



**Faculty of Engineering & Technology**  
**Electrical & Computer Engineering Department**  
**COMMUNICATIONS LAB**

**ENEE4113**

**Prelab #4 Experiment 6**

**Pulse Amplitude Modulation (Sampling)**

---

**Prepared by:**

Rivan Jaradat     1200081

**Partner:**

Amani Rabee:1201512

Noor Rahib: 1202853

**Instructor:**     Dr.Alhareth zyoud

**TA:**                Eng. Mohammad Albattat

**Section:** 5

**Date:**     29/11/2023

## Contents

Table of figure:.....	3
1.Part1: Time and Frequency Characteristics of pulse train .....	4
1.1.Block diagram:.....	4
1.2. Pulse @ D=10%.....	4
1.2.2.Frequency domain:.....	5
1.2.Pulse @ D=40% : .....	5
1.2.1.Time domain: .....	5
1.2.2.Frequency domain:.....	6
2.Part 2: Modulating signal (message signal) .....	6
2.2.Modulated signal @ fm=500Hz & D=50%: .....	7
2.3.Modulated signal @ fm=500Hz & D=10% .....	8
2.4.Modulated signal @ fm=500Hz & D=30% .....	10
2.5.Modulated signal @ fm=1000Hz & D=50% .....	11
2.6.Modulated signal @ fm=2000Hz & D=50%: .....	13
3.Sample and Hold (flat topped) Sampling.....	14
3.2. Modulated signal @ fm=500Hz & D=50% .....	15
3.3.Modulated signal @ fm=500Hz & D=10% .....	16
3.4.Modulated signal @ fm=500Hz & D=30% .....	17
3.5.Modulated signal @ fm=1000Hz & D=50% .....	18
3.6.Modulated signal @ fm=2000Hz & D=50% .....	19
4.Part 3:Characteristics of Pulse Amplitude Demodulation.....	20
4.2.De-Modulated signal Natural @ fm=500 & D=50%.....	20
4.3.De-Modulated signal Natural @ fm=500 & D=10%.....	21
4.4.De-Modulated signal Flat-Top @ fm=500 & D=50%: .....	22
5.Part 4: .....	23
5.1. Modulated signal @fm=3000 & D=50%.....	23
5.2.De-Modulated signal @fm=3000 & D=50%.....	24
5.3.Modulated signal @fm=3000 & D=50%.....	25
5.4.De-Modulated signal @fm=3000 & D=50%.....	26
6.General parameters: .....	27

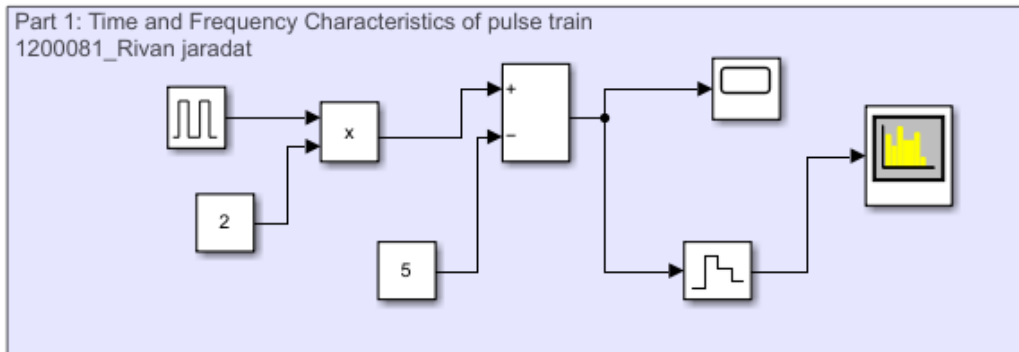
## Table of figure:

Figure 1.part1 at D=10% in time domain .....	4
Figure 2..part1 at D=10% in frequency domain .....	5
Figure 3.part1 at D=40% in time domain .....	5
Figure 4.part1 at D=40% in frequency domain .....	6
Figure 5.block diagram for Modulating signal (message signal) .....	6
Figure 6.Modulatem(t)&s(t) @ fm=500Hz & D=50% in time domain .....	7
Figure 7.Modulatem(t)&s(t) @ fm=500Hz & D=50% in frequency domain .....	7
Figure 8..pulse train in frequency domain @D=50% .....	8
Figure 9.Modulatem(t)&s(t) @ fm=500Hz & D=10% in time domain .....	8
Figure 10.Modulatem(t)&s(t) @ fm=500Hz & D=10% in frequency domain .....	9
Figure 11..pulse train in frequency domain @D=10% .....	9
Figure 12.Modulatem(t)&s(t) @ fm=500Hz & D=30% in time domain .....	10
Figure 13.m(t)&s(t) @ fm=500Hz & D=30% in frequency domain .....	10
Figure 14..pulse train in frequency domain @D=30% .....	11
Figure 15.m(t)&s(t) @ fm=1000Hz & D=50% in time domain .....	11
Figure 16.m(t)&s(t) @ fm=1000Hz & D=50% in frequency domain .....	12
Figure 17..pulse train in frequency domain @D=50% .....	12
Figure 18.m(t)&s(t) @ fm=2000Hz & D=50% in time domain .....	13
Figure 19.m(t)&s(t) @ fm=2000Hz & D=50% in frequency domain .....	13
Figure 20.pulse train in frequency domain @D=50% .....	14
Figure 21.m(t)&s(t) @ fm=500Hz & D=50% in time domain .....	15
Figure 22.s(t) ,m(t)@ fm=1000Hz & D=50% in frequency domain .....	15
Figure 23.s(t) ,m(t)@ fm=500Hz & D=10% in time domain .....	16
Figure 24.S(T) in frequency domain .....	16
Figure 25.s(t) ,m(t)@ fm=500Hz & D=30% in time domainFrequency domain: .....	17
Figure 26.s(t) in frequency domain .....	17
Figure 27.s(t) ,m(t)@ fm=1000Hz & D=50% in time domain .....	18
Figure 28.s(t) in frequency domain .....	18
Figure 29.s(t) ,m(t)@ fm=2000Hz & D=50% in time domain .....	19
Figure 30.s(t) in frequency domain .....	19
Figure 31.m(t) & demodulated signal in time domain at d=50% .....	20
Figure 32.demodulated signal in frequency domain .....	21
Figure 33.m(t) & demodulated signal in time domain at d=10% .....	21
Figure 34.demodulated signal in frequency domain .....	22
Figure 35.m(t) & demodulated signal in time domain at d=50% .....	22
Figure 36.demodulated signal in frequency domain .....	23
Figure 37.m(t) & Modulated signal @fm=3000 & D=50% in time domain .....	23
Figure 38.modulated signal in frequency domain .....	24
Figure 39.m(t) & deModulated signal @fm=3000 & D=50% in time domain .....	24
Figure 40.demodulated signal in frequency domain .....	25
Figure 41m(t) & Modulated signal @fm=3000 & D=50% in time domain .....	25
Figure 42.modulated signal in frequency domain .....	26
Figure 43.m(t) & de-Modulated signal @fm=3000 & D=50% in time domain .....	26
Figure 44.demodulated signal in frequency domain .....	27
Figure 45.general parameter .....	28

## Software Prelab:

### 1.Part1: Time and Frequency Characteristics of pulse train

#### 1.1.Block diagram:



#### 1.2. Pulse @ D=10%

Time domain:

