



**Faculty of Engineering and Technology**

**Electrical and Computer Engineering Department**

**COMMUNICATIONS LAB**

**ENEE4113**

**Experiment #:1**

**Experiment title: Normal Amplitude Modulation and Demodulation**

**PreLab 1**

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**Section: 2**

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## Normal Amplitude Modulation-Simulink

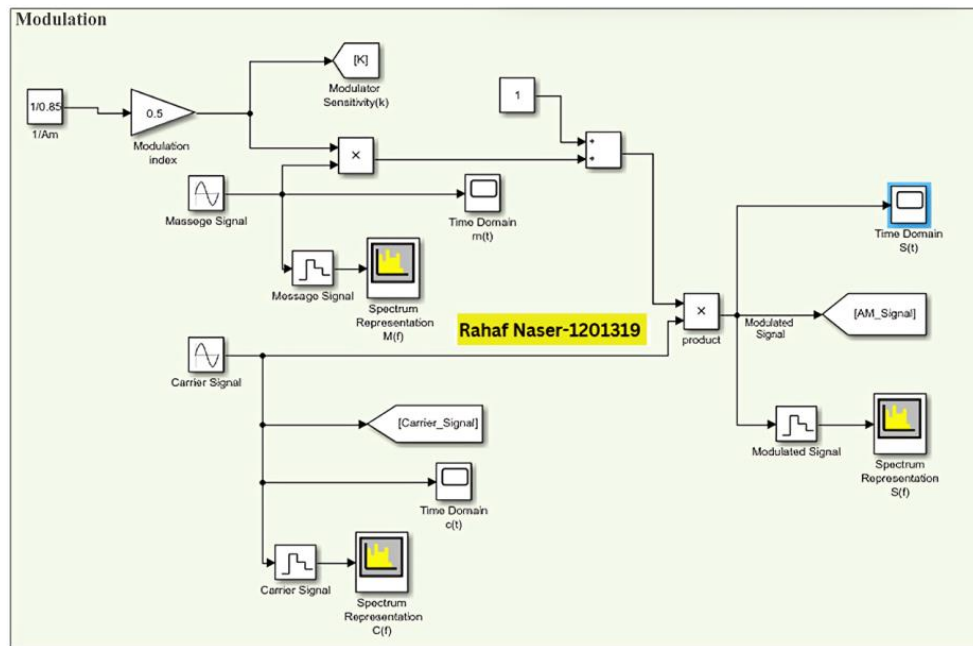


Figure 1: Normal Amplitude Modulation-Simulink

