Name: ALIMAN, EVE SETH E.

# Section: BSCPE4-01 Schedule:

Class number:

Date:

**Laboratory title: FREQUENCY MODULATION (FM) SIGNAL Learning Targets:**

1. To produce the frequency modulation (FM) signals using the mathematical equations.
2. To view the FM wave in the time domain using the plot function and frequency domain using the fast Fourier transform (FFT) function.

## INTRODUCTION

In frequency modulation (FM), the information signal varies the frequency of the carrier sine wave. The instantaneous value of the carrier frequency changes in accordance with the amplitude and frequency variations of the modulating signal.

The instantaneous value of the complete modulated wave vam:



The modulation index of FM, mfm, is the ratio of the deviation (amount of change denoted by the delta symbol) in the carrier and the modulating frequency. As such the values of mfm may range from any value, 0.25 for narrow-band FM, 5 for standard broadcast FM or higher as needed.



## PRE-LAB QUESTIONS

What particular functions in the Fourier transform are needed for the FM signal?

In the Fourier Transform of an FM (Frequency Modulated) signal, the important functions are the carrier frequency and multiple sidebands created by frequency variations. Unlike AM, FM produces an infinite number of sidebands spaced by the modulating frequency. These sidebands show how the frequency of the carrier changes with the input signal, carrying the actual information.

## MATERIALS/INSTRUMENTS

Computer with MATLAB or Octave pre-installed. The Signal Toolbox (MATLAB) or Signal PKG (Octave) should also be installed. For students who have no computers/laptops at home but can access the internet using cellular phones, they may use the online versions for MATLAB or Octave (requires email registration).

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1. **PROCEDURES**

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1. Type the code found at the end of the module in the MATLAB/Octave editor.
2. Save the file as ‘expt7\_fmsignal’.
3. Run the program.
4. Take note of MATLAB/Octave errors especially due to spelling errors. If you are unable to resolve the error message(s), ask you instructor for help.

## COMPUTATIONS

Write the FM voltage equation for a 10 V, 10 KHz carrier with a modulation index of 3 and a 1V, 500 Hz modulating signal.

vfm(t)= 10cos (2\*pi(10,000)t+3(1)sin(2\*pi(5,000)t))

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1. **OBSERVATIONS/OUTPUTS**

For F2F lab activities, the students should show their MATLAB/Octave output screen to the faculty. Draw and label the output signals as seen in the figures.

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| --- | --- |
| Figure 1 |  |
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As a FLEX activity, the student will be required to upload the image files of their output.

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1. **CONCLUSIONS**

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In this laboratory exercise, the Frequency Modulation (FM) signal was successfully generated and analyzed using MATLAB/Octave. The experiment demonstrated how changes in the amplitude and frequency of the modulating signal affect the carrier wave’s frequency, resulting in the production of multiple sidebands in the frequency domain. Through the Fourier Transform, the FM signal’s spectral components were clearly observed, confirming that frequency variations encode the information signal. Overall, this activity helped deepen the understanding of FM principles and their practical behavior in both time and frequency domains.

## POST LAB QUESTIONS

Modify the program by changing the values below and take note of the changes in the outputs in the FM wave and FM signal spectrum.

* 1. Change the value of variable ‘m’ from 6 to 2.

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| --- | --- |
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* 1. Change the value of variable ‘m’ from 6 to 10.

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