Faculty of Engineering and Technology

Electrical and Computer Engineering Department

ENEE4113

COMMUNICATION LABORATORY

PreLab #4

Pulse Amplitude Modulation

Student's Name: Lojain Abdalrazaq. **ID:** 1190707.

Instructor's Name: Ashraf Al-Rimawi.

Teaching Assistant: Mohammad Al-Battat.

Section: 5.

April 26, 2023

Part 1: Time and Frequency Characteristics of pulse train

Firstly, the block was built using Simulink as shown in the following figure. The input signal was with frequency 1000 Hz, amplitude 10V, and finally the duty cycle with 10%.

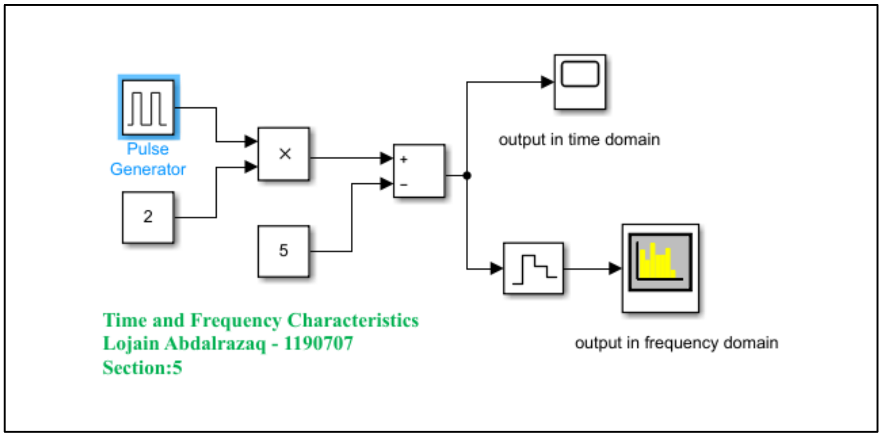

Figure 1 pulse train block diagram using simulink.

The settings of the input pulse generator is as the following:

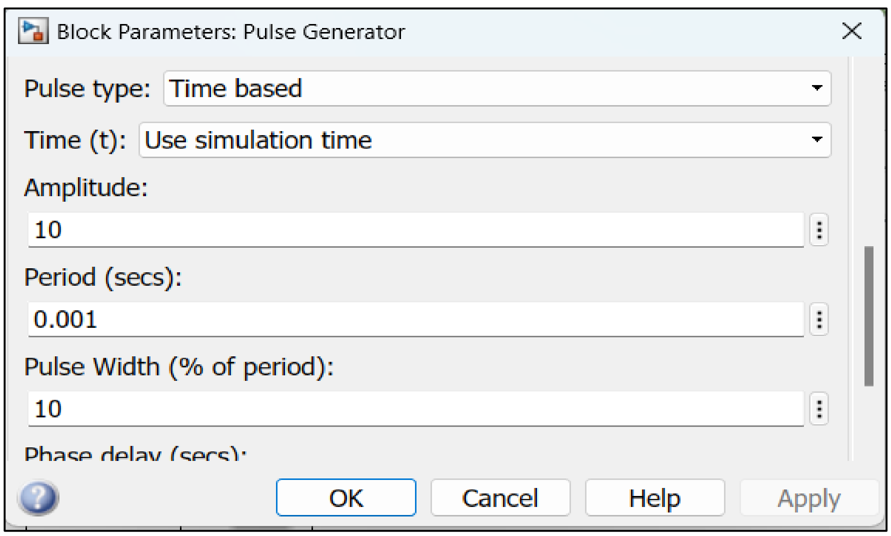

Figure 2 Settings of pulse generator.

The output signal of the pulse train in **time domain**:

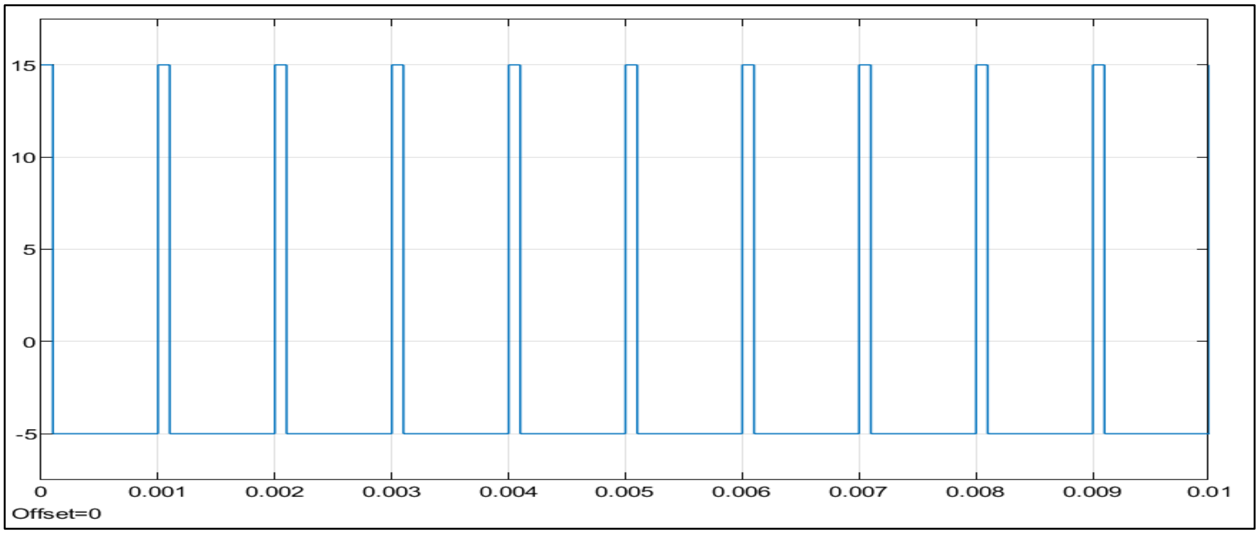

Figure 3 The output signal in time domain.

While, in **frequency domain after setting the Sample time equals to 1/1000 in zero-order hold block**:

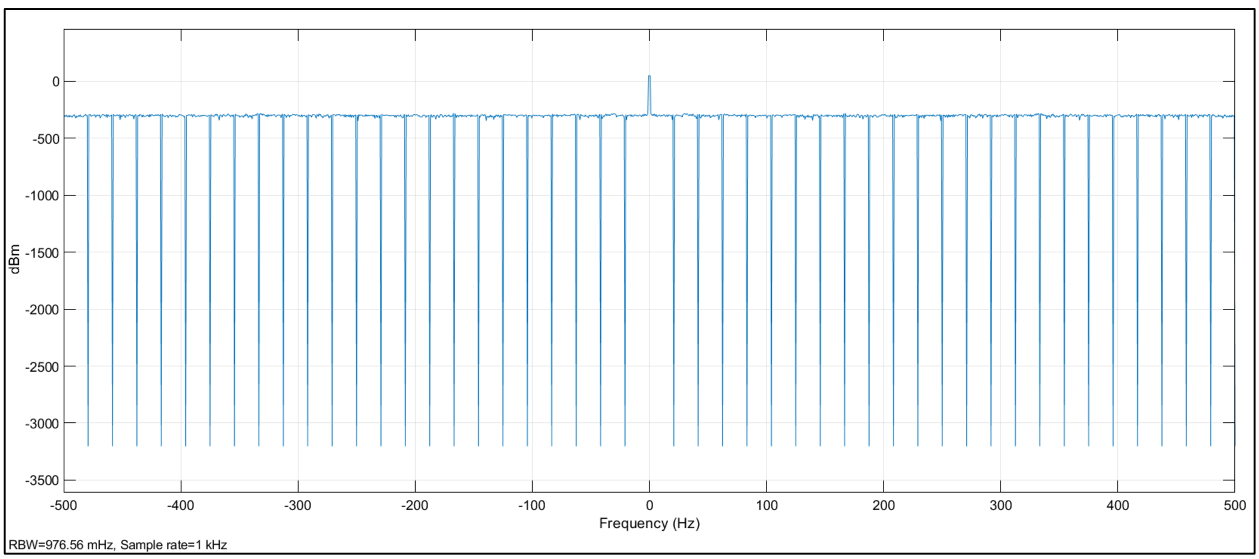

Figure 4 Pulse train signal in frequency domain.