### Message Signal– Time Domain:

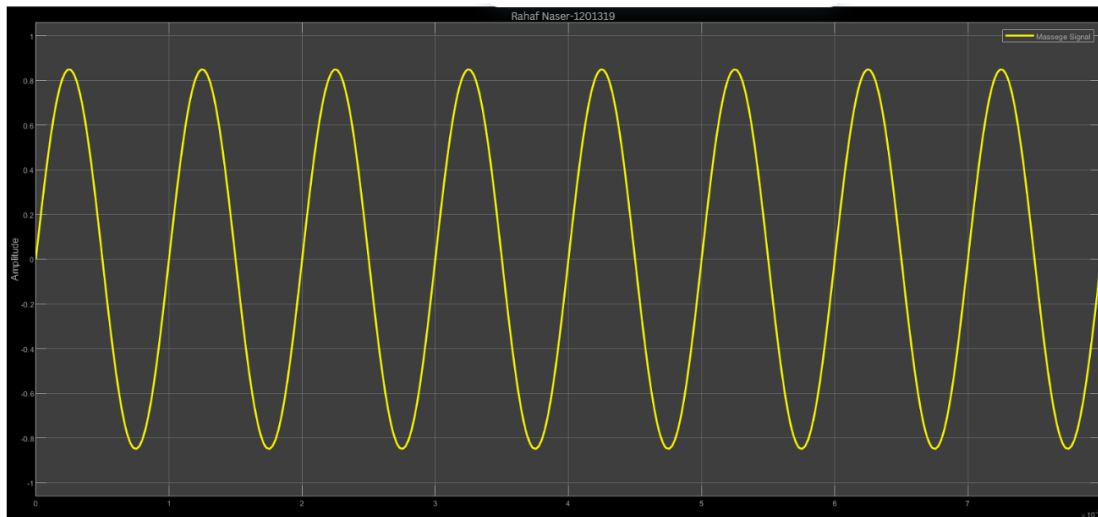


Figure 2: Message signal-time domain

### Message Signal– Frequency Domain:

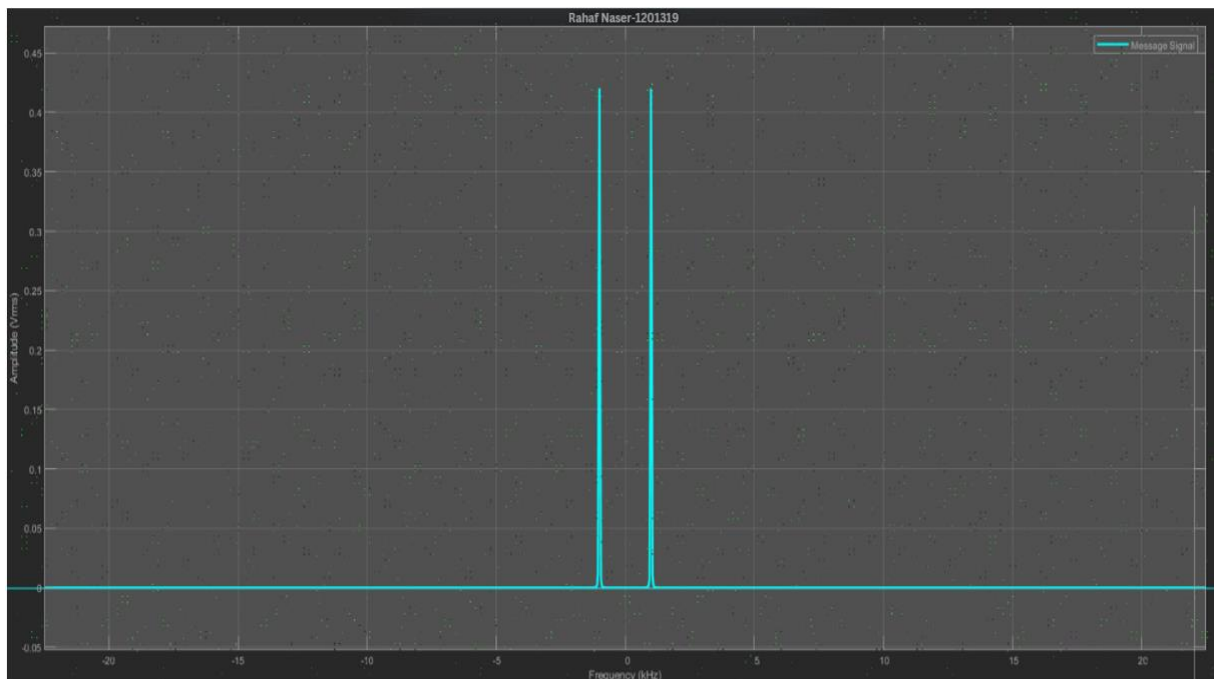


Figure 3: Message Signal-frequency domain

## 2. Carrier signal in time and frequency domain

### Carrier Signal– Time Domain:

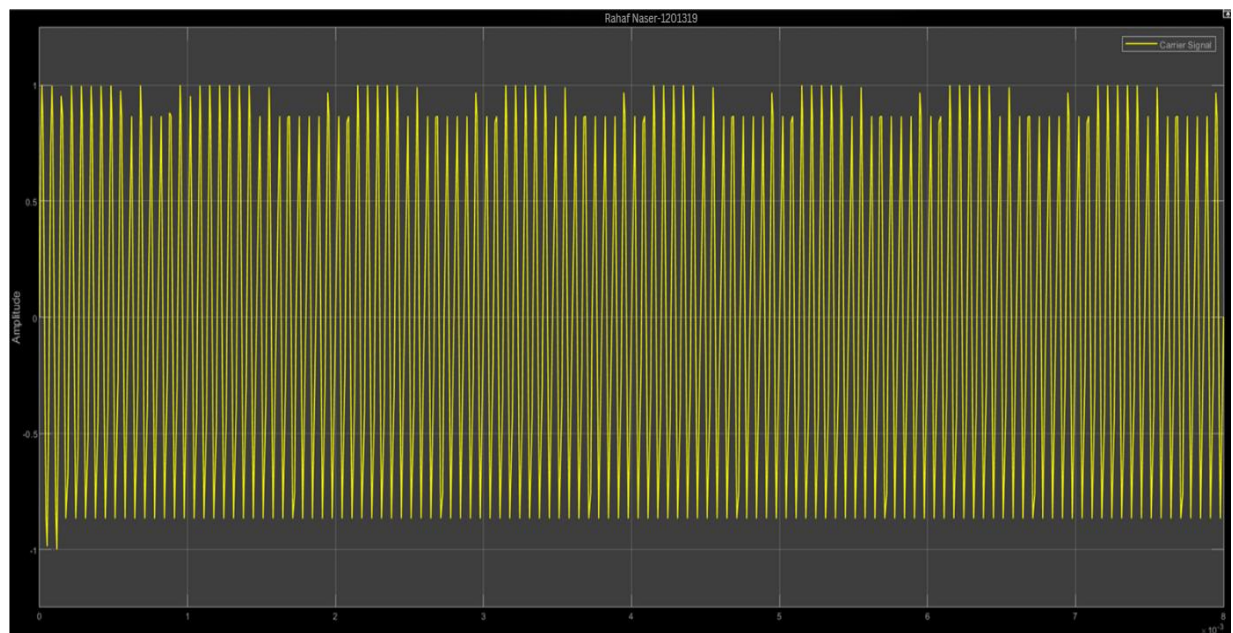


Figure 4: carrier signal-time domain

### Carrier Signal– Frequency Domain:

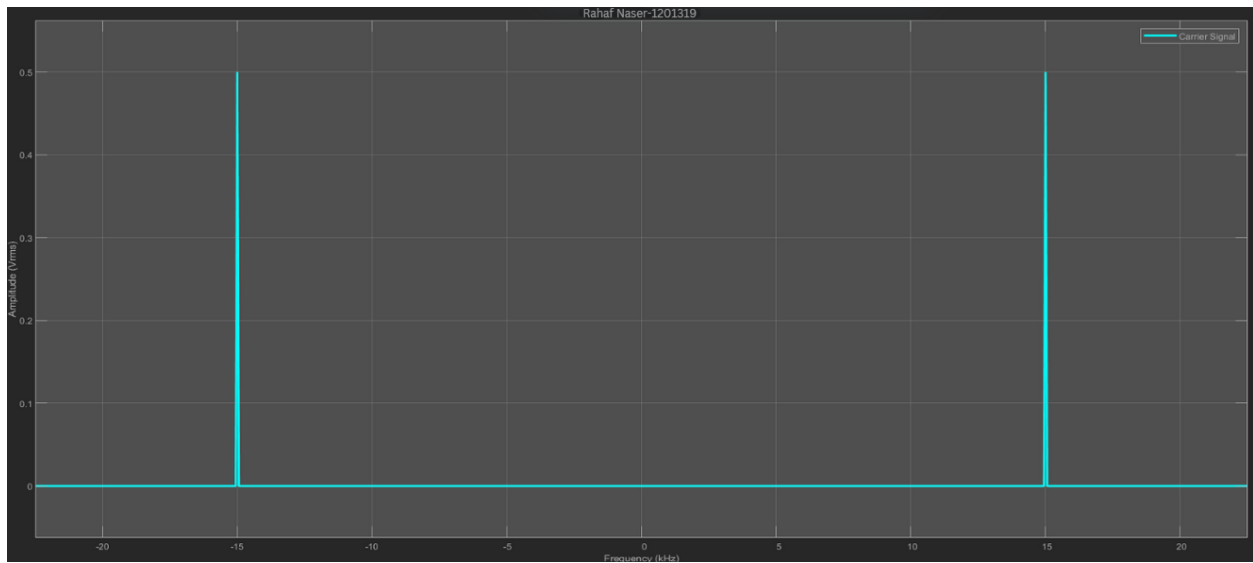


