Date 26/2/21

Expt. Name FM

Expt. No. 5

Page No. 9

Experiment-5

Spectra of Frequency Modulating Signals

Aim:

To determine and analyse different spectra of frequency modulating signals.

Apparatus:

- LabAlive Online Simulator
- Java Runtime Environment.

Theory:

Frequency Modulation varies the frequency of the sine wave carrier depending on the source signal. The difference between the instantaneous and center frequency of the carrier is proportional to the modulating signal's instantaneous amplitude.

$$\Delta f(t) = K_{fm}\, m(t).$$

where $\Delta f(t)$ → frequency deviation
K_{fm} → sensitivity of frequency modulator
$m(t)$ → modulating signal

Teacher's Signature:

Date _____ Expt. No. _____

Expt. Name _____ Page No. _____

Modulation Index, $\beta = \frac{\Delta f_{max}}{f_m} = \frac{k_m \hat{m}}{f_m}$

$\hat{m}$ → amplitude of modulating signal

f_m → modulating sine wave signal frequency.

Procedure:

a) Change the modulation index values and observe the change in spectra for DC, triangular, sawtooth and square wave.

b) Change the value of modulation index for which the carrier frequency disappears for DC, triangular, sawtooth and Square wave.

c) Similar adjust values such that 2nd and 3rd side bands disappears for different waveforms.

Observations:

- for DC wave, carrier frequency will not disappear and will be directly dependent on amplitude, shifts accordingly.
- for triangular wave, carrier frequency disappears at 2.925, first band disappears at 4.765, second at 6.32 and third at 7.82.
- Carrier frequency will not disappear also for sawtooth, as Fourier transform of sawtooth will give average at both ends and depends on amplitude.

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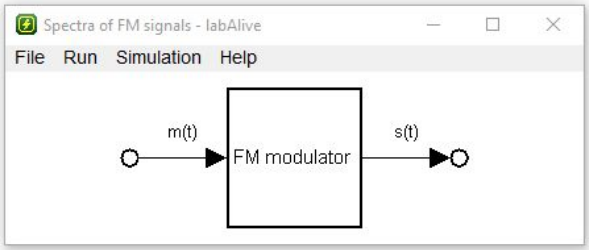
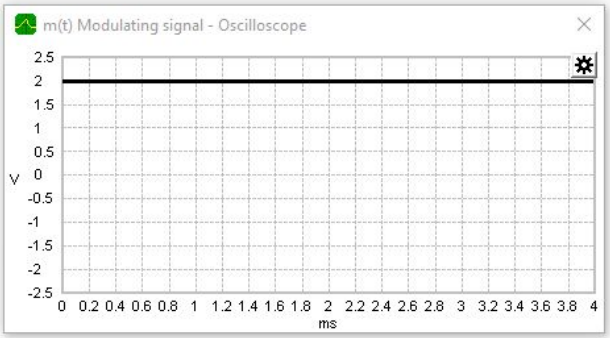
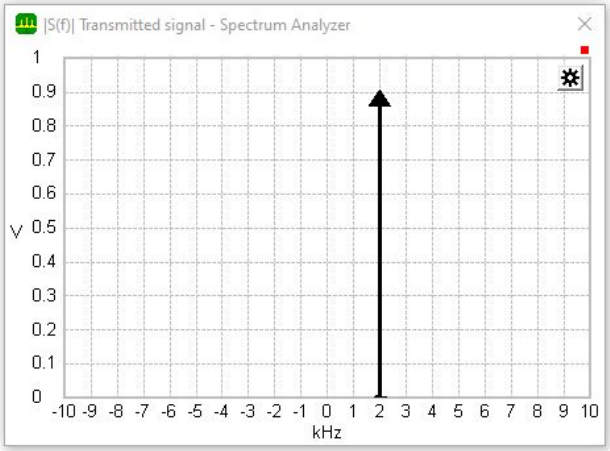
DC

