Part 1:
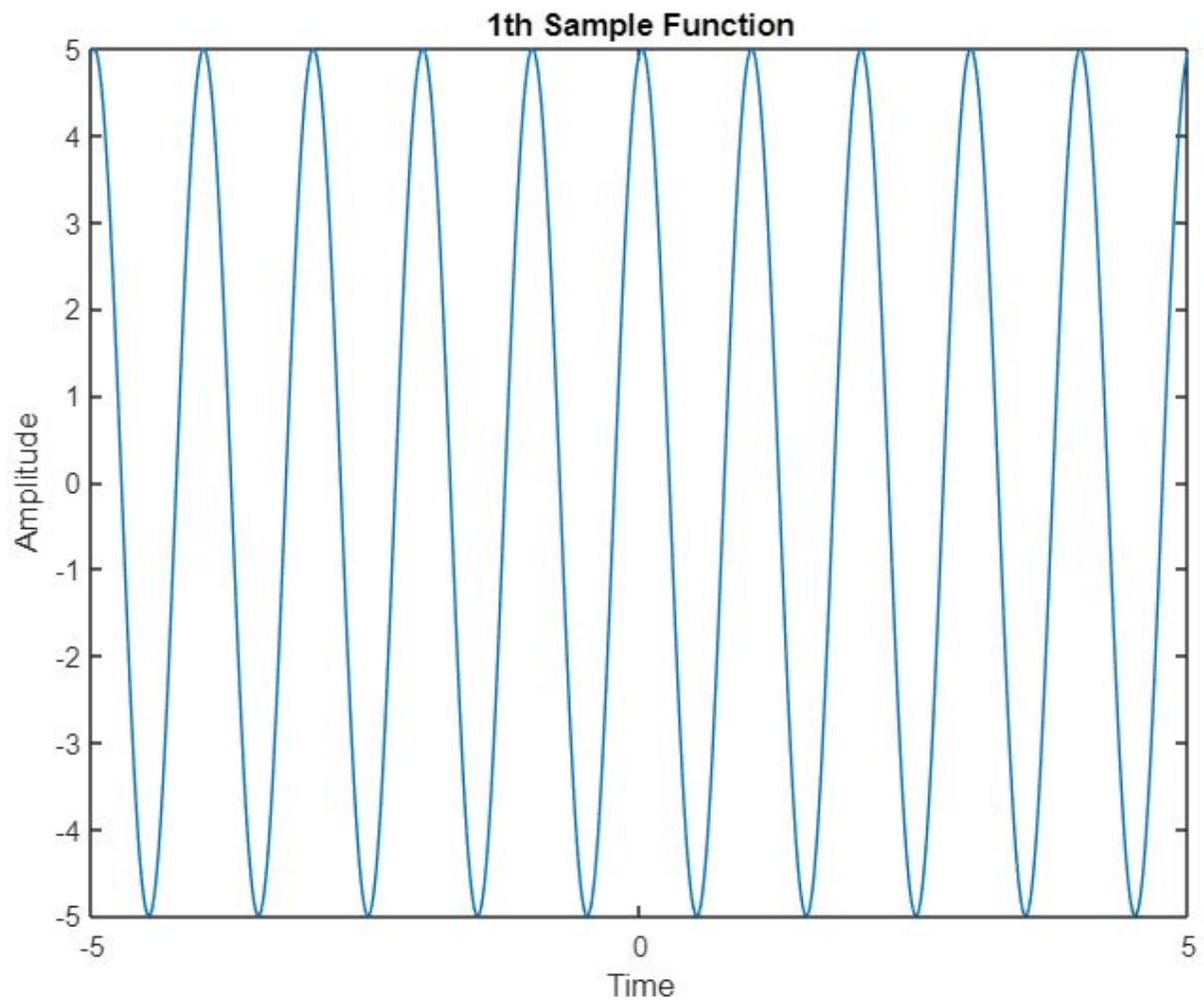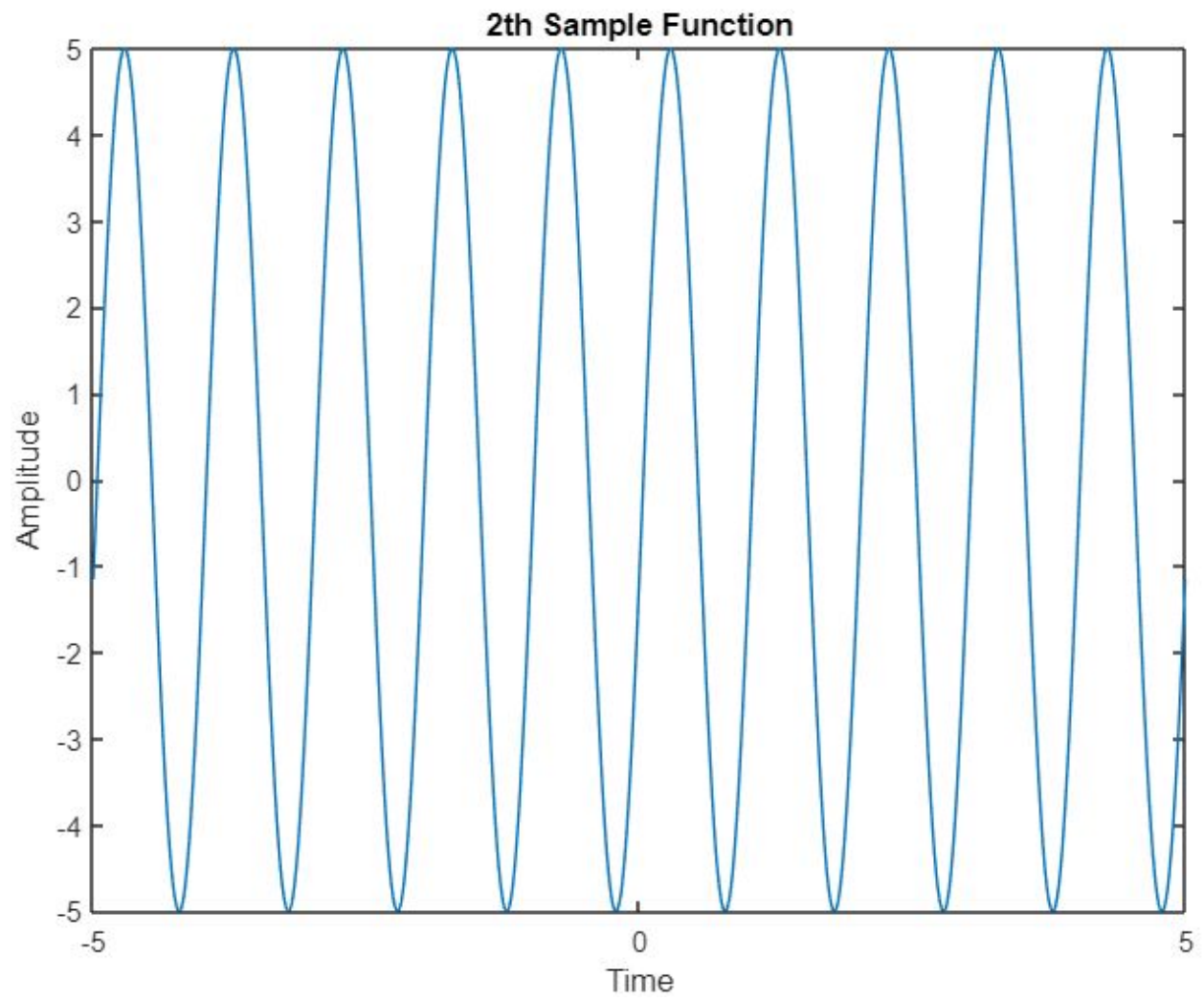
1) A plot of 5 random sample functions of the process X(t)
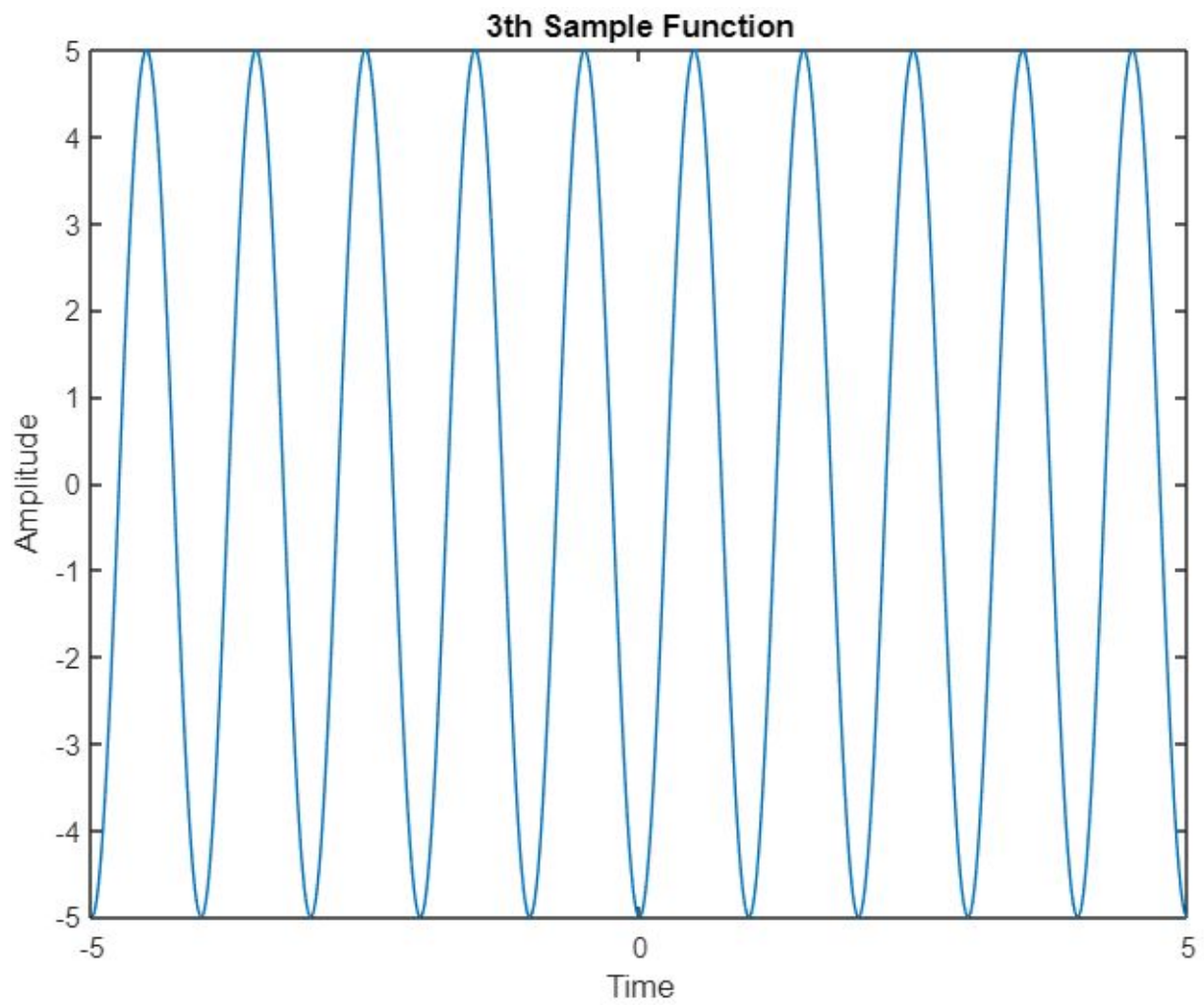
- 1th Sample Function