- When changing the duty cycle to **20%**:

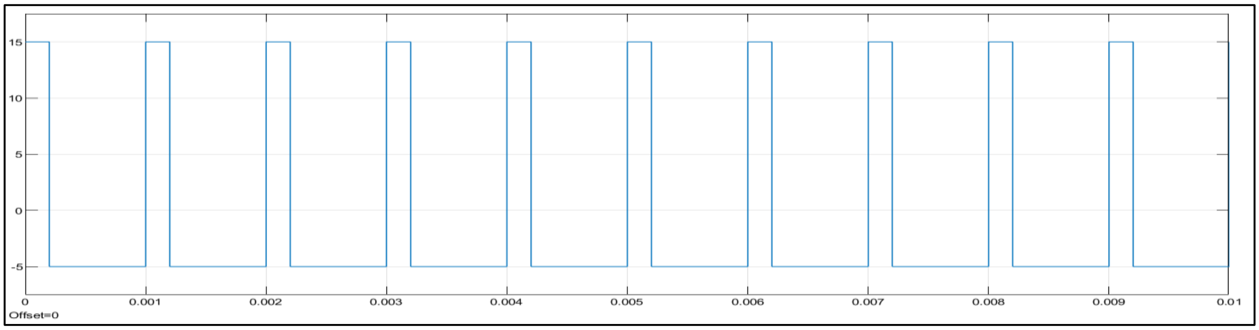

Figure 6 pulse train when duty cycle 20% in time domain.

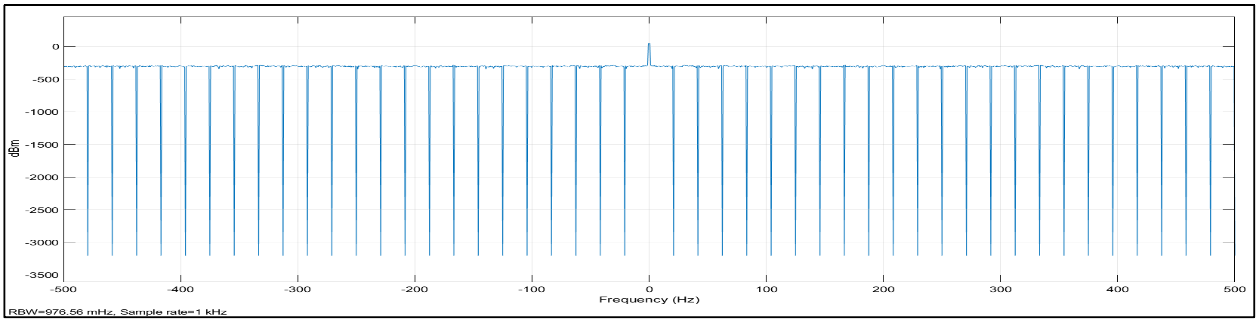

Figure 5 pulse train when duty cycle 20% in frequency domain.

- When changing the duty cycle to **40%**:

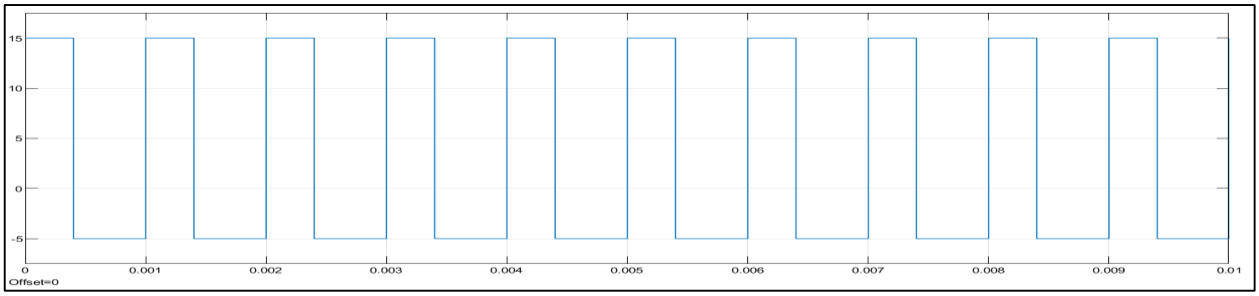

Figure 8 pulse train when duty cycle 40% in time domain.

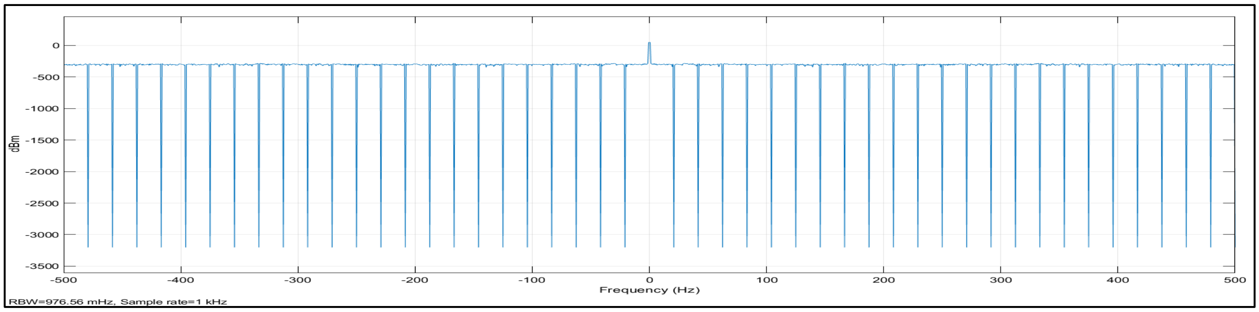

Figure 7 pulse train when duty cycle 40% in frequency domain.