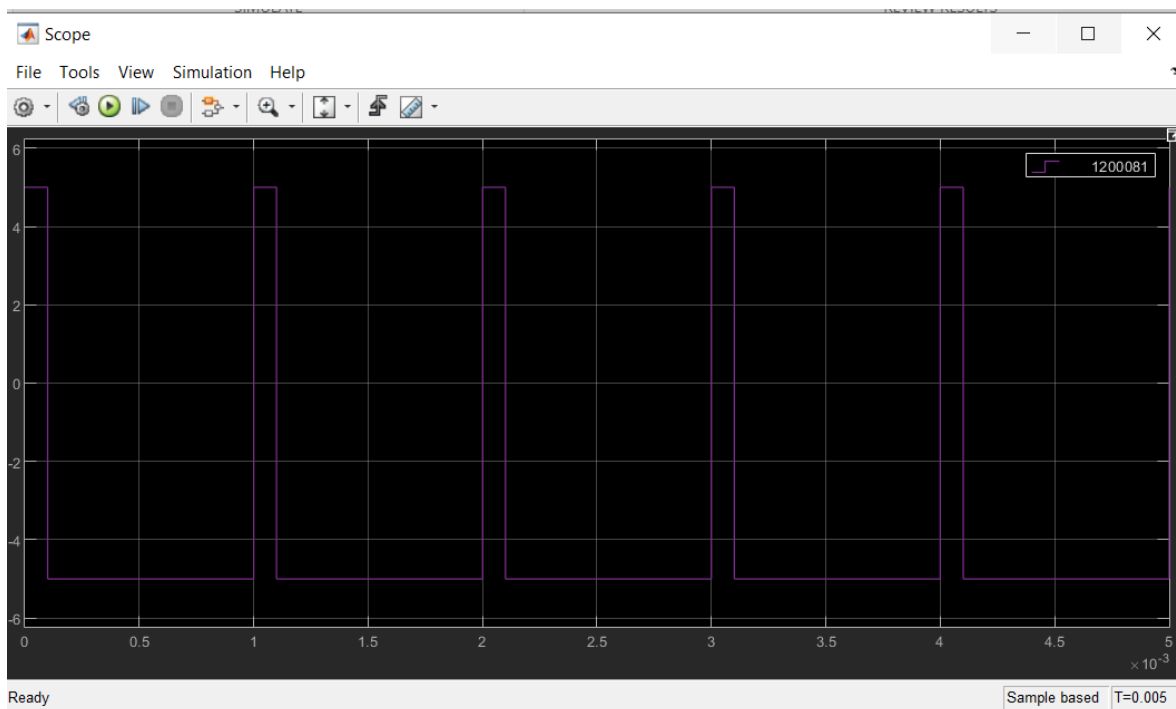


Figure 1.part1 at D=10% in time domain

### 1.2.2.Frequency domain:

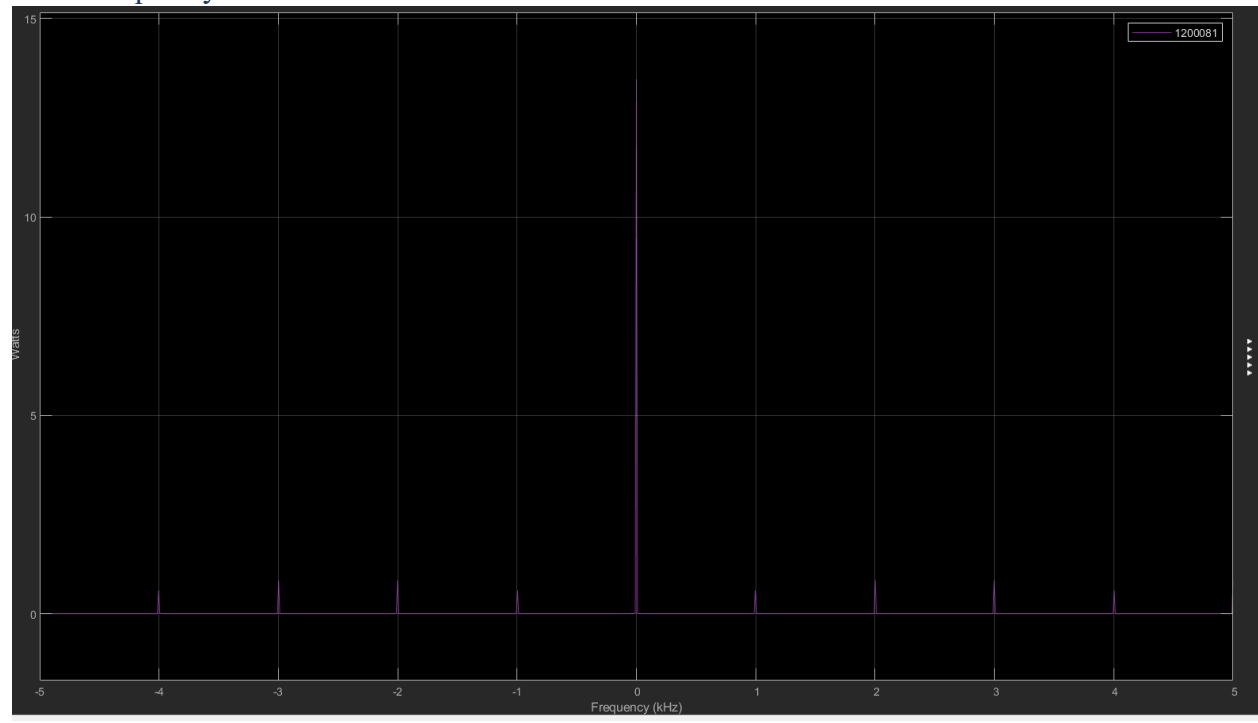


Figure 2..part1 at D=10% in frequency domain

### 1.2.Pulse @ D=40% :

#### 1.2.1.Time domain:

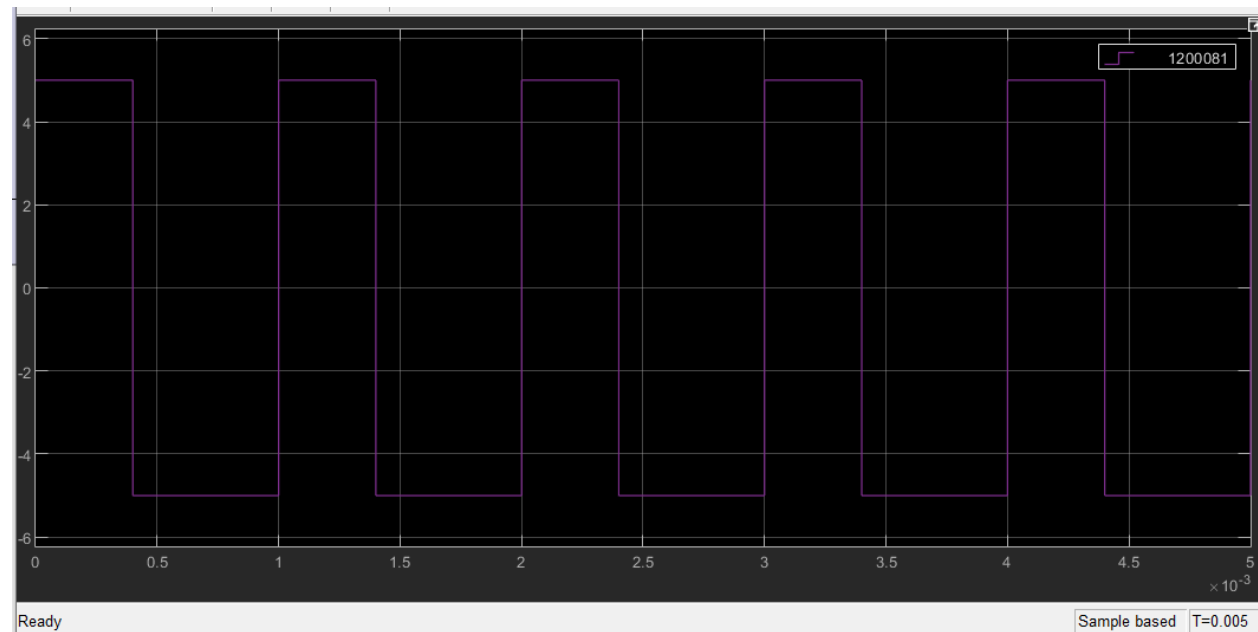


Figure 3.part1 at D=40% in time domain

### 1.2.2.Frequency domain:

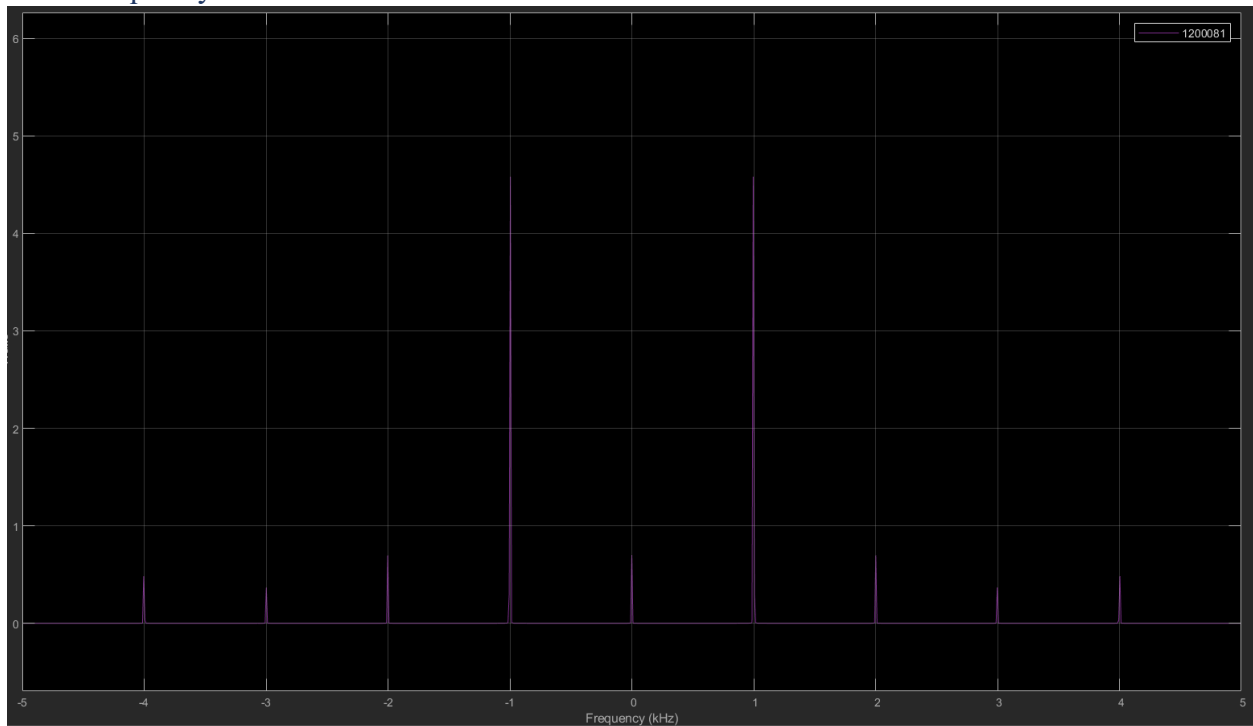


Figure 4.part1 at D=40% in frequency domain

## 2.Part 2: Modulating signal (message signal)

2.1.block diagram:

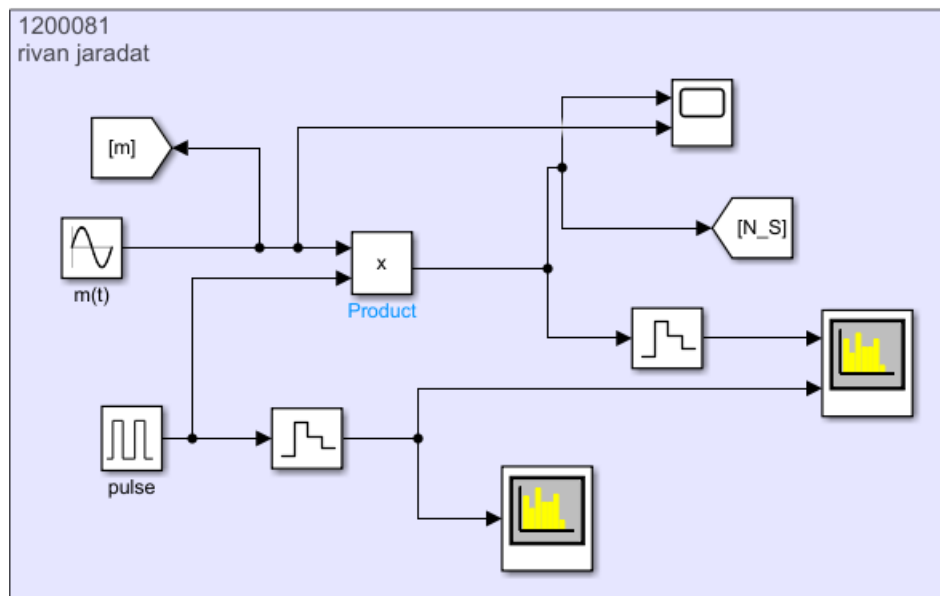


Figure 5 block diagram for Modulating signal (message signal)

## 2.2. Modulated signal @ $f_m=500\text{Hz}$ & $D=50\%$ :

### 2.2.1 Time domain :

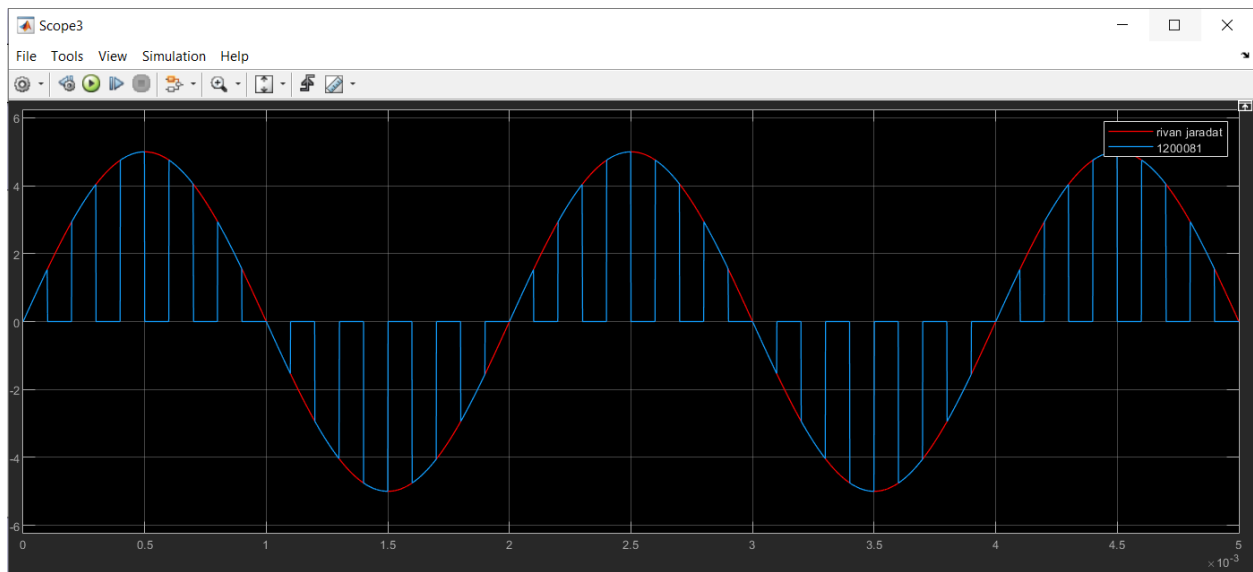


Figure 6.  $\text{Modulatem}(t)\&s(t)$  @  $f_m=500\text{Hz}$  &  $D=50\%$  in time domain

### 2.2.2. Frequency domain:

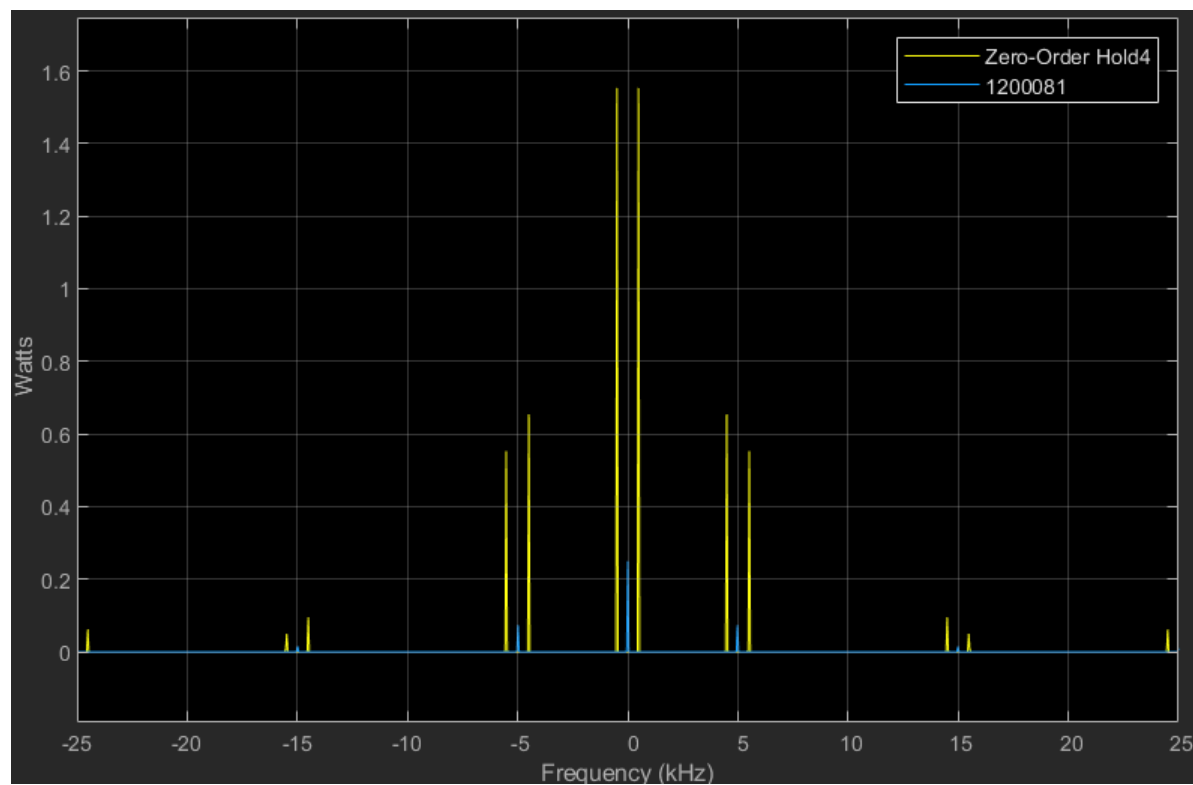


Figure 7.  $\text{Modulatem}(t)\&s(t)$  @  $f_m=500\text{Hz}$  &  $D=50\%$  in frequency domain