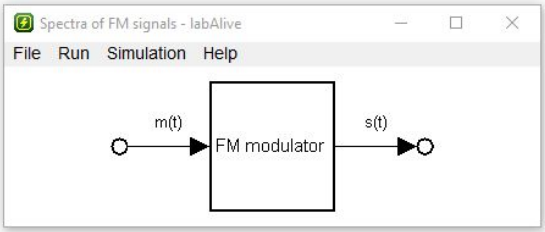


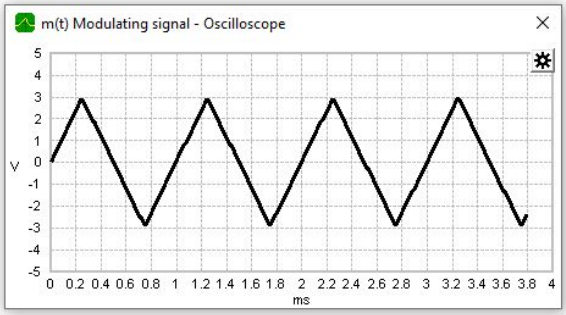


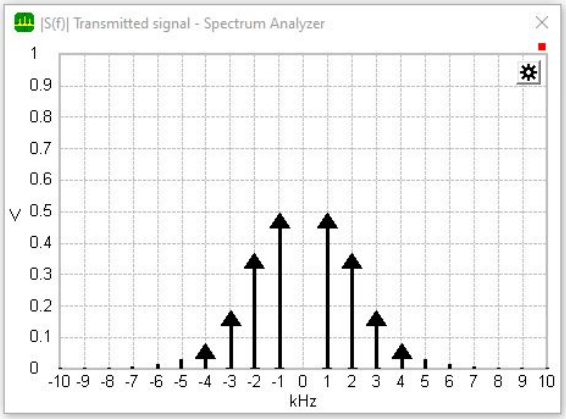


TRIANGULAR

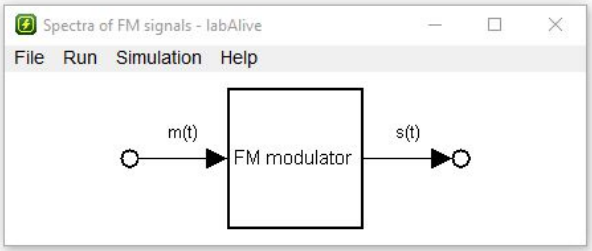
1) Carrier Frequency Disappears

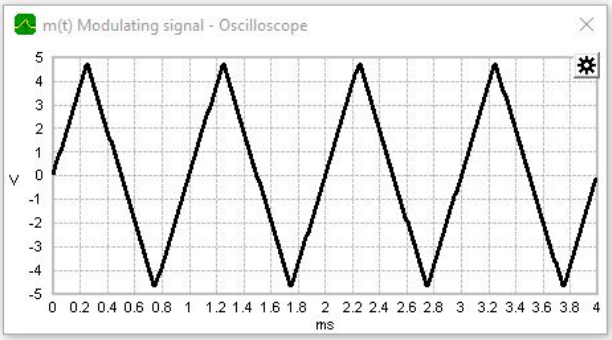


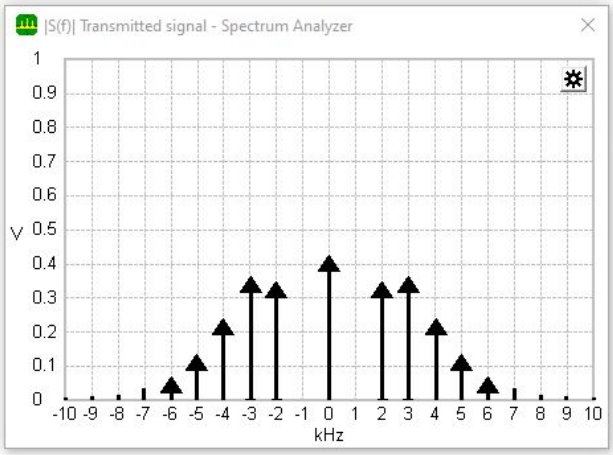


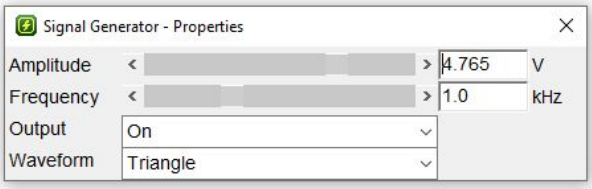


2) 1st Band Disappears