Figure 5: Carrier signal-frequency domain

### 3. modulated signal in time and frequency domain

#### Modulated Signal when $\mu = 0.5$ time domain:

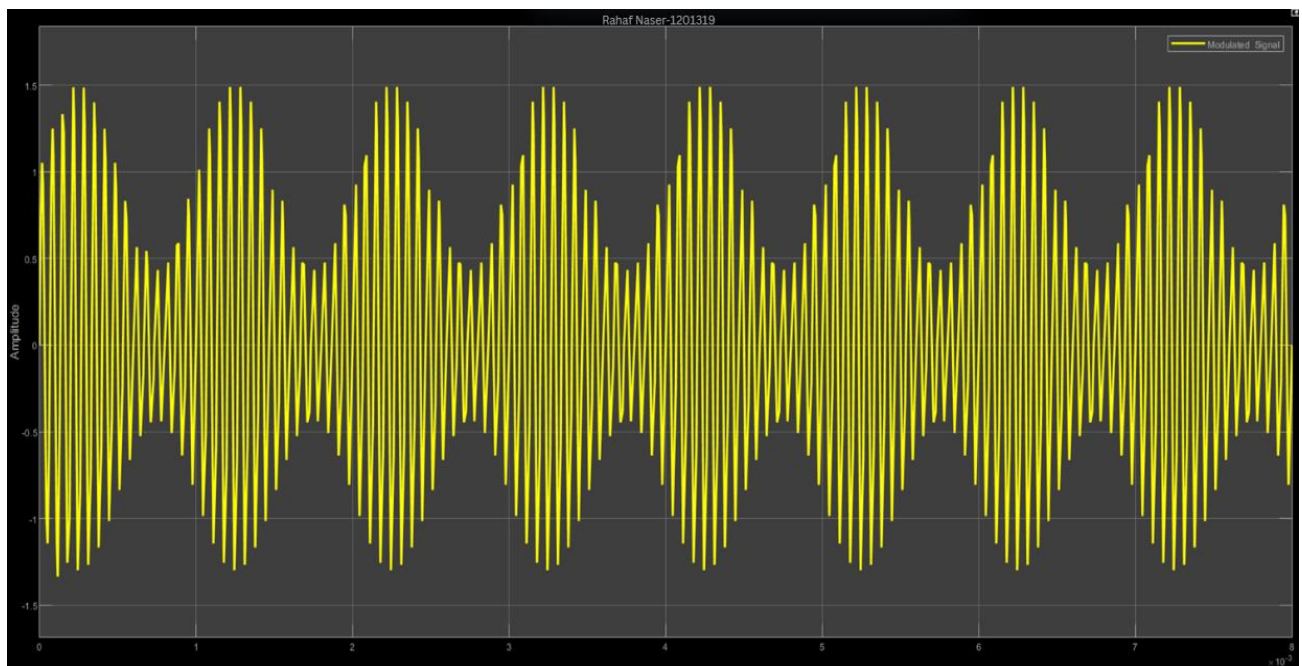


Figure 6: Modulated Signal when  $\mu = 0.5$  time domain

## Frequency Domain:

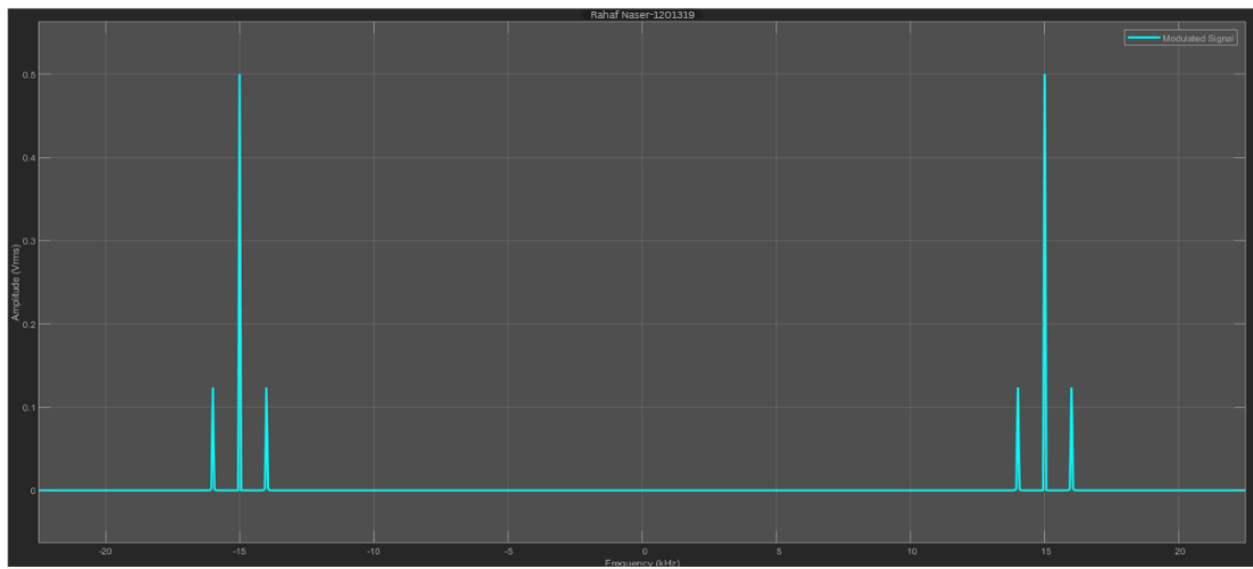


Figure 7: Modulated Signal when  $\mu = 0.5$  frequency domain

## when $\mu = 1$ time domain:

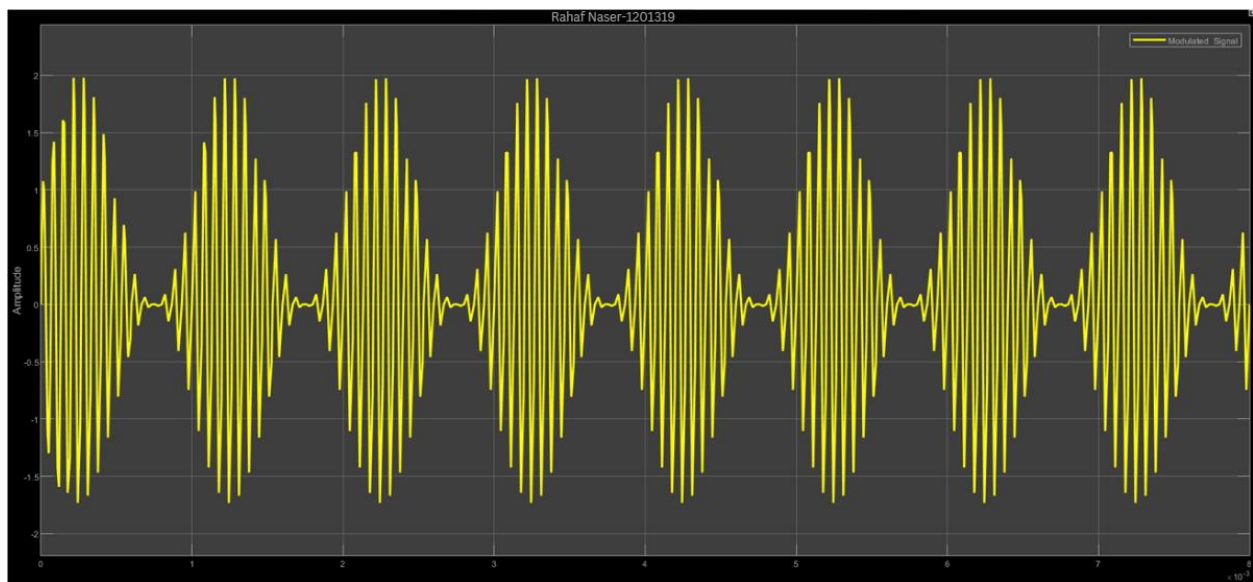