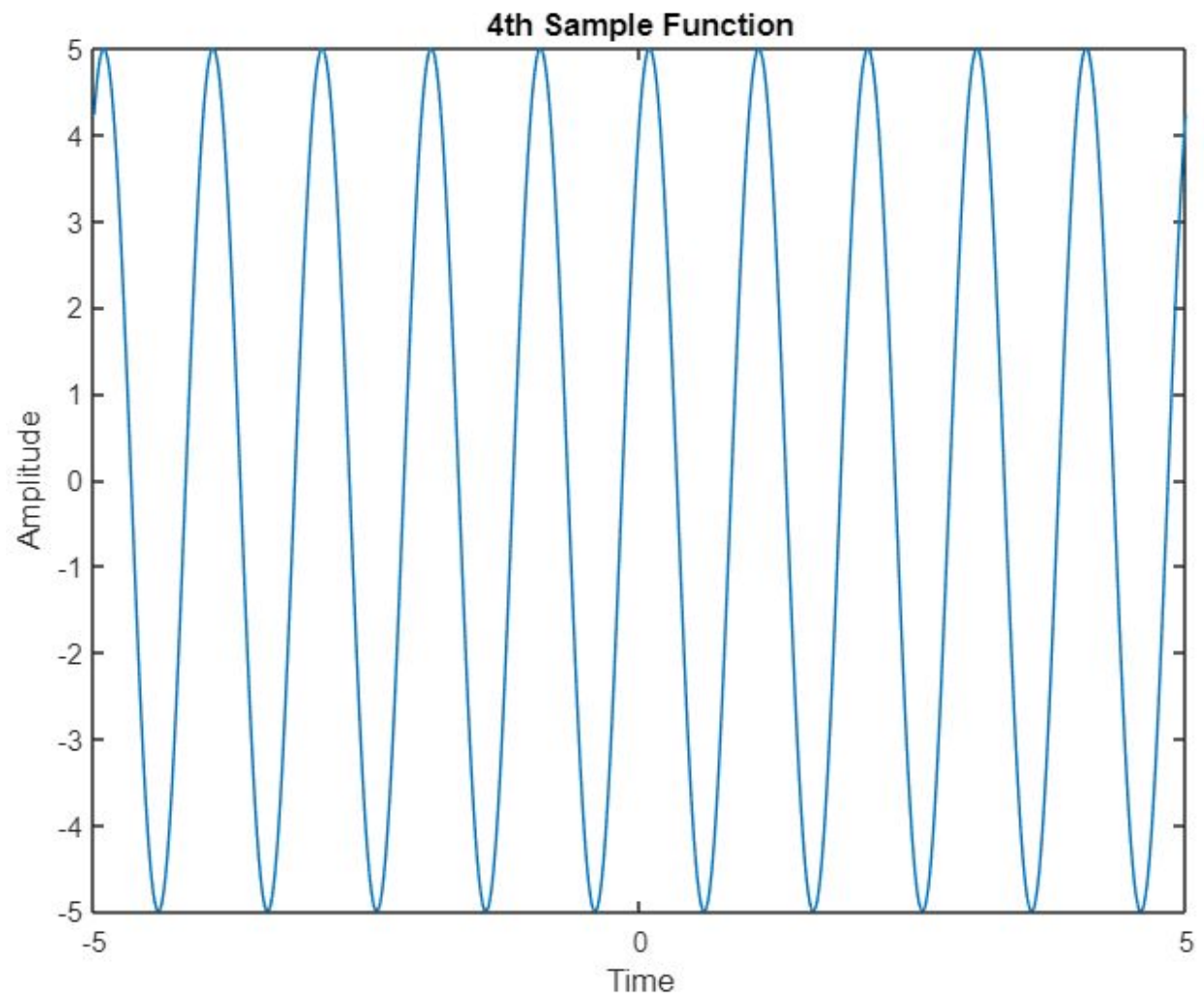

1th Sample Function

- 2th Sample Function

2th Sample Function

● 3th Sample Function

3th Sample Function
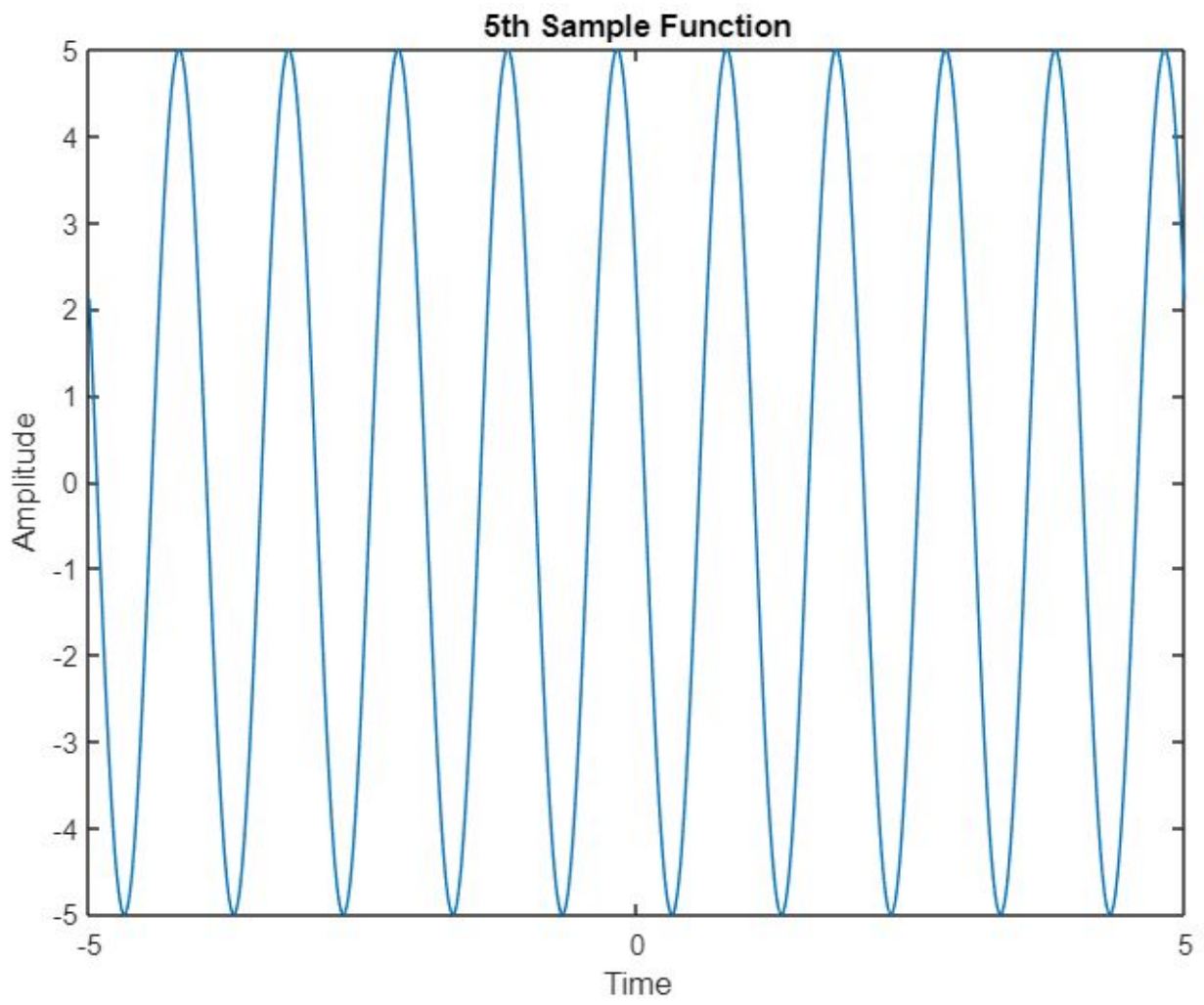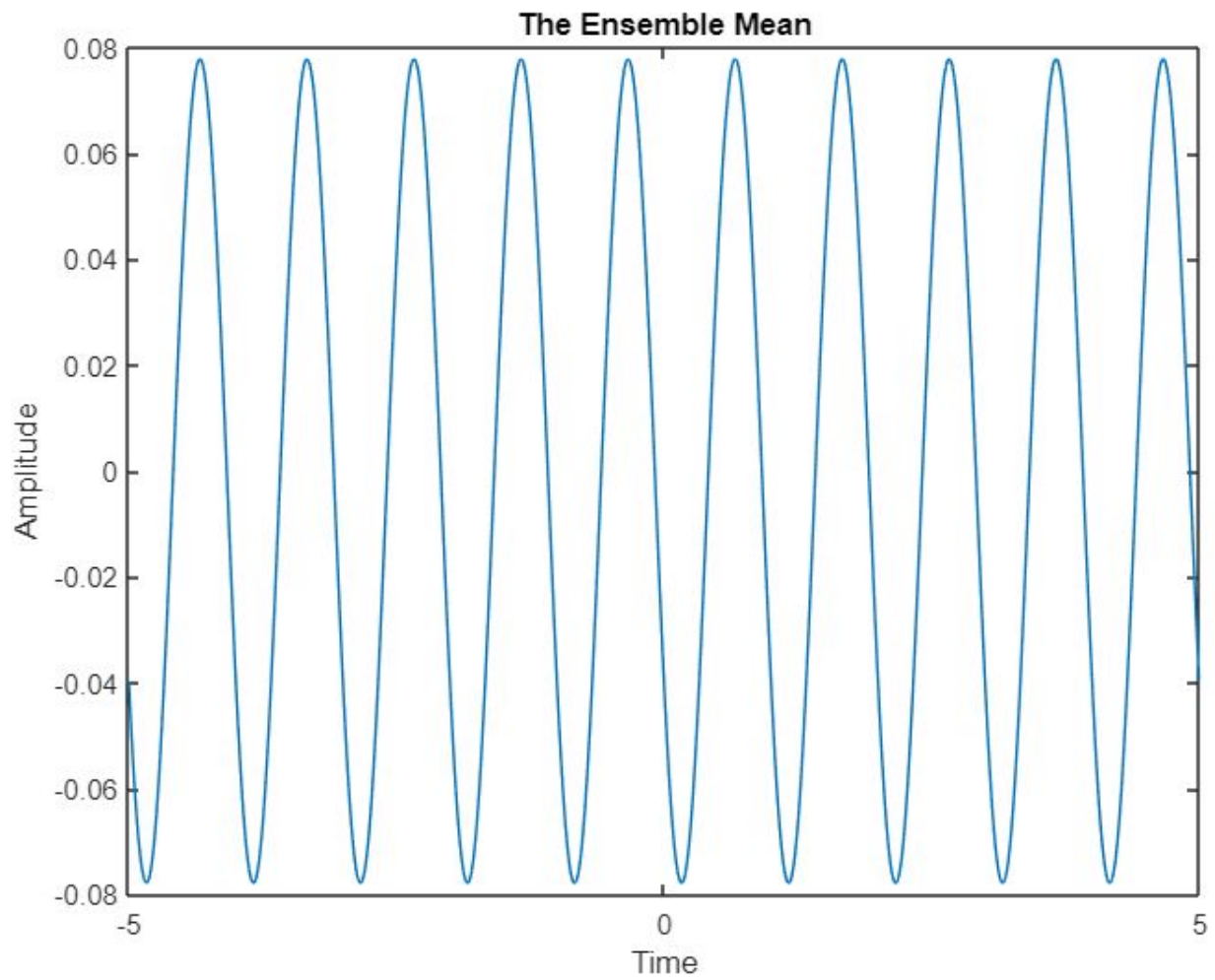
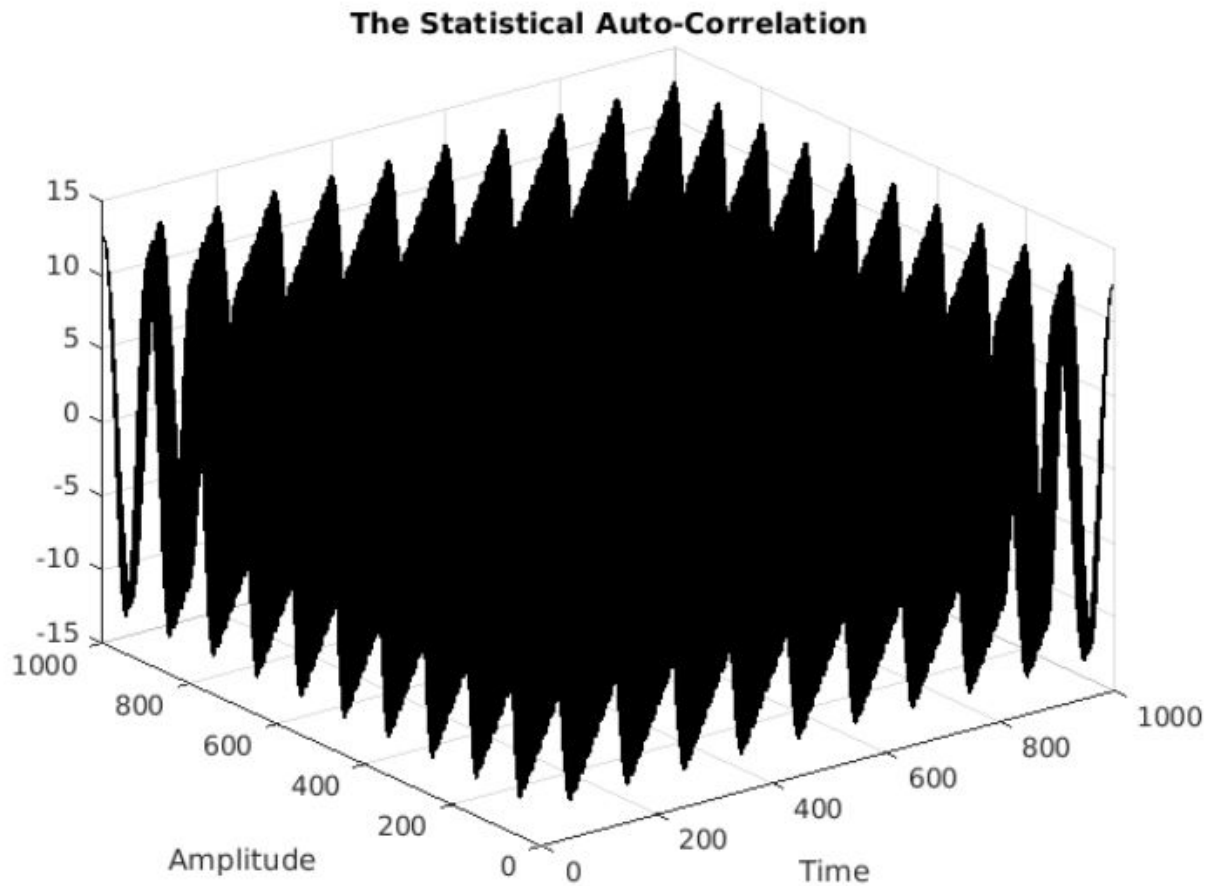- 4th Sample Function

4th Sample Function

- 5th Sample Function

2) A plot of the Ensemble Mean of the process X(t)

