BIRZEIT UNIVERSITY

Department of Electrical & Computer Engineering
ENEE4113 - Communications Laboratory

# Experiment #11
# Frequency Shift Keying (FSK) and Phase Shift Keying (PSK)

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**Section:** 4

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# 1 Simulation and Data Analysis

## 1.1 Frequency Shift Keying (FSK)

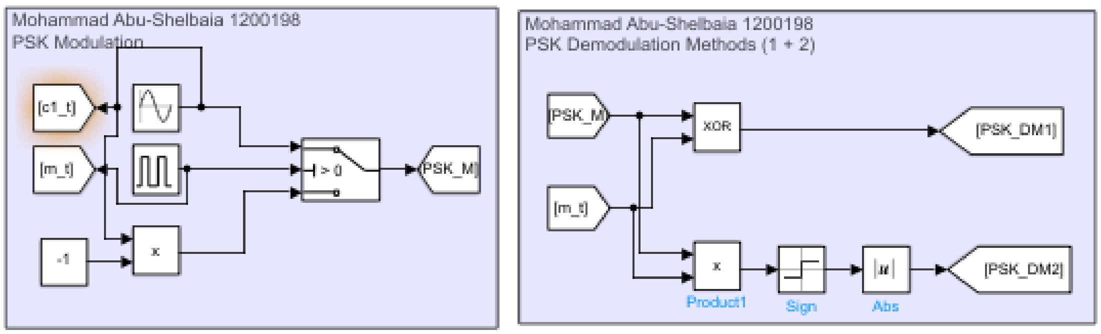


Figure 1: Modulation/Demodulation Simulink Block Diagram

The above system is simulated using MATLAB Simulink for different messages modulated over two carrier signal:

$$c(t) = \cos(2\pi(15k)t) \tag{1}$$

$$c(t) = \cos(2\pi(25k)t) \tag{2}$$

### 1.1.1 Input Signals

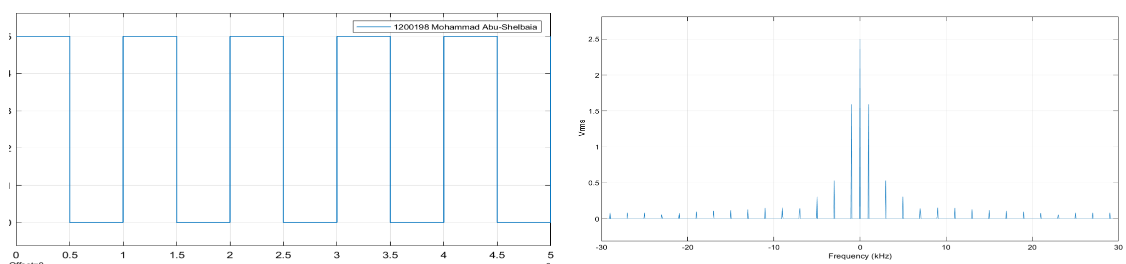


Figure 2: Message Signal

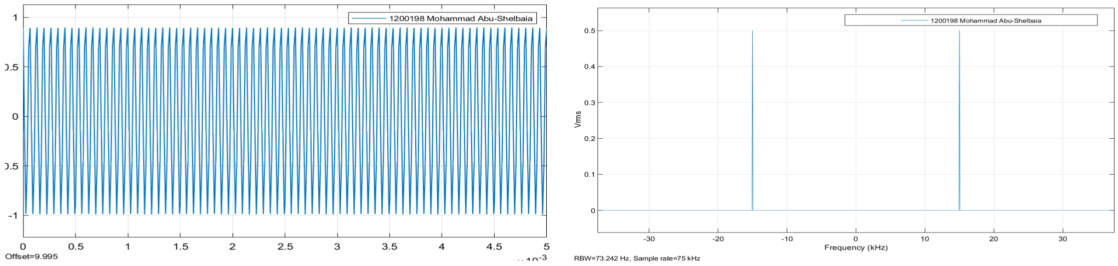


Figure 3: Carrier1 Signal

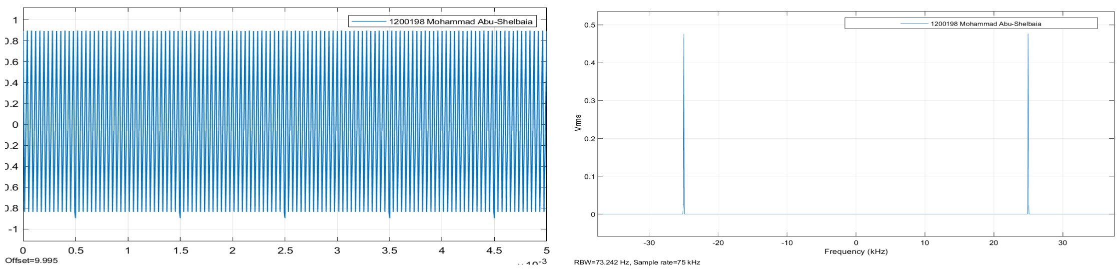


Figure 4: Carrier2 Signal

### 1.1.2 Modulation and Demodulation

**Refrence Modulating Signal** This is our refrence modulating signal, which is a pulse-train with a frequency of 1KHz, duty cycle of 50%, and an amplitude of 5V.

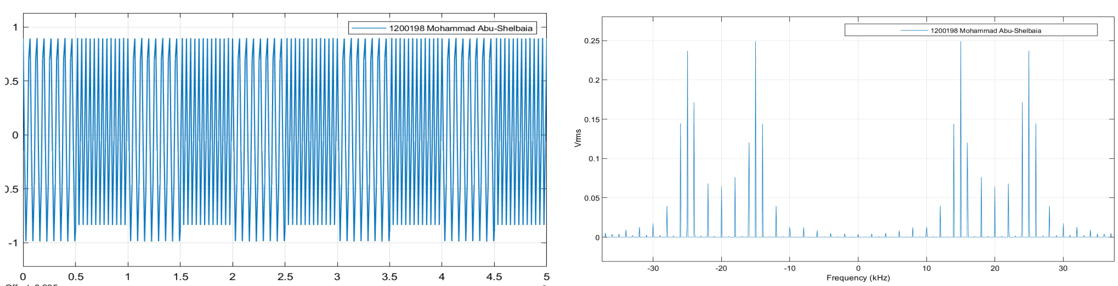


Figure 5: Modulated Singal

We can see that the modulated signal is a cosine wave with two different frequencies, 15KHz and 25KHz, each frequency is used to represent a bit, 0 or 1, the high frequency is used to represent 0, and the low frequency is used to represent 1.

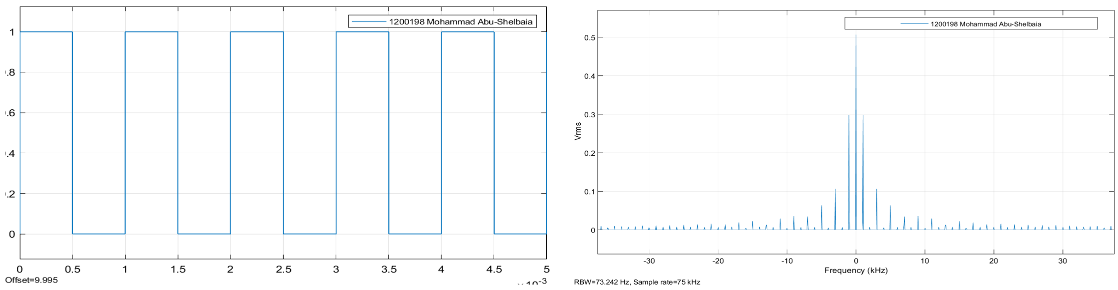


Figure 6: Demodulaed Singal

We can see that we have successfully demodulated the signal using both methods, the high portion of the message singal is recoverd as 1, and the low portion is recovered as 0.

**2V Modulating Signal**

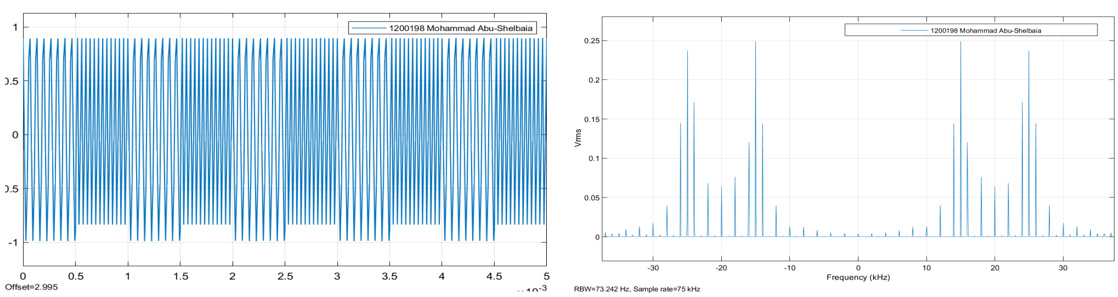


Figure 7: Modulated Singal (2V)

We can see that the amplitude of the modulating signal does not affect the modulated signal.