Figure 8: Modulated Signal when  $\mu = 1$  time domain

## Frequency Domain:

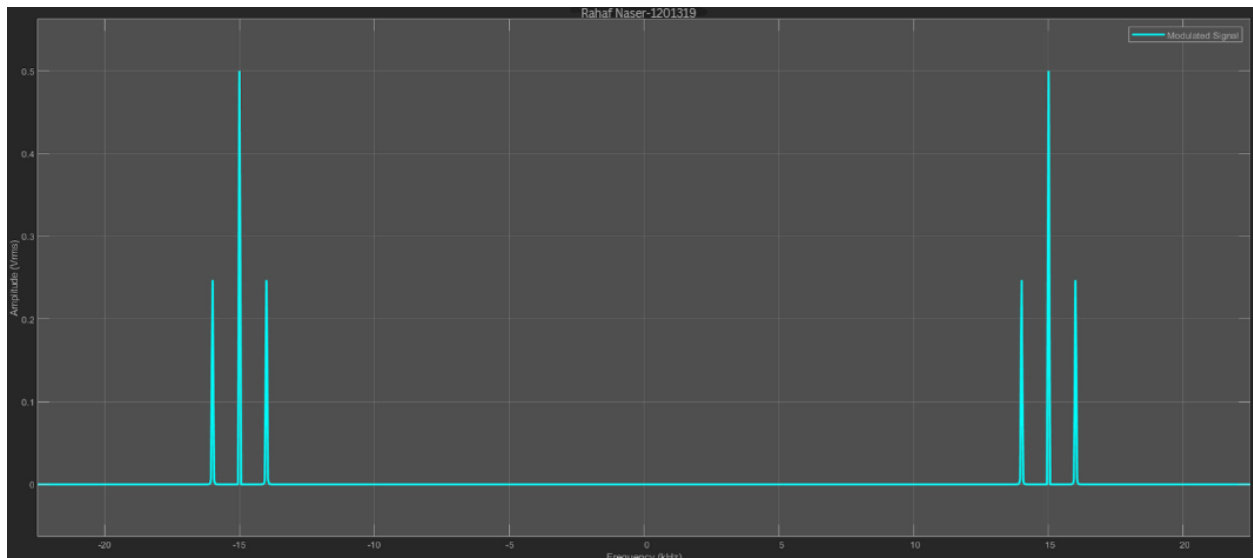


Figure 9: Modulated Signal when  $\mu = 1$  frequency domain

## Modulated Signal when $\mu = 2$

### time domain:

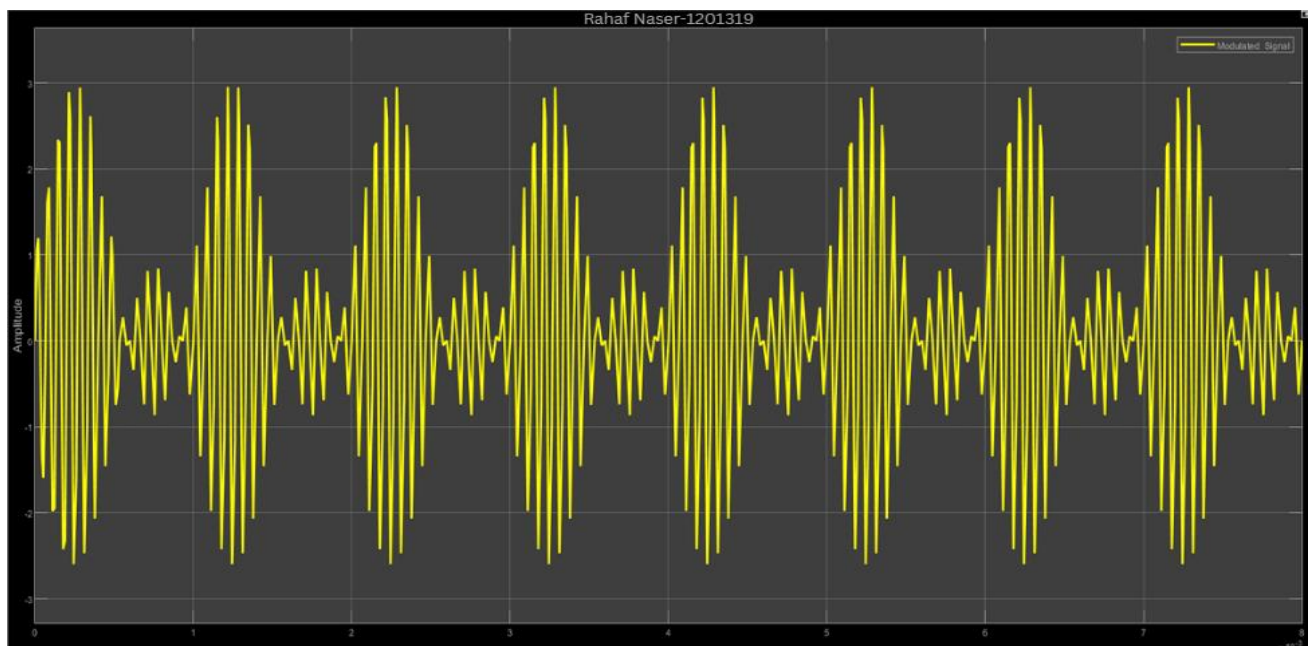


Figure 10: Modulated Signal when  $\mu = 2$  time domain



## Frequency Domain:

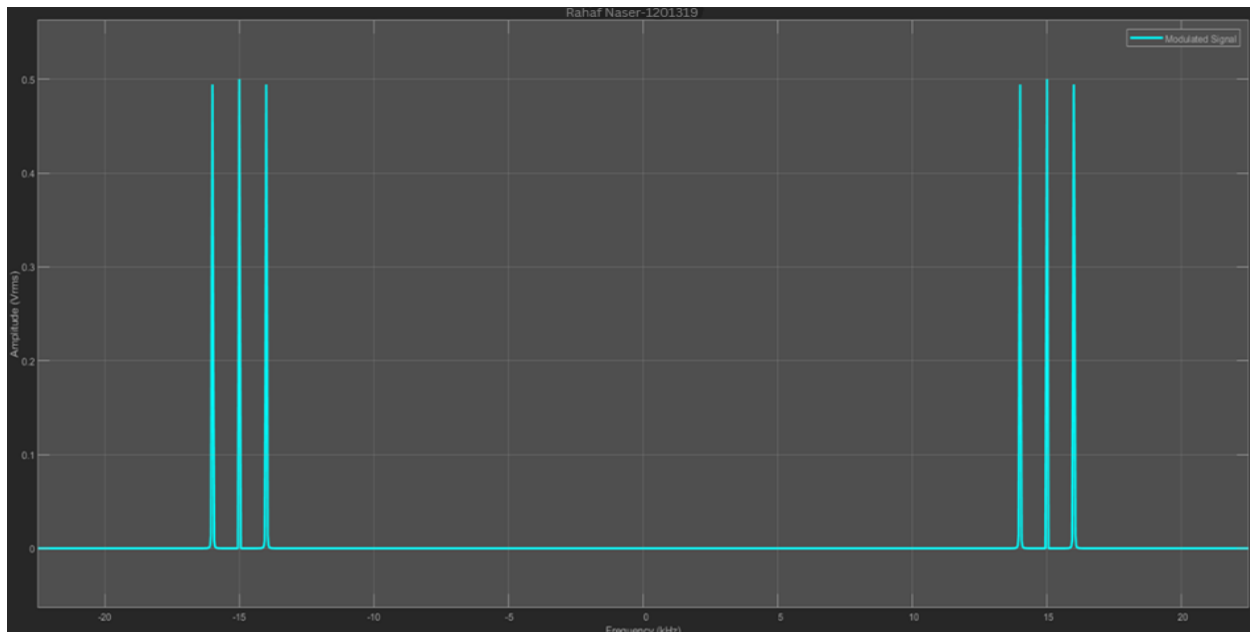


Figure 11: Modulated Signal when  $\mu = 2$  frequency domain

