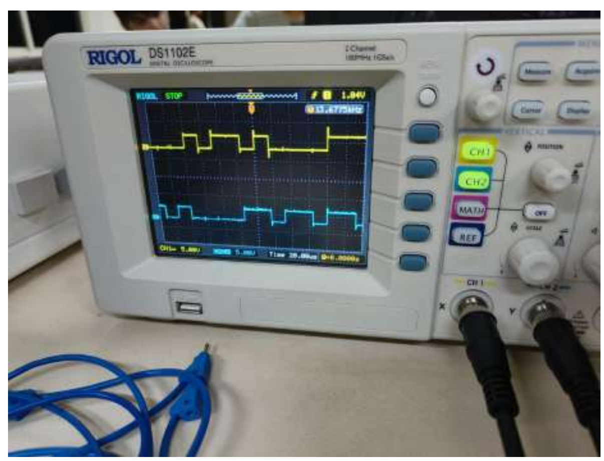
Sine/ 500 Hz	8 KHz	

Conclusion:

- Through this experiment, we observed how 32 bit frame output after detecting the framing pulse.
- The framing pulse is essential for accurately identifying and synchronizing the 32 bit frame, ensuring that the data is correctly aligned and transmitted.

Experiment 12

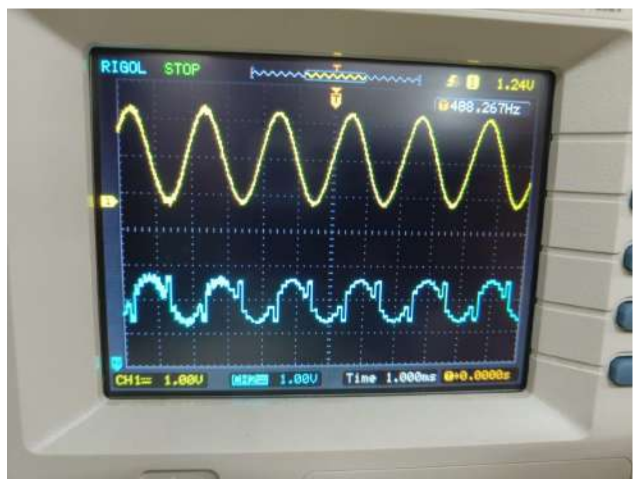
I/P Signal Type/Freq	Channel	Sampling Freq	Sampled Outputs

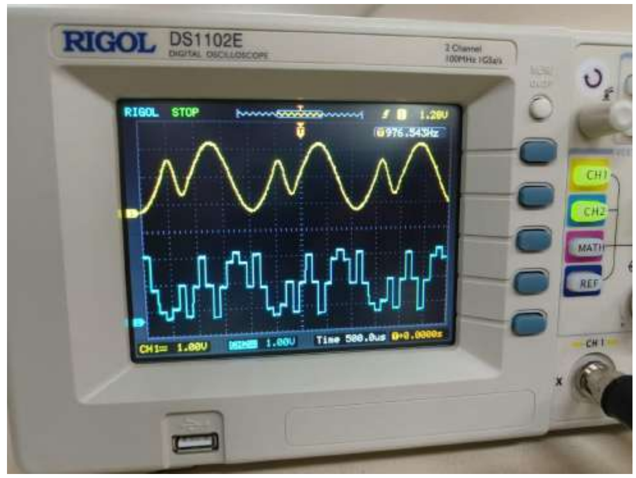
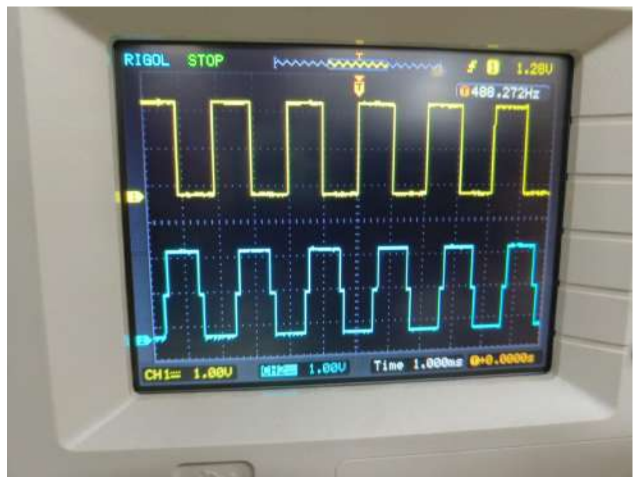
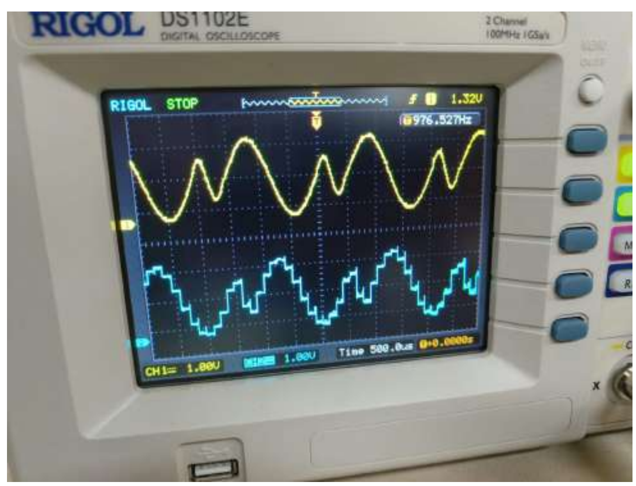
Sine/ 500 Hz	Channel1	8 KHz	
Sine/ 500 Hz	Channel2	8 KHz	
Sine/ 500 Hz	Channel3	8 KHz	