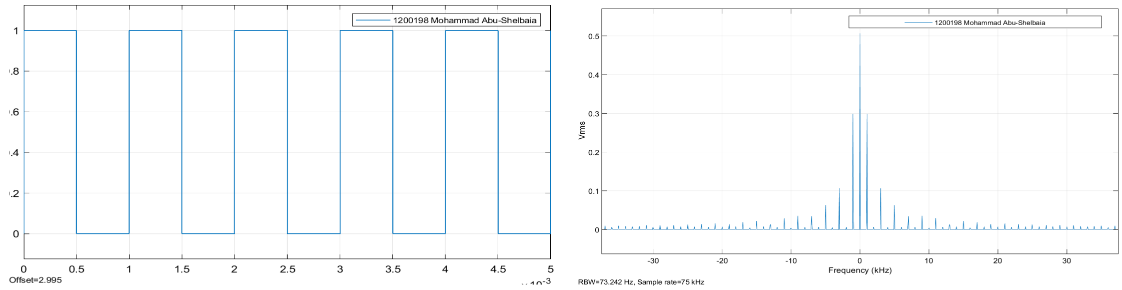


Figure 8: Demodulated Singal (2V)

We can see the same results as before, and we conclude that the amplitude of the modulating signal does not affect the demodulation process.

**500Hz Modulating Signal**

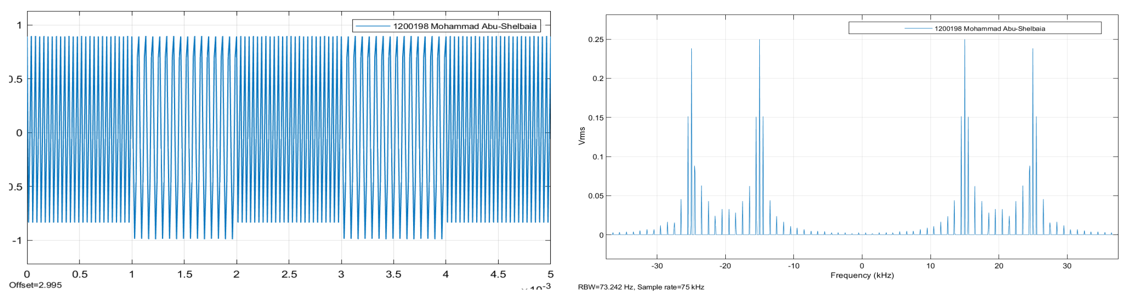


Figure 9: Modulated Singal (500Hz)

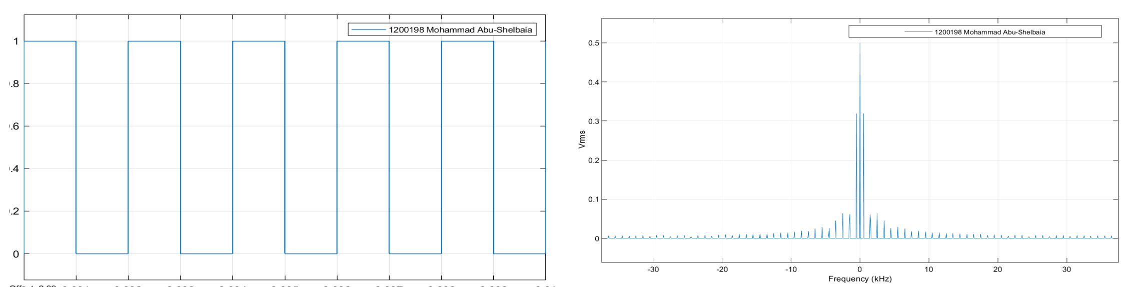


Figure 10: Demodulated Singal (500Hz)

Here the freqeuncy deviation (The space between pulses) is lower which saves bandwidth.