- When changing the duty cycle to **50%**:

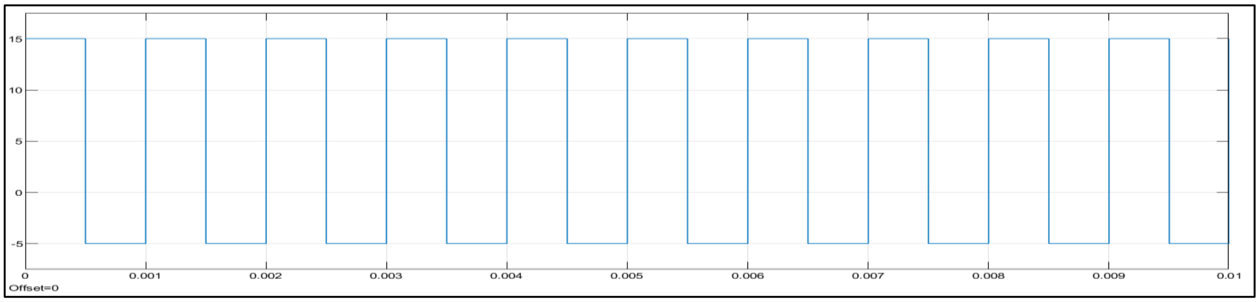

Figure 10 pulse train when duty cycle 50% in time domain.

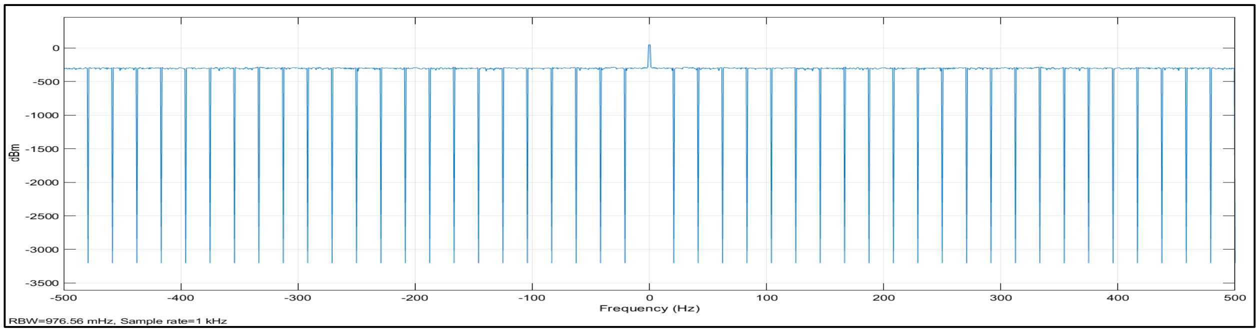

Figure 9 pulse train when duty cycle 50% in frequency domain.

- When changing the duty cycle to **90%**:

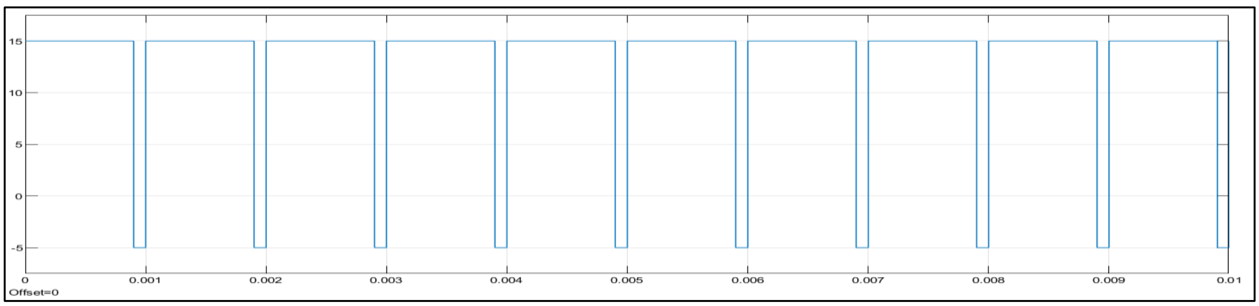

Figure 12 pulse train when duty cycle 90% in time domain.

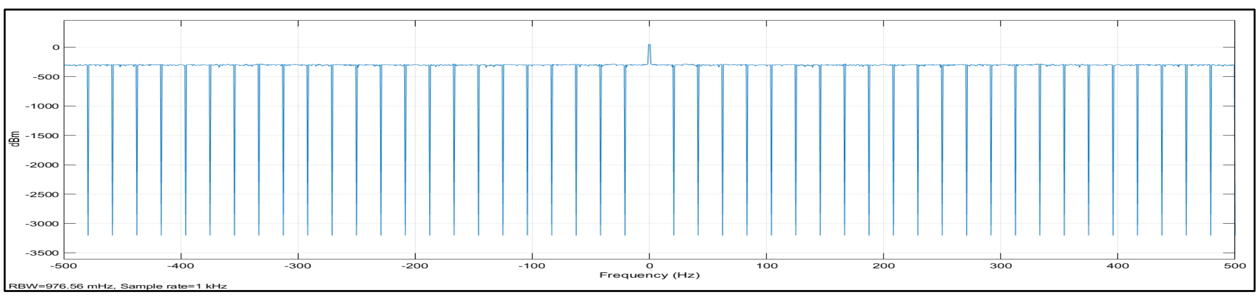

Figure 11 pulse train when duty cycle 90% in frequency domain.

Part 2: Pulse Amplitude Modulation using Natural Sampling

The following figure represents the pulse amplitude modulation using natural sampling block diagram:

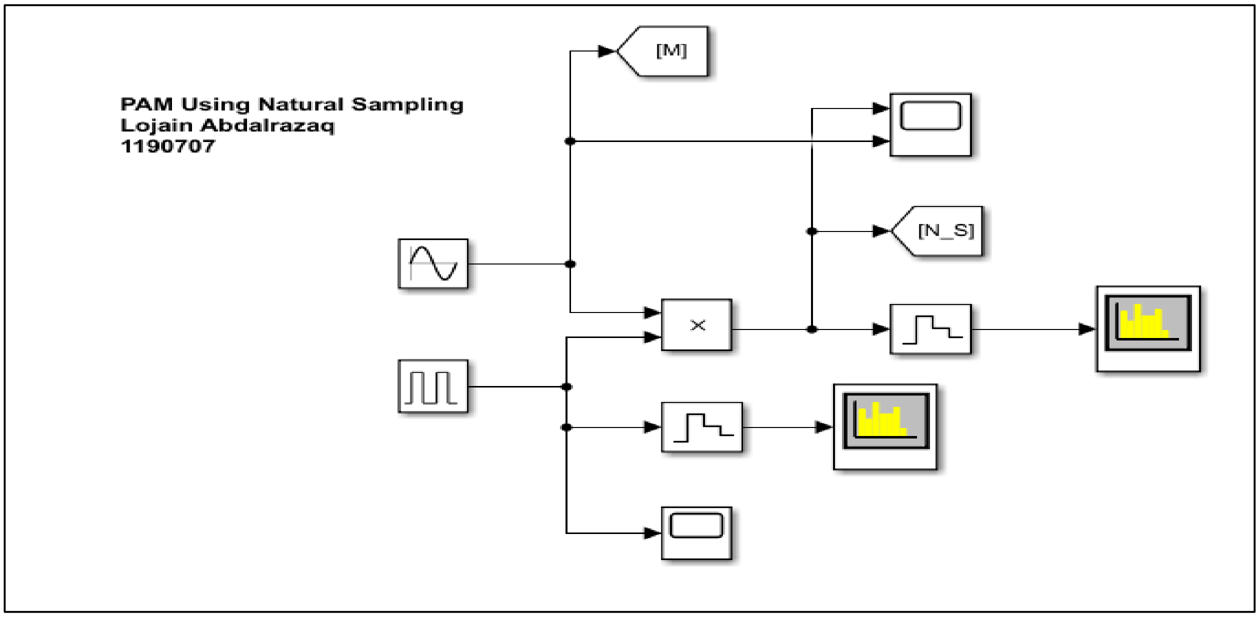

Figure 13 PAM using Natural sampling block diagram.

