

**Faculty of Engineering & Technology**

**Electrical & Computer Engineering Department**

**Communications Lab-****ENEE4113**

**Prelab #3 Experiment 4 Frequency Modulation**



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**Section:** 1

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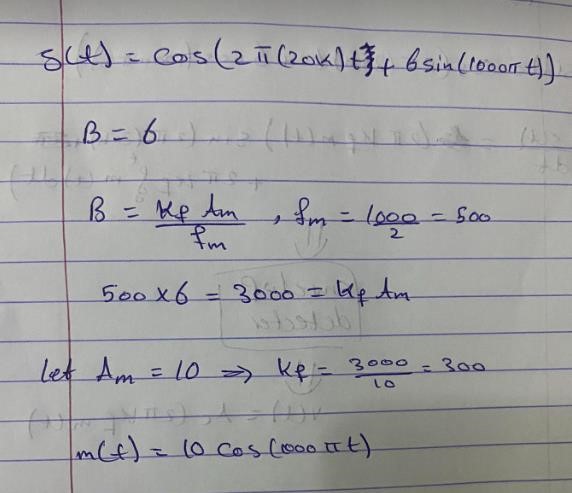
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Consider the frequency modulated signal:

S(t) = cos(2\*pi\*(20k)\*t + 6\*sin(1000\*pi\*t))

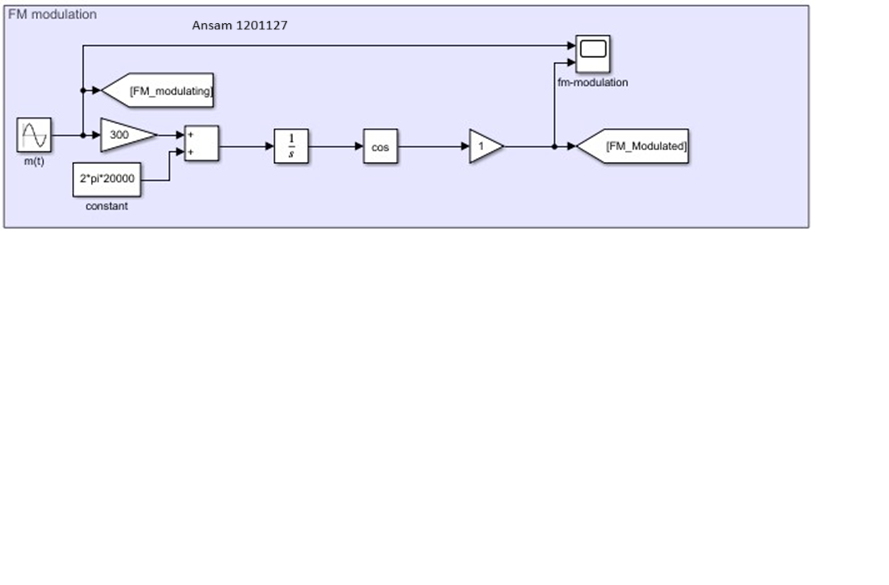
# Extract the message signal m(t) from s(t). [by hand solution]