Conclusion:

- Through this experiment, we observed how the demultiplexed output of a 4 channel PCM correctly separates and displays each channel’s output at the designated test points, namely TP29, TP32, TP35, TP38.

Experiment 13

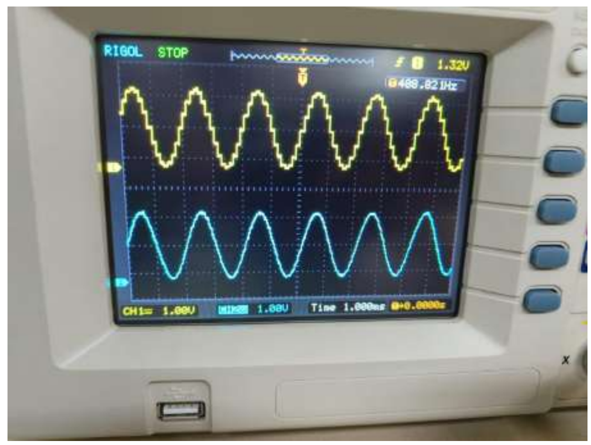
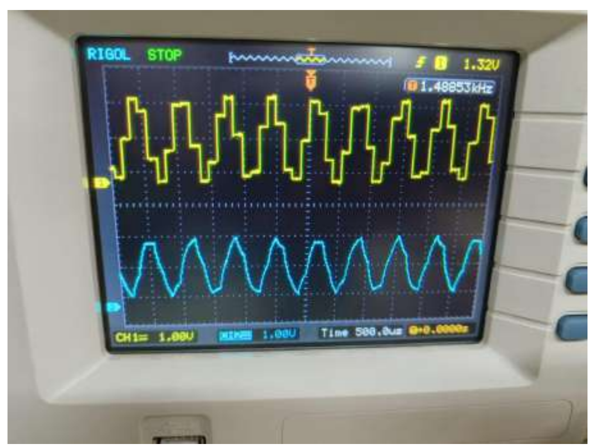
I/P Signal Type/Freq	Channel	Sampling Freq	Sampled Outputs
Sine/ 500 Hz	Channel1	8 KHz	
Sine/ 500 Hz	Channel1	8 KHz	