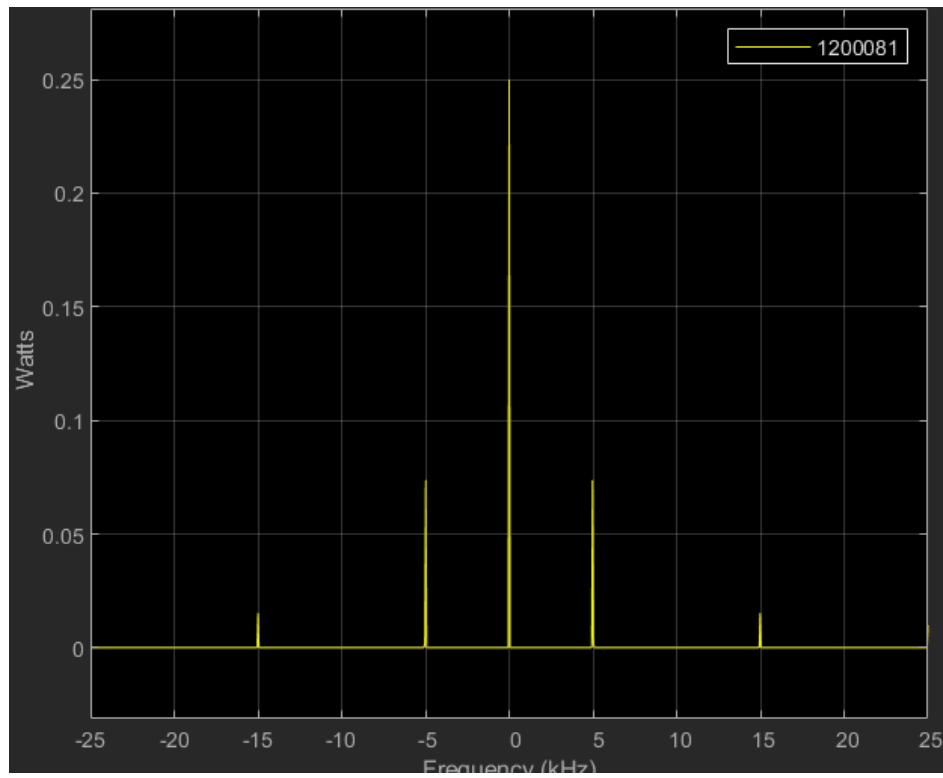


Figure 8..pulse train in frequency domain @D=50%

## 2.3.Modulated signal @ fm=500Hz & D=10%

### 2.3.1.Time domain :

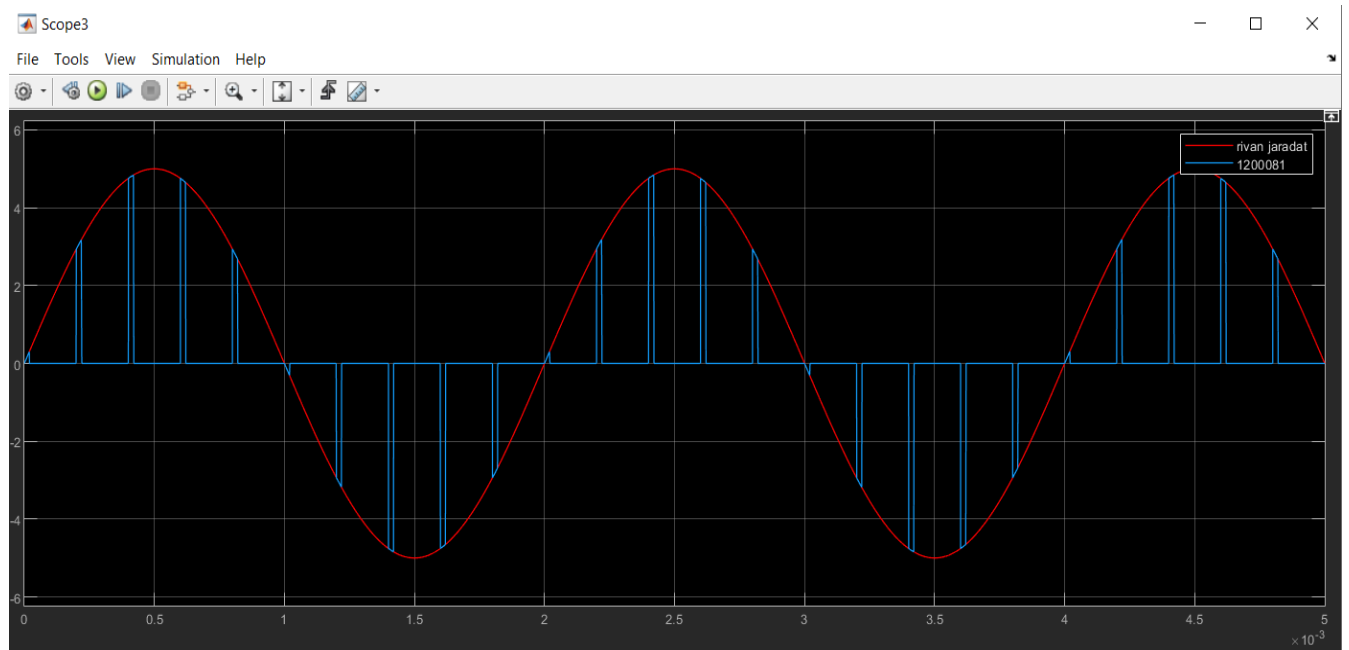


Figure 9.Modulatem(t)&s(t) @ fm=500Hz & D=10% in time domain



### 2.3.2.Frequency domain:

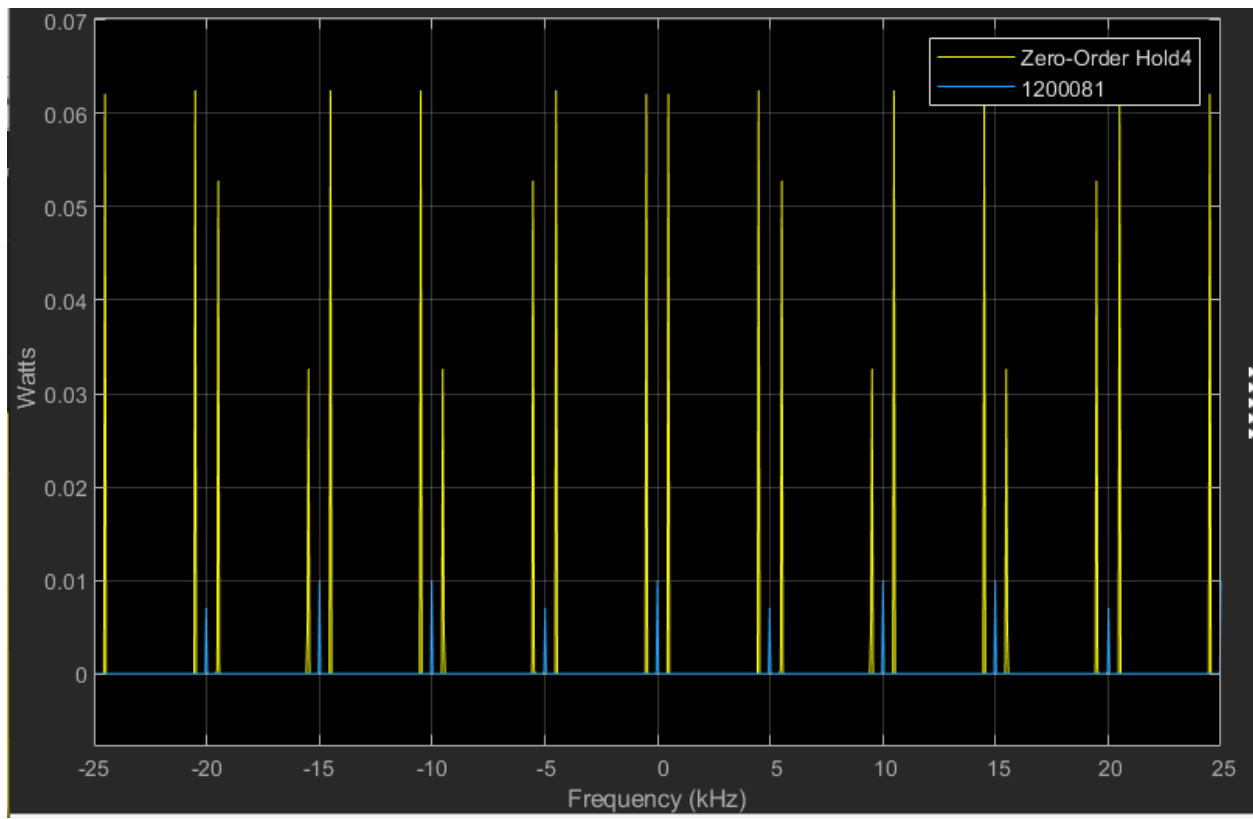


Figure 10.  $\text{Modulatem}(t) \& s(t)$  @  $f_m = 500\text{Hz}$  &  $D = 10\%$  in frequency domain

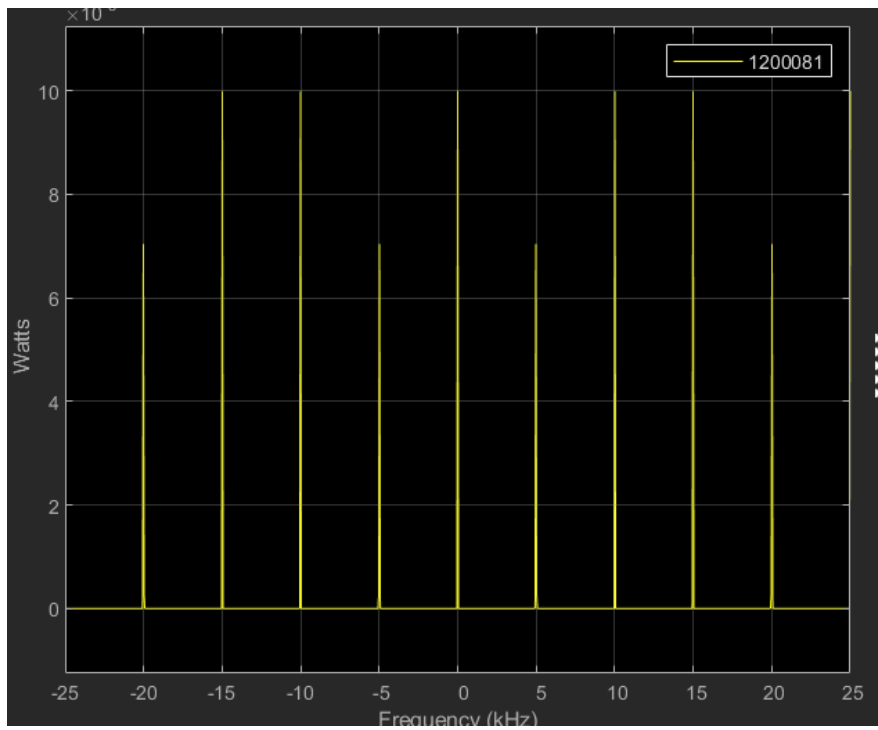


Figure 11..pulse train in frequency domain @  $D = 10\%$

## 2.4. Modulated signal @ $f_m=500\text{Hz}$ & $D=30\%$

### 2.4.1. Time domain :

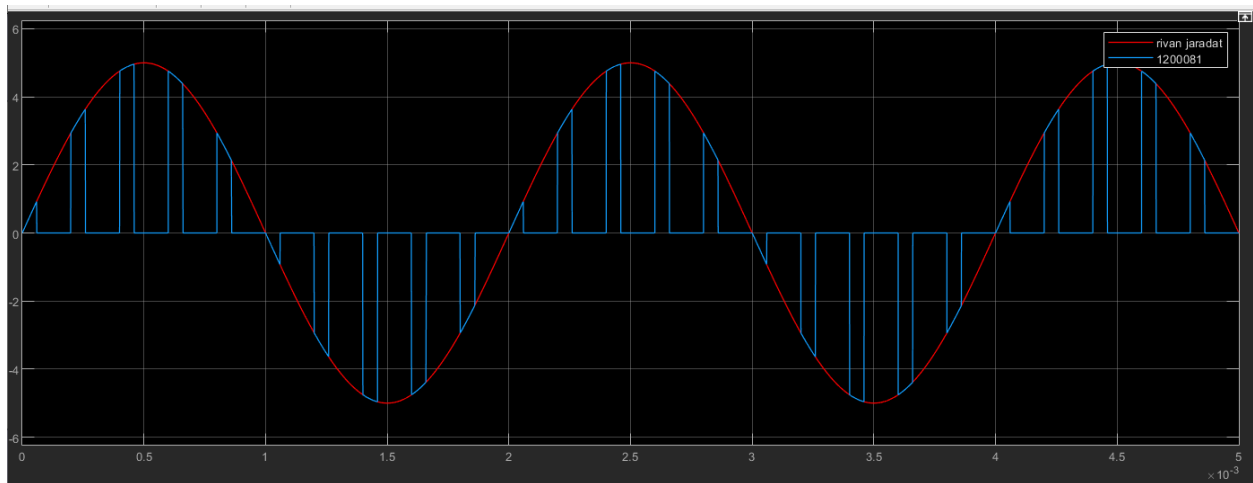


Figure 12.  $Modulatem(t)&s(t)$  @  $f_m=500\text{Hz}$  &  $D=30\%$  in time domain