*Figure 1:Extract m(t) from s(t) by hand*

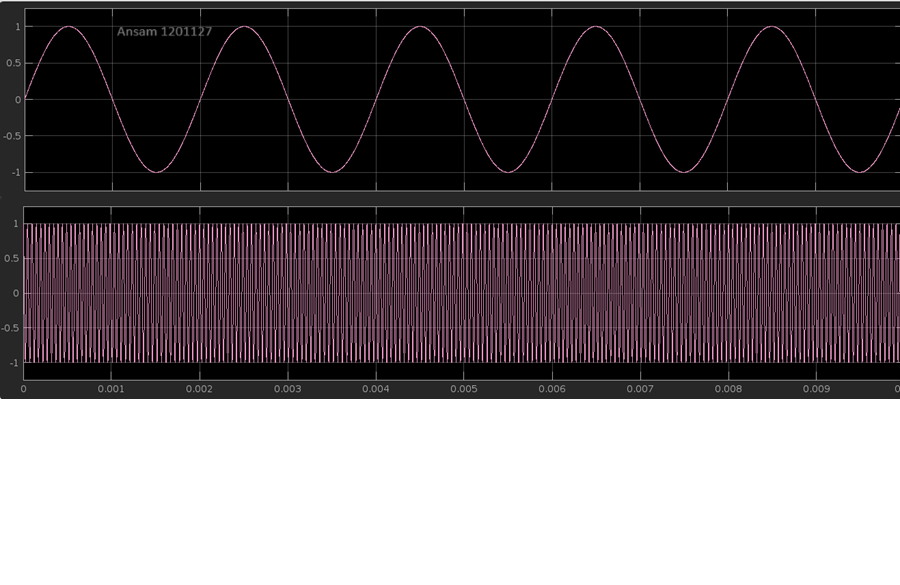


# Plot 5 cycle from message signal m(t) and s(t) versus t.

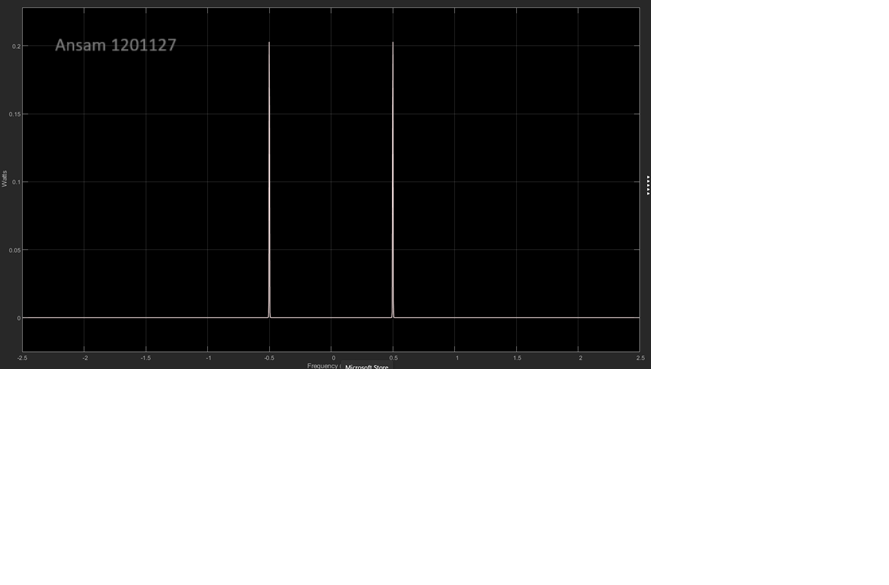
*Figure 2: FM modulation block diagram*



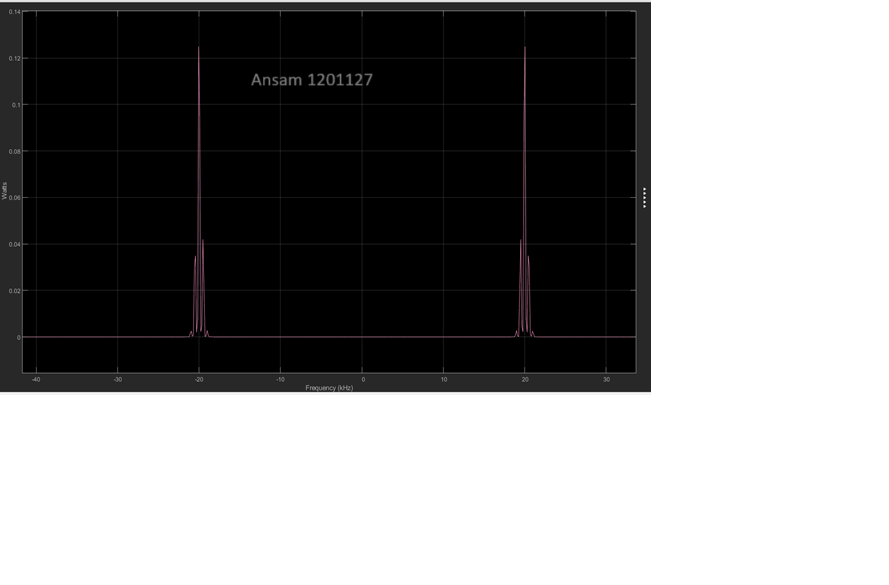
*Figure 3: m(t) & s(t) in time domain*