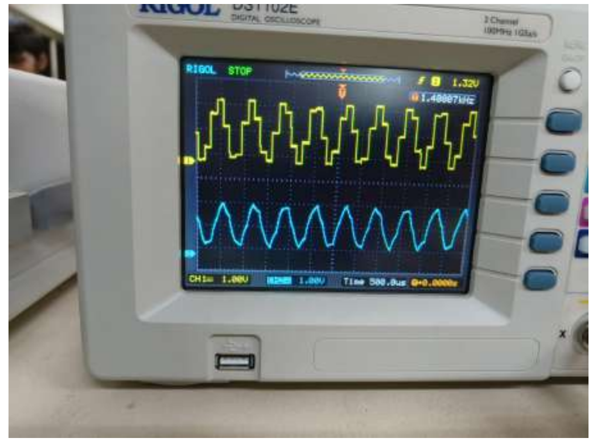
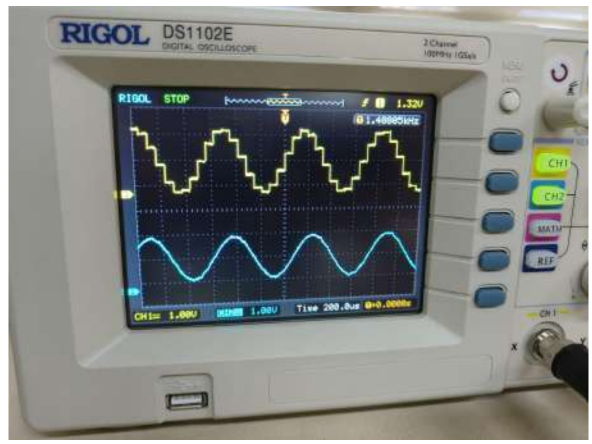
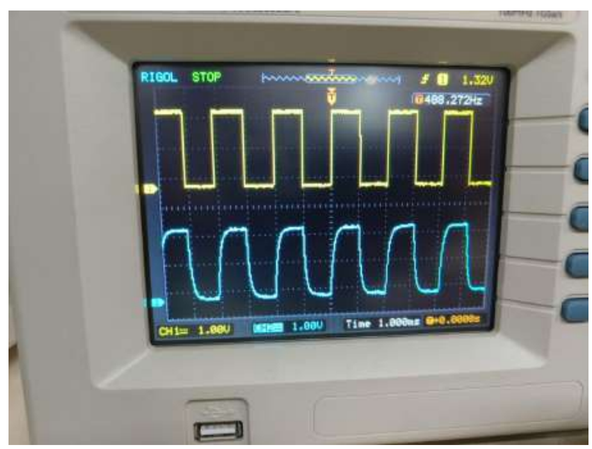
Arbitrary/500 Hz	Channel2	8 KHz	
Square/ 500 Hz	Channel3	8 KHz	
Arbitrary/500 Hz	Channel4	8 KHz	

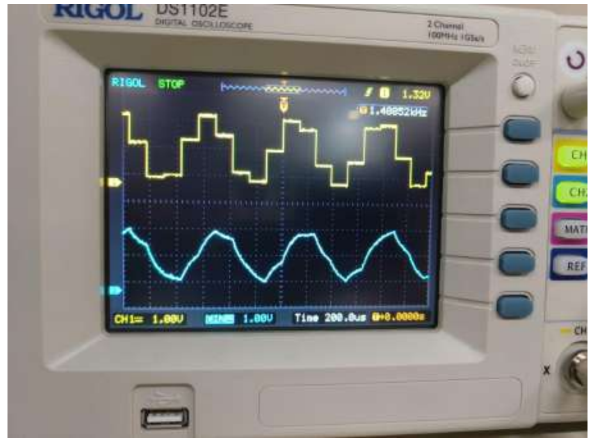
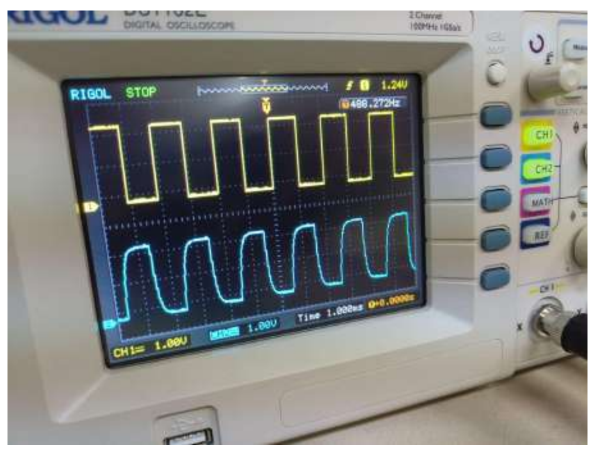
Conclusion:

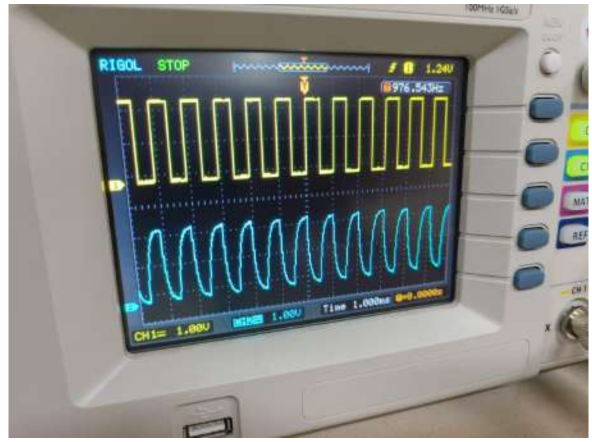
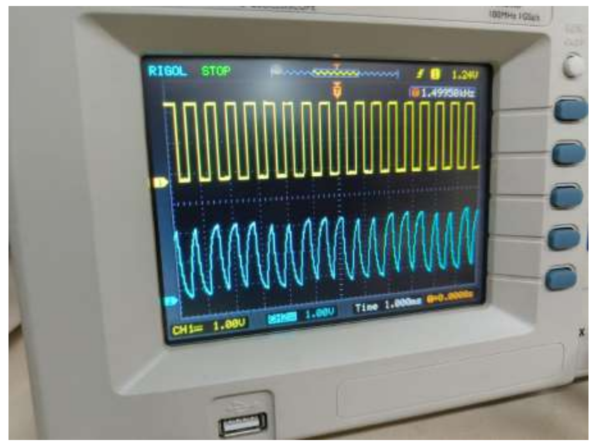
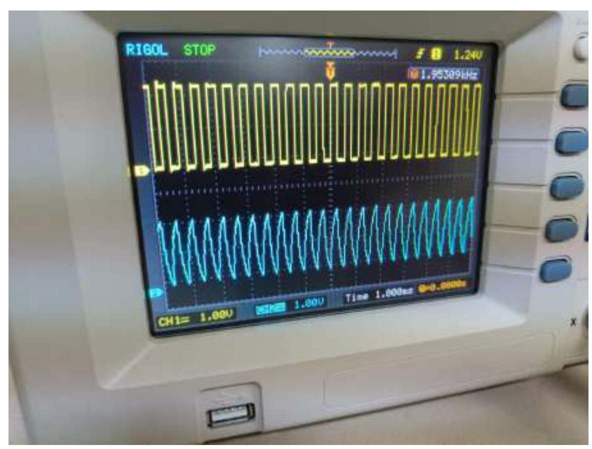
- Through this experiment, we learned how demodulated outputs of a 4 channel PCM system accurately recovered the original signal from the sampling process.
- This confirms that the TDM PCM system effectively demodulates the multiplexed signal and reconstructs the original channel signal.

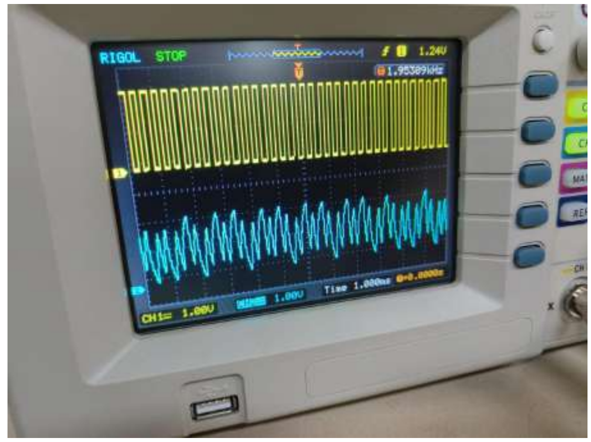
Experiment 14

I/P Signal Type/Freq	Channel	Sampling Freq	Sampled Outputs
Sine/ 500 Hz	Channel1	8 KHz	
Sine/1.5 KHz	Channel1	8 KHz	

Sine/1.5 KHz	Channel2	8 KHz	
Sine/1.5 KHz	Channel2	16 KHz	
Square/ 500 Hz	Channel3	8 KHz	

Sine/1.5 KHz	Channel3	8 KHz	
Arbitrary/ 500 Hz	Channel4	8 KHz	
Square/ 500 Hz	Channel1	8 KHz	

Square/ 1 KHz	Channel1	8 KHz	
Square/ 1.5 KHz	Channel1	8 KHz	
Square/ 2 KHz	Channel1	8 KHz	

Square/ 3 KHz	Channel1	8 KHz	

Conclusion:

- Through this experiment, we observed how Low Pass Filter is used for the demodulated signals
- The filter smooths out the demodulated square wave due to its 5 kHz cutoff frequency.
- This confirms that LPF attenuates high frequency components and presents clear representation of demodulated signals.

Matlab Experiment:

Matlab Code:

```
s = sign(randn(1, 400)); % Generate 400 random bits
for a = [0,0.05,0.1,0.2]
 x = s + a* (s.*s); %input non - linear signal
 Tau=64; % Define the symbol period
 dataup=upsample(x, 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 cos ine 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
 a
 eyel=eyediagram( yrz,2*Tau,Tau,Tau/2); title ('RZ eye - diagram');
 eye2=eyediagram( ynrz,2*Tau,Tau,Tau/2); title ('NRZ eye-diagram');
 eye3=eyediagram( ysine,2*Tau,Tau,Tau/2); title('Half-sine eye-diagram');
 eye4
```