### 0.10 Duty-Cycle Modulating Signal

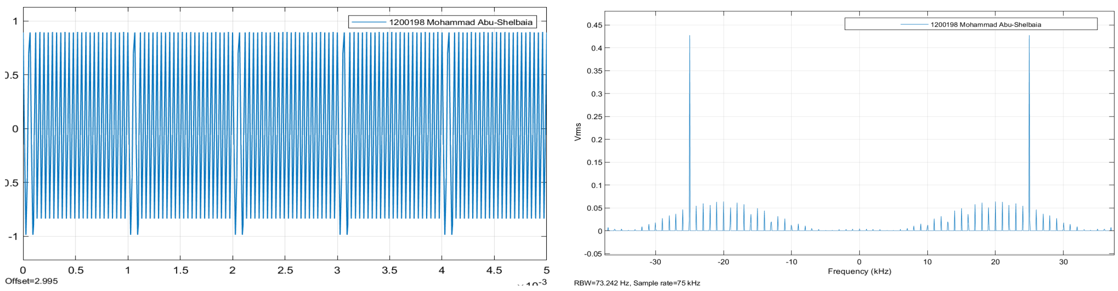


Figure 11: Modulated Singal (10% Duty Cycle)

We notice that the duty cycle of the modulating signal does not affect the modulated signal in simulation but it might affect it in real life since it looks like a noise to the modulated signal.

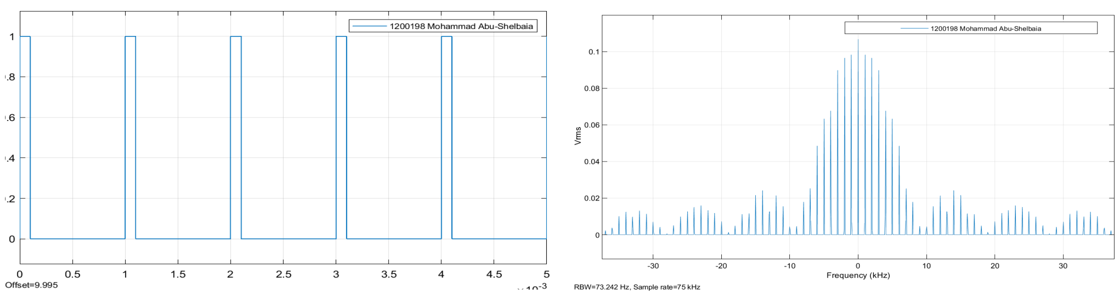


Figure 12: Demodulated Singal (10% Duty Cycle)

We can see as all the previous parts we were able to recover the message correctly, the high portion of the message singal is recoverd as one, and the low portion is recovered as zero.

## 1.2 Phase Shift Keying (PSK)

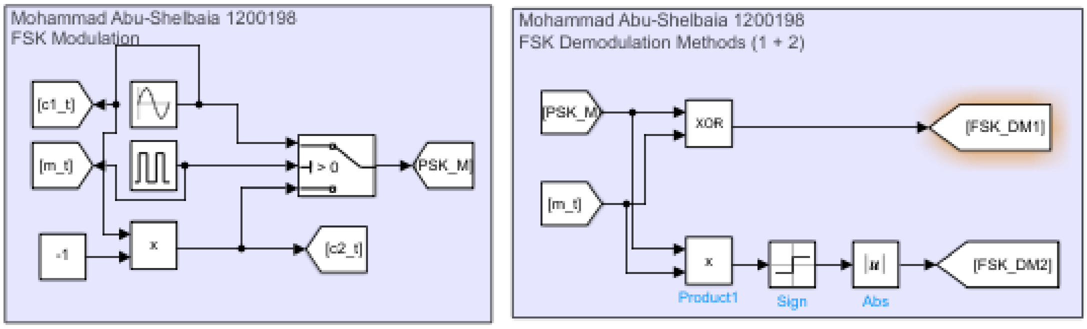


Figure 13: Modulation/Demodulation Simulink Block Diagram

The above system is simulated using MATLAB Simulink for different messages modulated over one carrier signal with a phase shift of 180 degrees:

$$c(t) = \cos(2\pi(20k)t) \tag{3}$$

### 1.2.1 Input Signals

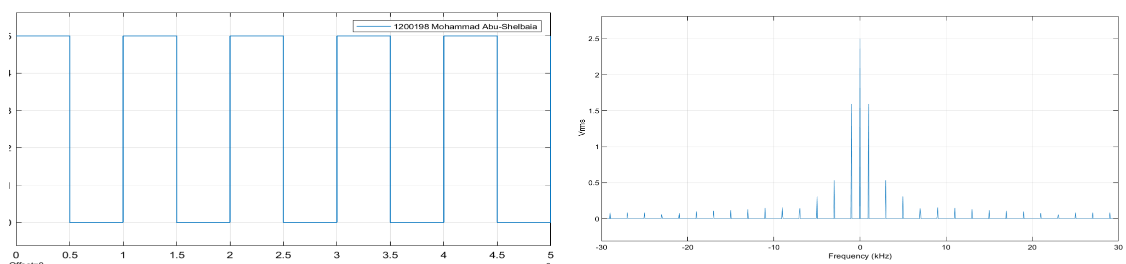


Figure 14: Message Signal

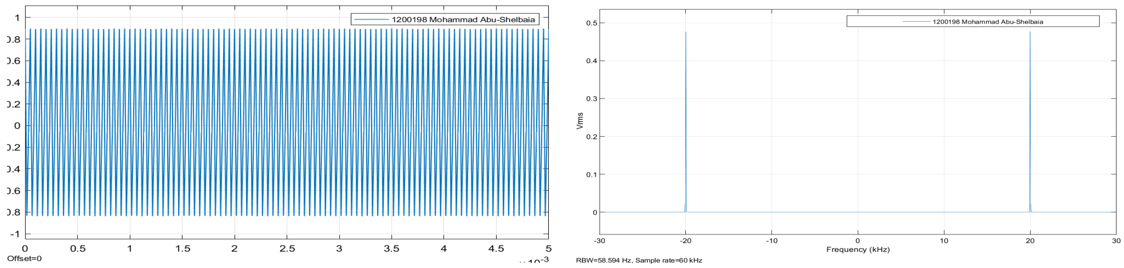


Figure 15: Carrier Signal

### 1.2.2 Modulation and Demodulation

**Refrence Modulating Signal** This is our refrence modulating signal, which is a pulse-train with a frequency of 1KHz, duty cycle of 50%, and an amplitude of 5V.

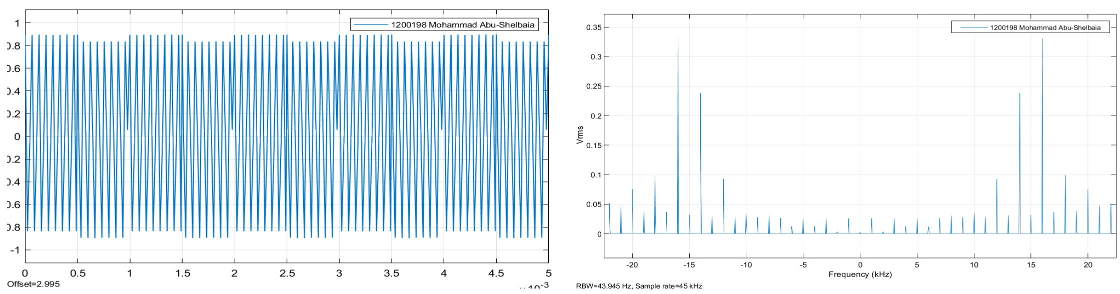


Figure 16: Modulated Singal

We can see that the modulated signal is a cosine wave with two different phases, 0 and 180 degrees, each phase is used to represent a bit, 0 or 1, the high phase is used to represent 0, and the low phase is used to represent 1.