The Ensemble Mean

Comment :

The analytical result means that the Ensemble Mean is equal to 0 and we can conclude from the figure that the Ensemble mean is approximately equal to zero

3) A 3D plot of the ACF between ith sample and the jth sample for every i and j.
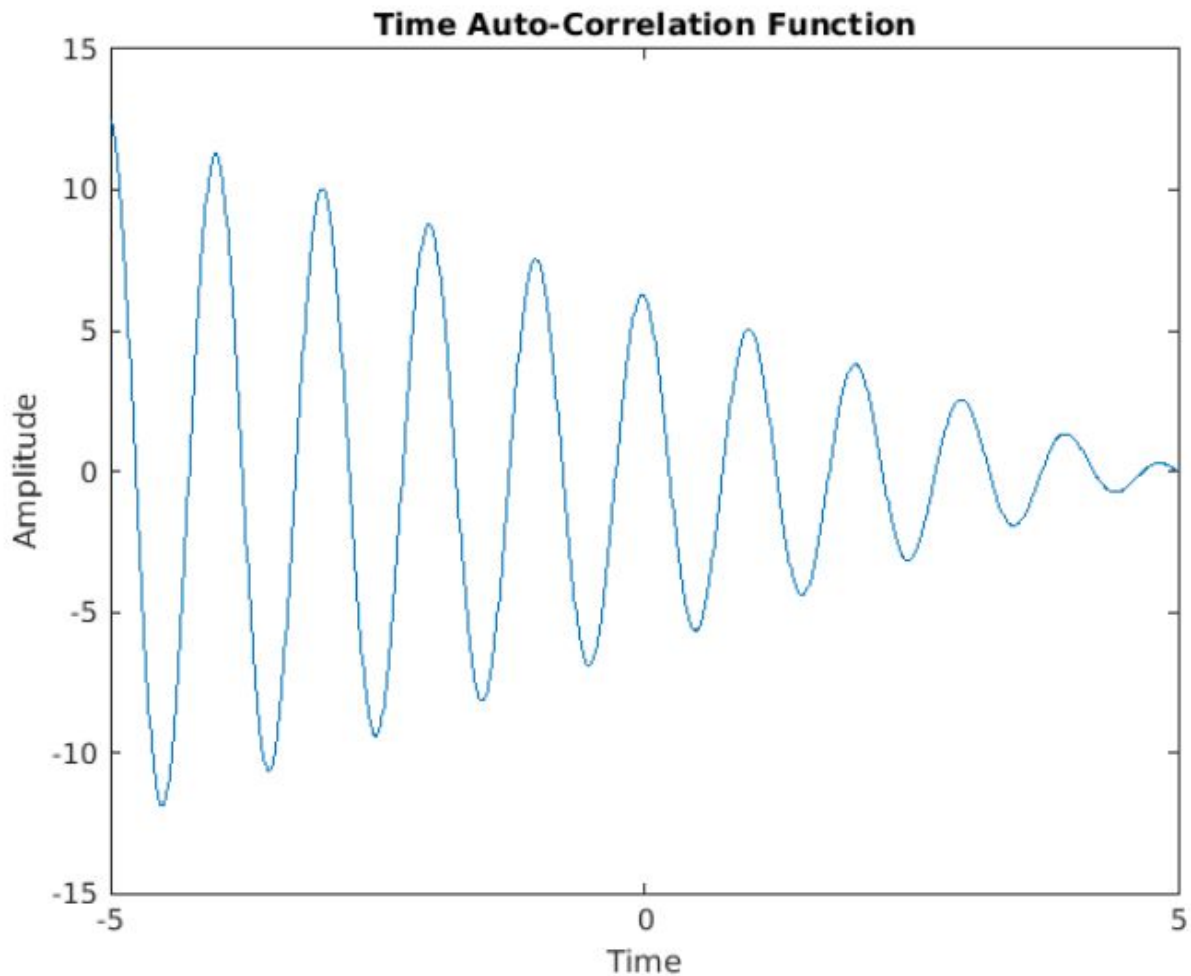
The Statistical Auto-Correlation