Pnrz.m

```
 function pout=pnrz(T)
 pout=ones(1, T);
 end
```

Prz.m

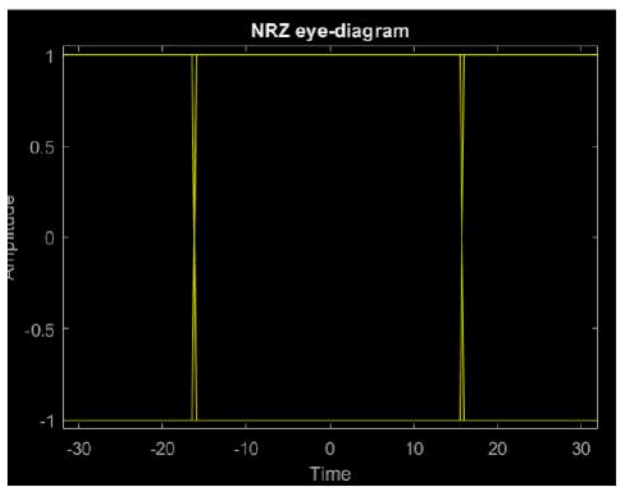
```
 function pout=prz(T)
 pout=[zeros(1,T/4) ones(1,T/2) zeros(1,T/4)];
 End
```

Psine.m

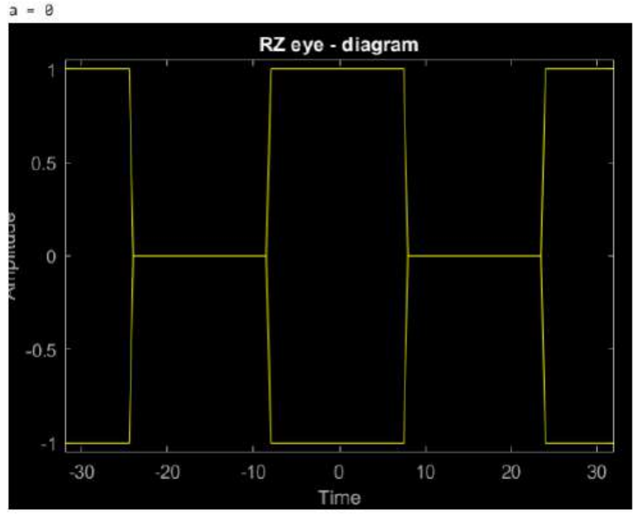
```
function pout=psine(T)
 pout=sin(pi*(0 : T- 1)/T);
 end
```

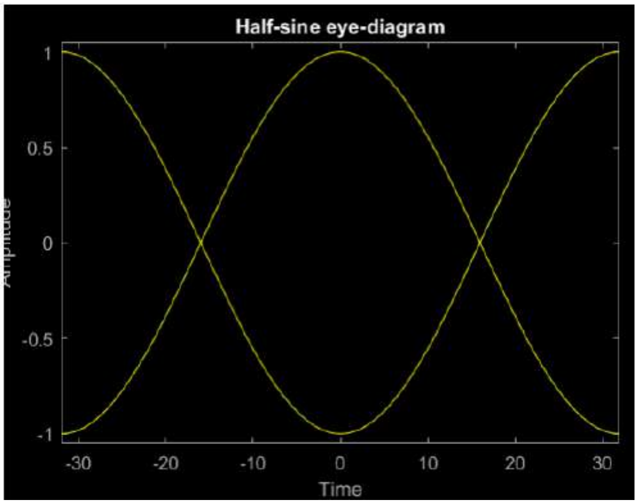
Prcos.m

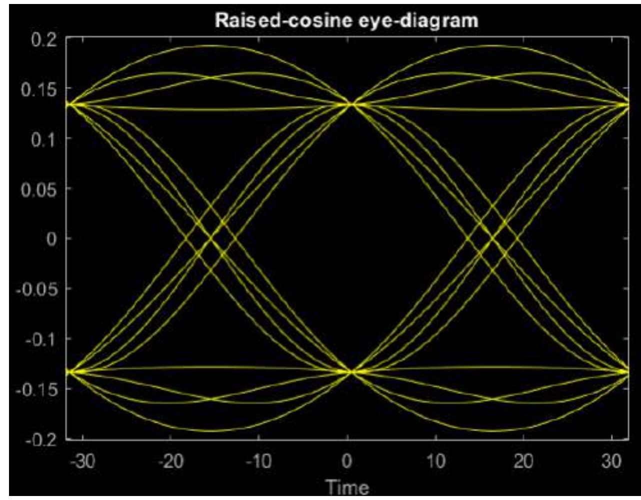
```
function y = prcos(rollfac, length, T)
span = length;
sps = T;
 y = rcosdesign(rollfac, span, sps, 'normal');
 end
```