## 4.Coherent demodulation

### Simulink:

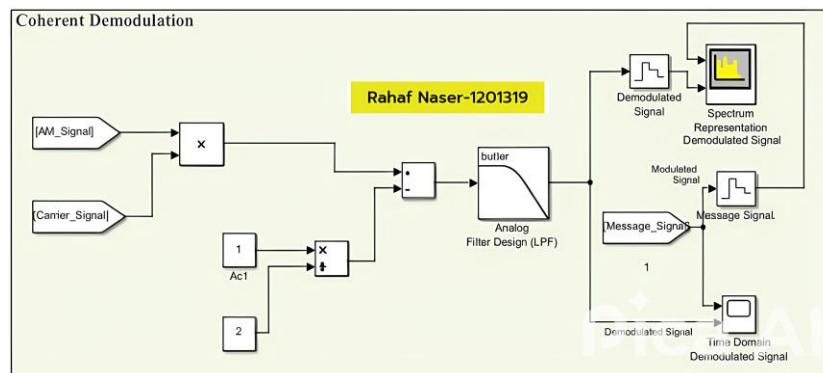


Figure 12: Simulink of coherent demodulation

### Demodulated Signal and Message signal when $\mu = 0.5$ time domain:

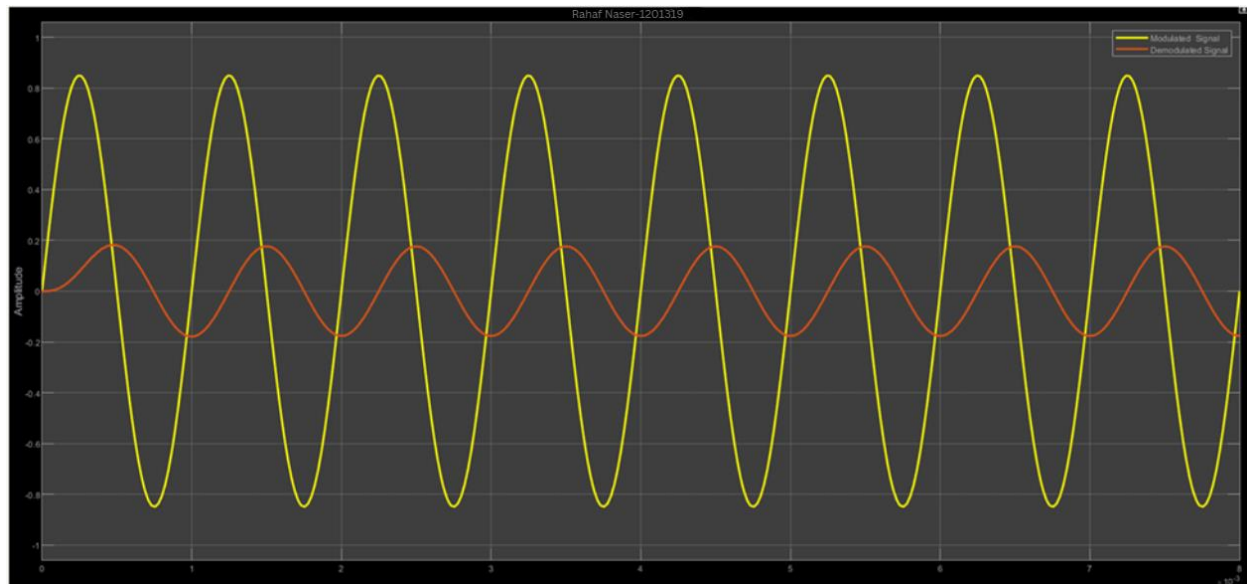


Figure 13: Demodulated Signal and Message signal when  $\mu = 0.5$  time domain

### Frequency Domain:

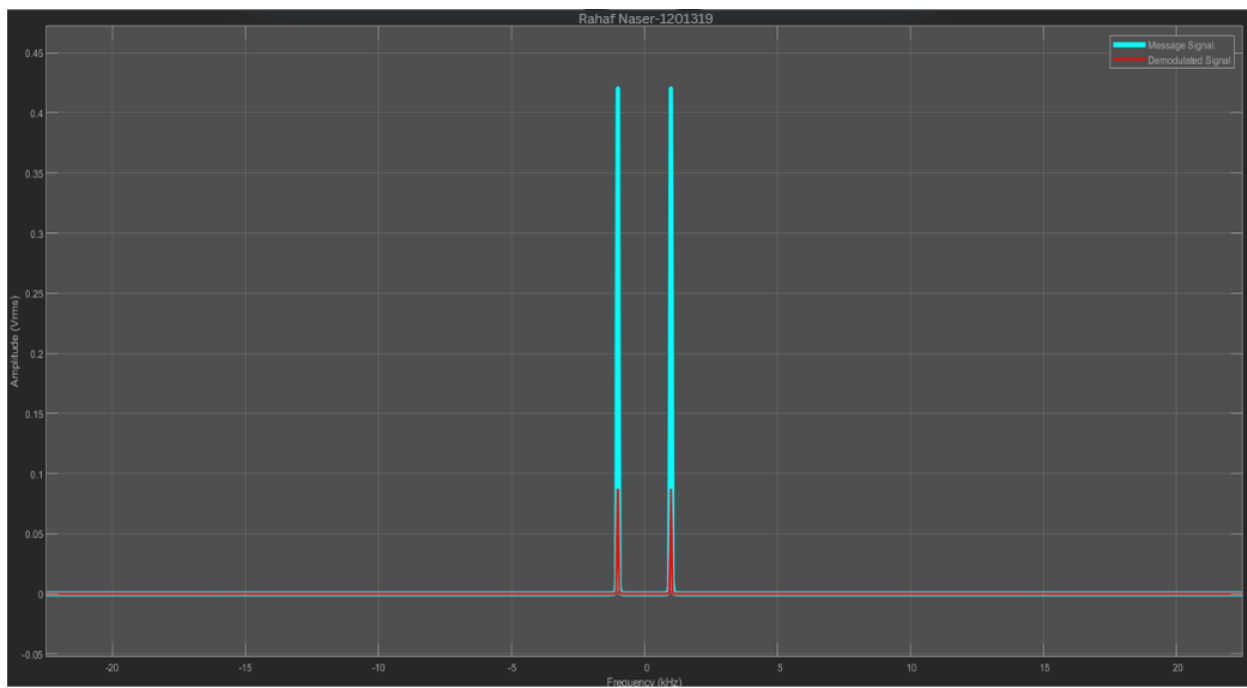


Figure 14: Demodulated Signal and Message signal when  $\mu = 0.5$  frequency domain