Comment :

Since the example we are using is Ergodic WSS as we can notice that the amplitude of the ACF is dependent only on the difference in time(tau).

4) The value of the time average and the time ACF of a random sample function.

```
Time_mean =

      0.0011
```

Time Auto-Correlation Function

5) Is there a relation between the statistical mean and the time mean, for the test process?

Yes there is as the statistical mean is equal to the time mean due to the ergodic Wss

5) Is there a relation between the statistical ACF and the time ACF, for the test process?

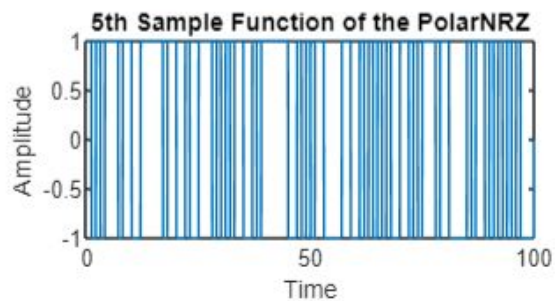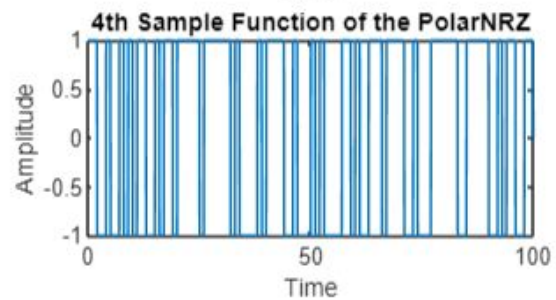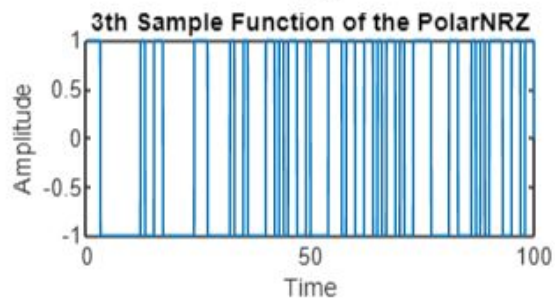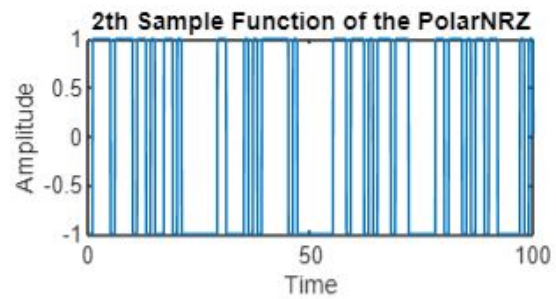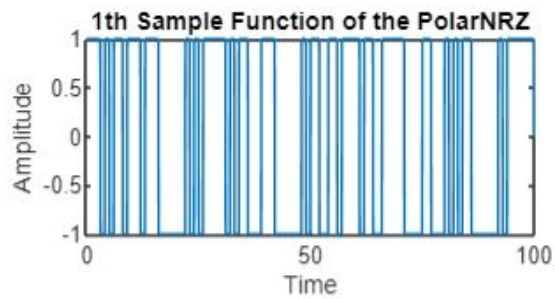Yes, there is as the Statistical ACF is equal to the time ACF for the reason above

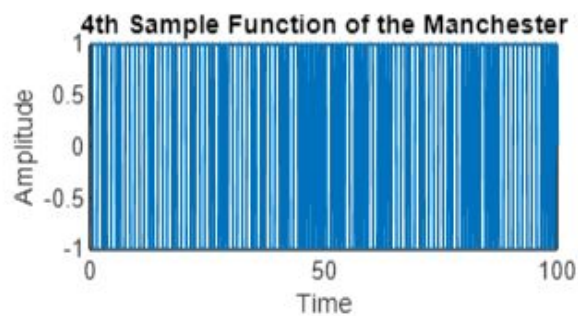6) Plot the PSD of the process
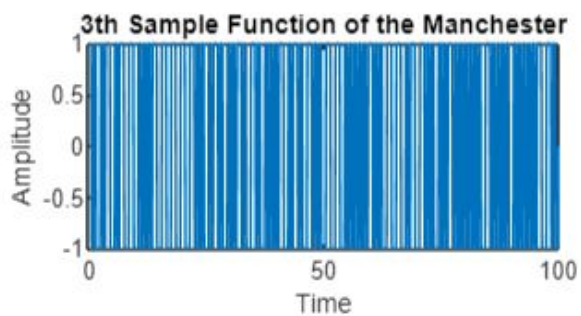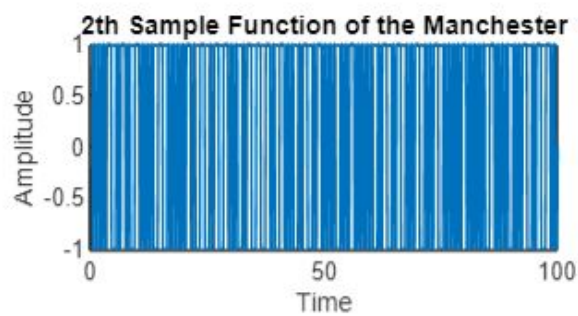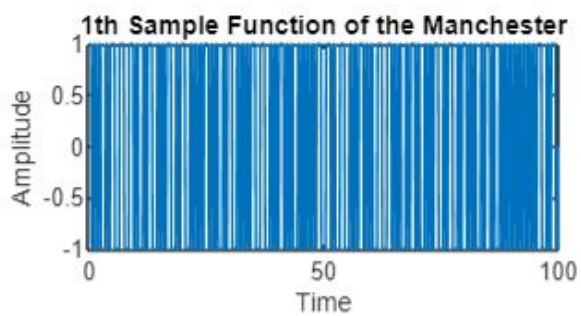
Power Spectral Density
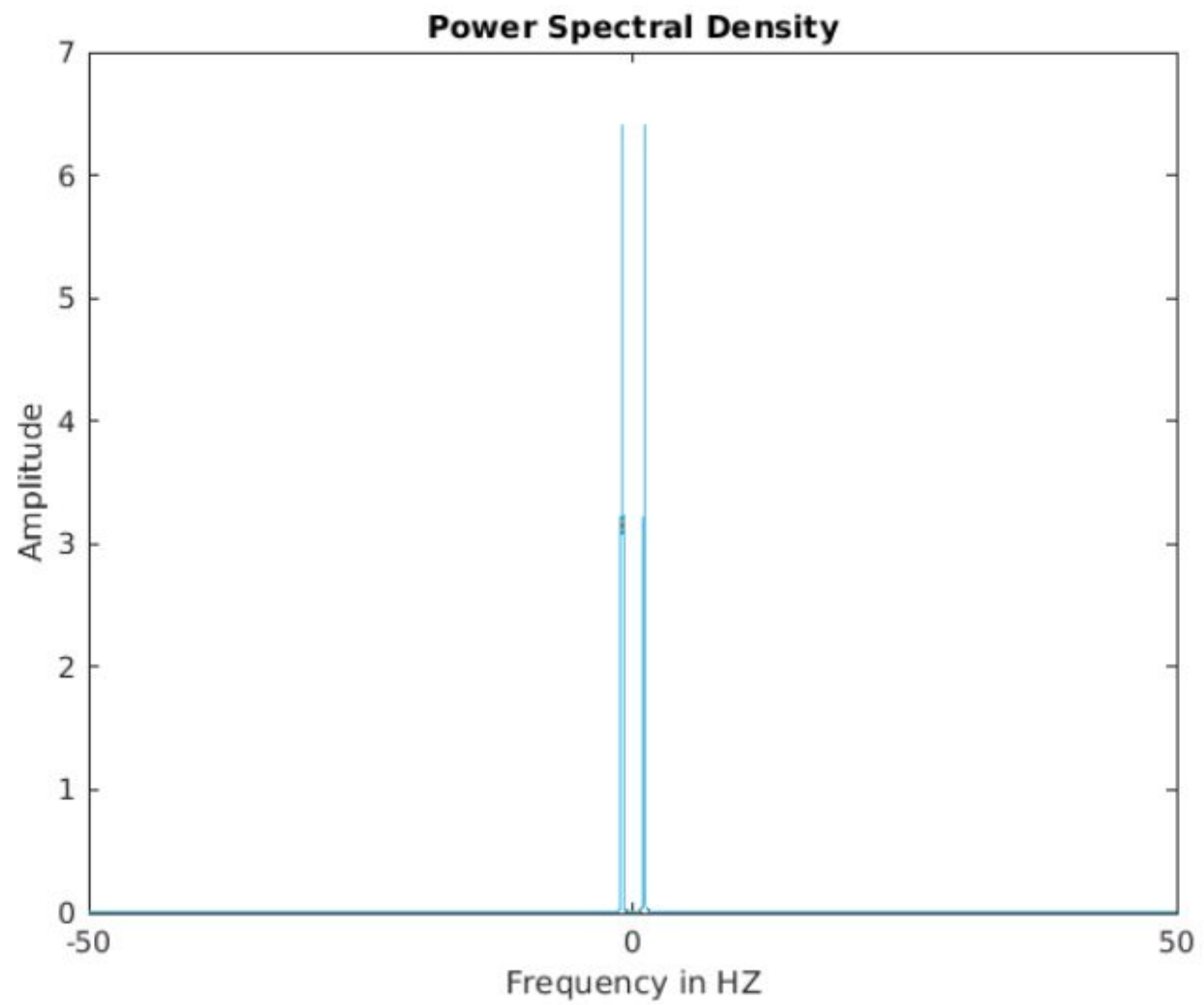
Part 2:

1) A plot of 5 random sample functions of the process, each plotted in a different subplot.

- PolarNRZ

● Manchester

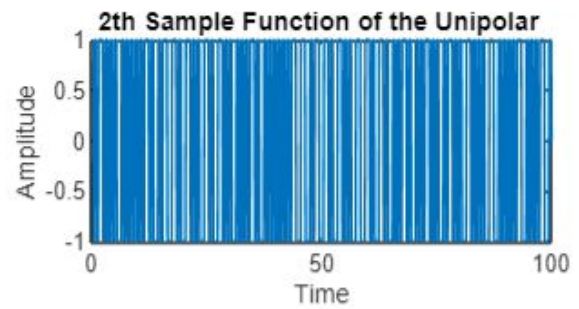**1th Sample Function of the Manchester**

Amplitude vs *Time*

2th Sample Function of the Manchester

Amplitude vs *Time*

3th Sample Function of the Manchester

Amplitude vs *Time*

4th Sample Function of the Manchester

Amplitude vs *Time*

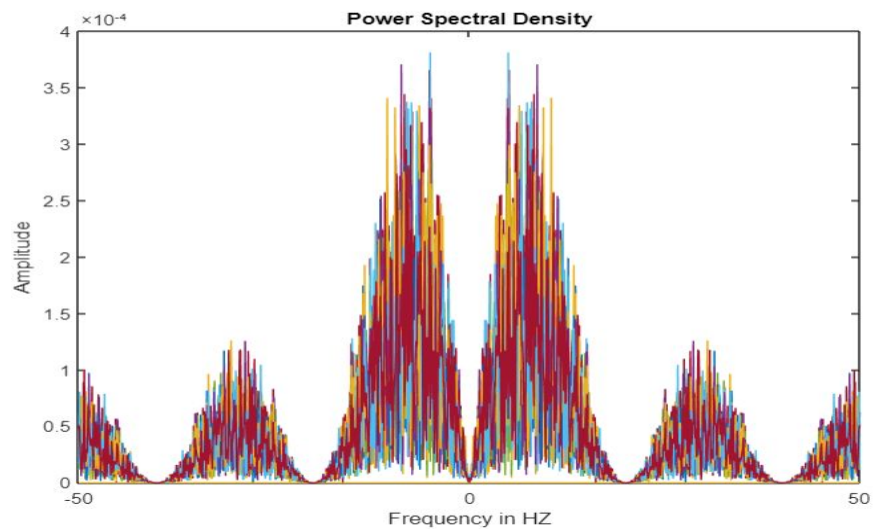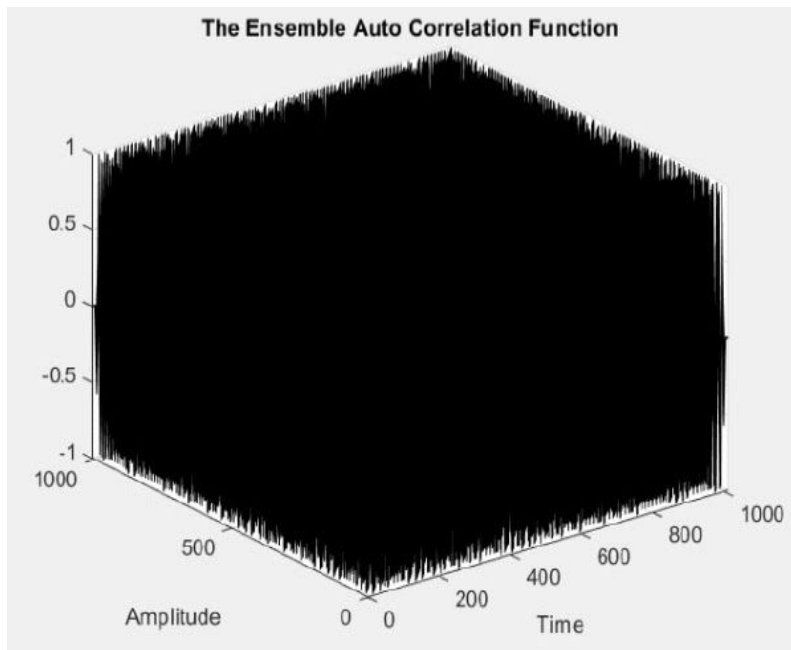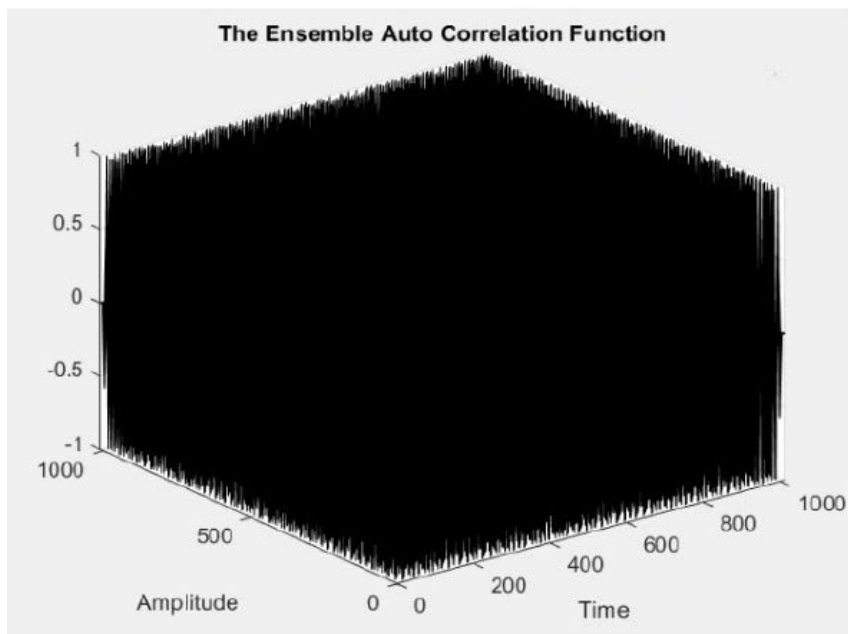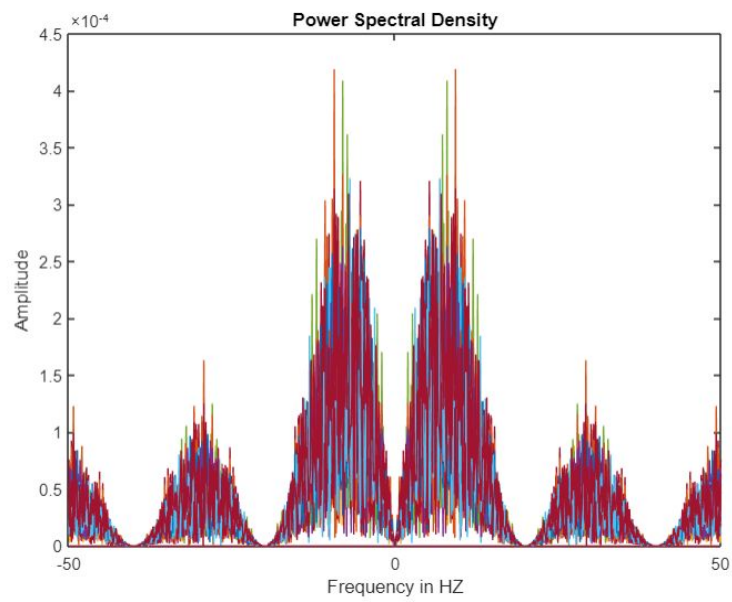**5th Sample Function of the Manchester**