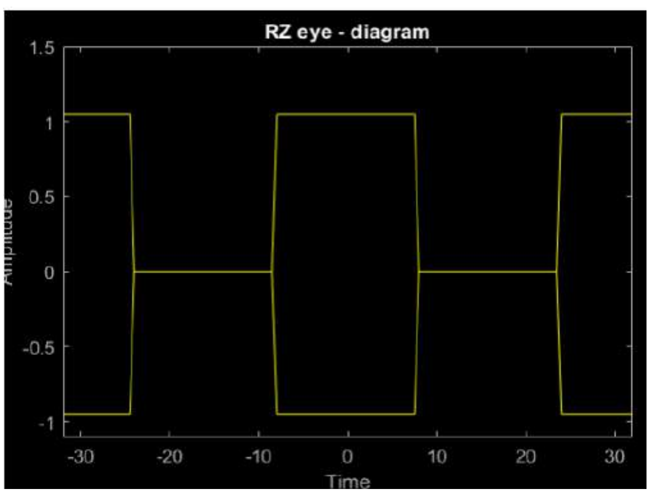


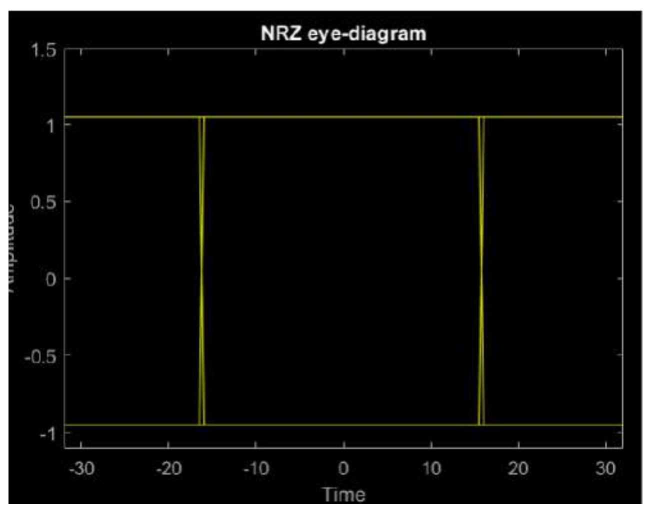
a = 0

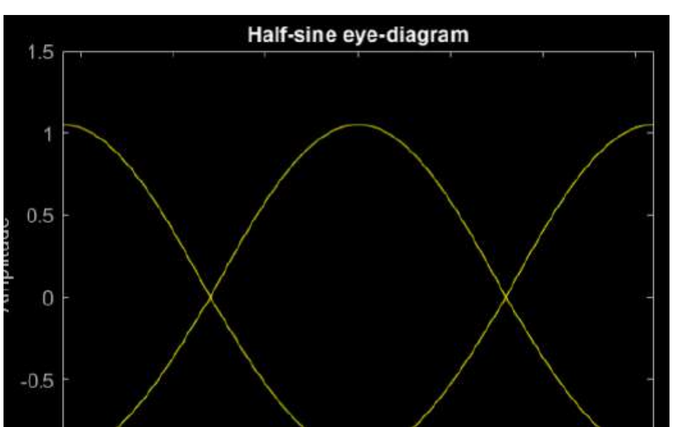


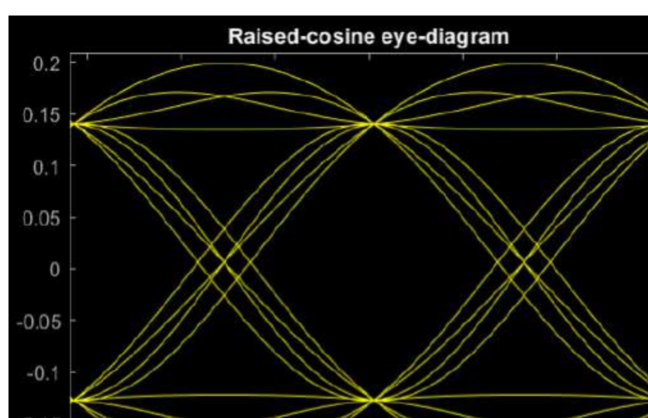

Half-sine eye-diagram
Time

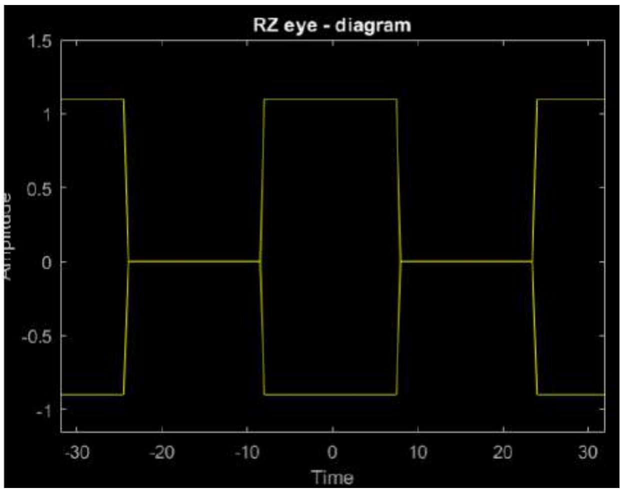

Raised-cosine eye-diagram
Time

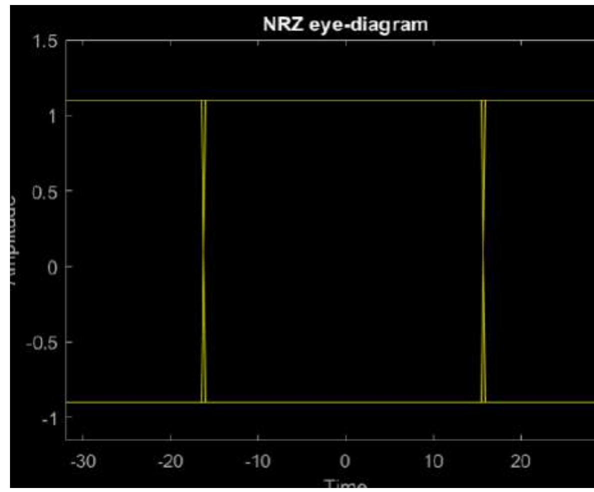

RZ eye - diagram