### Demodulated Signal and Message signal when $\mu = 1$ time domain:

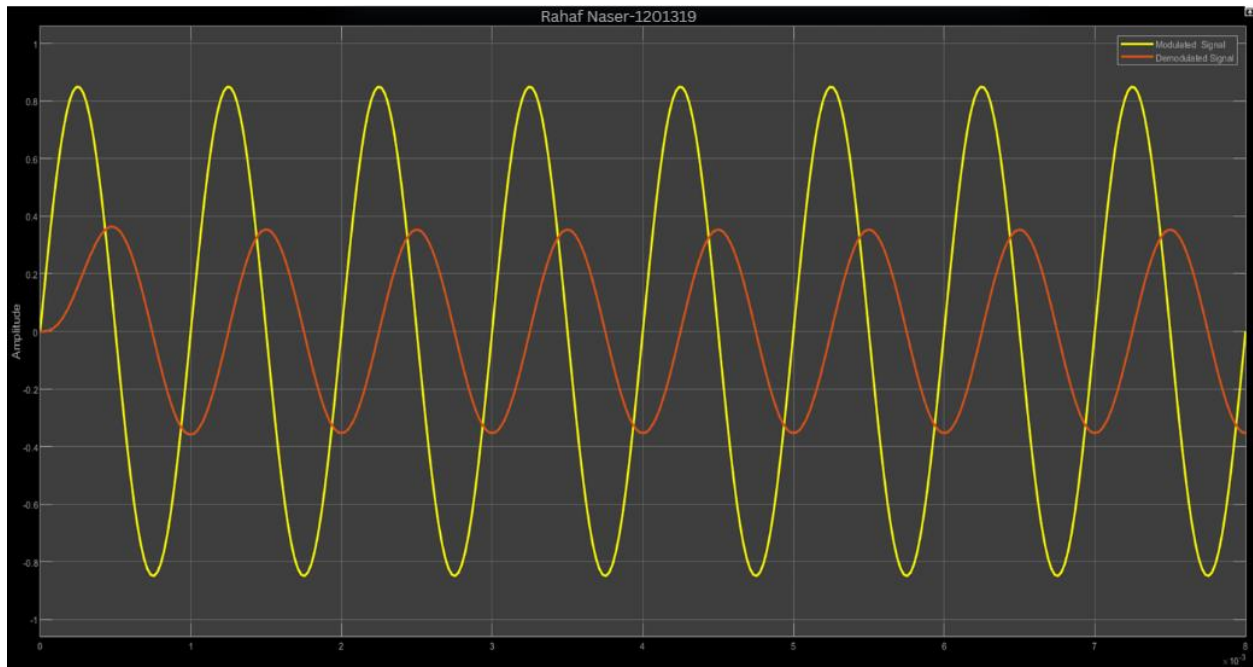


Figure 15: Demodulated Signal and Message signal when  $\mu = 1$  time domain

### Frequency Domain

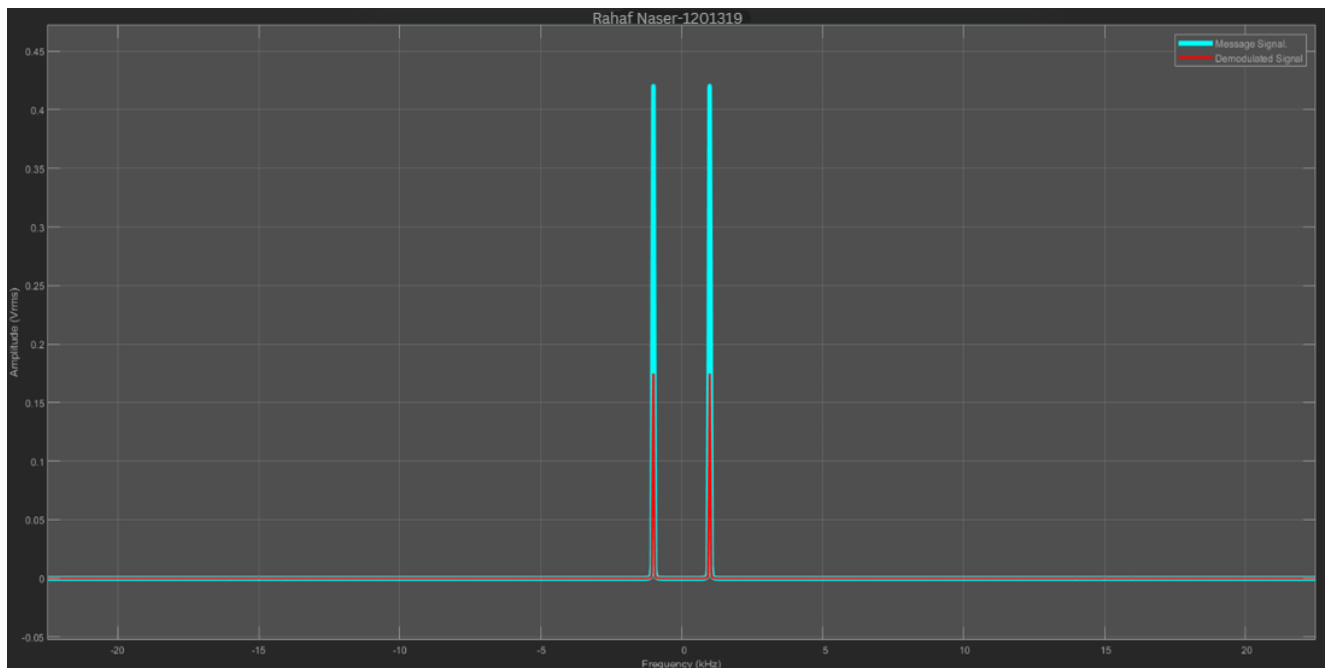


Figure 16: Demodulated Signal and Message signal when  $\mu = 1$  frequency domain

### Demodulated Signal and Message signal when $\mu = 2$ time domain:



Figure 17: Demodulated Signal and Message signal when  $\mu = 2$  time domain

### Frequency Domain:

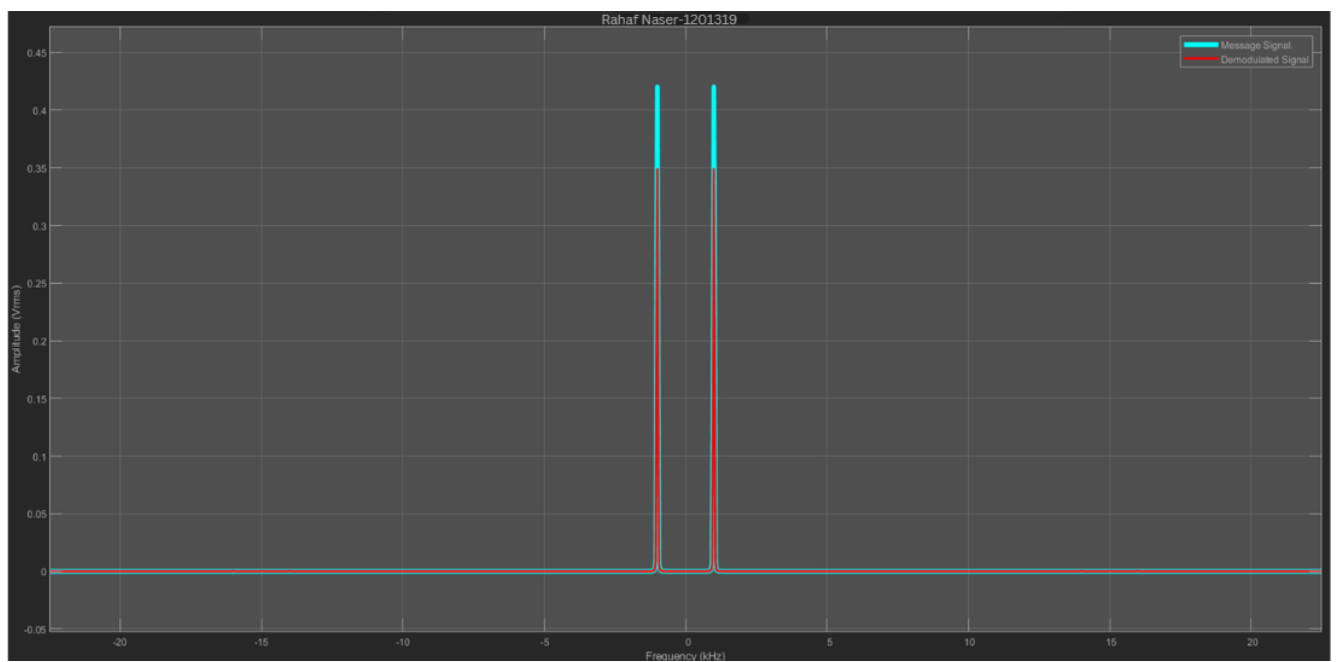


Figure 18: Demodulated Signal and Message signal when  $\mu = 2$  frequency domain