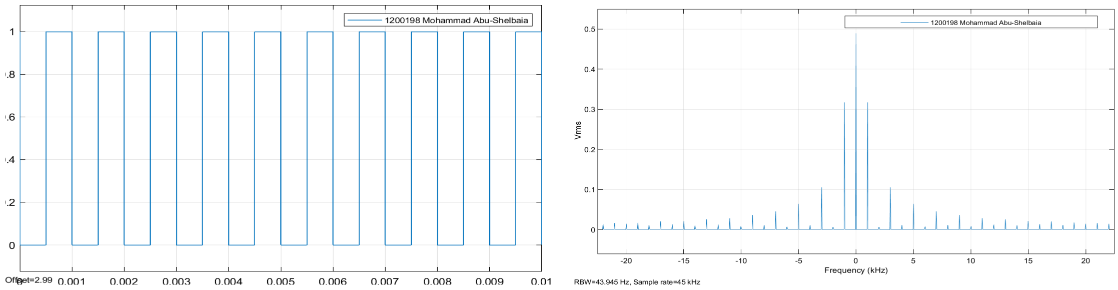


Figure 17: Demodulaed Singal Method 1

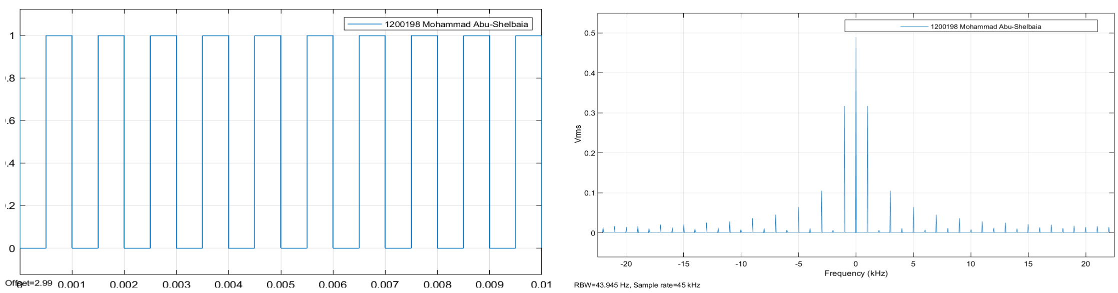


Figure 18: Demodulated Singal Method 2

We can see that we have successfully demodulated the signal using both methods, the high portion of the message singal is recoverd as 1, and the low portion is recovered as 0.

**2V Modulating Signal**

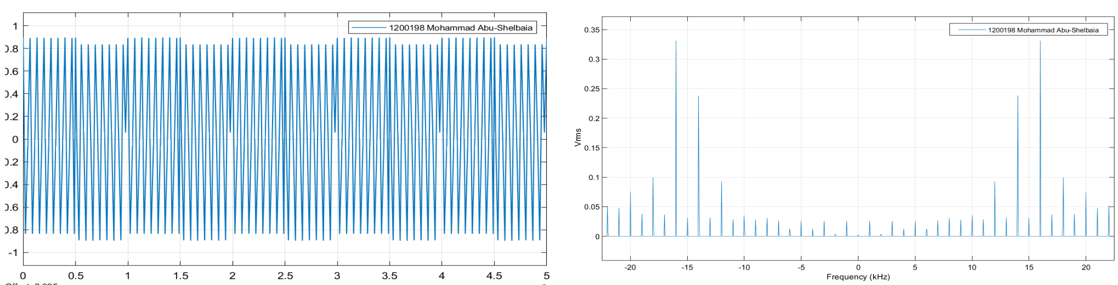


Figure 19: Modulated Singal (2V)

We can see that the modulated signal amplitude is lower, but the same characteristics are still there.

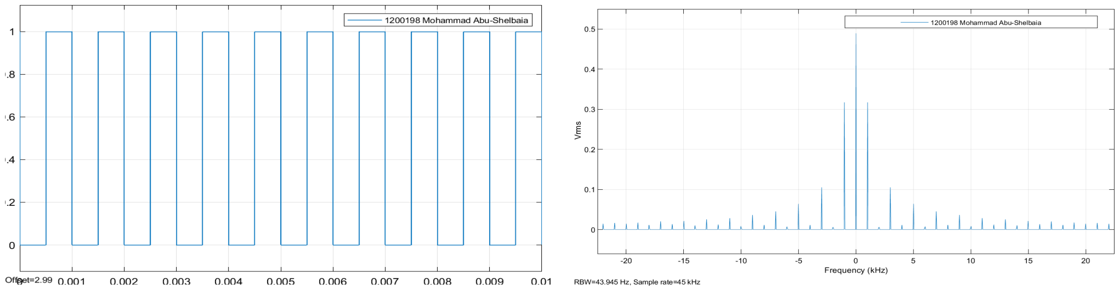


Figure 20: Demodulated Singal Method 1 (2V)