Time

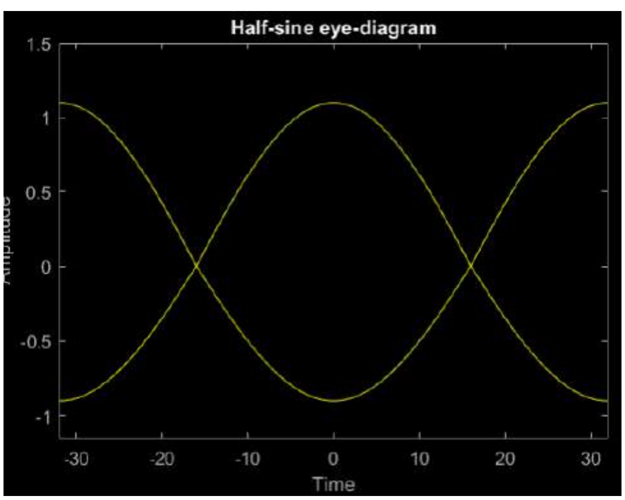

NRZ eye-diagram
Time

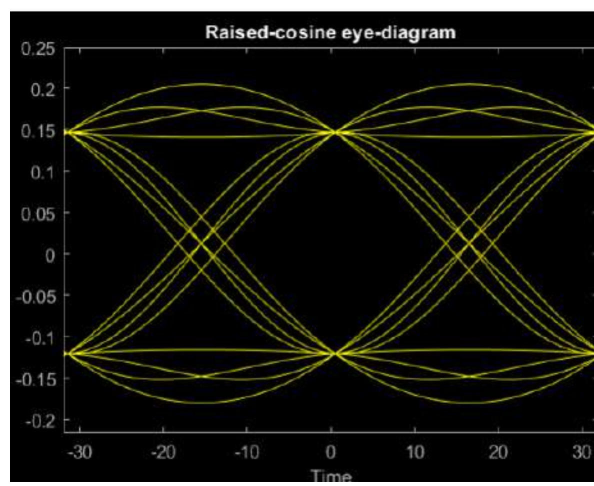

Half-sine eye-diagram


Raised-cosine eye-diagram

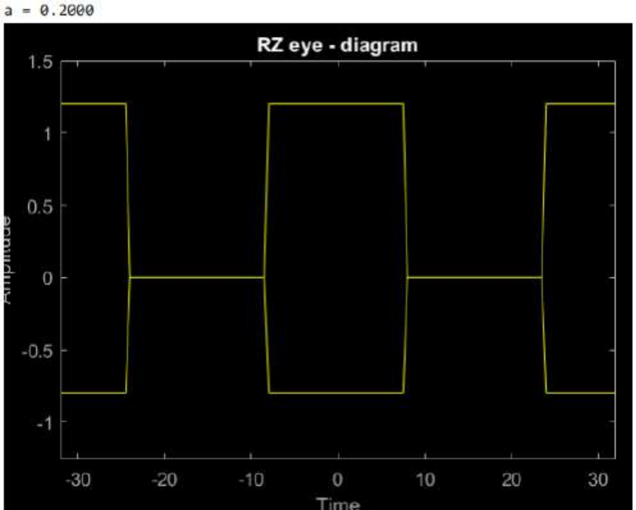

RZ eye - diagram
Time

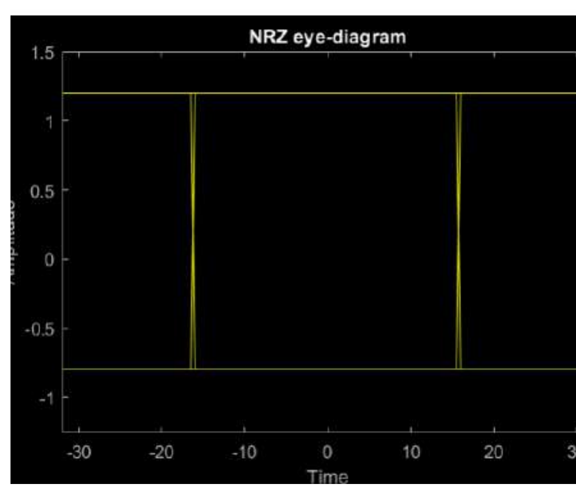

NRZ eye-diagram

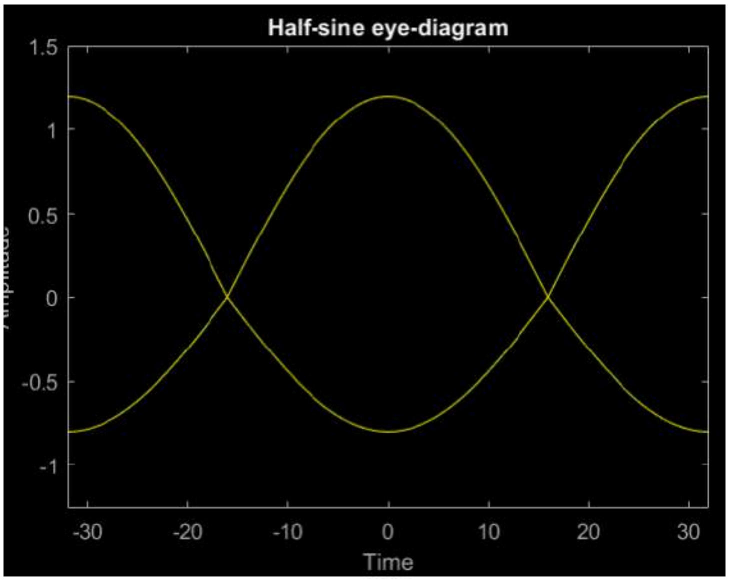