## 5. Envelope Detector demodulation

**Simulink:**

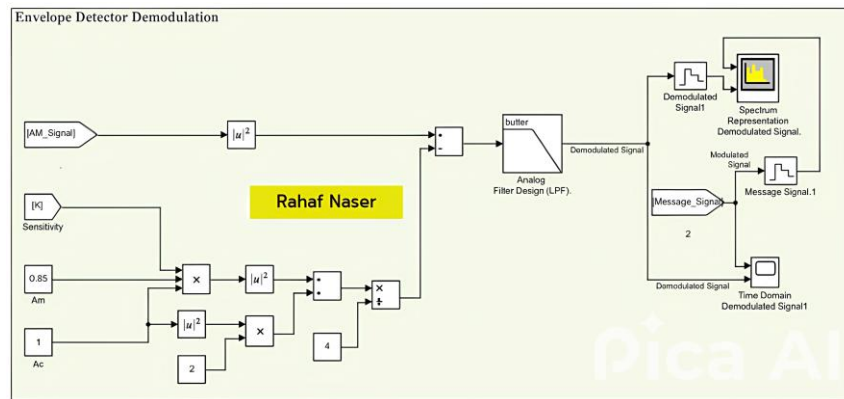


Figure 19: Simulink of Envelope Detector demodulation

**Demodulated Signal and Message signal when  $\mu = 0.5$ -time domain**

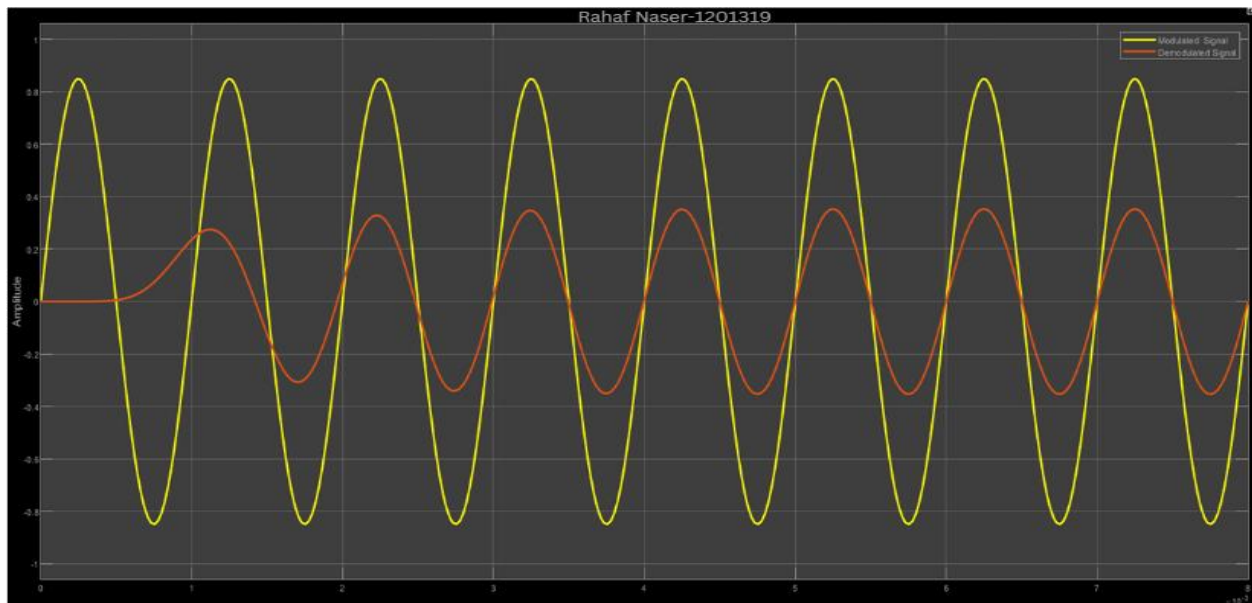


Figure 20: Demodulated Signal and Message signal when  $\mu = 0.5$ -time domain

## Frequency Domain:

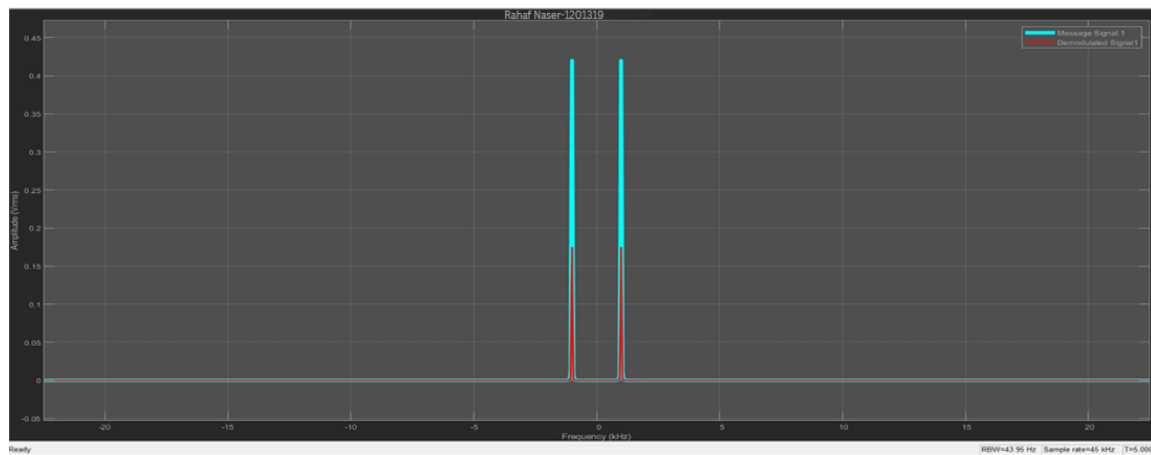


Figure 21: Demodulated Signal and Message signal when  $\mu = 0.5$ -frequency domain

## Demodulated Signal and Message signal when $\mu = 1$ time domain:

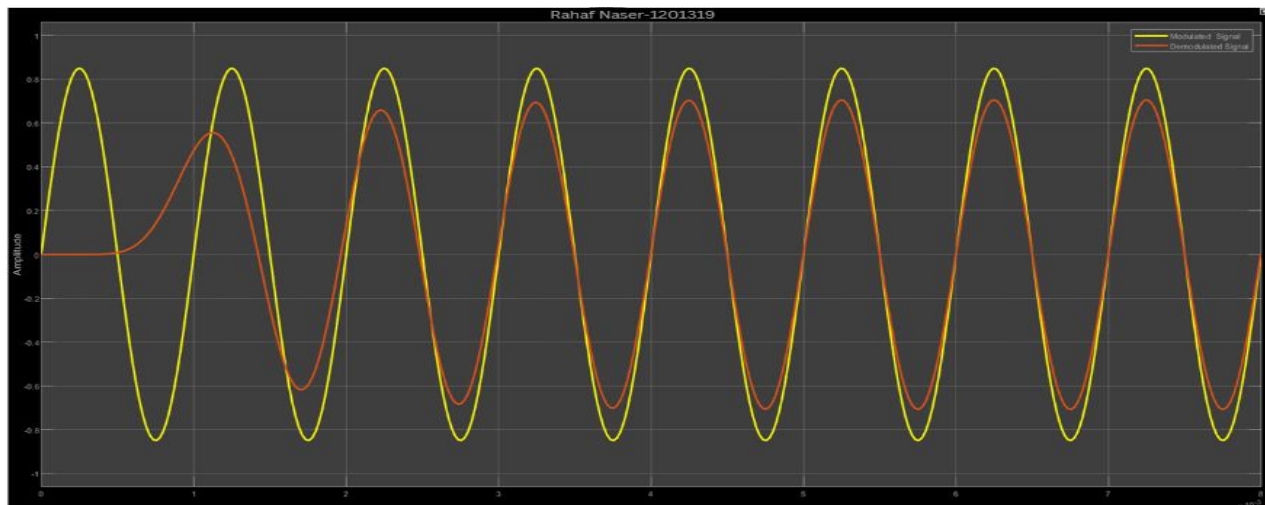


Figure 22: Demodulated Signal and Message signal when  $\mu = 1$  time domain

## Frequency Domain:

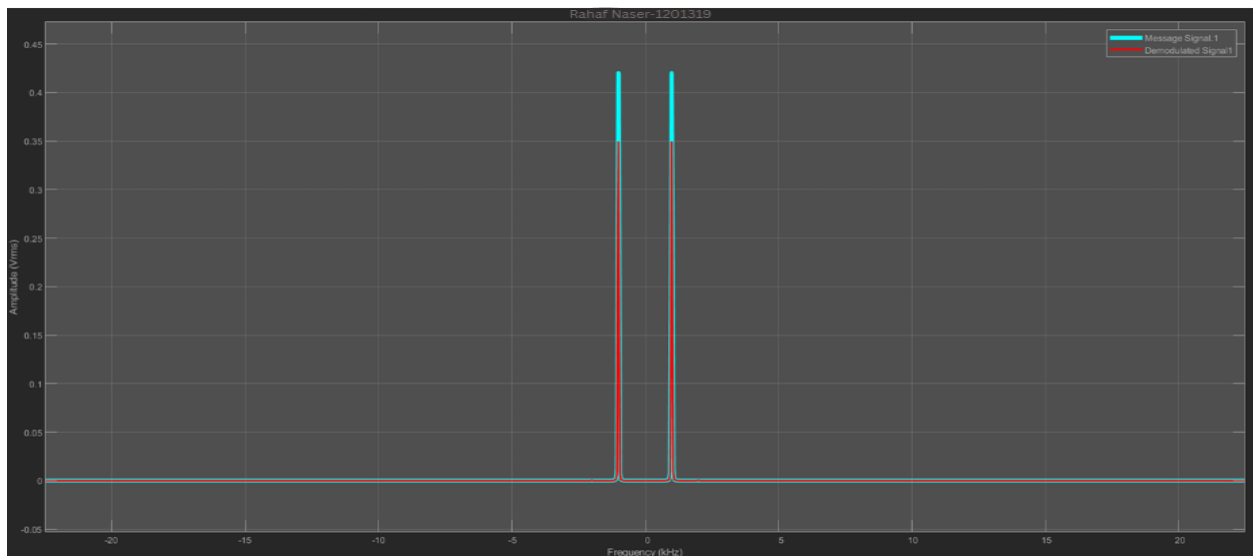


Figure 23: Demodulated Signal and Message signal when  $\mu = 1$  frequency domain

