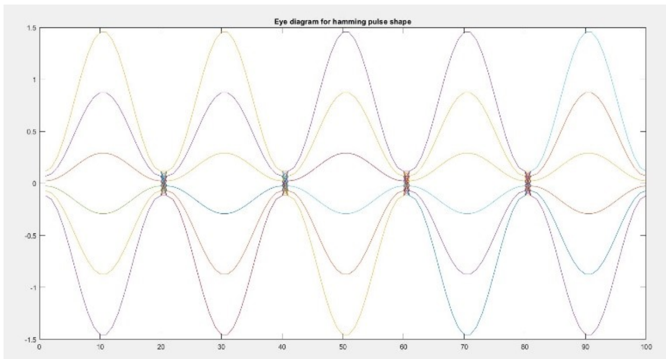
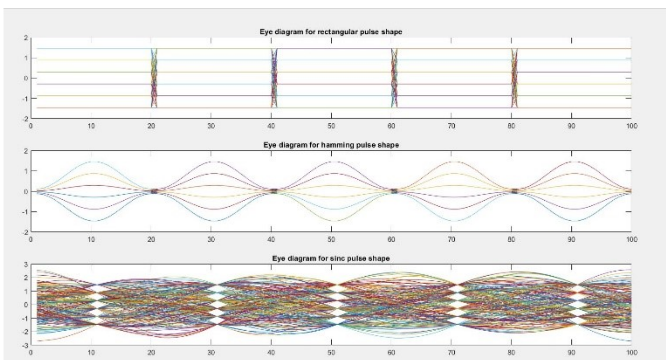
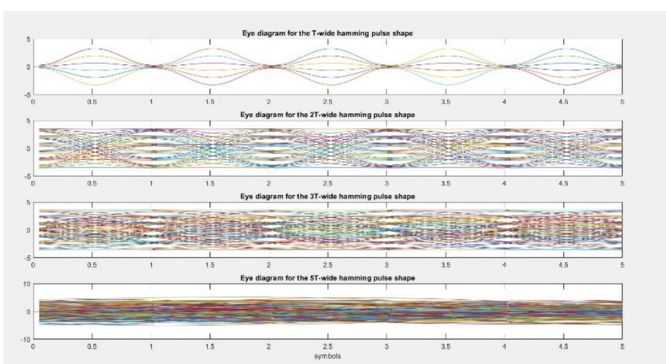
Name: Bithiah Ngan
Course: ELC 4350
Assignment: HW 3
Date: 4/30/2021