Half-sine eye-diagram
Time

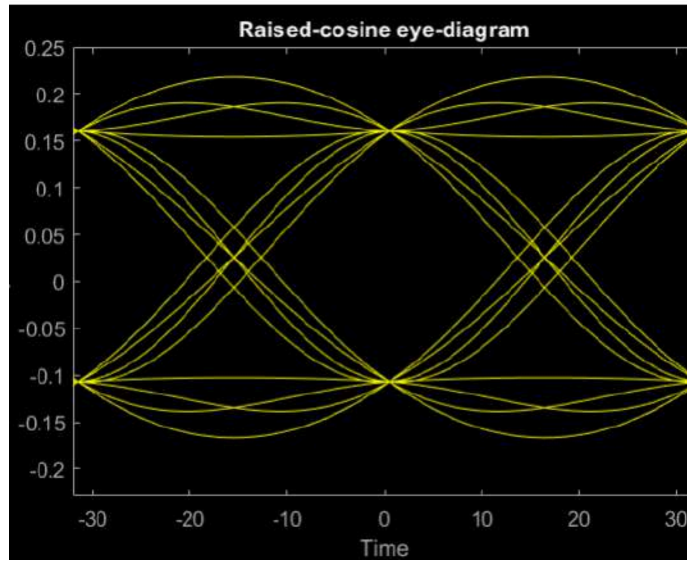

Raised-cosine eye-diagram

a = 0.2000


RZ eye - diagram
Time


NRZ eye-diagram
Time


Half-sine eye-diagram
1.5
1
0.5
0
-0.5
-1
-30
-20
-10
0
10
20
30
Time


Raised-cosine eye-diagram
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-30
-20
-10
0
10
20
Time