### 2.4.2. Frequency domain:

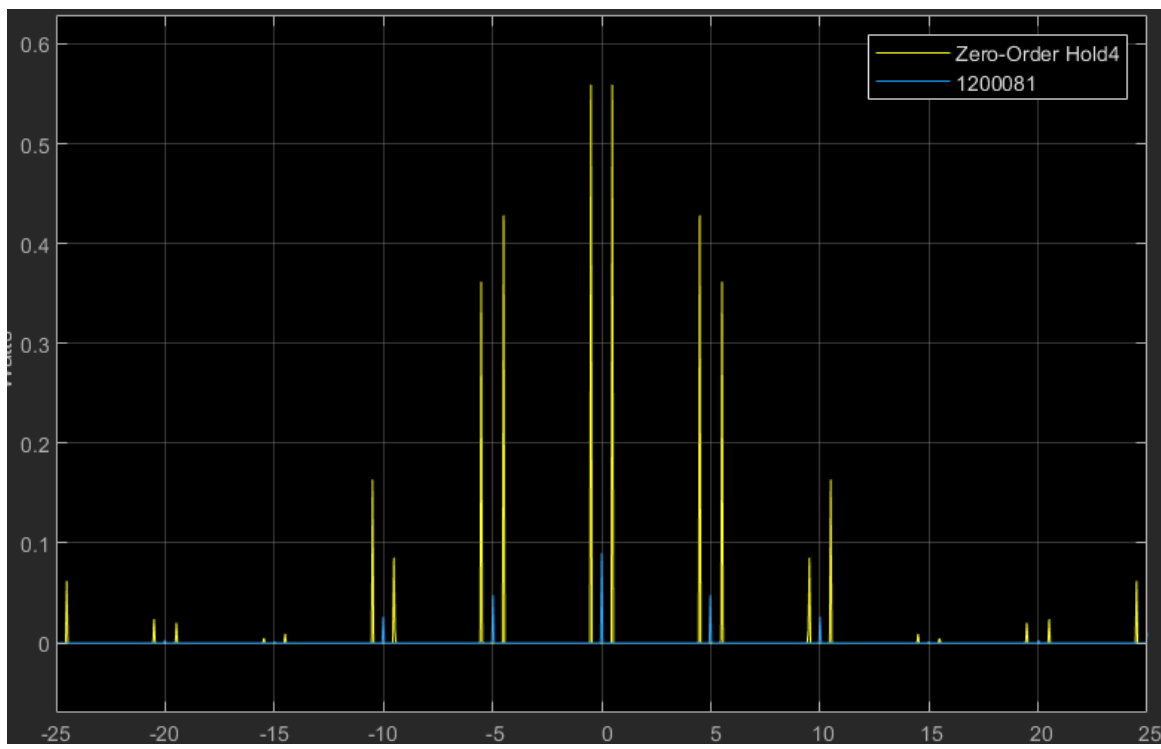


Figure 13.  $m(t)&s(t)$  @  $f_m=500\text{Hz}$  &  $D=30\%$  in frequency domain

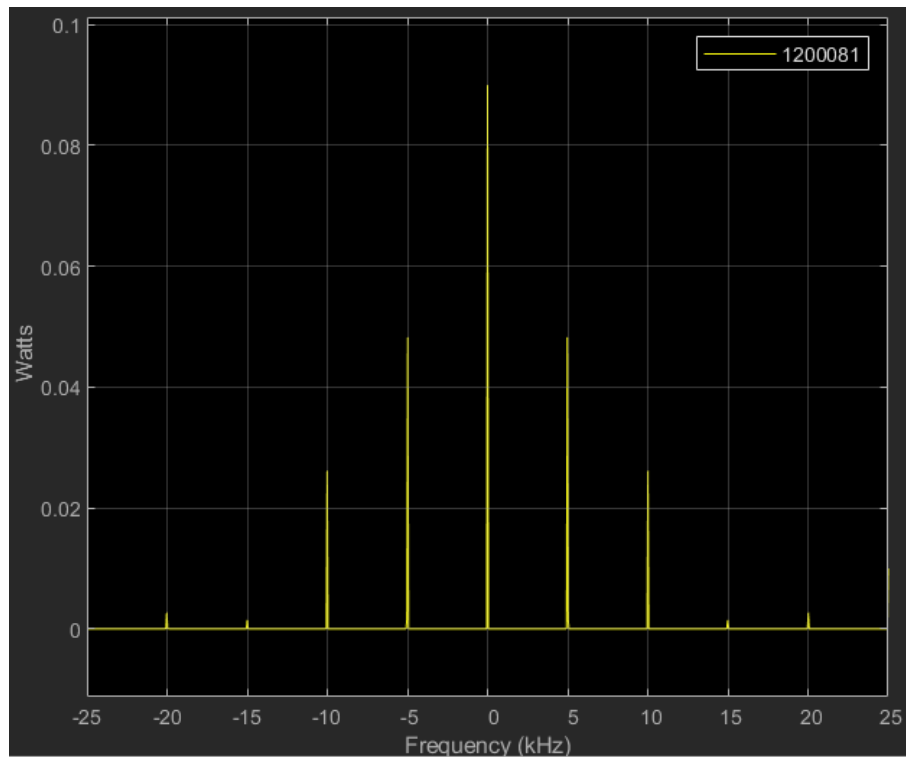


Figure 14..pulse train in frequency domain @D=30%

## 2.5.Modulated signal @ $f_m=1000\text{Hz}$ & $D=50\%$

### 2.5.1.Time domain :

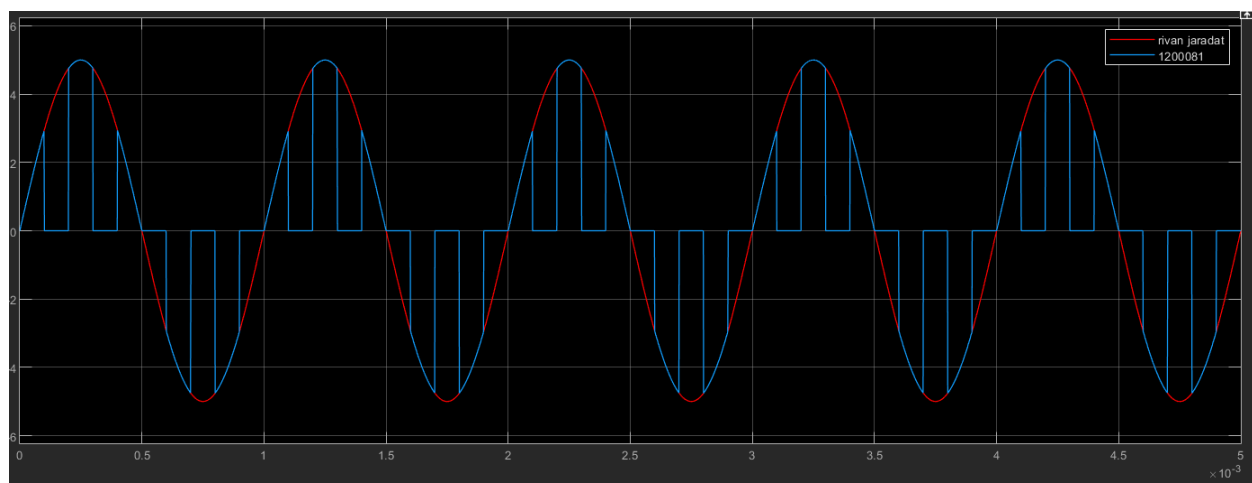


Figure 15. $m(t)$ & $s(t)$  @  $f_m=1000\text{Hz}$  &  $D=50\%$  in time domain

### 2.5.2.Frequency domain

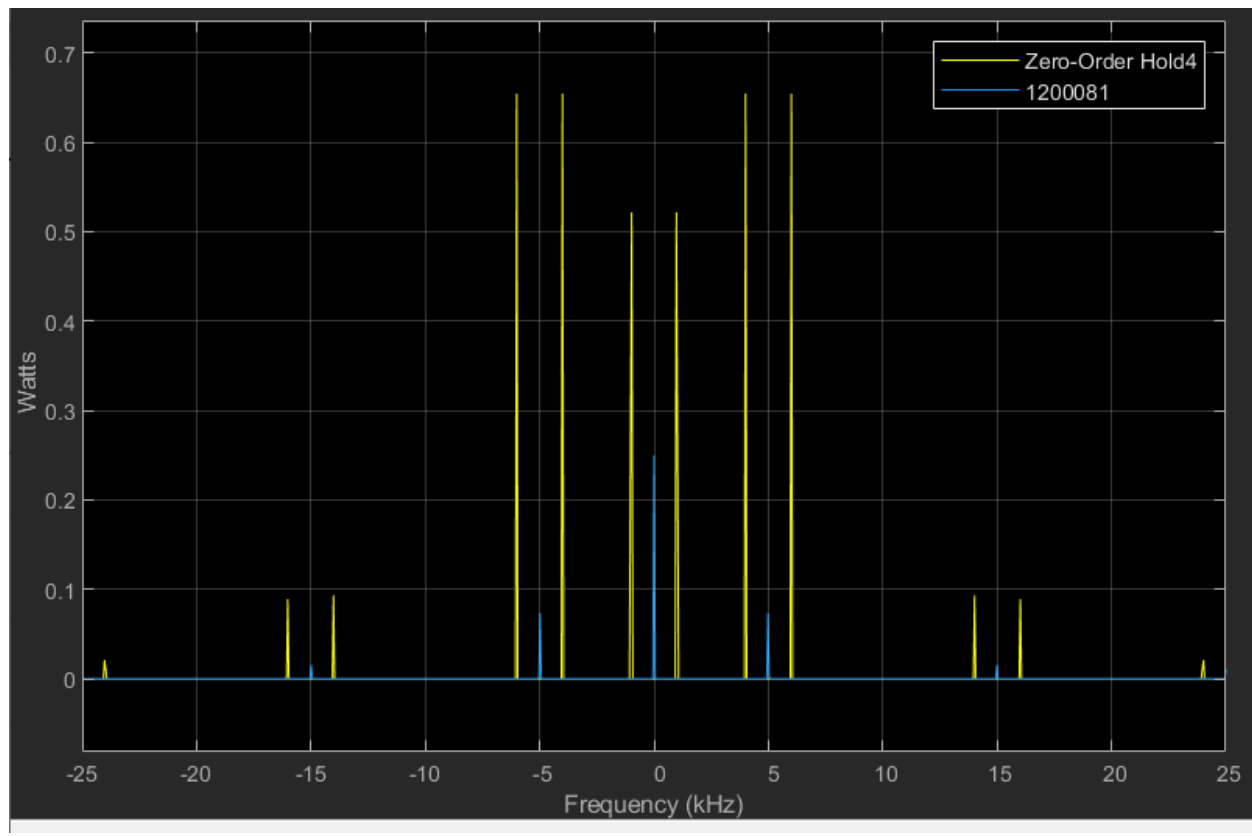


Figure 16.  $m(t)$  &  $s(t)$  @  $f_m=1000\text{Hz}$  &  $D=50\%$  in frequency domain

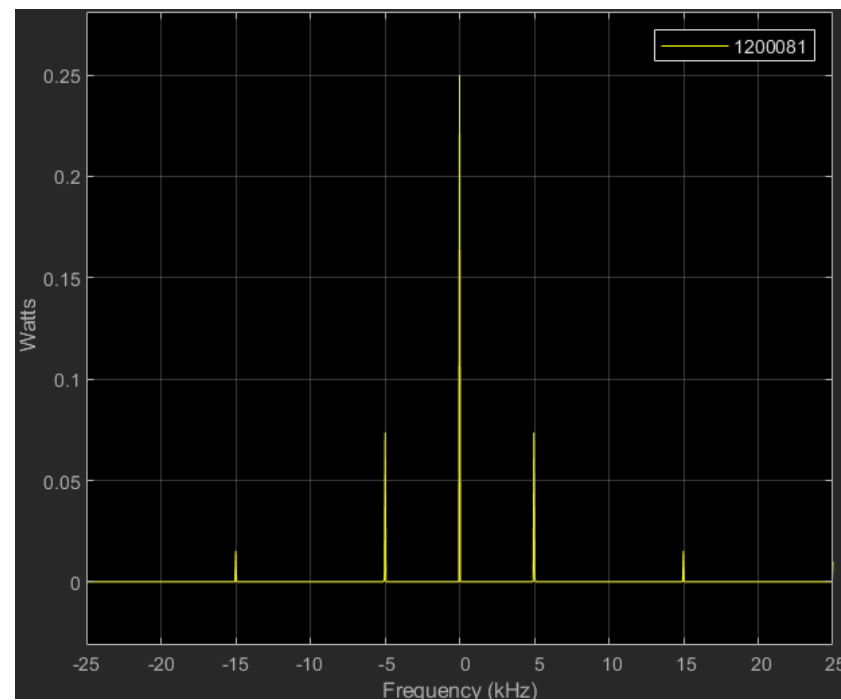


Figure 17. pulse train in frequency domain @  $D=50\%$

## 2.6. Modulated signal @ $f_m=2000\text{Hz}$ & $D=50\%$ :

### 2.6.1. Time domain :

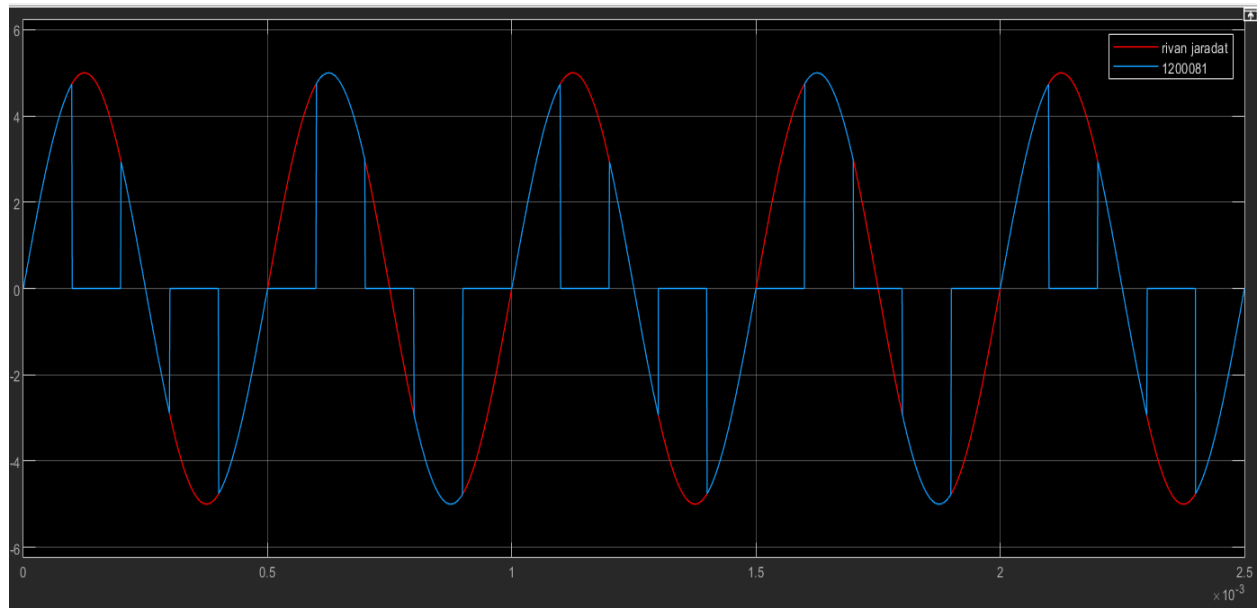


Figure 18.  $m(t)$  &  $s(t)$  @  $f_m=2000\text{Hz}$  &  $D=50\%$  in time domain

### 2.6.2. Frequency domain

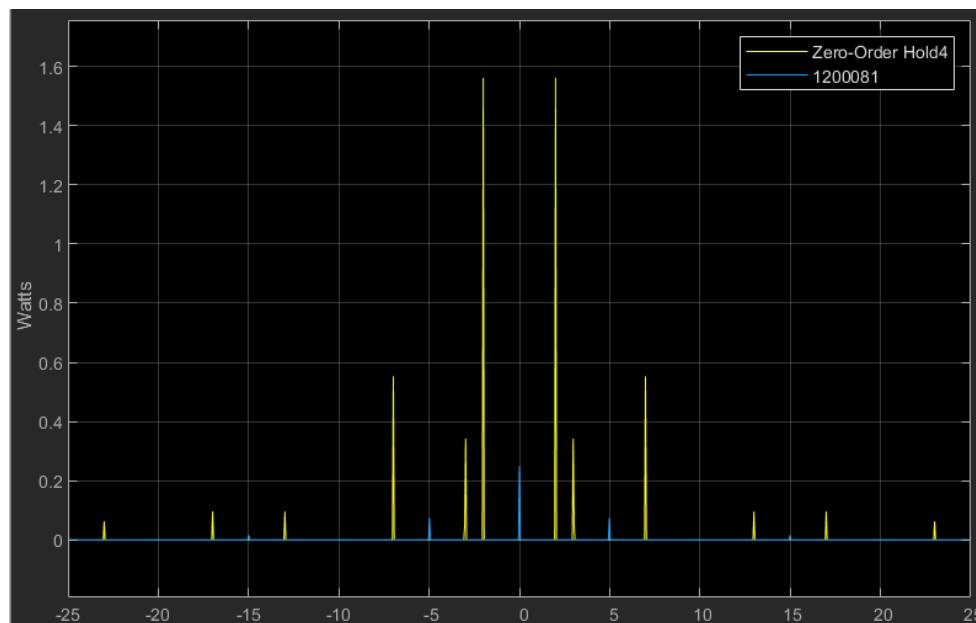


Figure 19.  $m(t)$  &  $s(t)$  @  $f_m=2000\text{Hz}$  &  $D=50\%$  in frequency domain

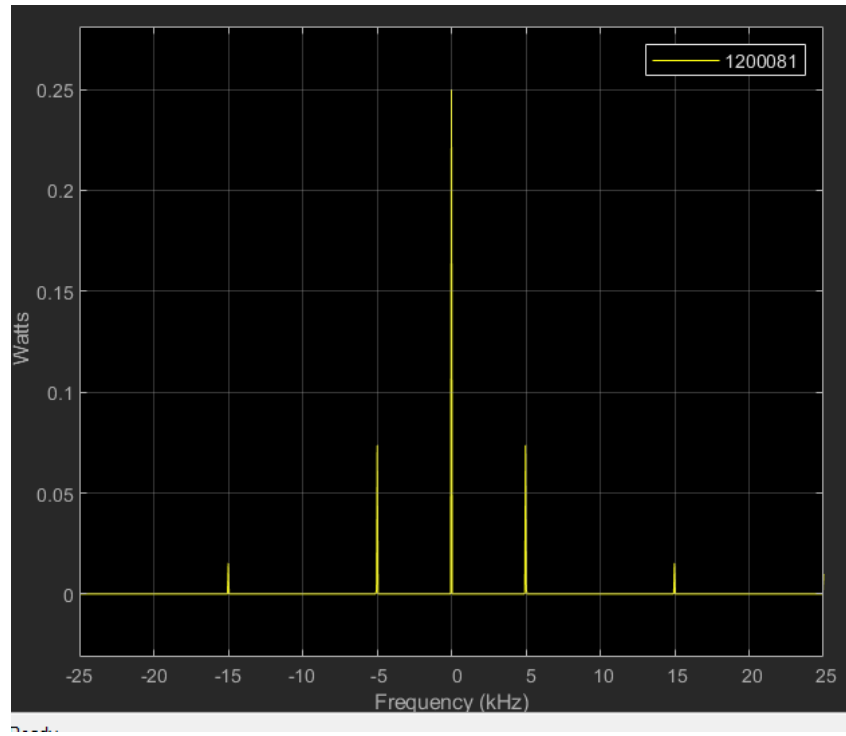
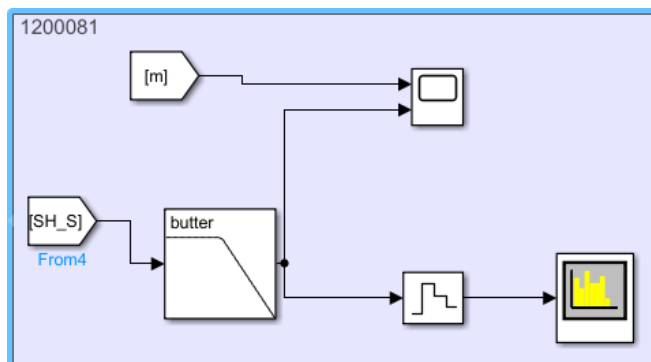
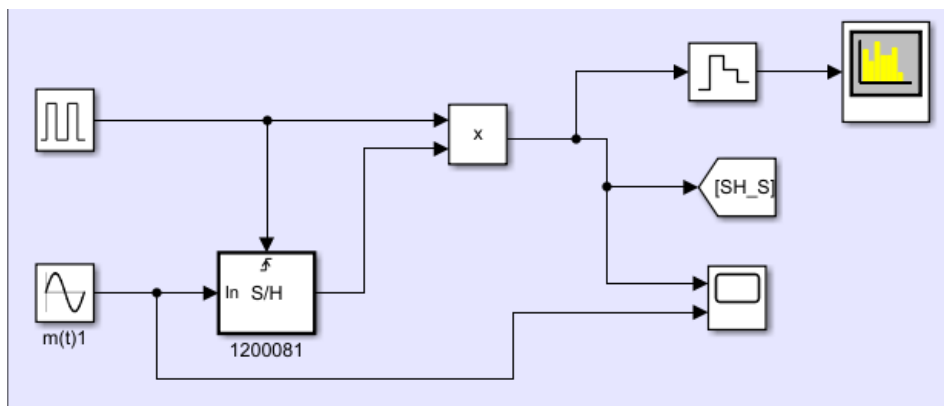