Using the 10V amplitude and 500 Hz frequency for the cosine input signal, and 20% duty cycle pulse generator, the modulated signal in time is as the following:

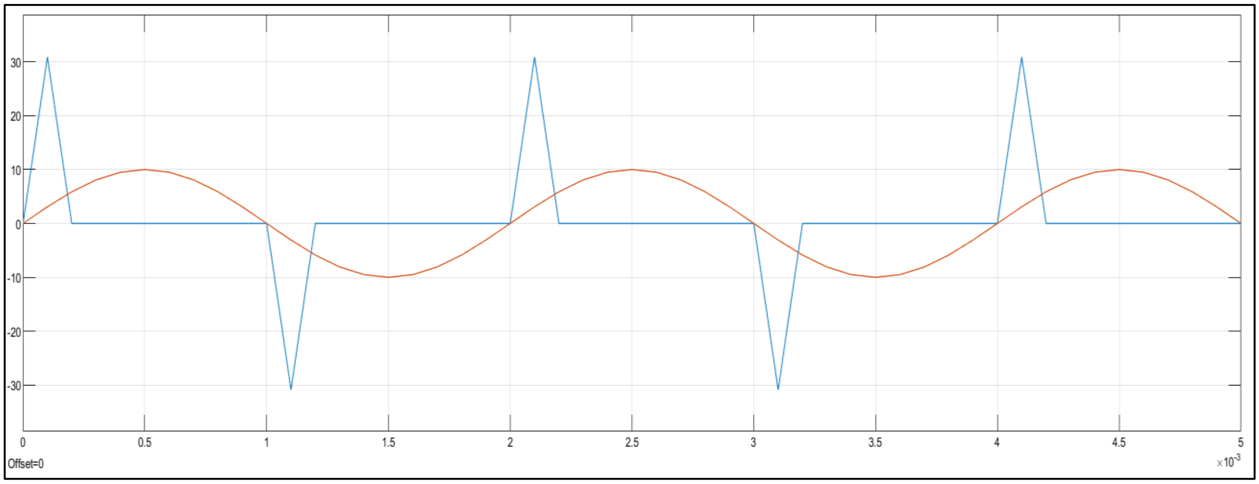

Figure 14 The modulated signal using Natural Sampling in time domain.

While the modulated signal in frequency domain:

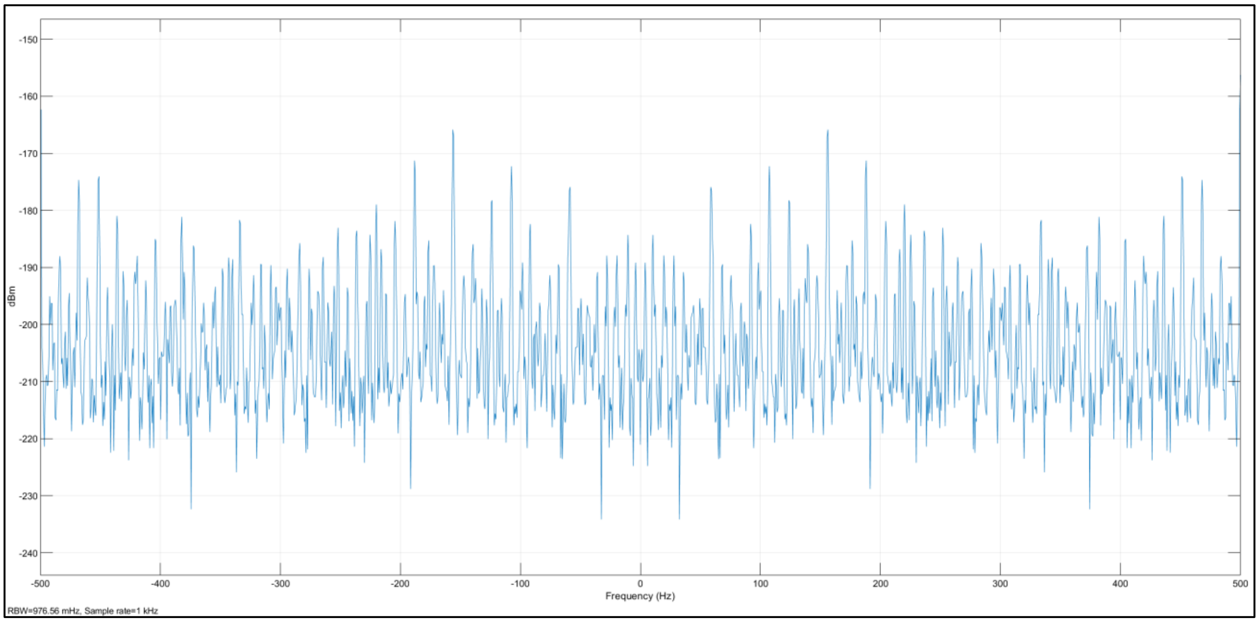

Figure 15 Modulated signal in time domain.

And the pulse signal in frequency domain:

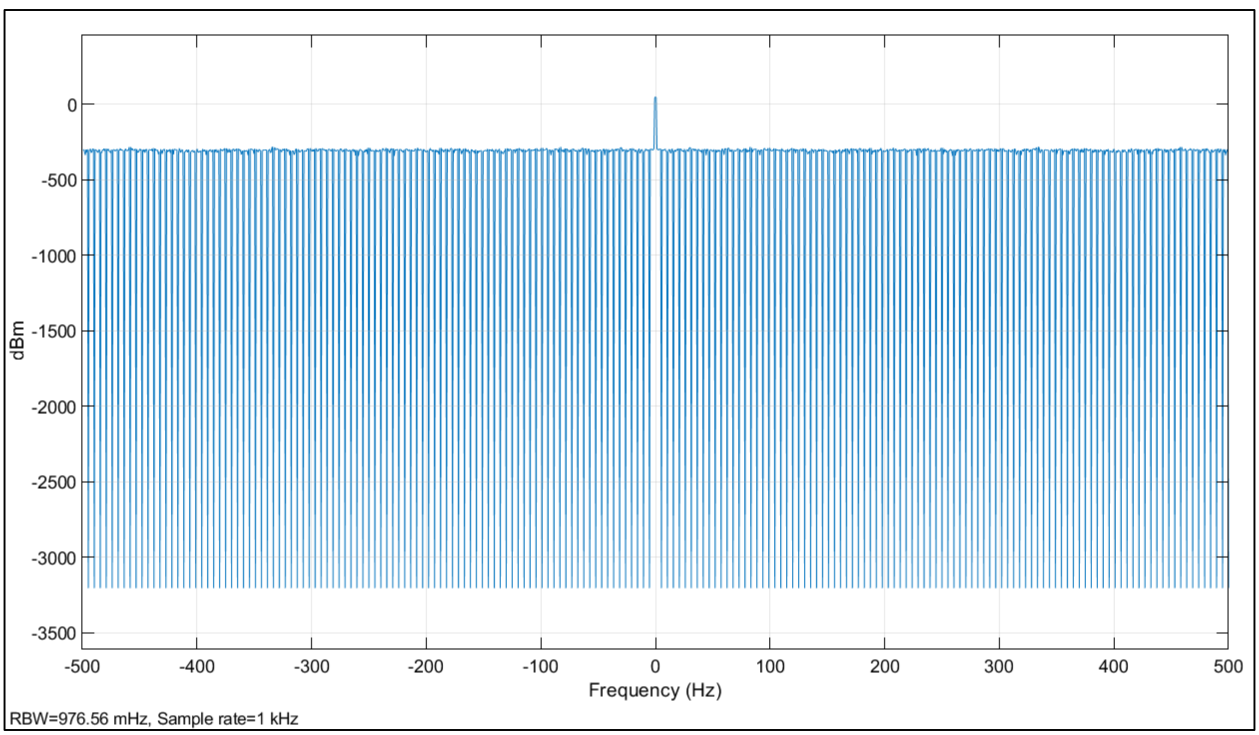

Figure 16 Input pulse signal in frequency domain.

Now, when changing the duty cycle of the input pulse signal from 20% to 50%, keeping the frequency and amplitude, the modulated signal in time and frequency domain will be as the following:

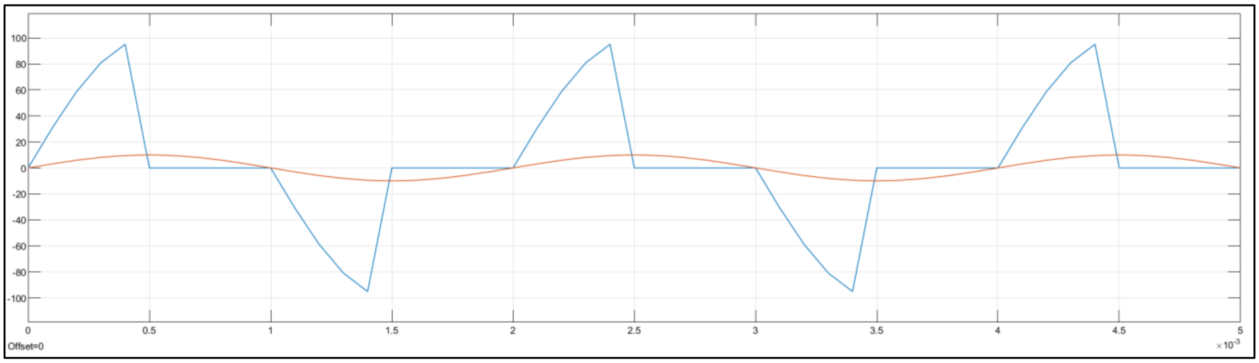

Figure 17 The modulated signal using natural sampling in time domain.

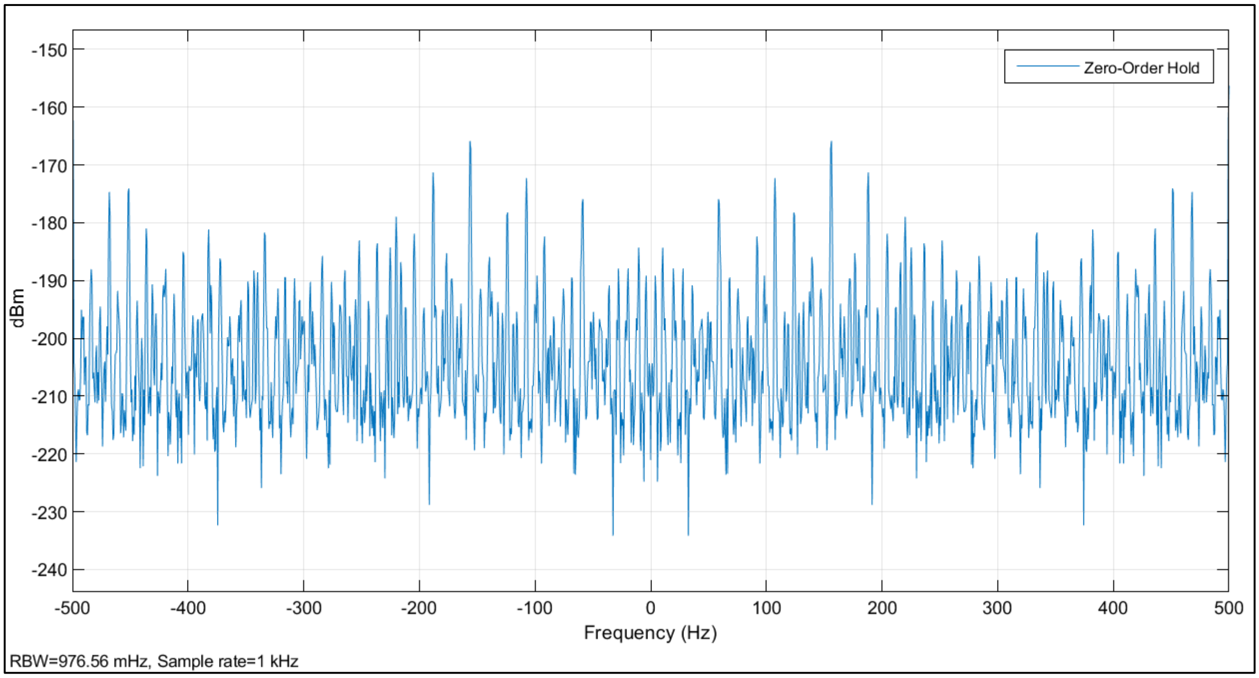

Figure 18 The modulated signal using natural sampling in frequency domain.

Part 3: Pulse Amplitude Demodulation using Natural Sampling

Now, the block diagram shows the demodulation block diagram of the natural sampling of Pulse Amplitude Modulation using SIMULINK:

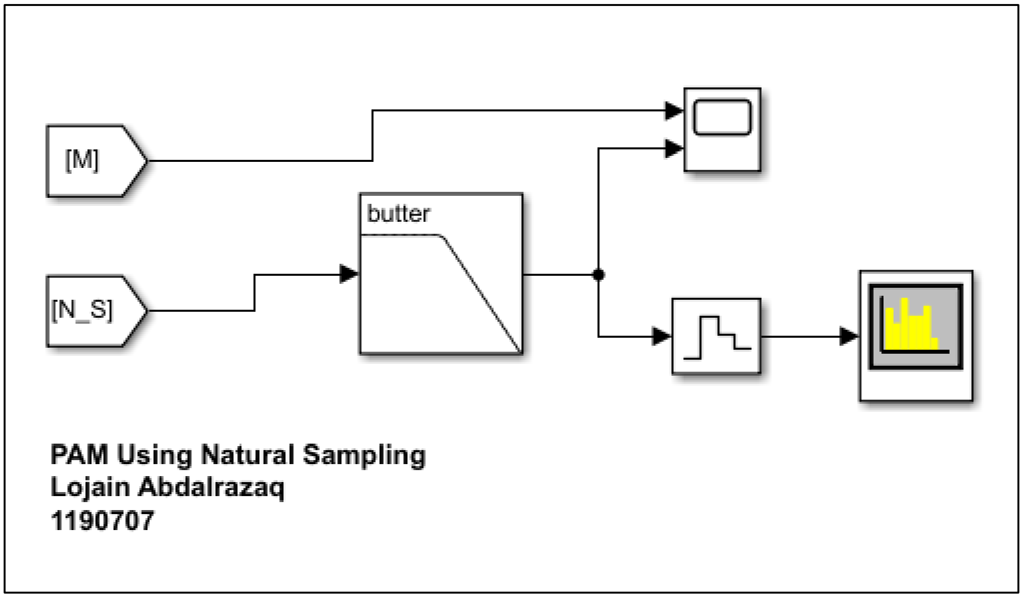

Figure 19 Natural Sampling Demodulation block diagram.