Amplitude vs *Time*
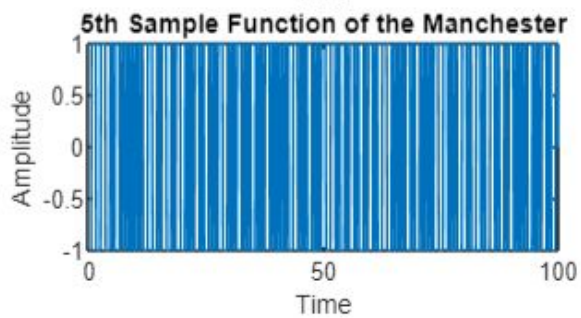
- UniPolarNRZ
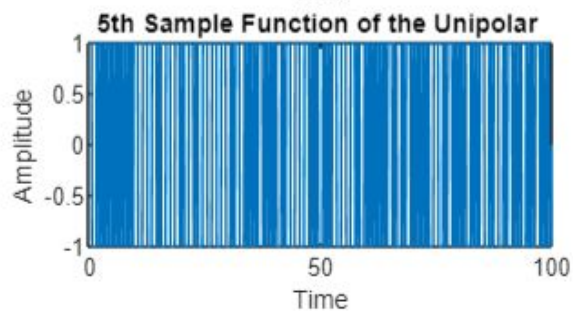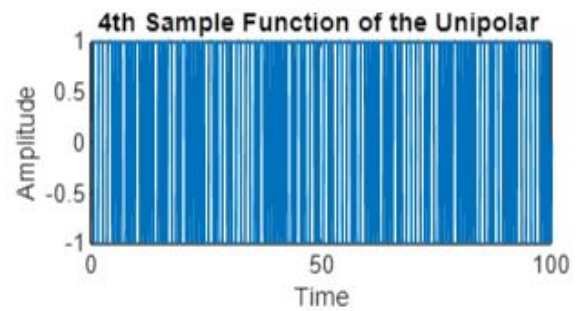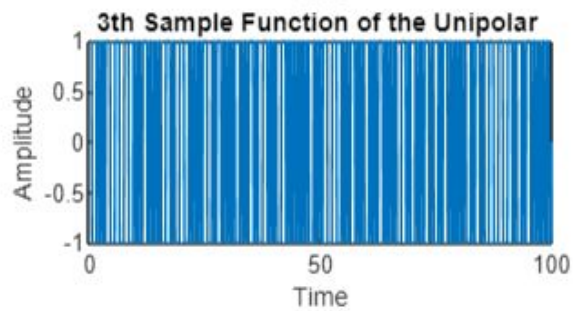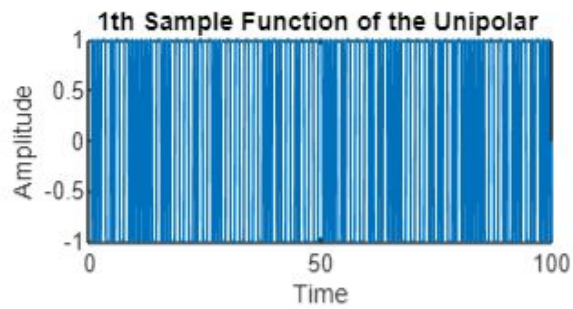
2) A figure containing 3 horizontal subplots for the ACF for Tb = 1; 10; 100 second, and 3 other horizontal subplots for the PSD for Tb = 1; 10; 100 second.
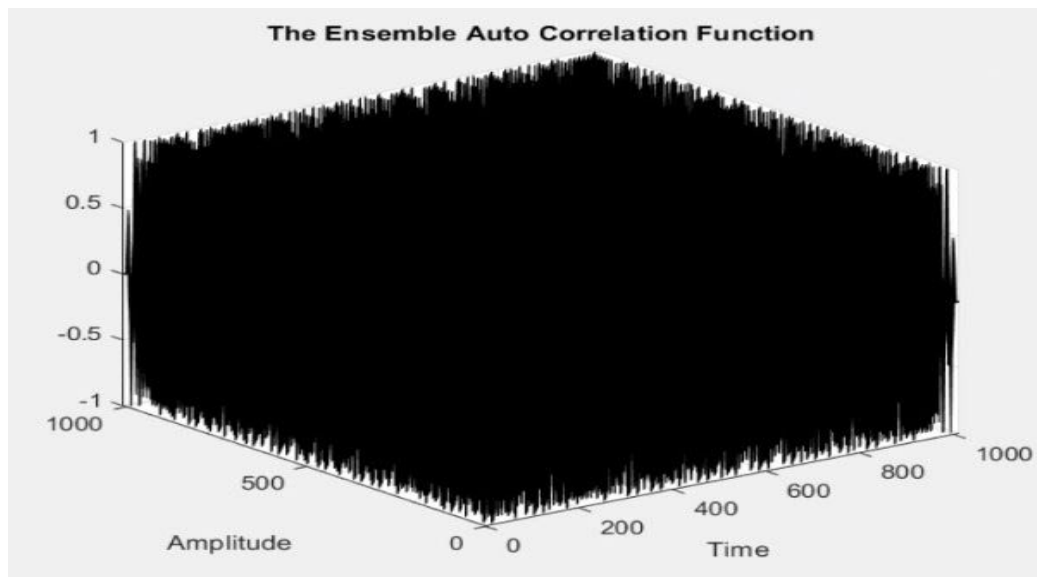
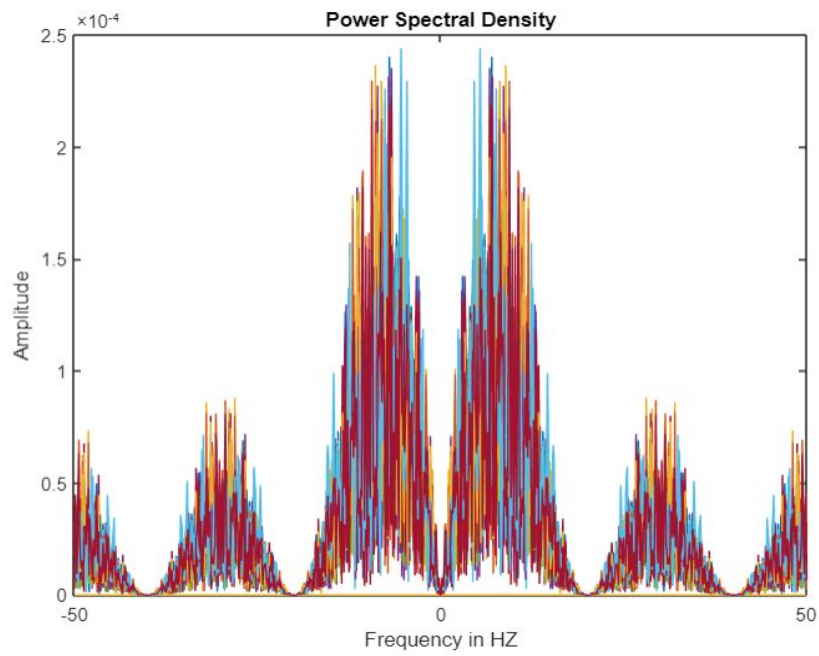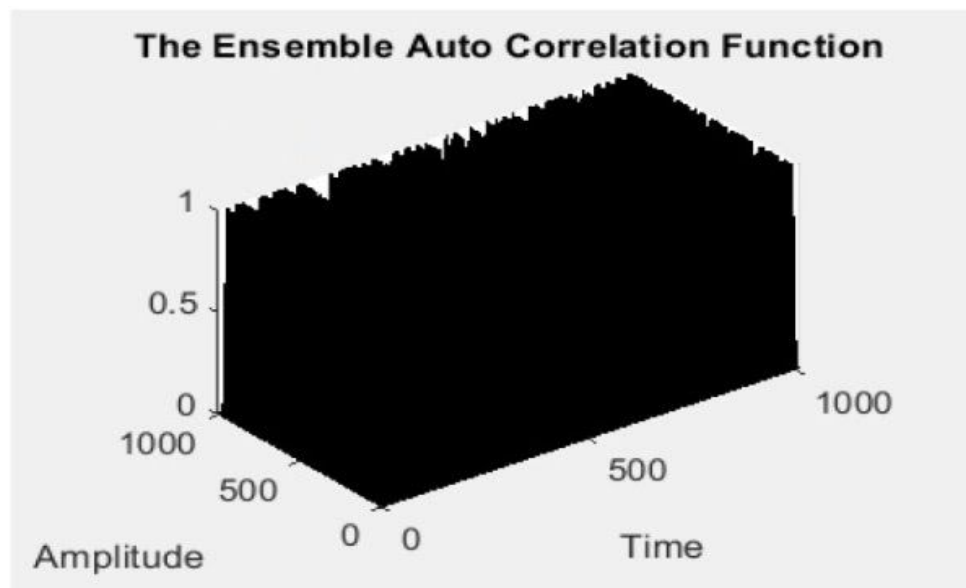**A) Manchester**
1 Second