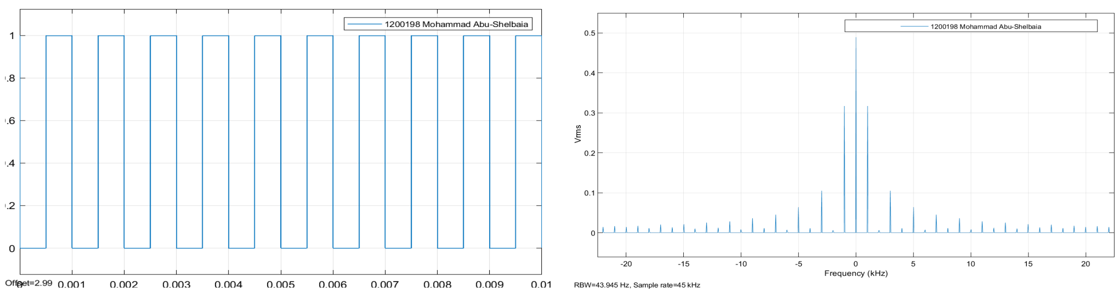


Figure 21: Demodulated Singal Method 2 (2V)

We can see that the amplitude of the modulating signal does not affect the demodulation process.

**500Hz Modulating Signal**

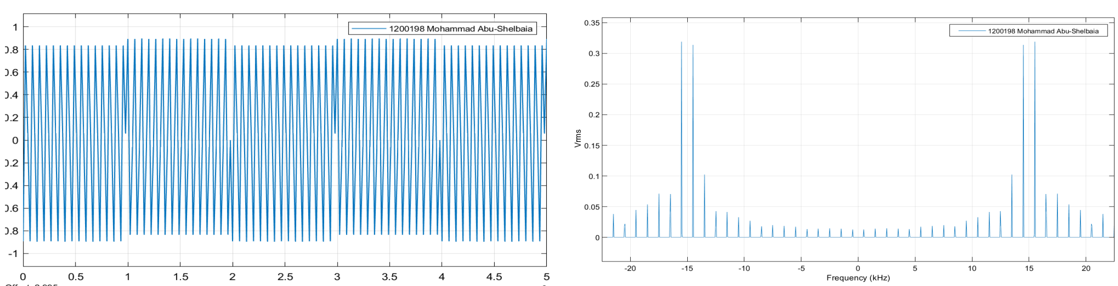


Figure 22: Modulated Singal (500Hz)

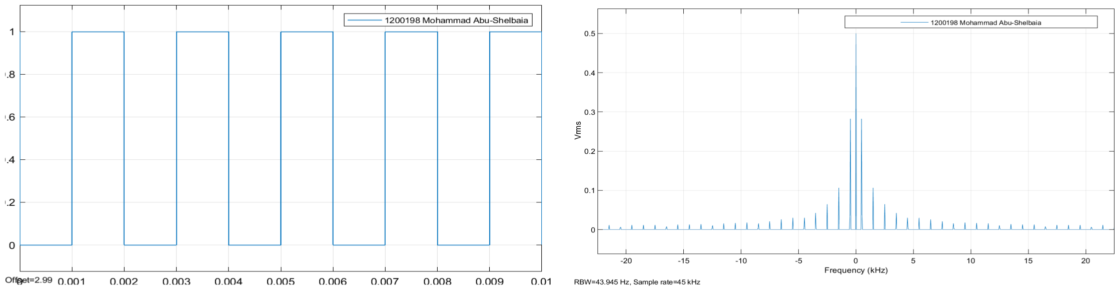


Figure 23: Demodulated Singal Method 1 (500Hz)

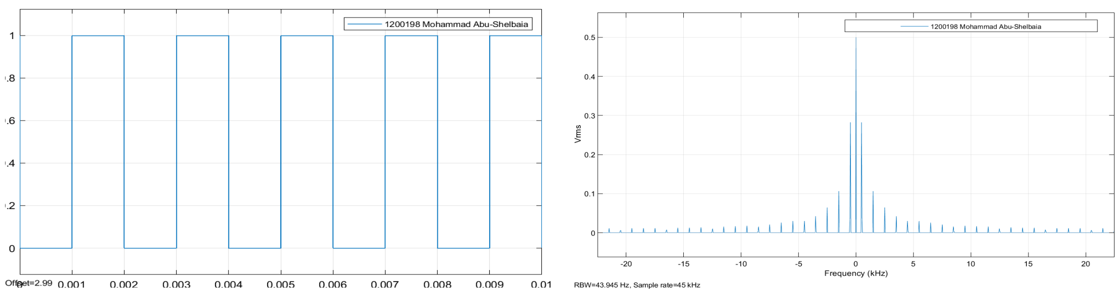


Figure 24: Demodulated Singal Method 2 (500Hz)

We can see that the frequency deviation (The space between pulses) is lower which saves bandwidth and we can also see in comparison with the Frequency Shift Keying (FSK) that the phase shift keying (PSK) uses less bandwidth since it uses only one carrier signal.