In this step, I returned the cycle with 20%, and applied a frequency of the filter equals to 2*pi*500, and the demodulated signal in time domain is as the following:

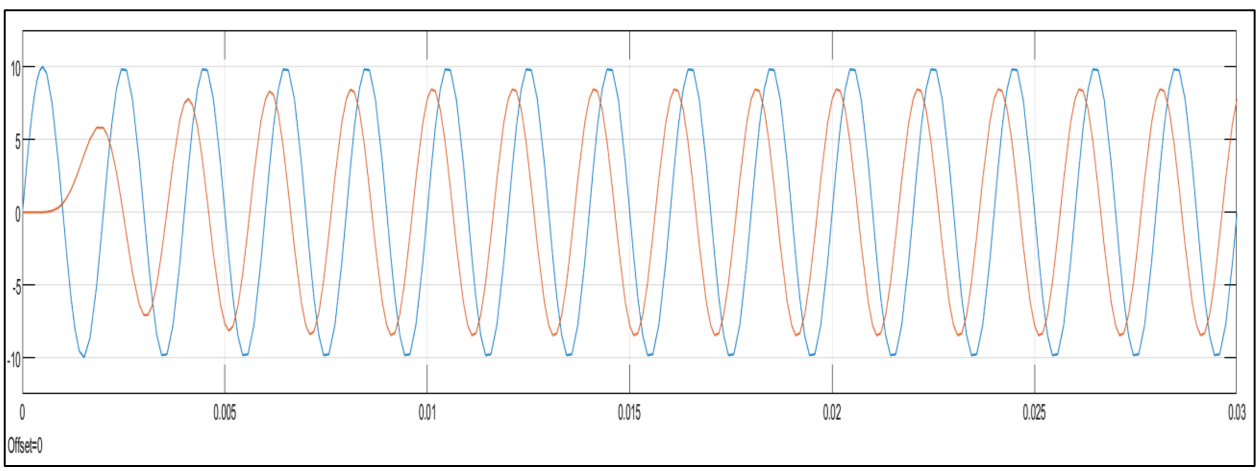

Figure 20 The demodulated signal in time domain.

The following figure shows the frequency domain of the demodulated signal:

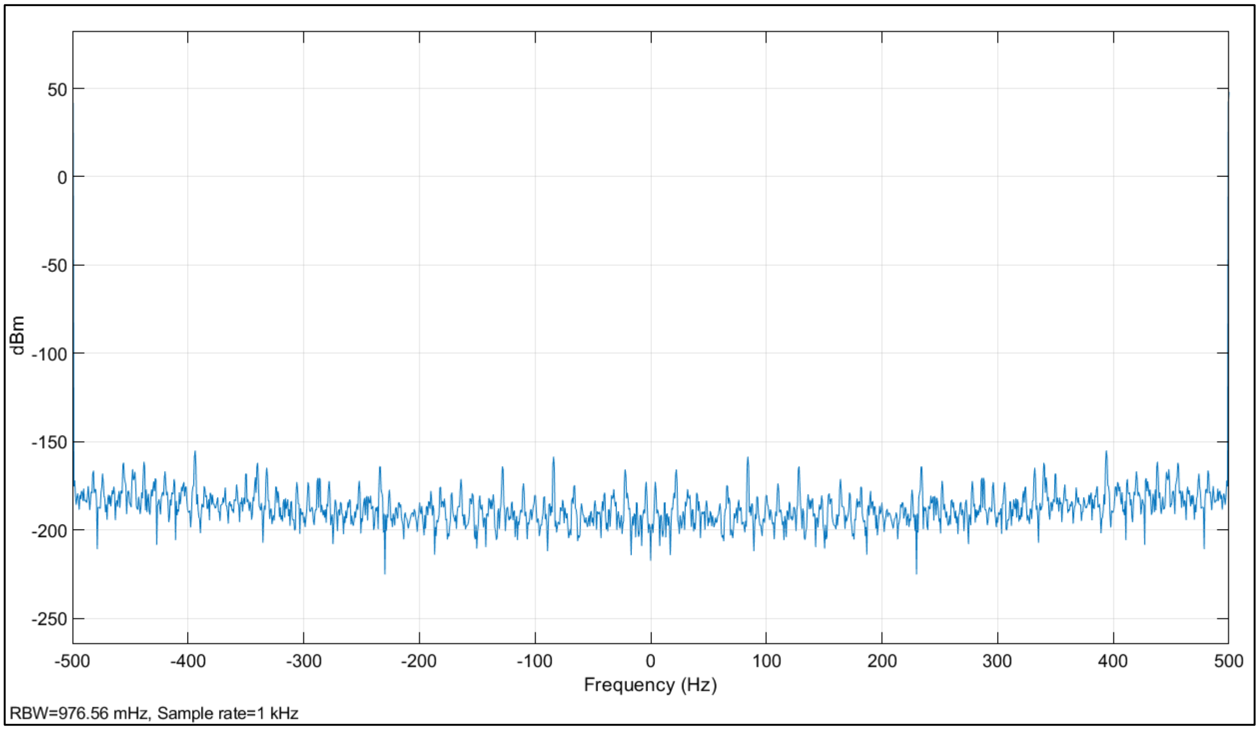

Figure 21 The demodulated signal in frequency domain.

Part 4: Pulse Amplitude Modulation using Flat-Topped Sampling

Firstly, the block diagram of the PAM using flat-tapped sampling using SIMULINK is as the following:

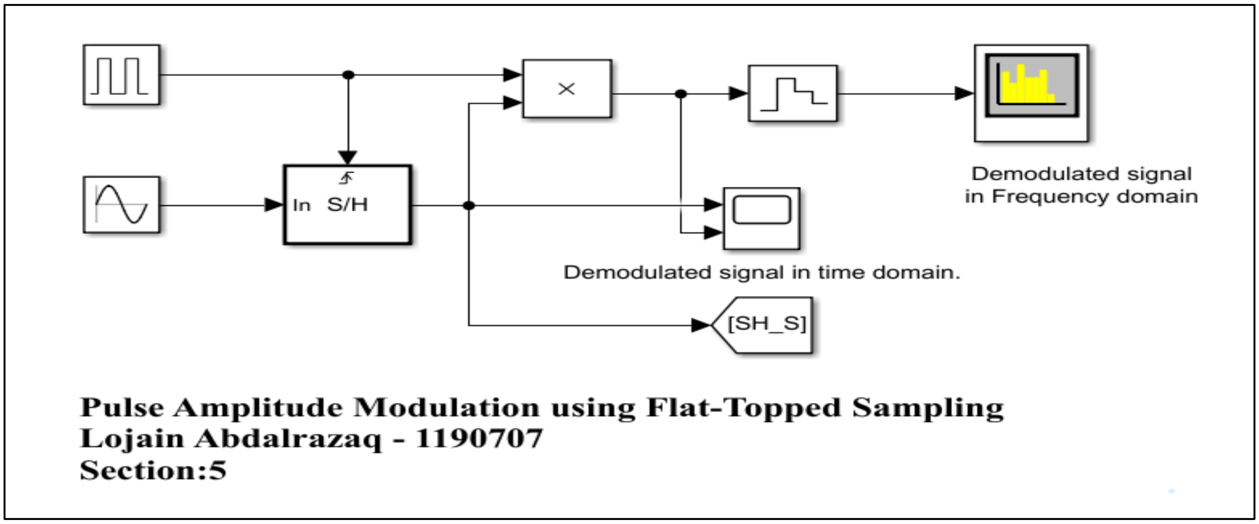

Figure 22 The block diagram of flat-tapped sampling.