10 seconds

Power Spectral Density
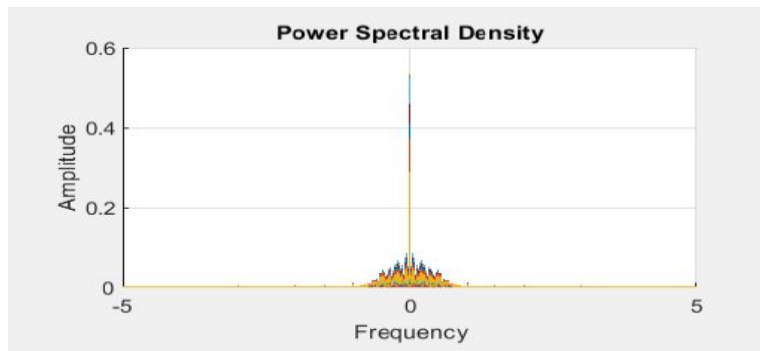

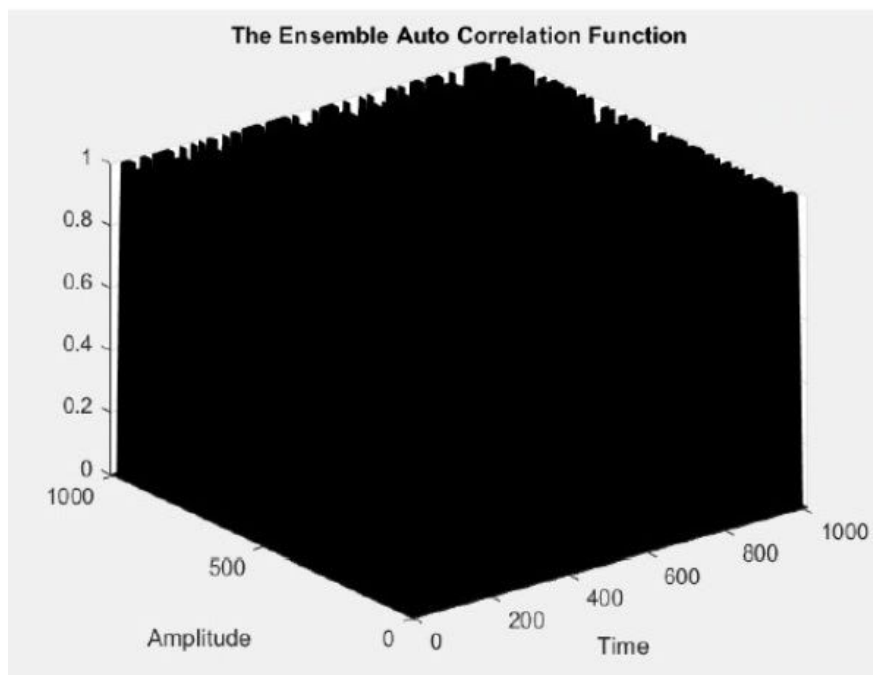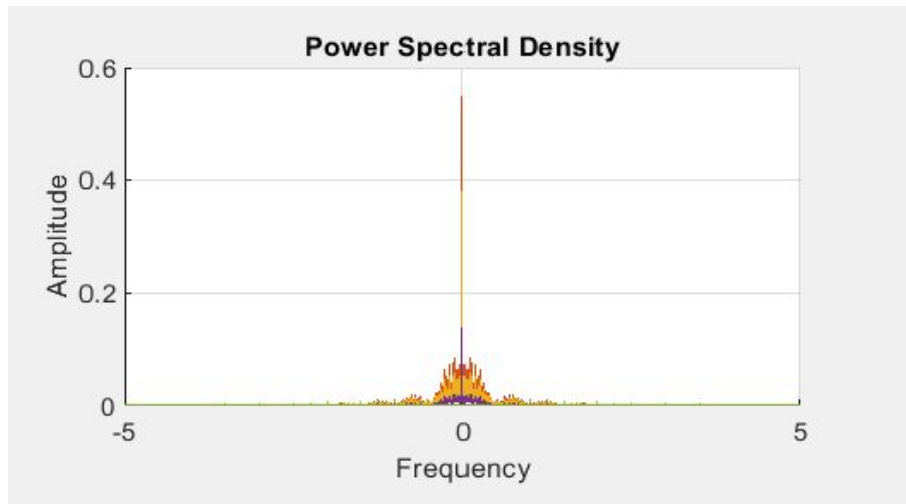The Ensemble Auto Correlation Function

100 Seconds

Comment:

If the time average and the ensemble average are equal, that would make it ergodic. The analytical solution should be equal to zero at zero and has a two peaks at -1 and 1 approximately is at the bit time and amplitude is 0.9Tb
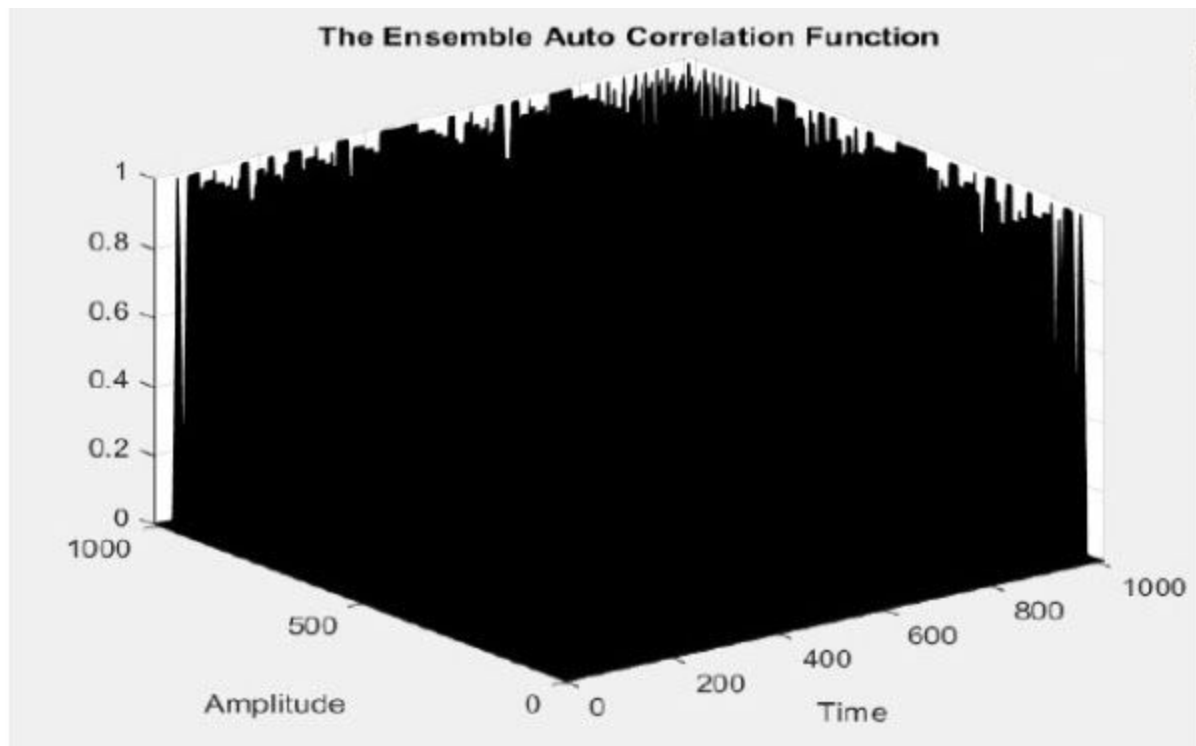
B) Unipolar
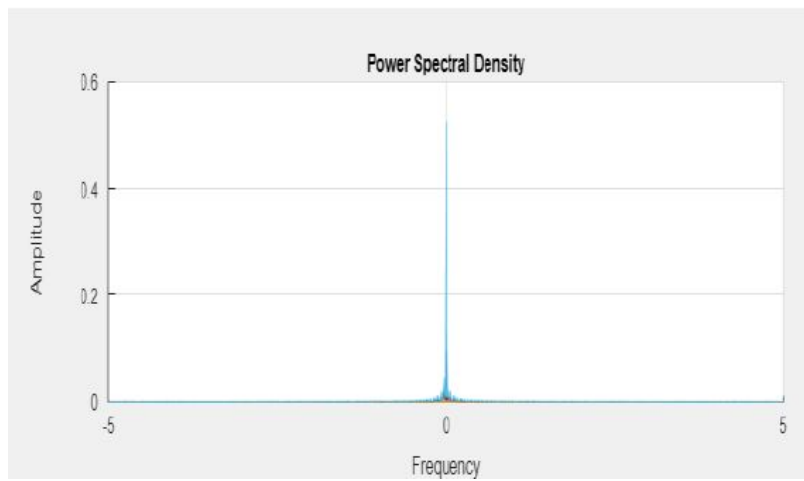1 seconds

Power Spectral Density

The Ensemble Auto Correlation Function

10 Seconds

Power Spectral Density

The Ensemble Auto Correlation Function

100 Seconds

Power Spectral Density

The Ensemble Auto Correlation Function

Comment:

We can notice that the ACF has an error and that the analytical solution (A sinc squared function) does reach zero due it has finite domain.The analytical solution first zero is at the bit time and amplitude is ($T_b * A^2$ /4) and has a delta function of amplitude (A^2 /4)
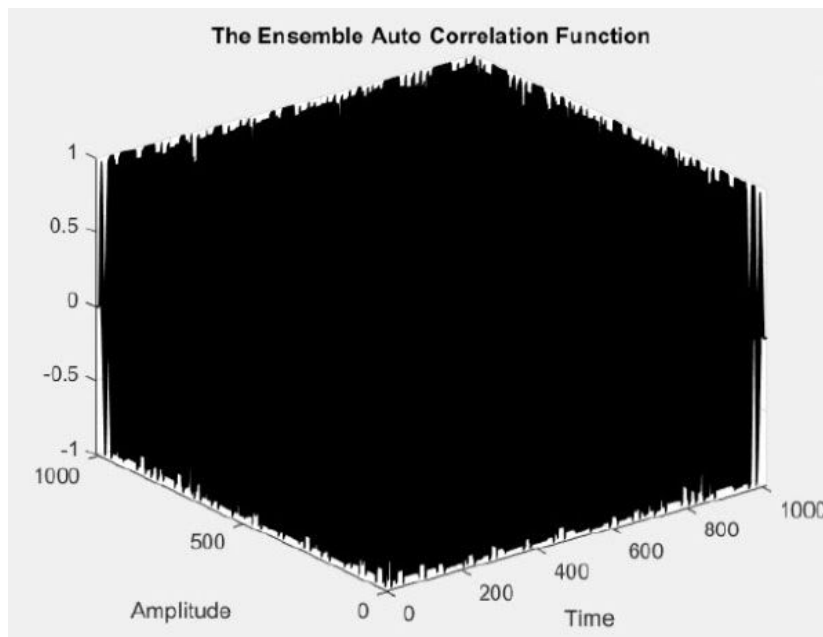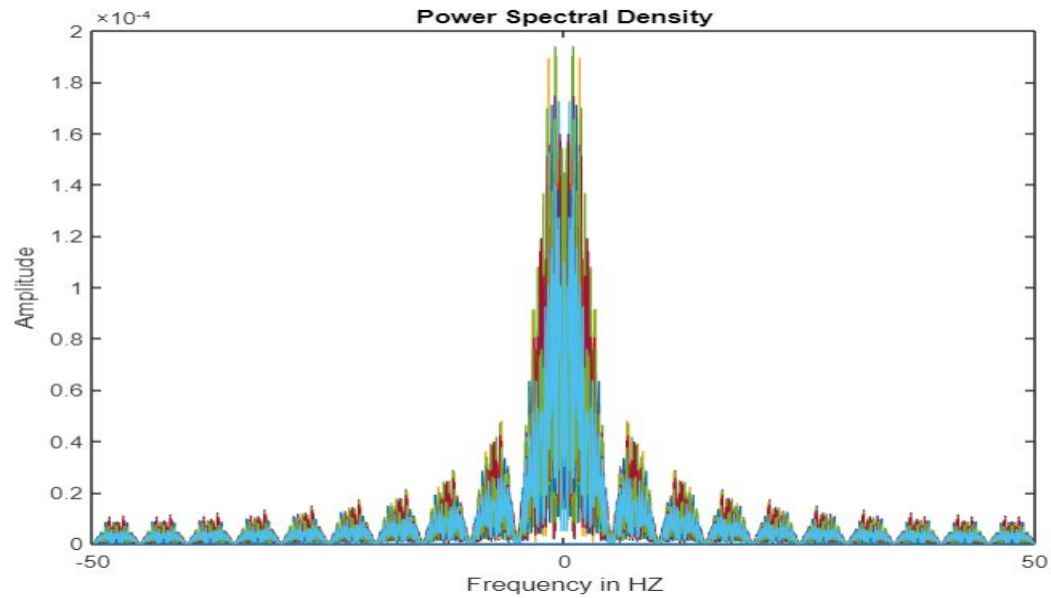
C) Polar
   1 Seconds

10 seconds

Power Spectral Density

The Ensemble Auto Correlation Function
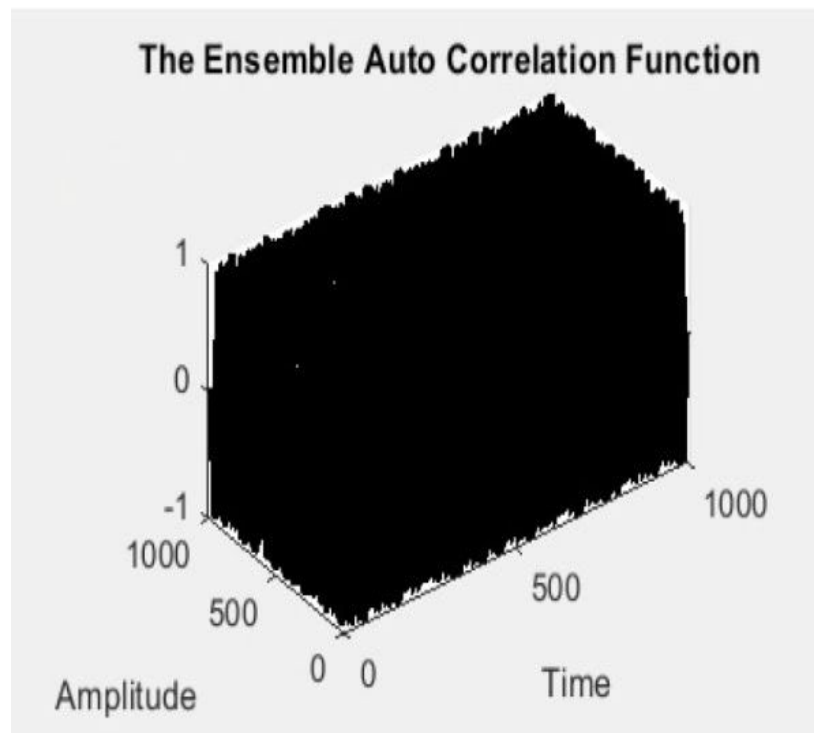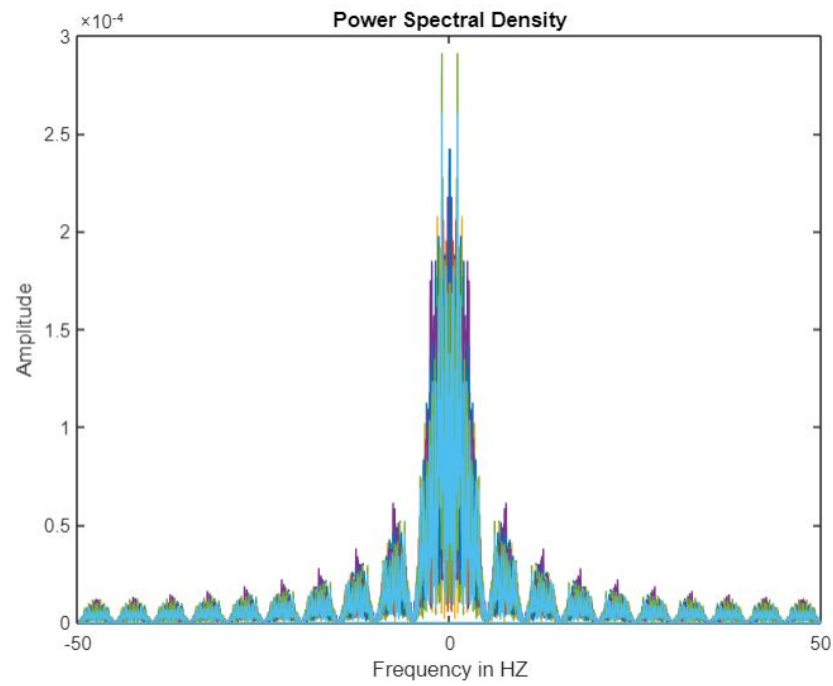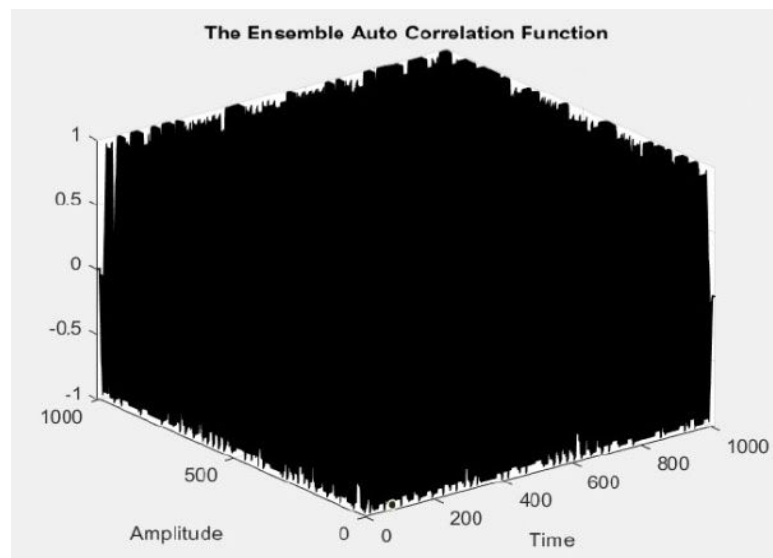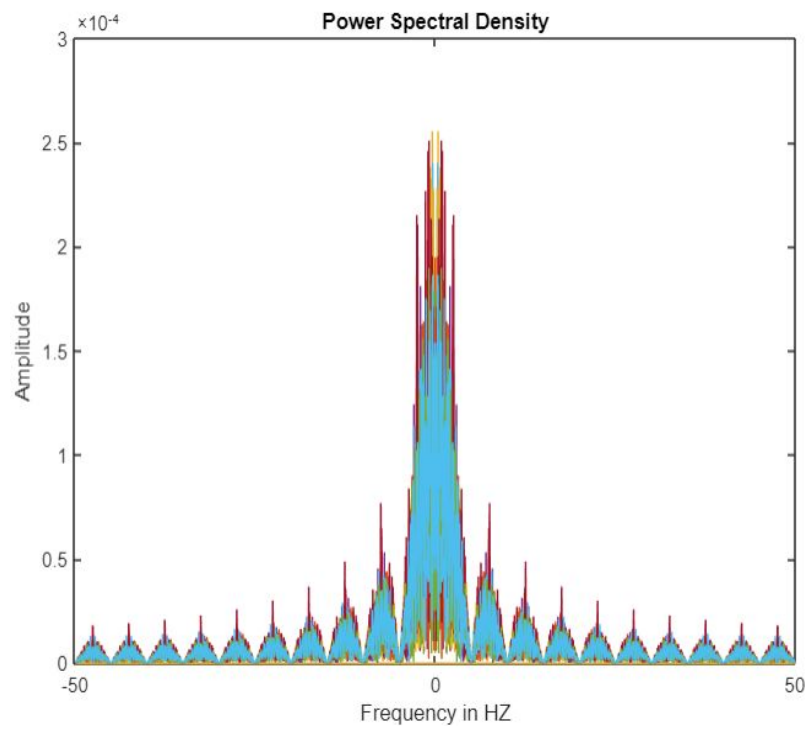
100 seconds

Comment:

It would be ergodic, due to the fact that the time average and the ensemble average are equal.
A sinc squared function whose first zero amplitude is (Tb) should be the analytical solution.