Question 1

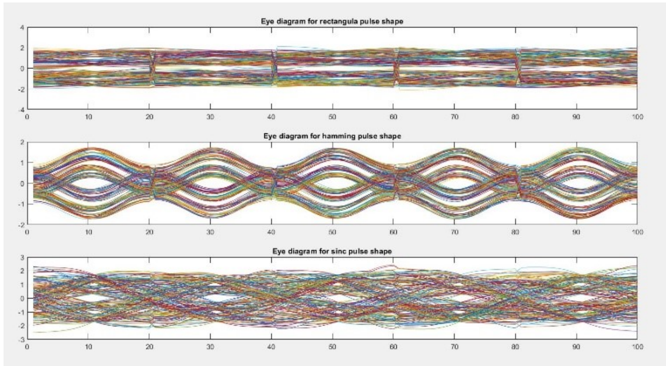




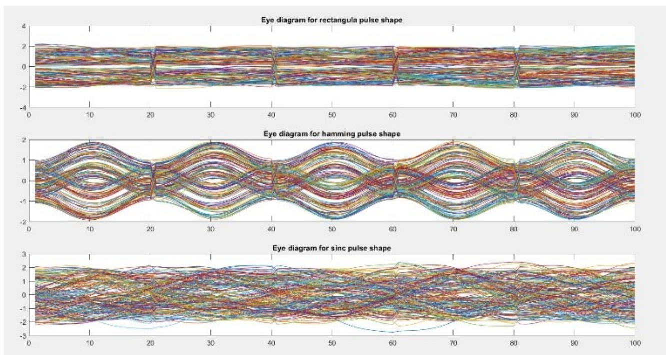


Question 2

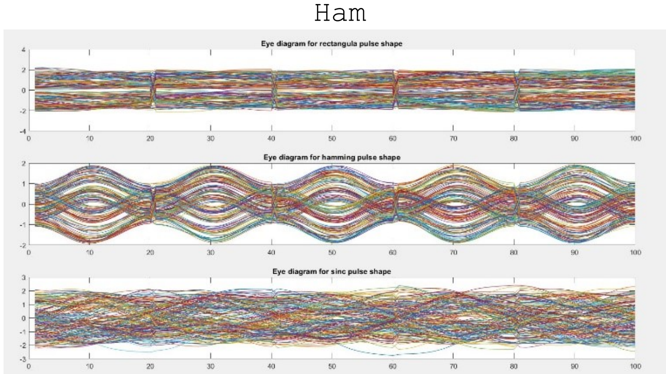
Values of v that have eye diagrams remain open are v = 0.42 for rectangle v = 0.48 for Hamming, and v = 0.52 for sinc pulse shapes.