Figure 20.pulse train in frequency domain @D=50%

### 3.Sample and Hold (flat topped) Sampling

Block diagram:



### 3.2. Modulated signal @ $f_m=500\text{Hz}$ & $D=50\%$

Time domain:

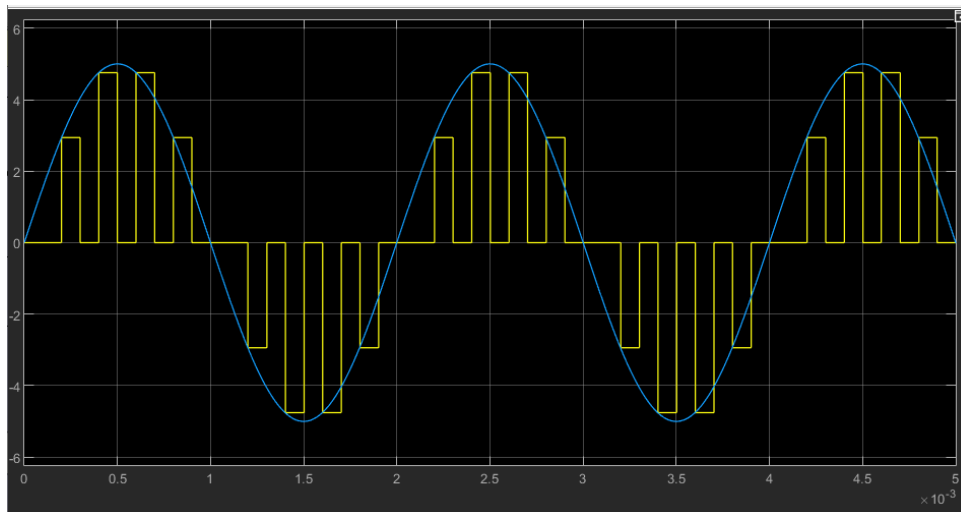


Figure 21.  $m(t)$  &  $s(t)$  @  $f_m=500\text{Hz}$  &  $D=50\%$  in time domain

Frequency domain:

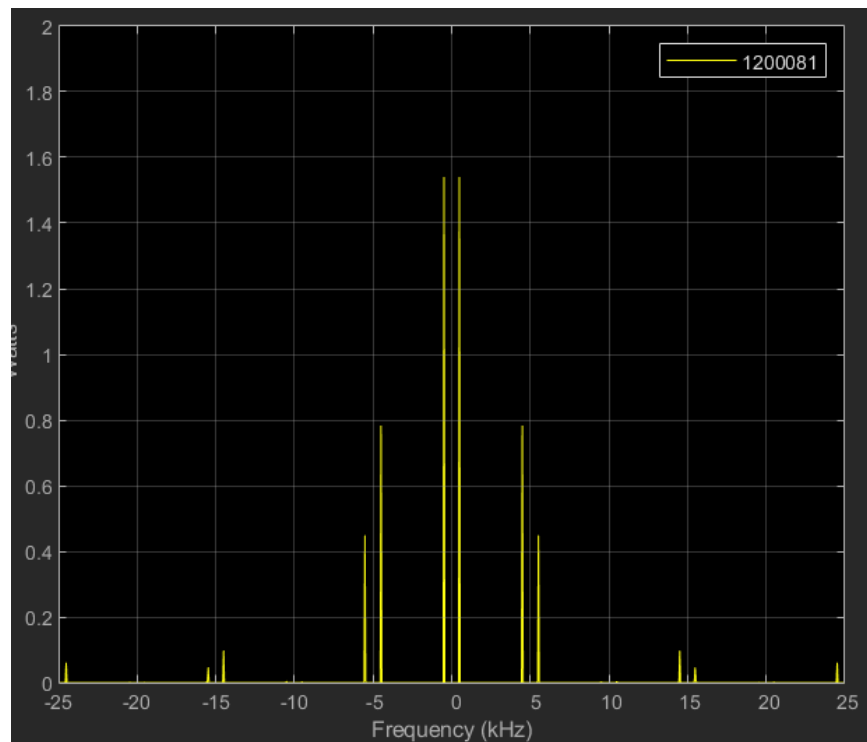


Figure 22.  $s(t)$ ,  $m(t)$  @  $f_m=1000\text{Hz}$  &  $D=50\%$  in frequency domain

### 3.3. Modulated signal @ $f_m=500\text{Hz}$ & $D=10\%$

Time domain:

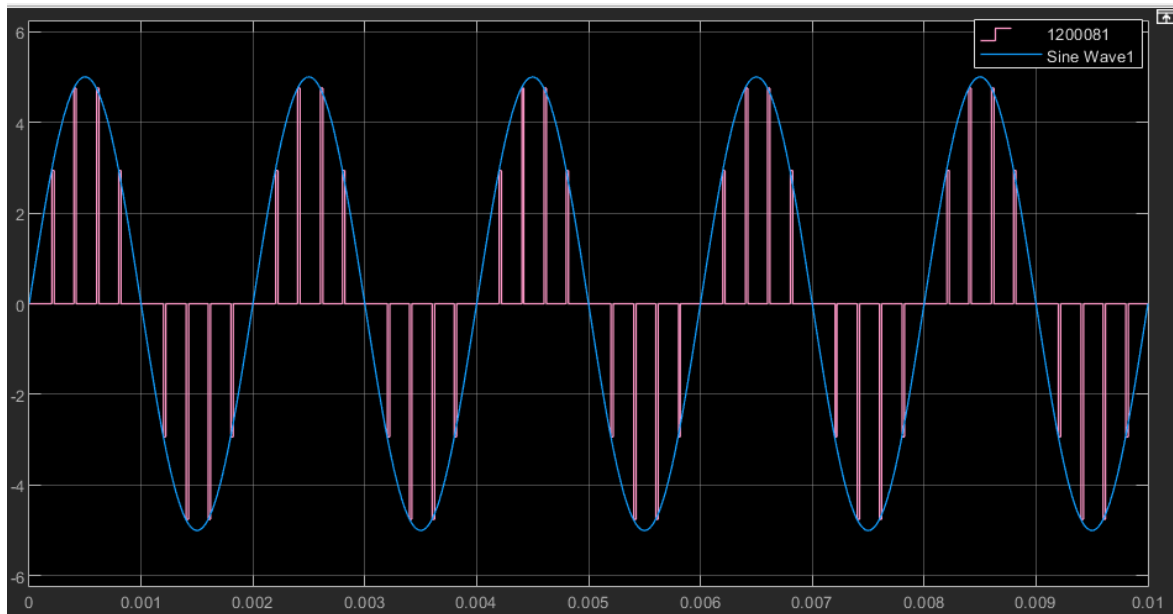


Figure 23.  $s(t)$ ,  $m(t)$  @  $f_m=500\text{Hz}$  &  $D=10\%$  in time domain

Frequency domain:

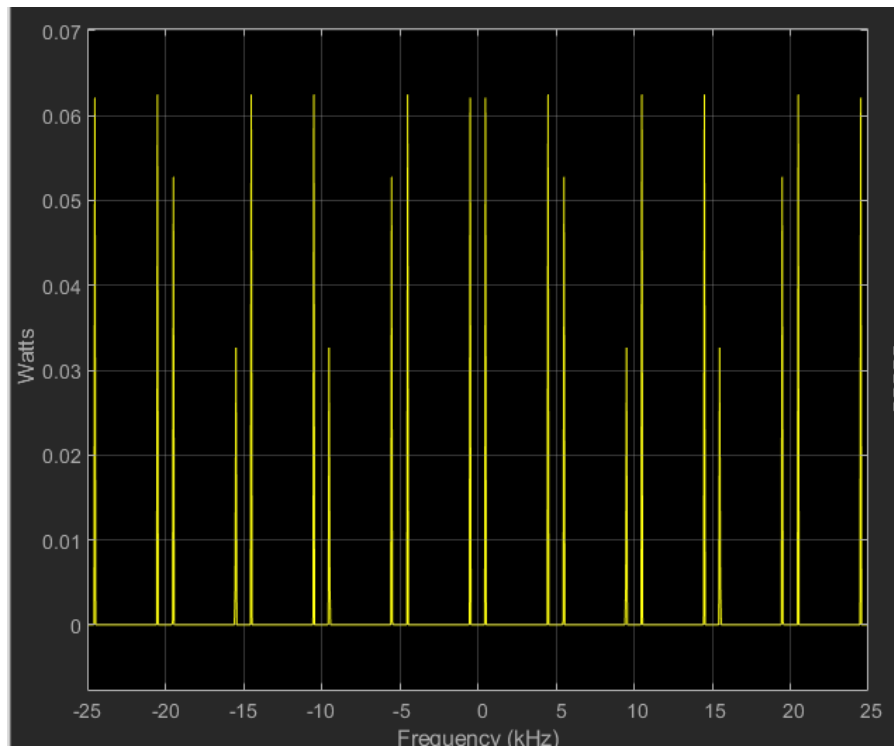


Figure 24.  $S(f)$  in frequency domain



### 3.4. Modulated signal @ $f_m=500\text{Hz}$ & $D=30\%$

Time domain:

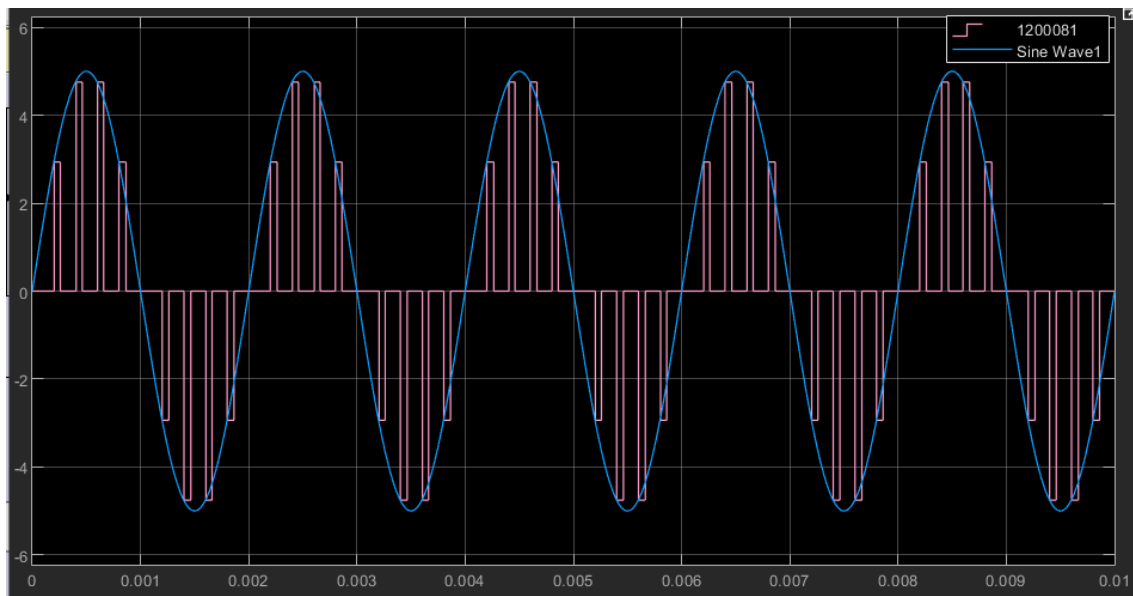


Figure 25.  $s(t)$ ,  $m(t)$  @  $f_m=500\text{Hz}$  &  $D=30\%$  in time domain

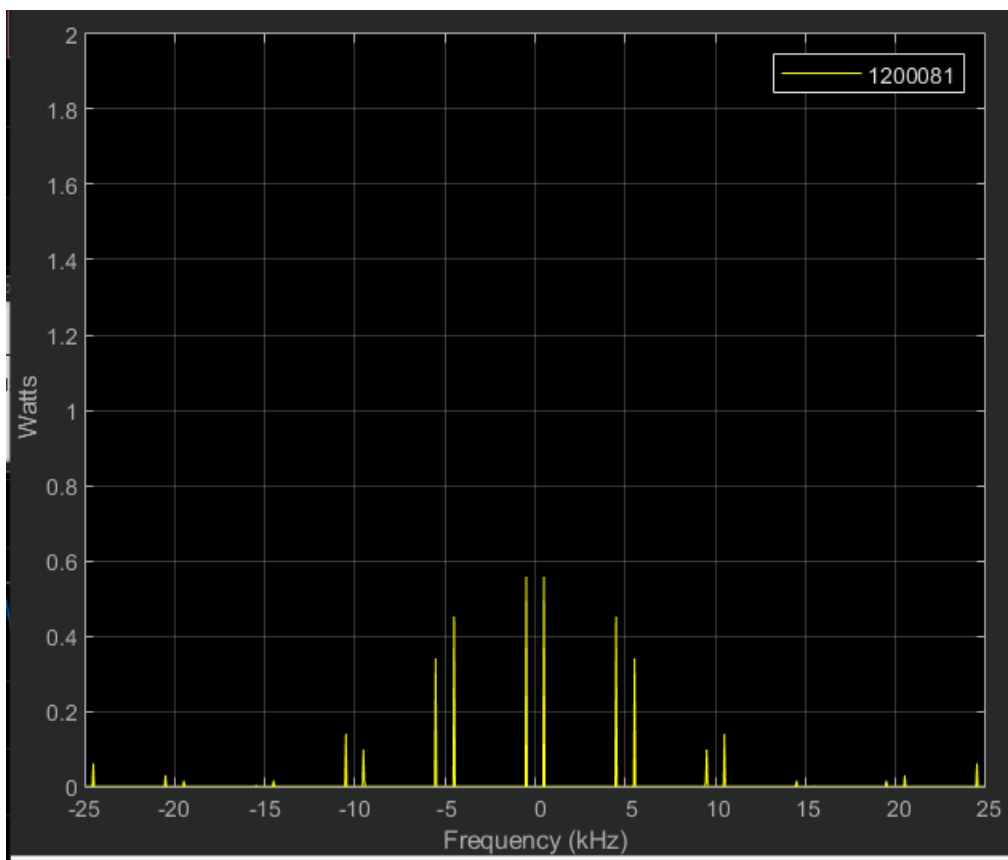


Figure 26.  $s(t)$  in frequency domain

### 3.5. Modulated signal @ $f_m=1000\text{Hz}$ & $D=50\%$

Time domain:

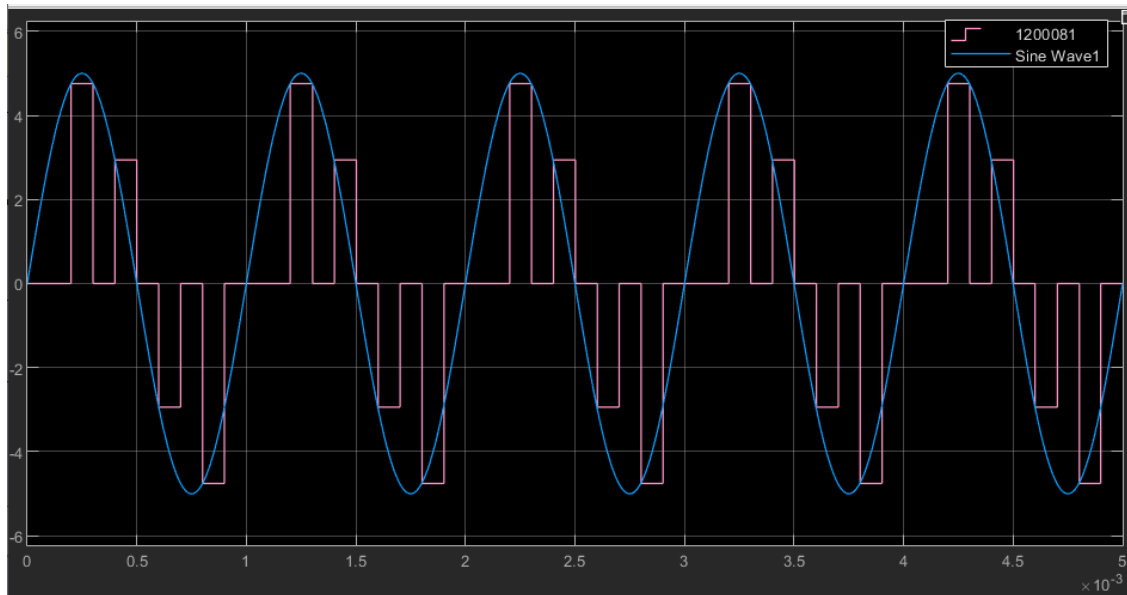


Figure 27.  $s(t)$ ,  $m(t)$  @  $f_m=1000\text{Hz}$  &  $D=50\%$  in time domain

Frequency domain:

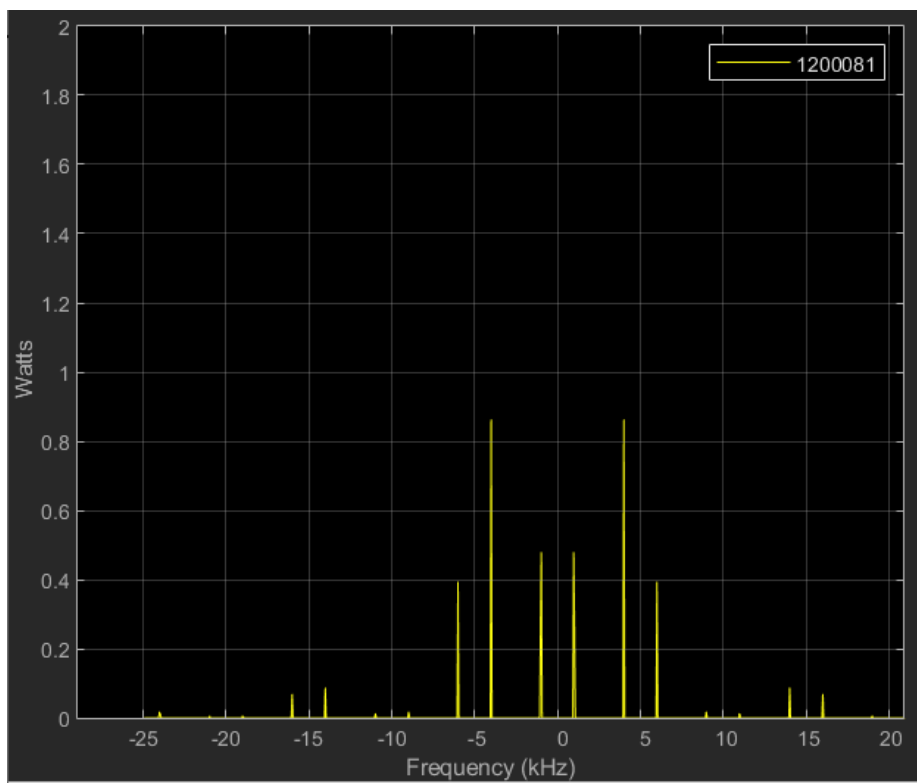


Figure 28.  $s(t)$  in frequency domain

### 3.6. Modulated signal @ $f_m=2000\text{Hz}$ & $D=50\%$

Time domain:

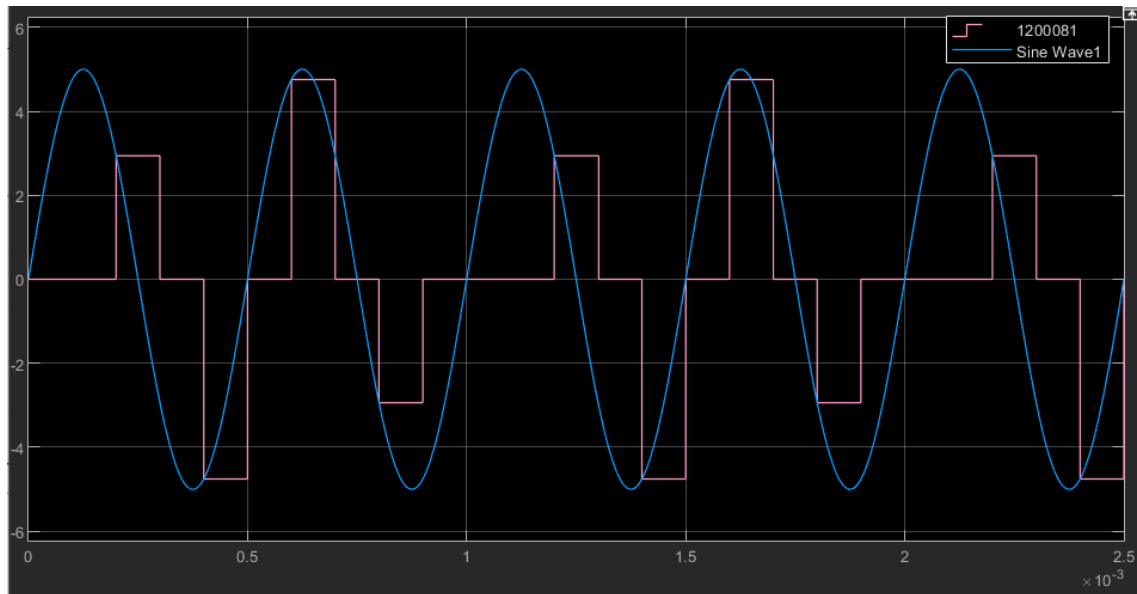


Figure 29.  $s(t)$ ,  $m(t)$  @  $f_m=2000\text{Hz}$  &  $D=50\%$  in time domain

Frequency domain:

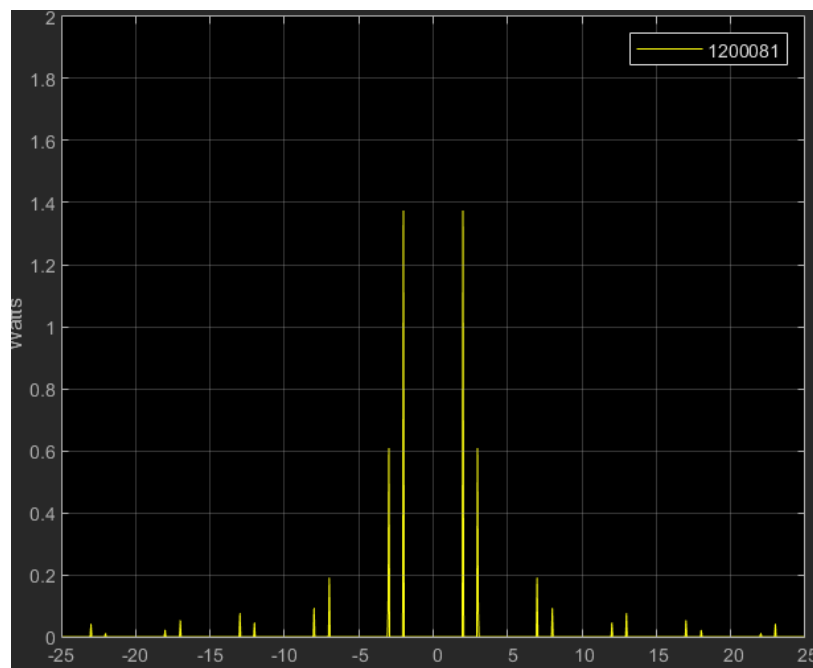
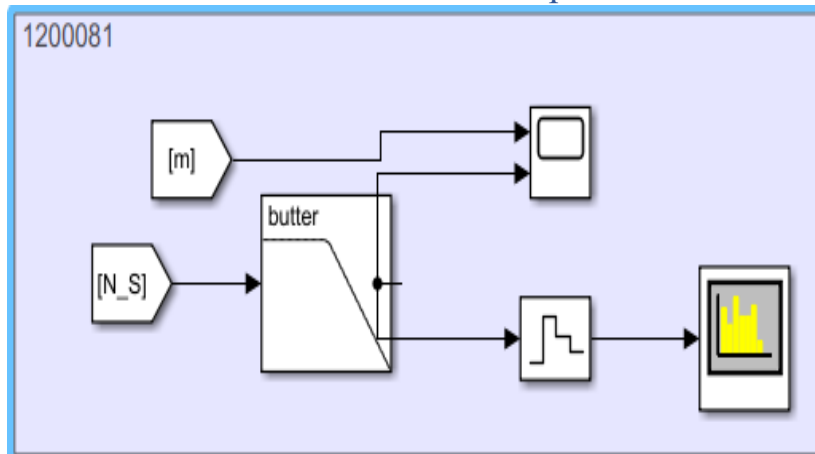


Figure 30.  $s(t)$  in frequency domain

#### 4.Part 3:Characteristics of Pulse Amplitude Demodulation



#### 4.2.De-Modulated signal Natural @ $f_m=500$ & $D=50\%$

Time domain:

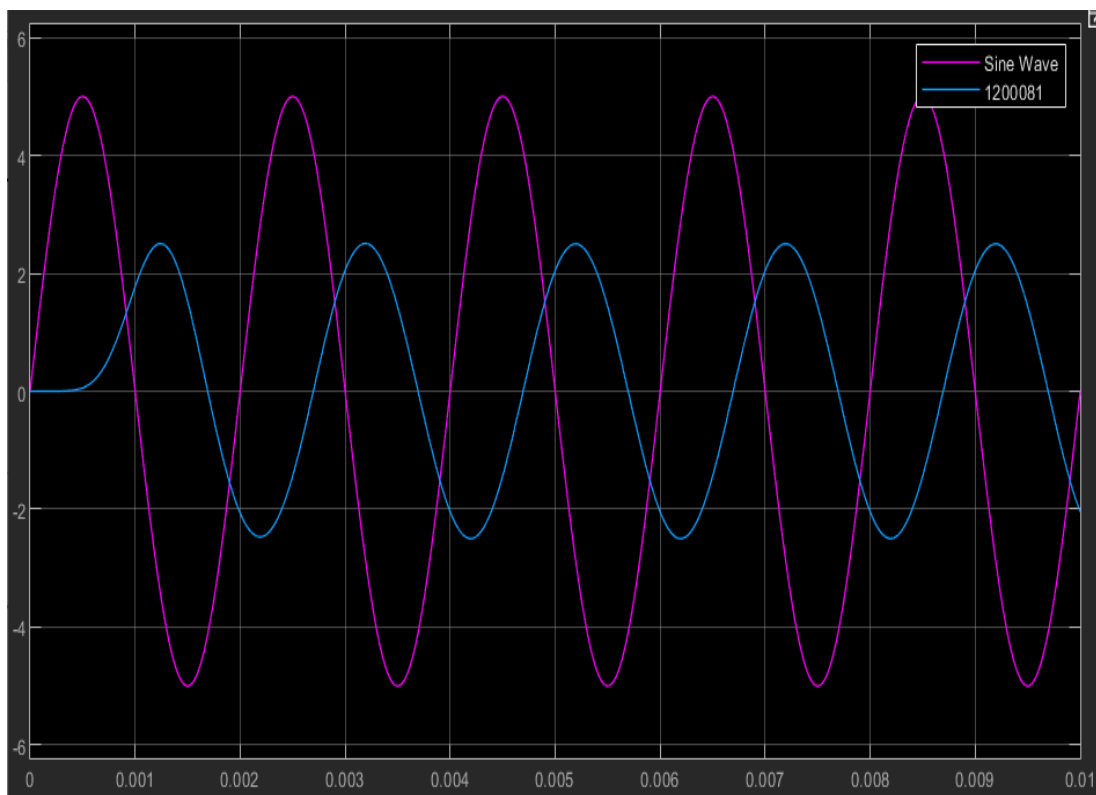


Figure 31m(t) & demodulated signal in time domain at  $d=50\%$

Frequency domain:

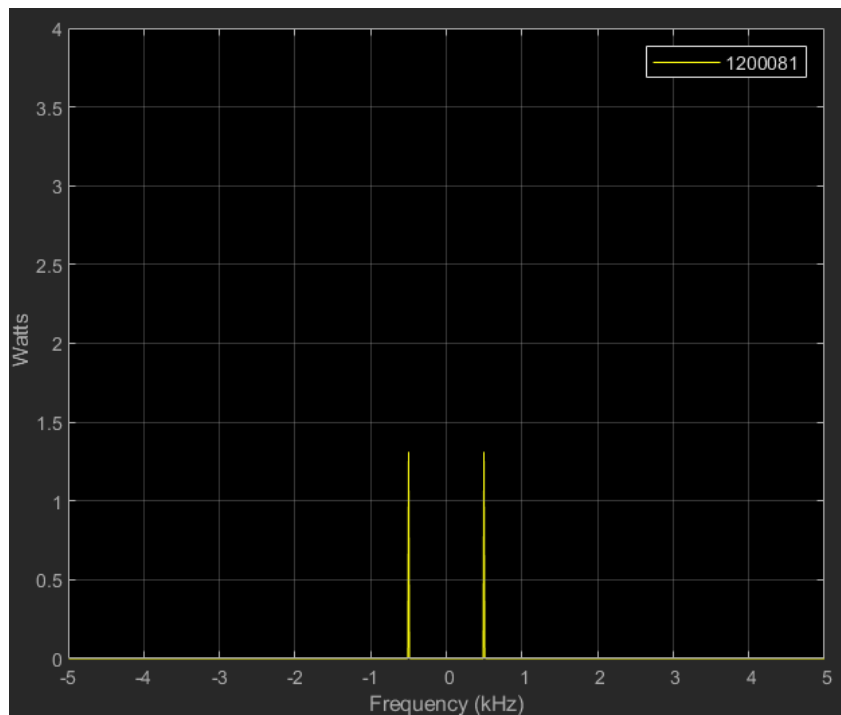


Figure 32.demodulated signal in frequency domain

#### 4.3.De-Modulated signal Natural @ $f_m=500$ & $D=10\%$

Time domain:

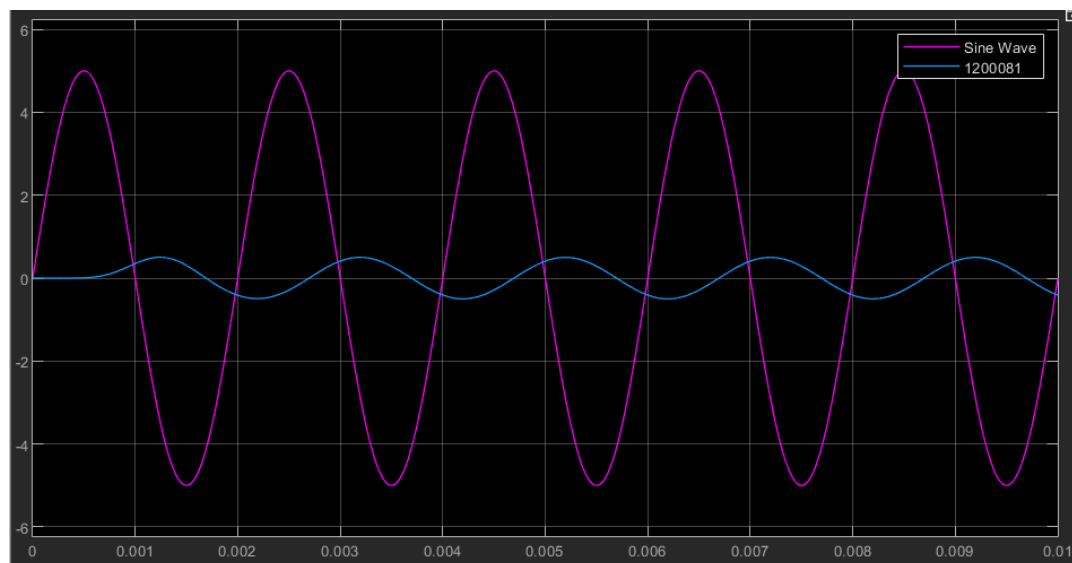


Figure 33. $m(t)$  & demodulated signal in time domain at  $d=10\%$

Frequency domain:

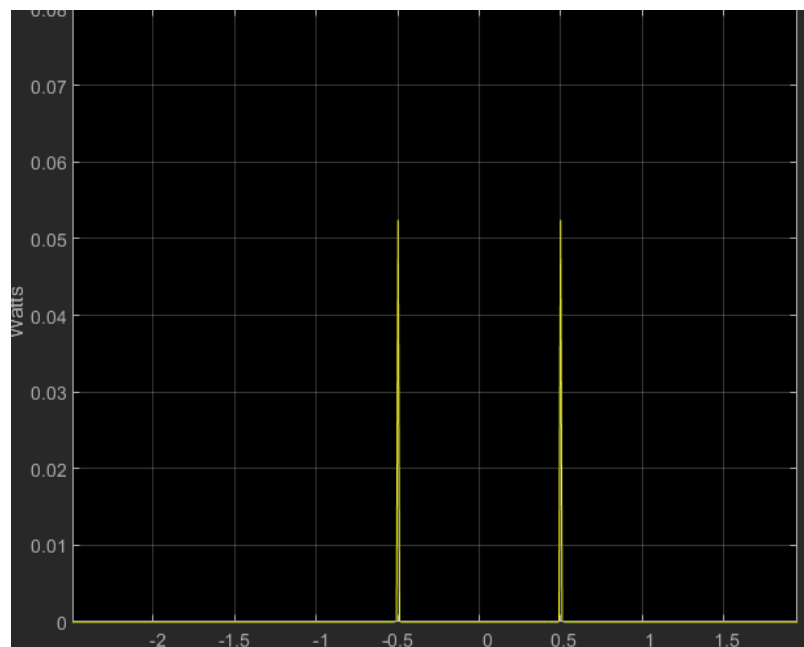


Figure 34. demodulated signal in frequency domain

---

#### 4.4. De-Modulated signal Flat-Top @ $f_m=500$ & $D=50\%$ :

Time domain:

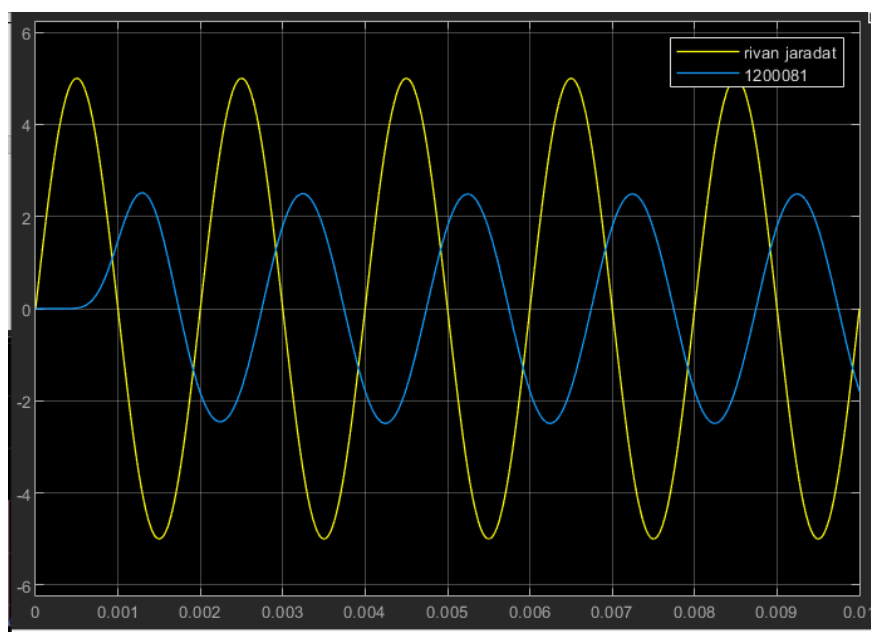


Figure 35.  $m(t)$  & demodulated signal in time domain at  $d=50\%$

Frequency domain:

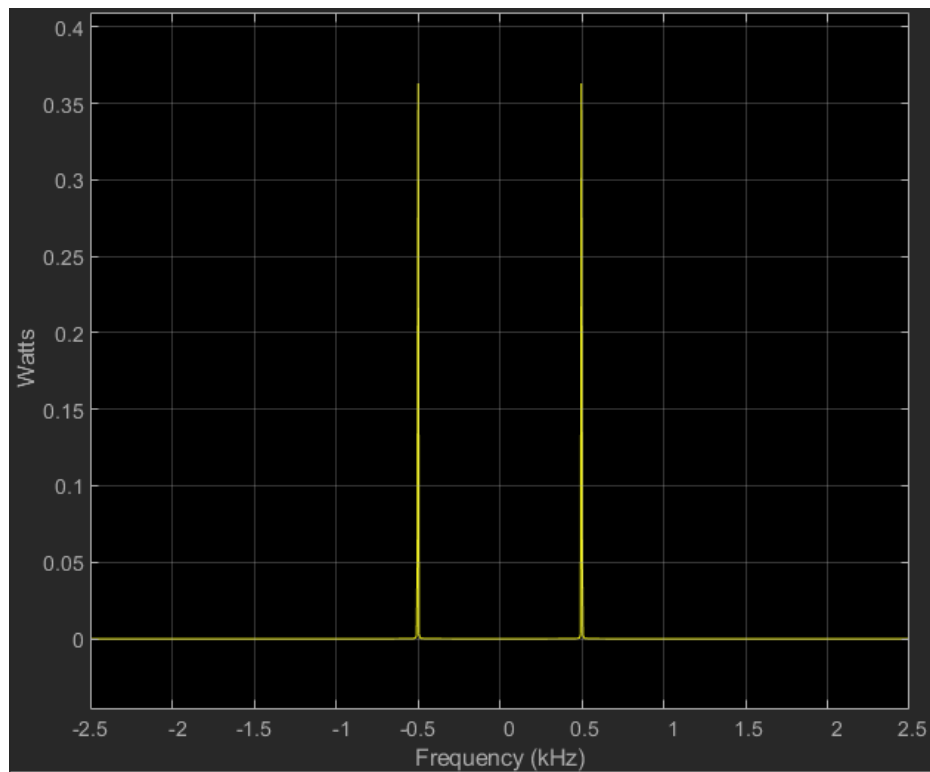


Figure 36.demodulated signal in frequency domain

## 5.Part 4:

### 5.1. Modulated signal @fm=3000 & D=50%

Time domain:

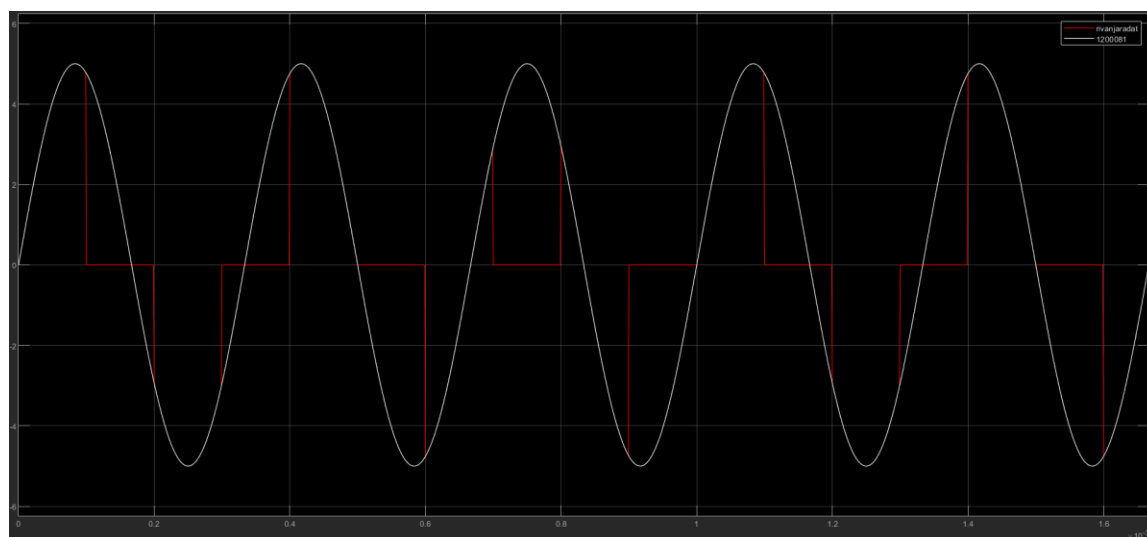


Figure 37.m(t) & Modulated signal @fm=3000 & D=50% in time domain

Frequency domain:

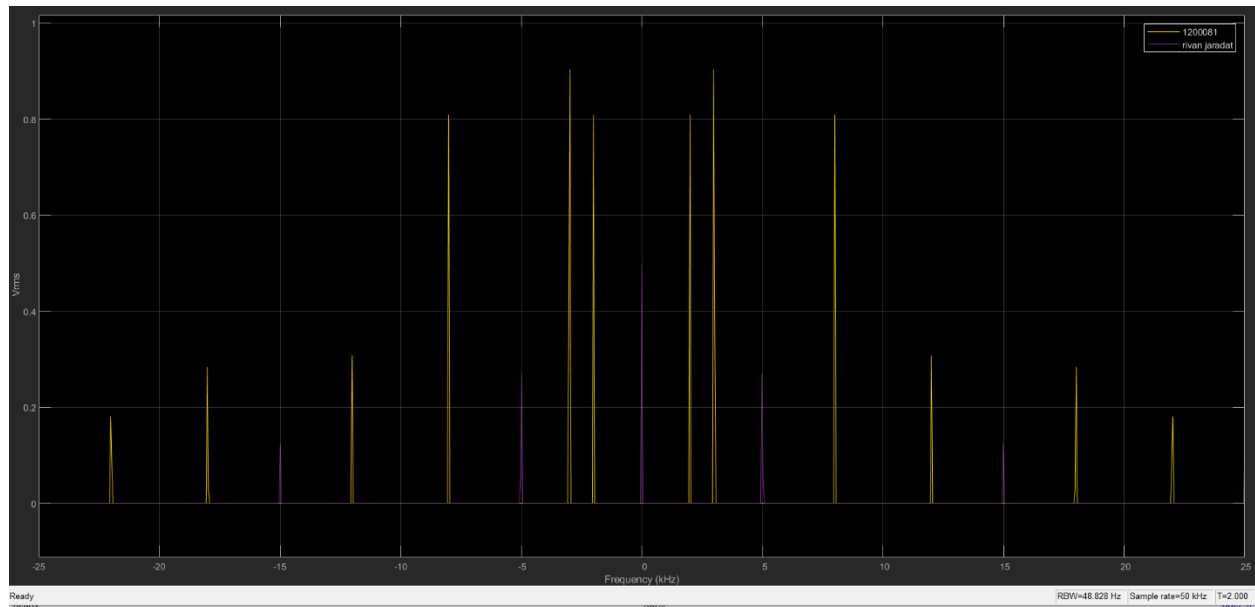


Figure 38.modulated signal in frequency domain

## 5.2.De-Modulated signal @fm=3000 & D=50%

Time:



Figure 39.m(t) &deModulated signal @fm=3000 & D=50% in time domain



Frequency :Domain:

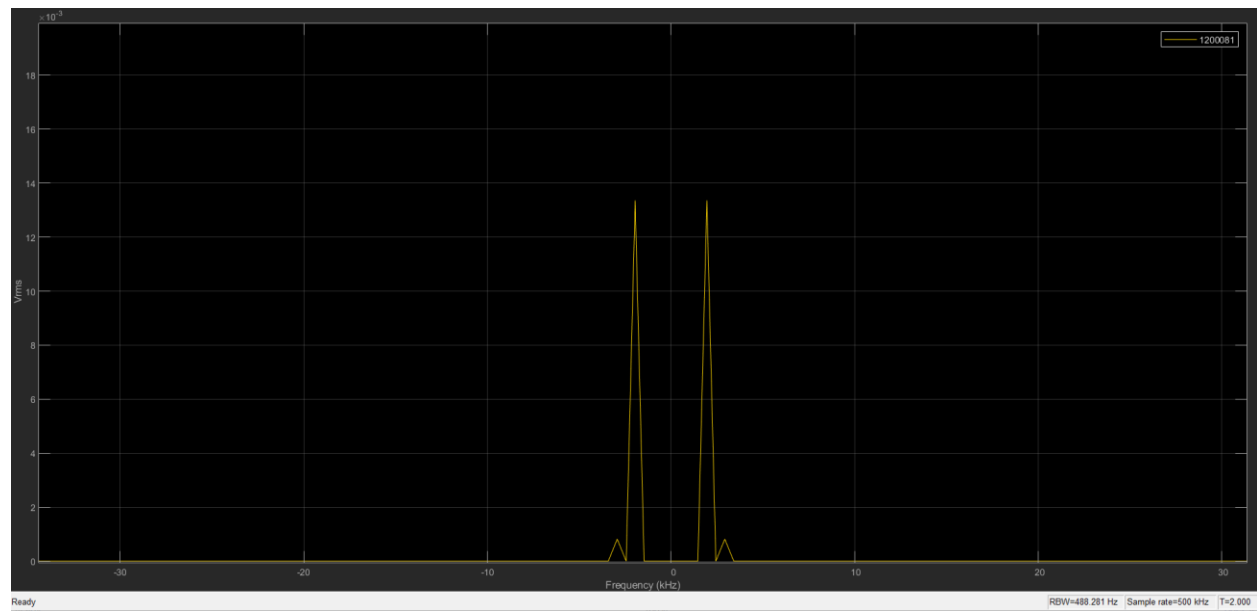


Figure 40.demodulated signal in frequency domain

Way 2: flat topped

5.3.Modulated signal @fm=3000 & D=50%

Time:

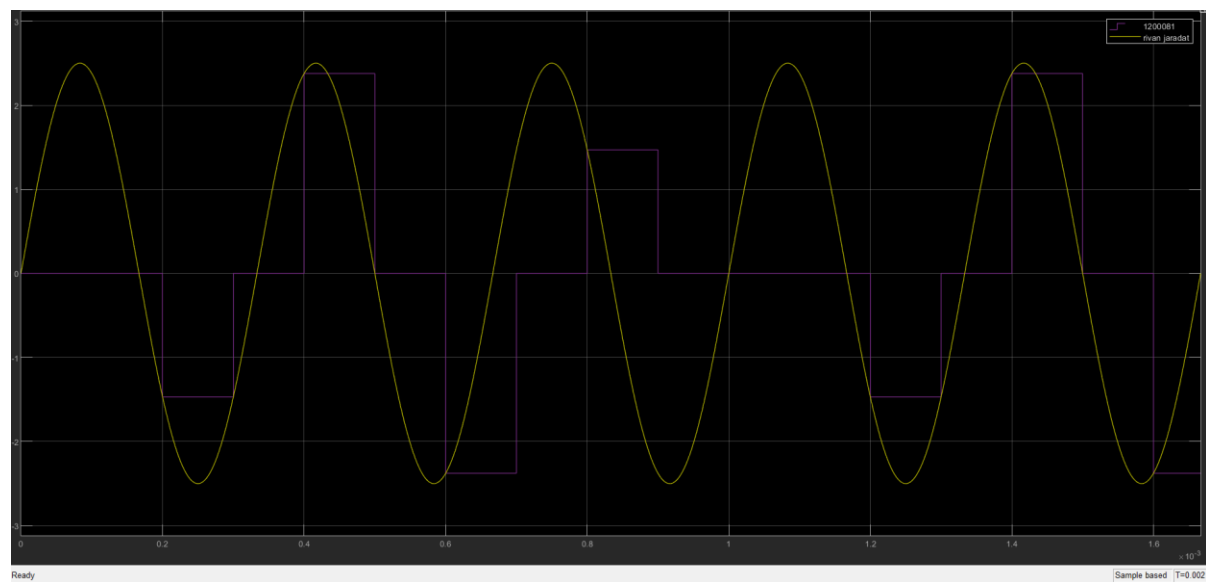


Figure 41m(t) &Modulated signal @fm=3000 & D=50% in time domain

Frequency Domain:

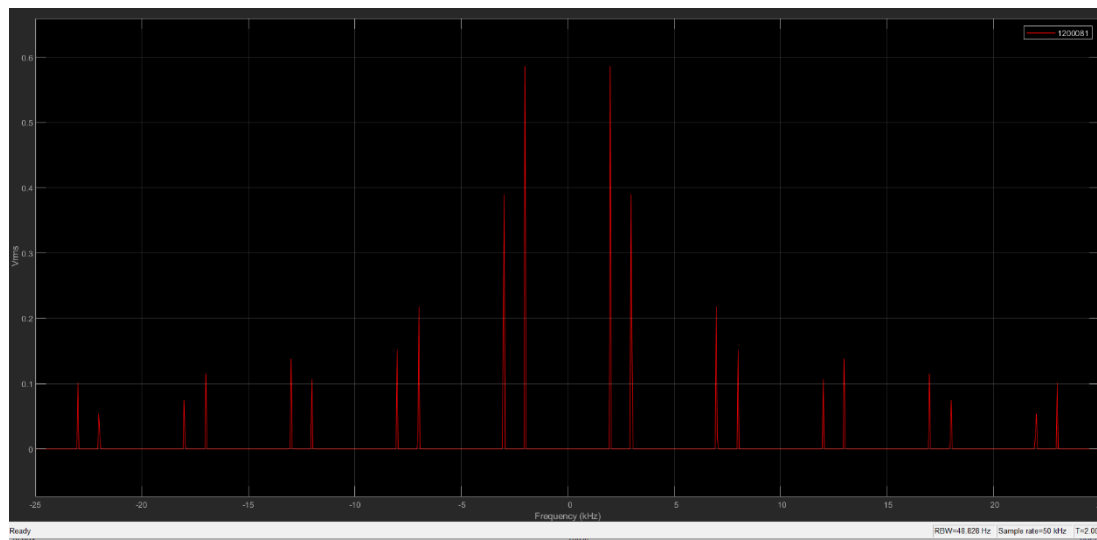


Figure 42. modulated signal in frequency domain

#### 5.4. De-Modulated signal @fm=3000 & D=50%

Time domain:

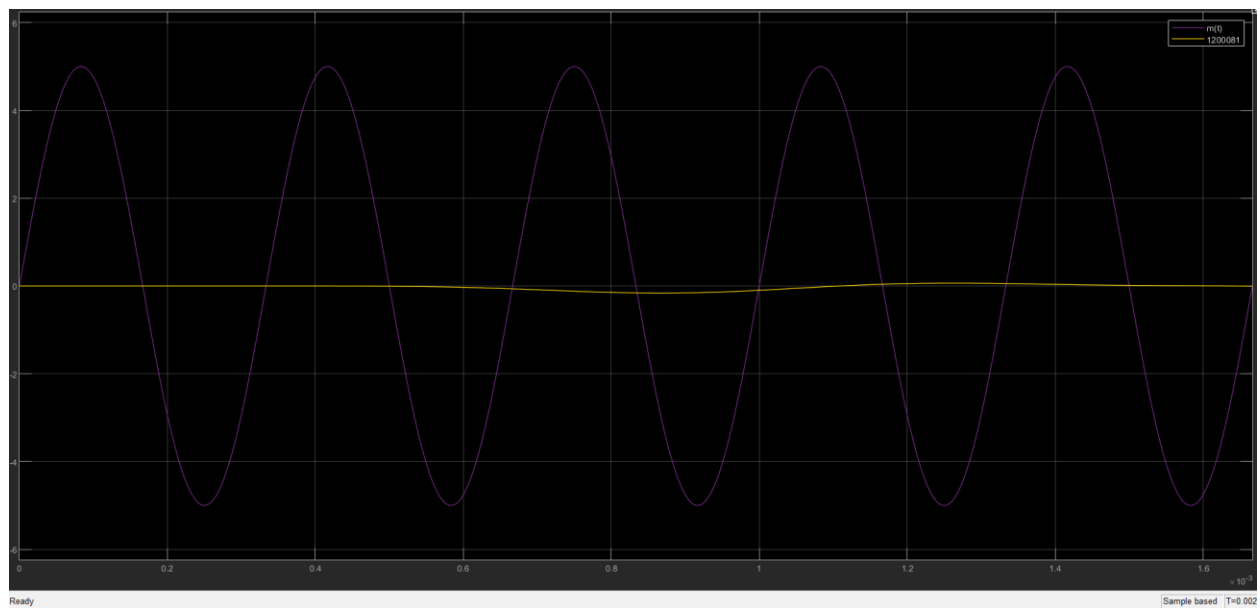


Figure 43.  $m(t)$  & de-Modulated signal @fm=3000 & D=50% in time domain

## Frequency Domain:

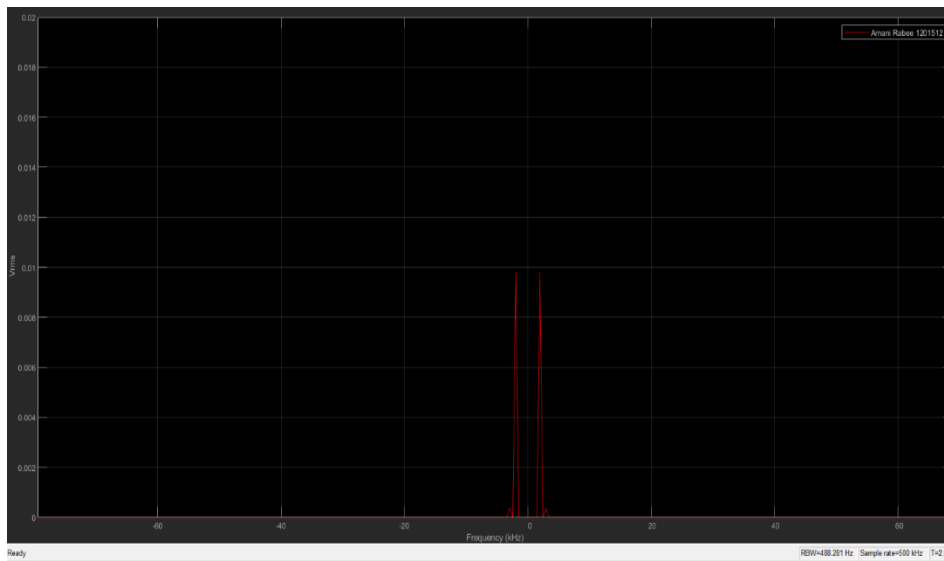
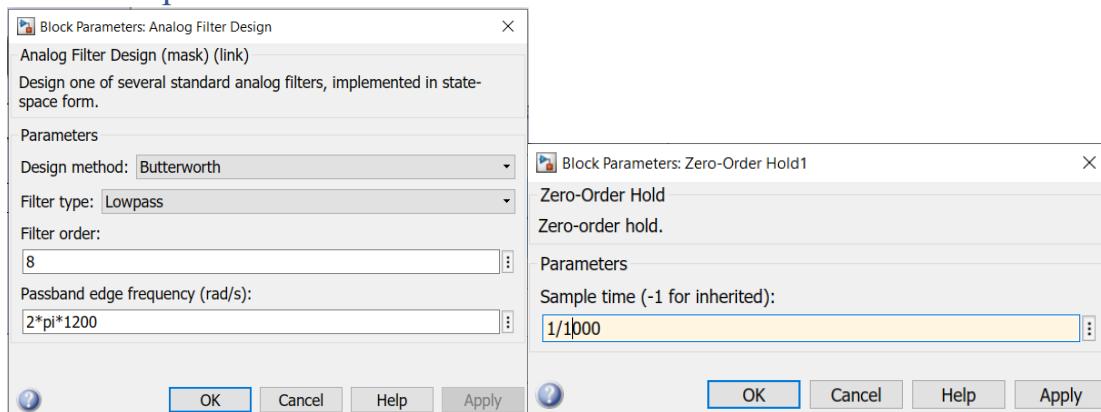


Figure 44. demodulated signal in frequency domain

## 6. General parameters:



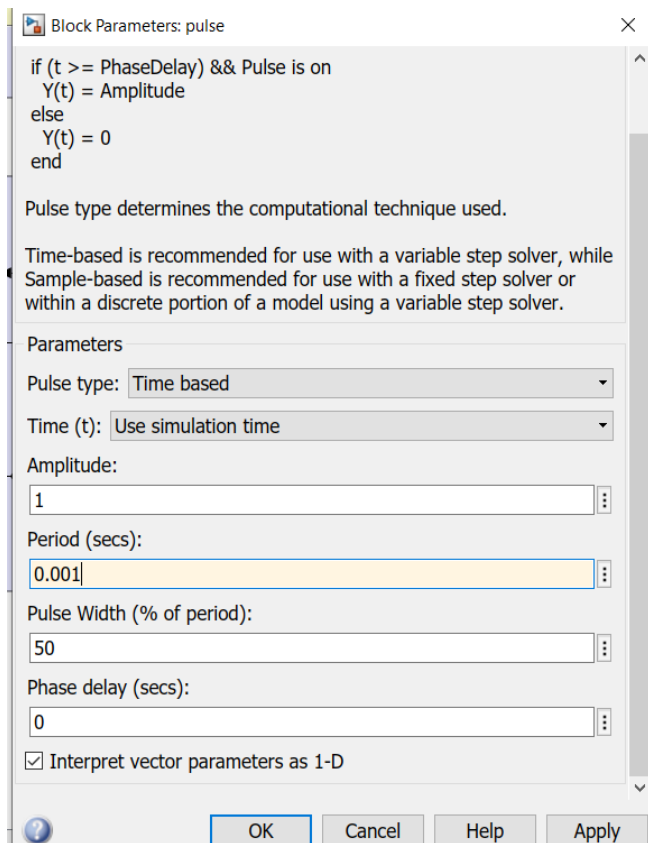


Figure 45. general parameter