**0.10 Duty-Cycle Modulating Signal**

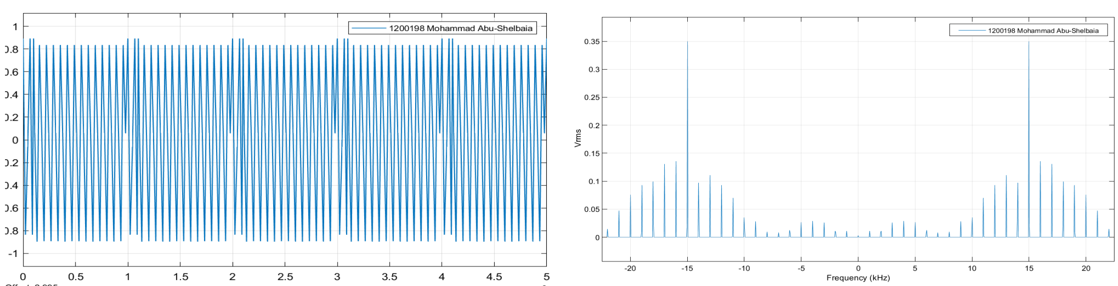


Figure 25: Modulated Singal (10% Duty Cycle)

We notice that the duty cycle of the modulating signal does not affect the modulated signal in simulation but it might affect it in real life since it looks like a noise to the modulated signal.

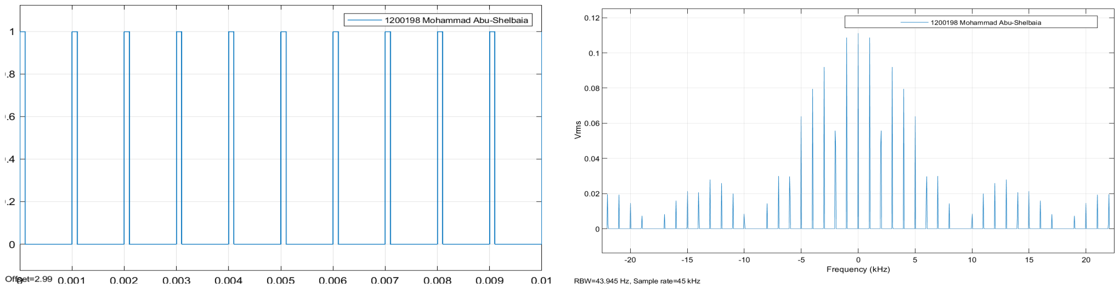


Figure 26: Demodulated Singal Method 1 (10% Duty Cycle)

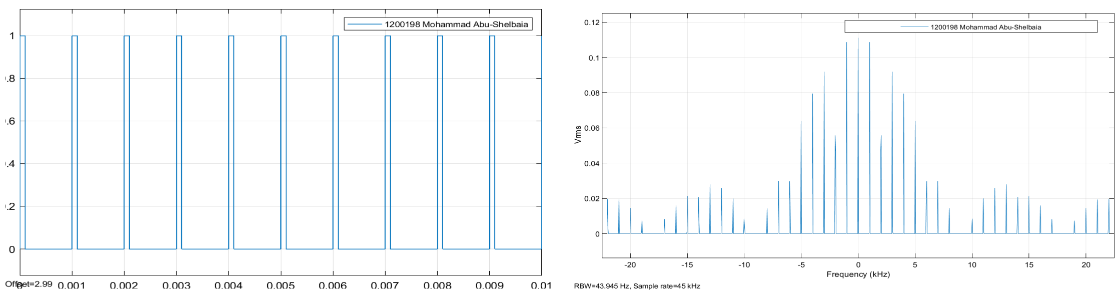


Figure 27: Demodulated Singal Method 2 (10% Duty Cycle)

We can see as all the previous parts we were able to recover the message correctly, the high portion of the message singal is recoverd as one, and the low portion is recovered as zero.