*Figure 4: m(t) in frequency domain*

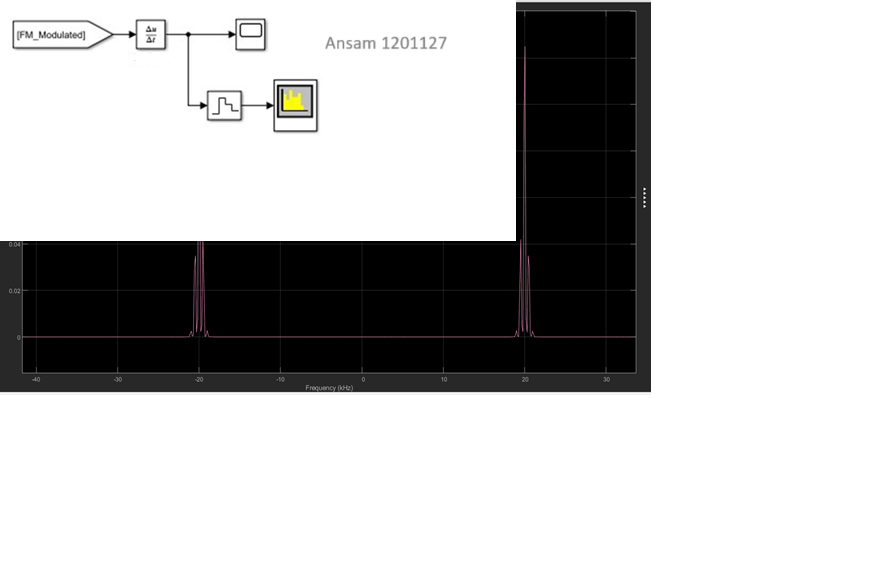


*Figure 5: s(t) in frequency domain*

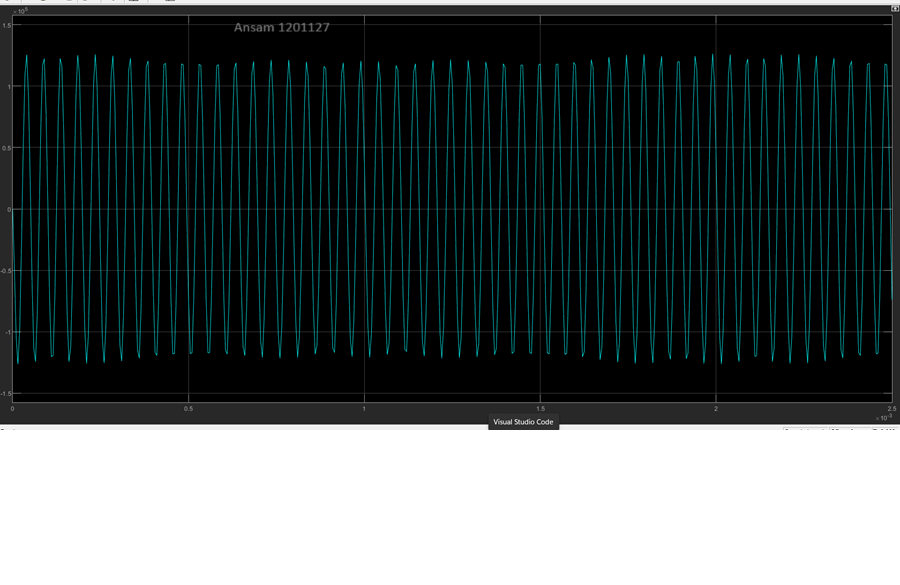


# Differentiate s(t) with respect to t and plot ds(t)/dt. Notice how this operation transforms an FM waveform into an AM waveform.