rec

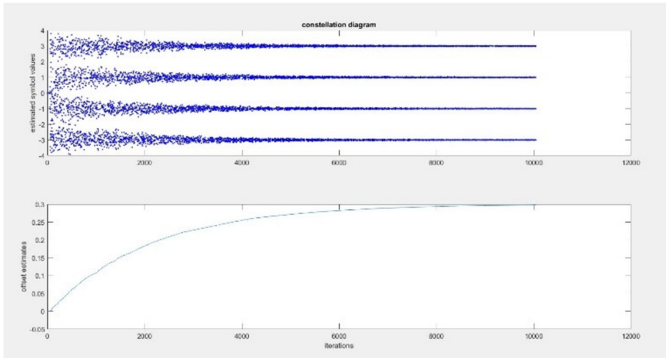


Ham

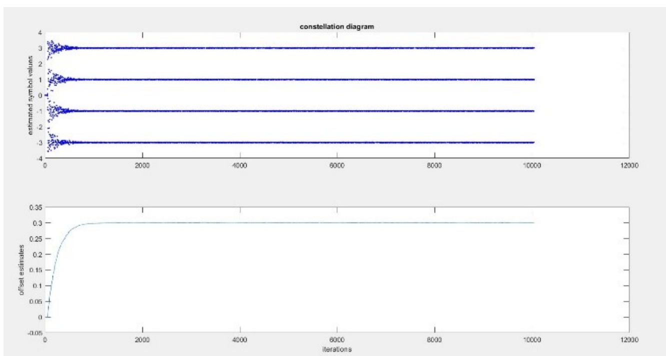


Question 3

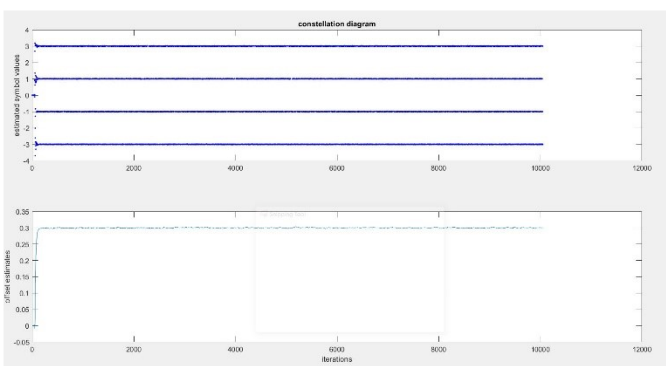
Step size = 0.001



Step size = 0.01



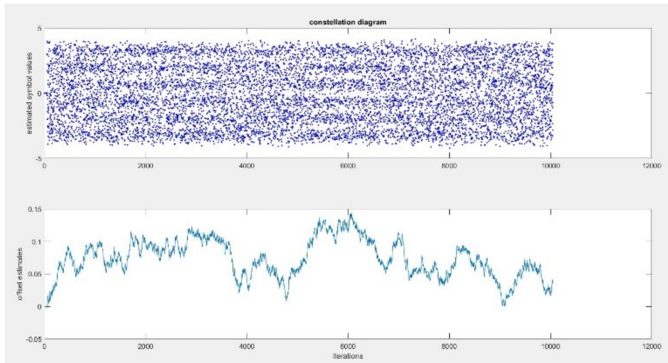
Step size = 0.1



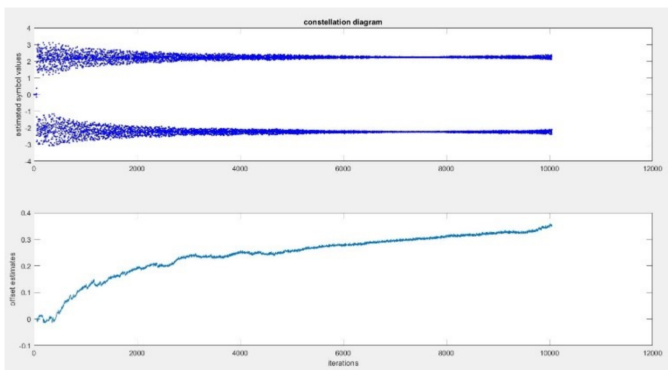
(a) As mu value increases, convergence rate increases. Range of step sizes from 0.001 to 0.01 results better constellation diagrams. Yet, s, the step size for mu can be too small or too large, and the adaptive algorithm will fail to converge to the correct gain value.

(b)

6-PAM

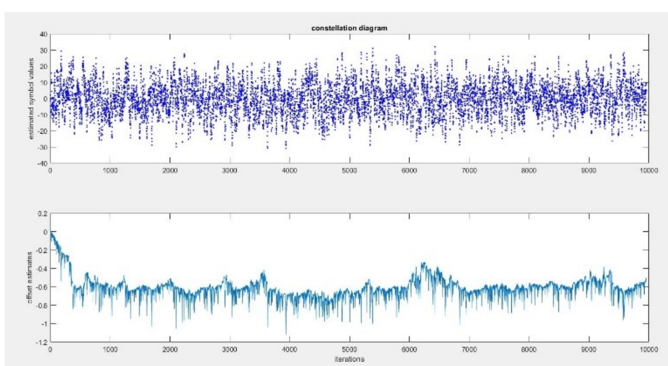


2-PAM



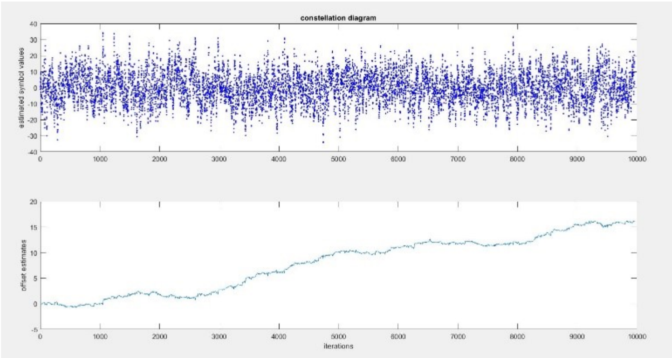
Question 4

A rectangular pulse shape at 4-PAM is worse than SRRC because rectangular pulse shape is more sensitive to repetitive data and synchronizing error.



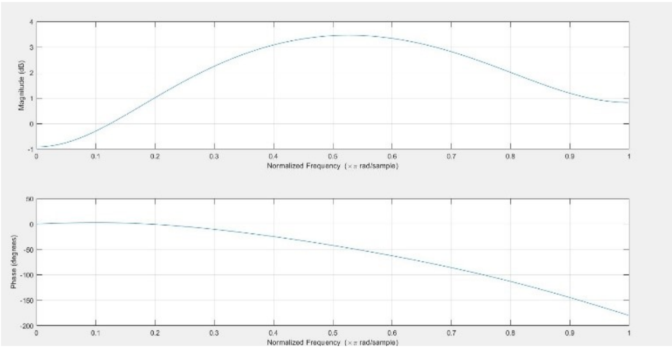
Question 5

When noise is added to the signal, the convergence of the timing-offset parameter tau increases and the final converged value increases.