## Demodulated Signal and Message signal when $\mu = 2$ time domain:

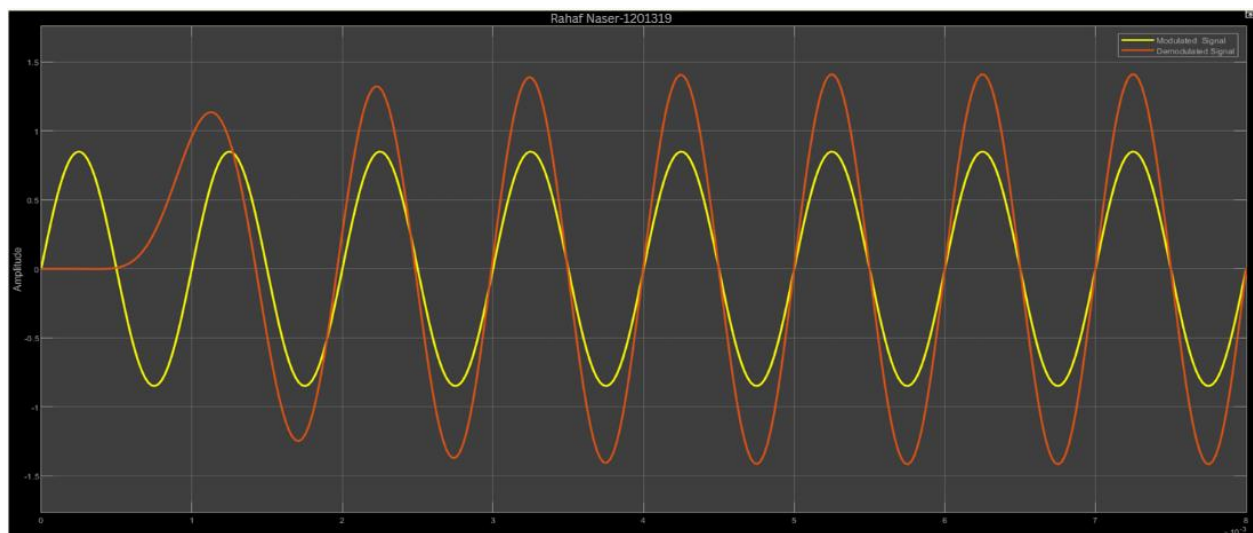


Figure 24: Demodulated Signal and Message signal when  $\mu = 2$  time domain

## Frequency Domain:

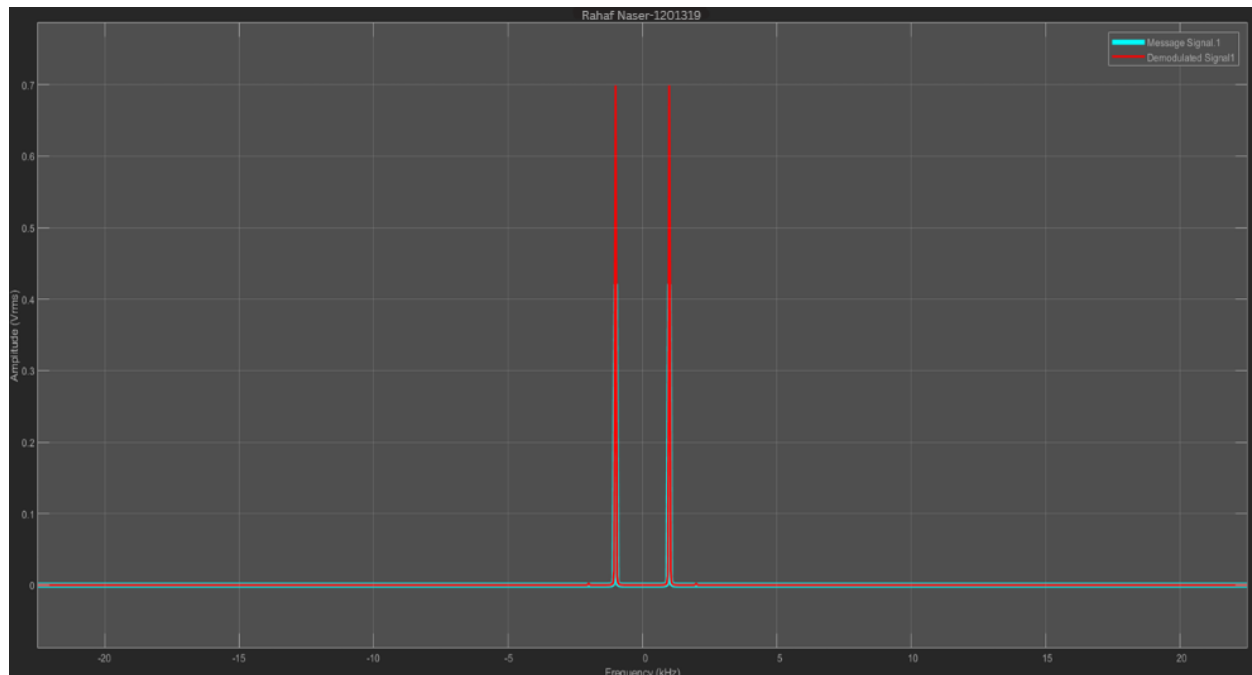


Figure 25: Demodulated Signal and Message signal when  $\mu = 2$  frequency domain

Here's a discussion of each result section:

### 1. Normal Amplitude Modulation - Results in Time and Frequency Domains

- This section presents the AM process in both time and frequency domains.
- Includes a Simulink model used to generate and analyze the AM signal.
- The message signal is visualized in time and frequency domains to understand its spectral characteristics.

### 2. Carrier Signal in Time and Frequency Domain

- Describes the carrier signal, which is a high-frequency sinusoidal wave.
- The time-domain representation shows a periodic waveform, while the frequency domain confirms its spectral content as a single peak at the carrier frequency.

### 3. Modulated Signal in Time and Frequency Domain

- Displays modulated signals for different modulation indices ( $\mu = 0.5, 1$ , and  $2$ ).
- The time-domain plots illustrate how modulation depth changes the amplitude of the carrier.
- The frequency-domain plots show sidebands at the sum and difference frequencies of the carrier and message signals.



#### 4. Coherent Demodulation

- Uses a synchronous demodulation method (Simulink-based implementation).
- Examines demodulated signals at different modulation indices to compare with the original message signal.
- The frequency domain results confirm how effectively the message signal is recovered.

#### 5. Envelope Detector Demodulation

- Uses an envelope detector to recover the message signal.
- The time and frequency domain results demonstrate the effectiveness of this simple demodulation method.
- The results for different values of  $\mu$  show how well the envelope detector works under varying modulation depths.