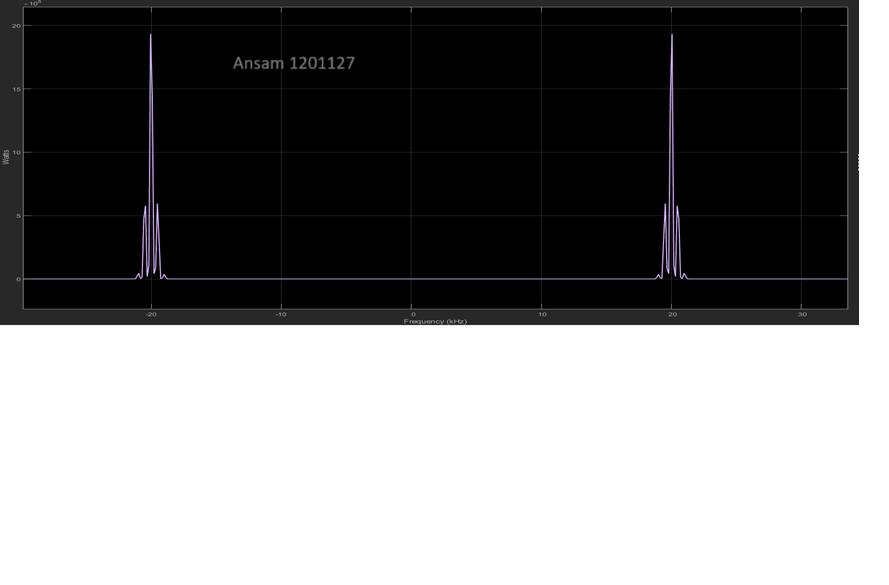
*Figure 6:Differentiate s(t) block diagram*



*Figure 7: Differentiate s(t) in time domain*



*Figure 8:Differentiate s(t) in frequency domain*



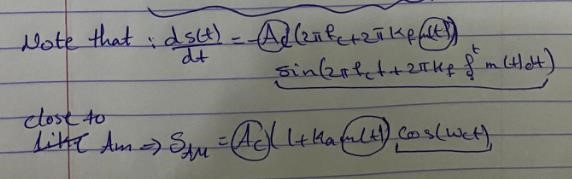
Differentiate s(t) helps for demodulation. An FM signal may be demodulated by means of

What is called discriminator .Ideal discriminator defined as y(t) = Kd \* 𝑑𝜃 /dt. The differentiation does the equation close to AM modulation

.

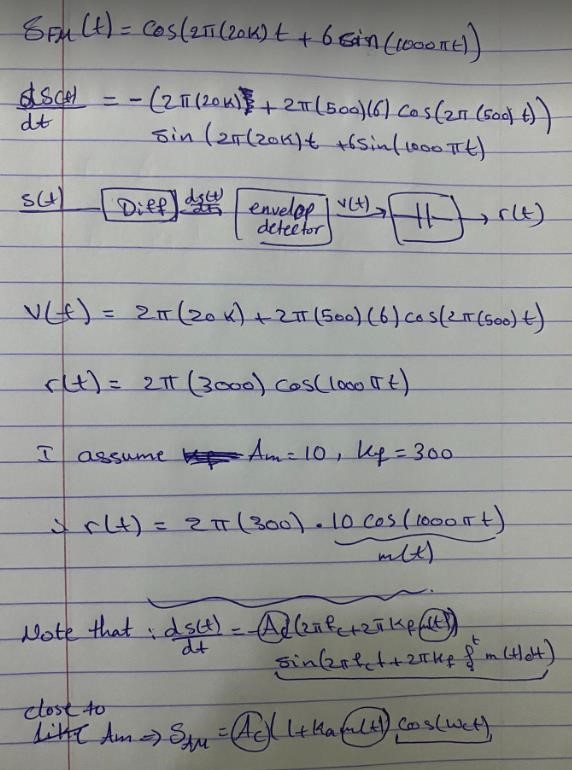
By hand:

*Figure 9:Differentiate s(t) by hand*



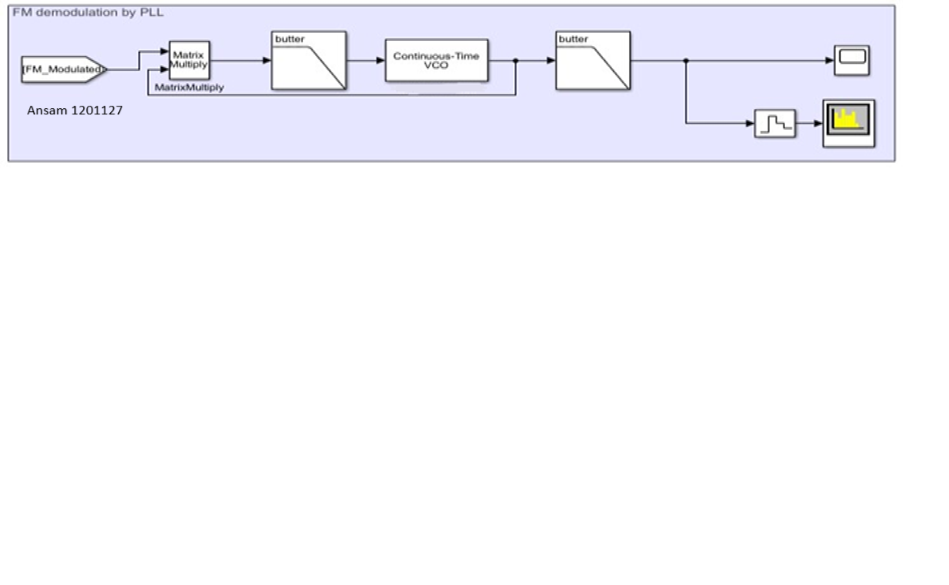
# Apply ds(t)/dt to an ideal envelope detector, subtract the dc term and show that the detector’s output is linearly proportional to m(t).