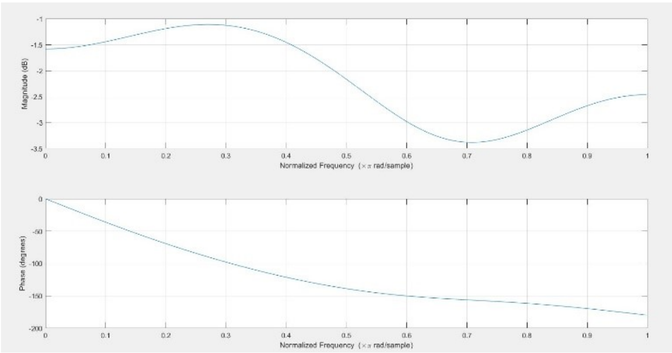


Question 6

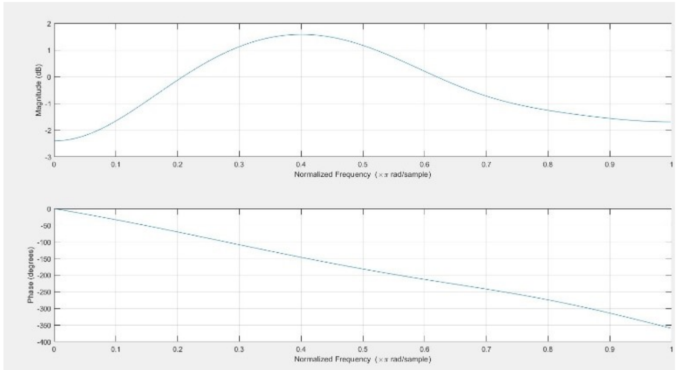
Frequency response of the channel b



Frequency response of the equalizers



The product of the magnitude of the frequency responses



The equalized channel has a magnitude response that is equal to 0 dB (unity gain)is at 0.3 Hz and 0.5 Hz. A constant delay corresponds to a linear phase response and the phase response is closed to linear.

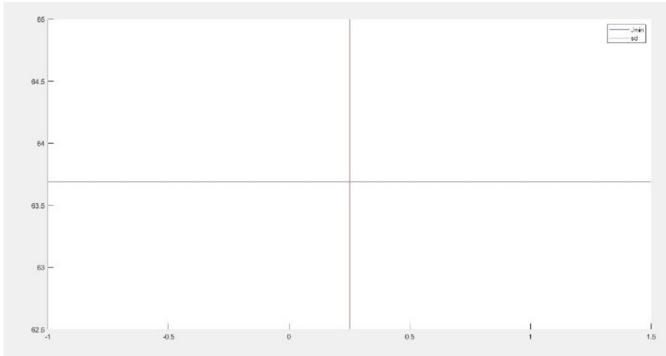
Question 7

(a). For the equalizer with delay 2, the largest sd I can add and still have no errors is 0.25.

```
%% LSequalizer.m find a LS equalizer f for the channel b
b=[ 0.5 1 -.6]                    % define channel
sd = 0.25
m=1000; s=sign(randn(1,m));         % binary source of length m
r=filter(b,1,s)+sd*randn(size(s));             % output of channel
n=3;                                % length of equalizer - 1
delta=2;                            % use delay <=n*length(b)
p=length(r)-delta;
R=toeplitz(r(n+1:p),r(n+1:-1:1)); % build matrix R
S=s(n+1-delta:p-delta)';            % and vector S
f=inv(R'*R)*R'*S;                   % calculate equalizer f
Jmin=S'*S-S'*R*inv(R'*R)*R'*S;      % Jmin for this f and delta
y=filter(f,1,r);               % equalizer is a filter
dec=sign(y);                        % quantize and find errors
err=0.5*sum(abs(dec(delta+1:end)-s(1:end-delta)))
freqz(conv(f,b),1)
```

```
ommand Window

sd =

    0.2500


err =

     0
```

(b)



(c) For the equalizer with delay 1, the largest sd I can add and still have no errors is 0.2.Greater 0.2 causes error sometimes.

(d) Equalizer with delay 2 is a better one.