The modulated signal when the pulse generator with 20% duty cycle in time domain:

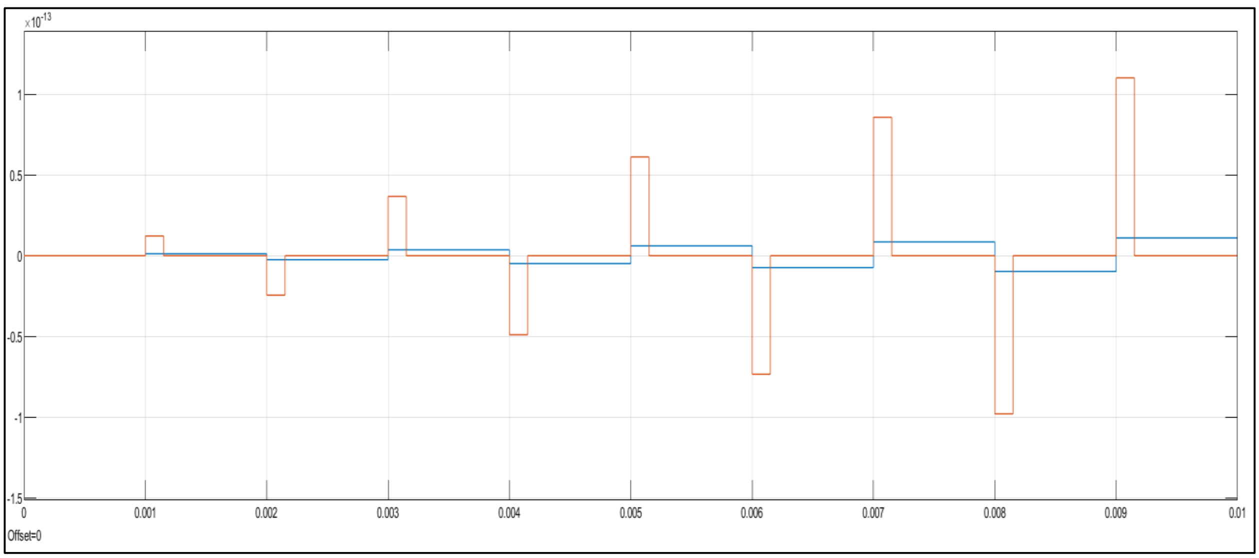

Figure 23 modulated signal using flat-tapped in time domain.

While in frequency domain:

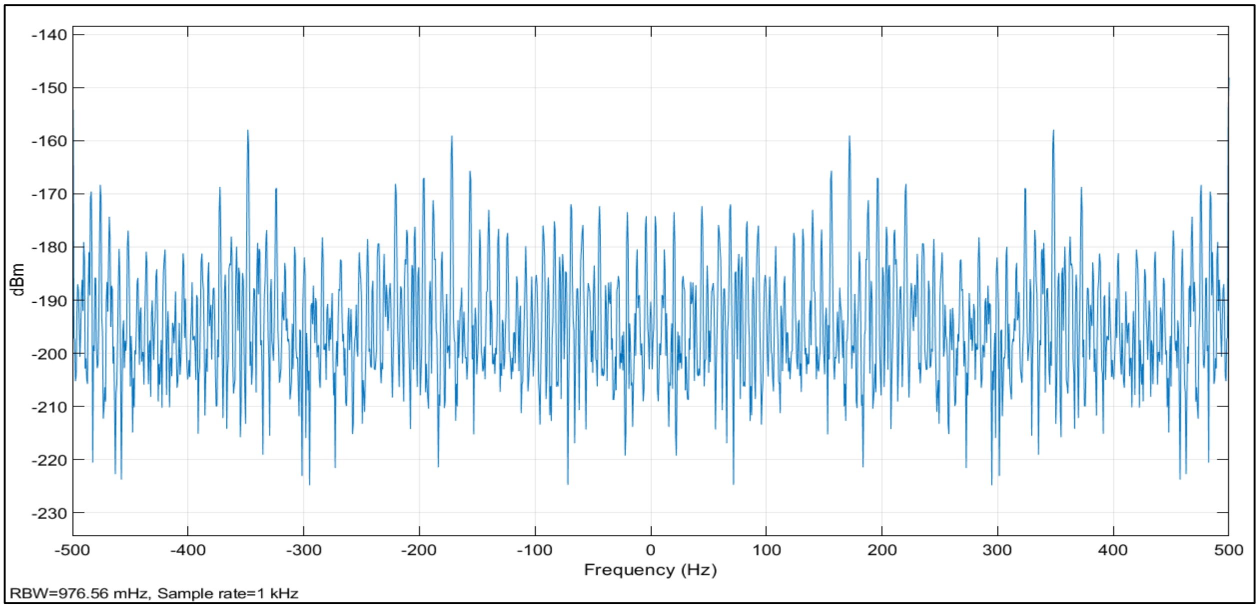

Figure 24 the modulated signal in frequency domain using flat-tapped.

Part 5: Pulse Amplitude Demodulation using Flat-Topped Sampling

Finally, the demodulation block diagram for the concept of flat-topped sampling using SIMULINK is as the following:

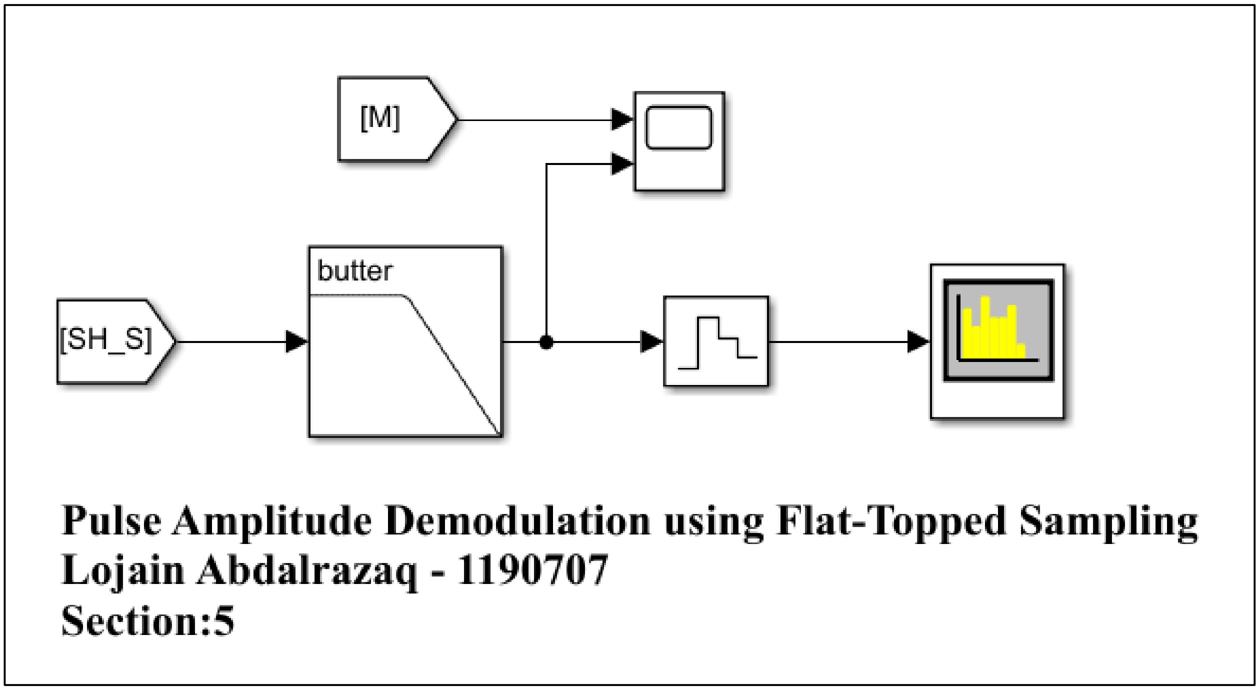

Figure 25 the PAM demodulation using flat-topped sampling.

And the demodulated signal in time domain is as the following:

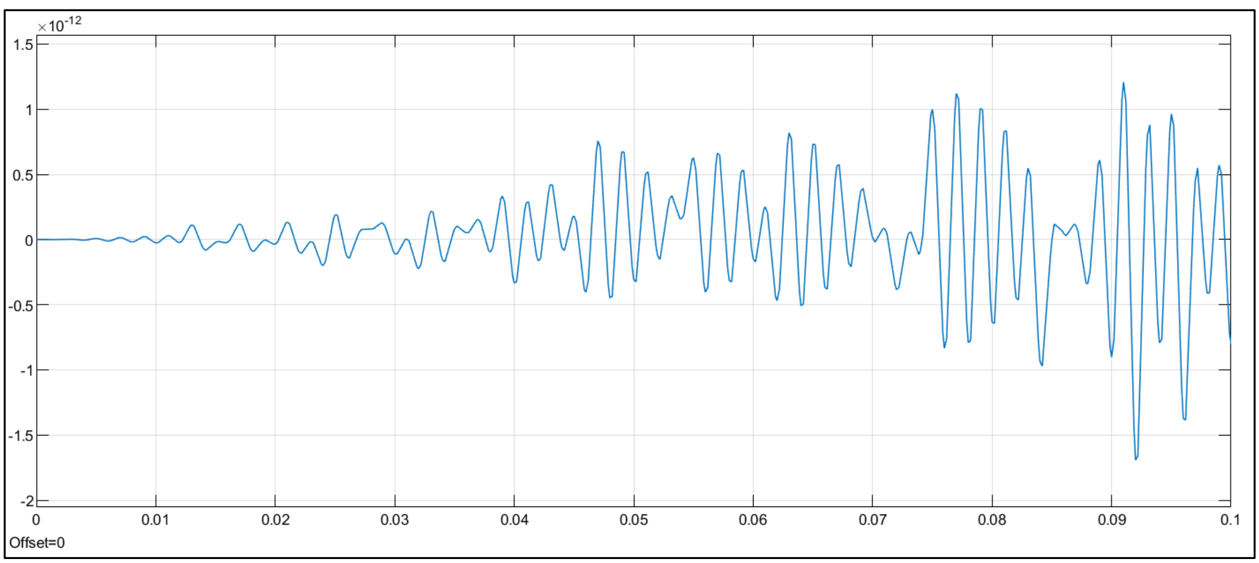

Figure 26 demodulated signal suing flat-topped in time domain.

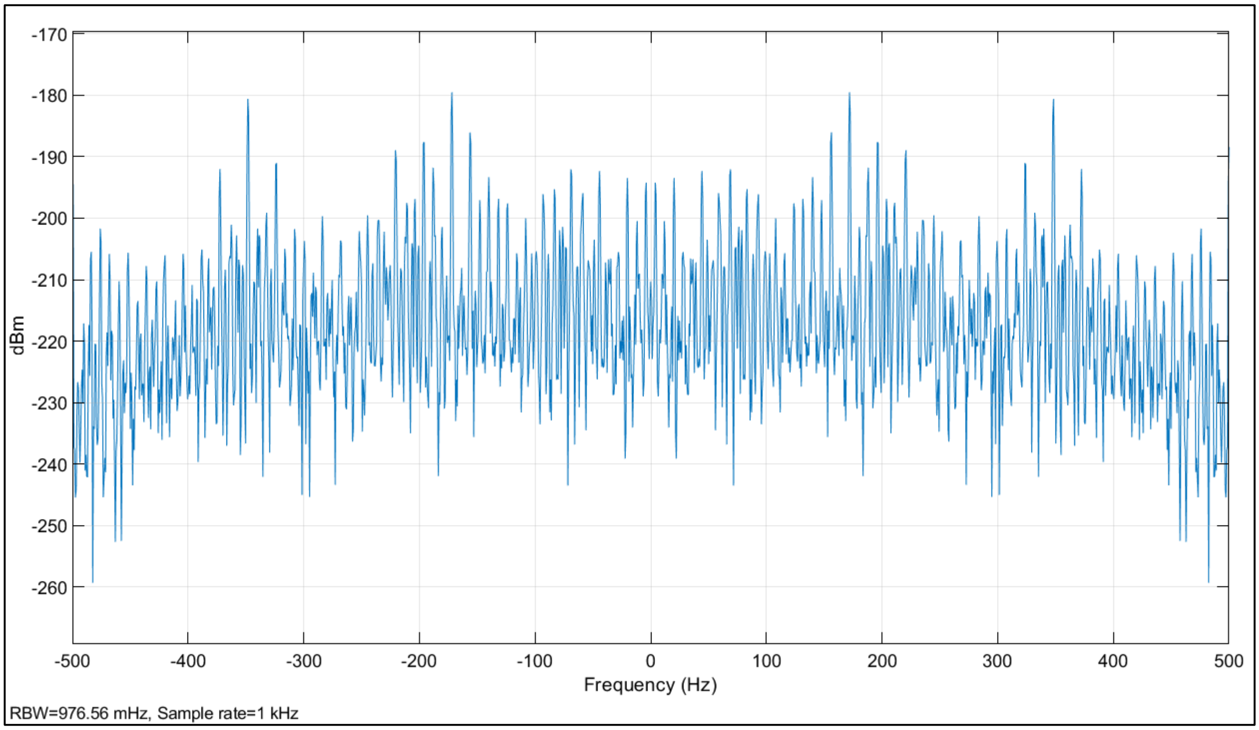

Figure 27 The demodulated signal in frequency domain.