*Figure 10: Differentiate s(t) with envelop detector by hand*

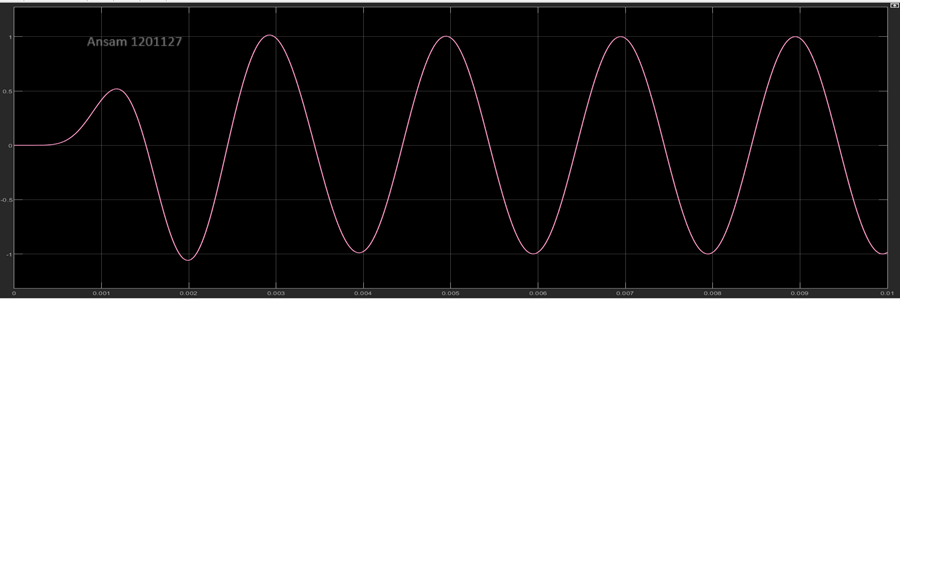


# Extract message signal by using phase-locked loop (PLL).

*Figure 11:FM demodulation using PLL block diagram*



*Figure 12:Demodulated signal in time domain*

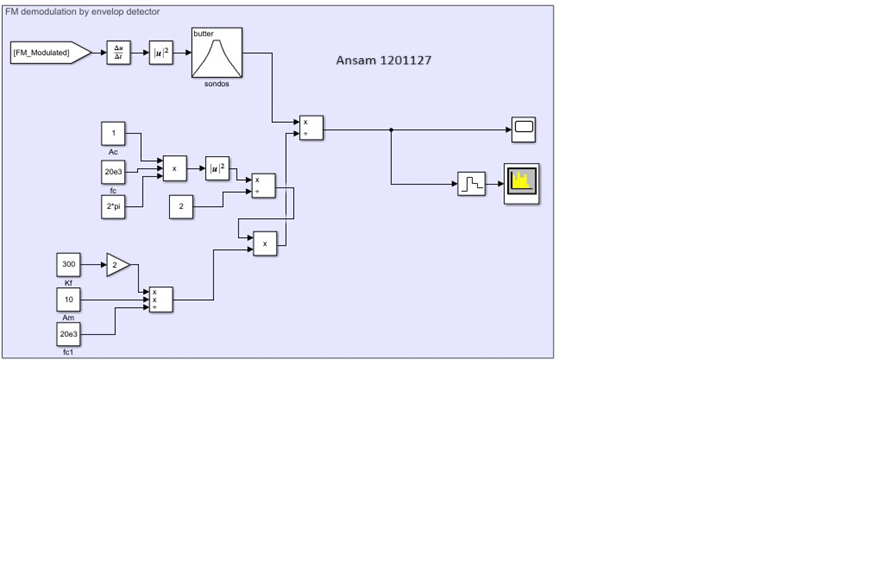


*Figure 13:Demodulated signal in frequency domain*

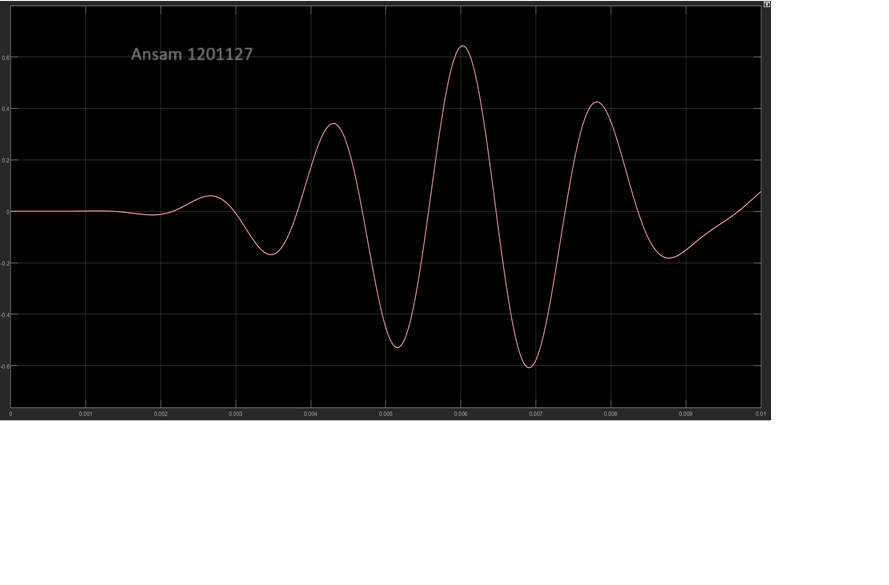


# Extract the message signal by using the envelop detector.

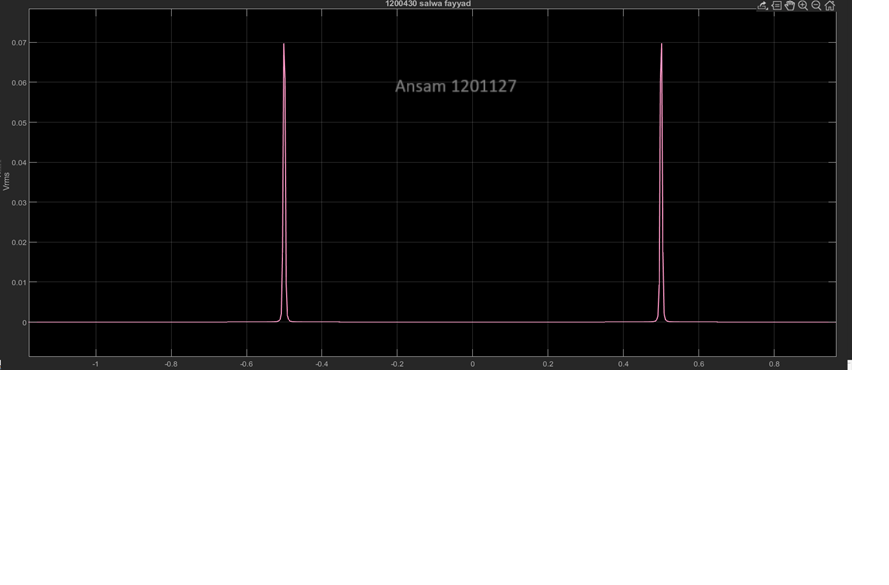
*Figure 14:FM demodulation using envelop detector block diagram*



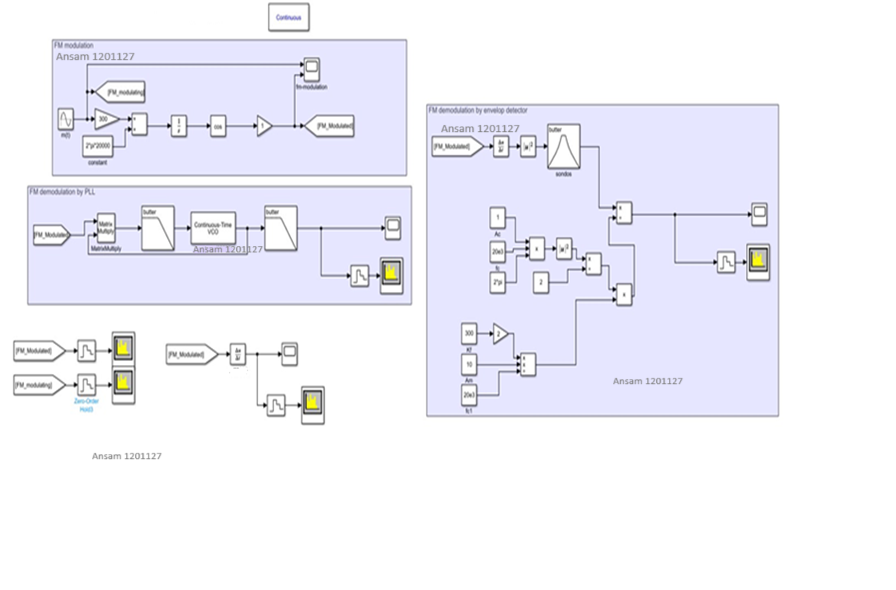
*Figure 15:Demodulated signal in time domain*



*Figure 16:Demodulated signal in frequency domain*

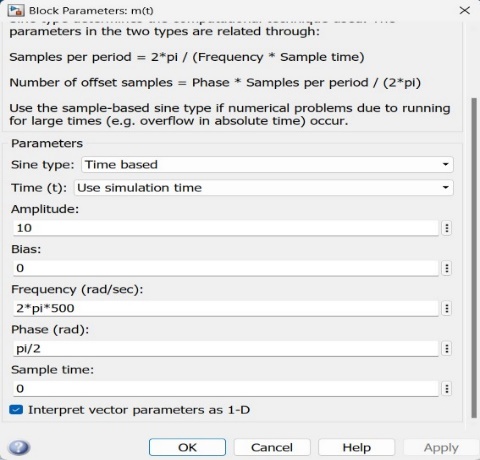


*Figure 17:Hole system block diagram*



# Parameters

*Figure 18: m(t) parameters*



*Figure 19: Filters parameters*