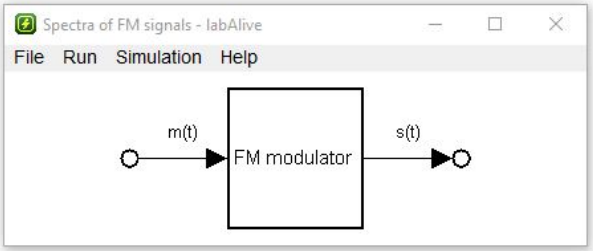


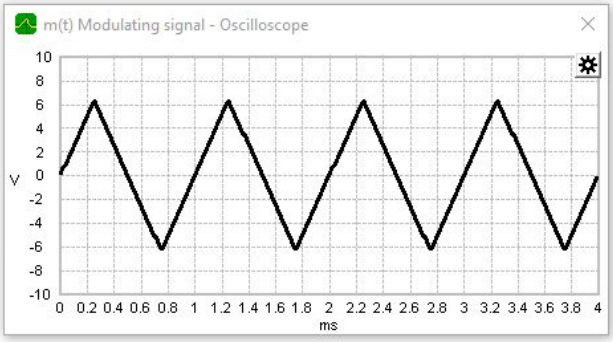


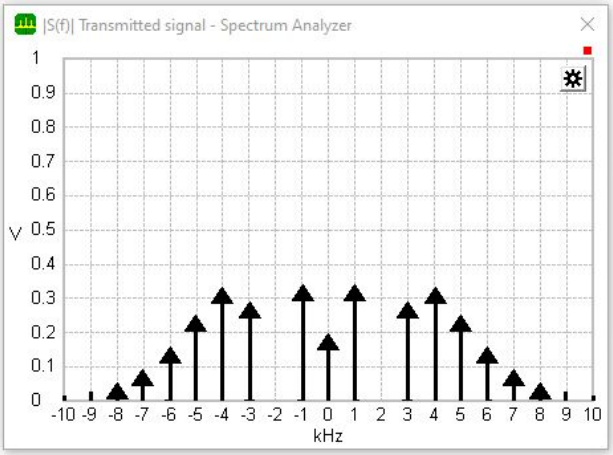




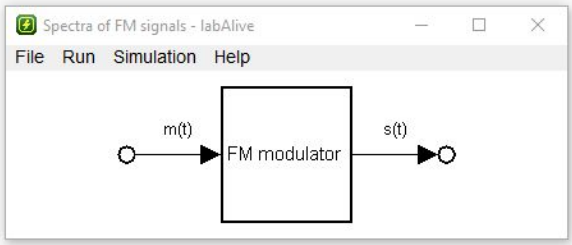
3) 2nd Band Disappears

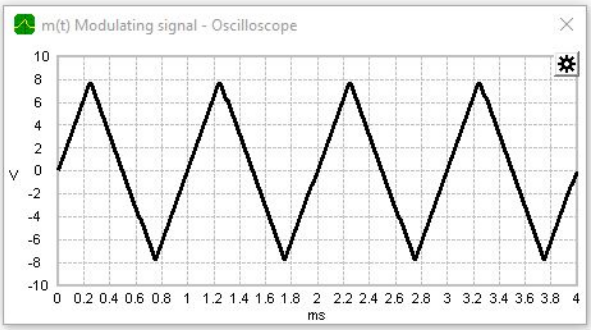


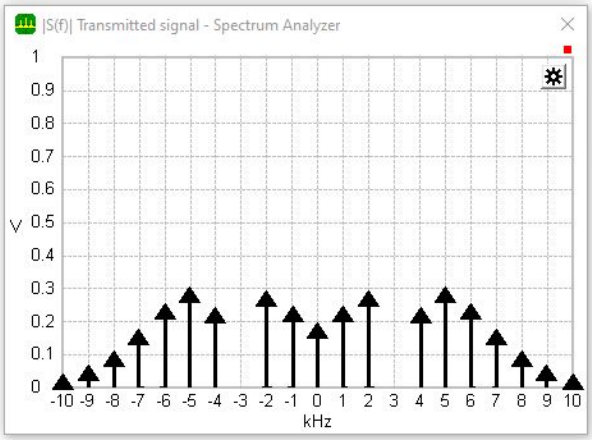


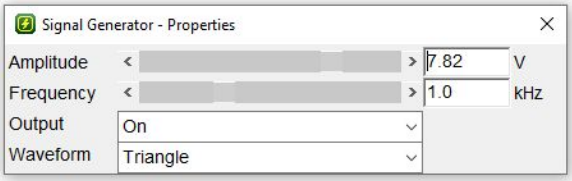


4) 3rd Band Disappears

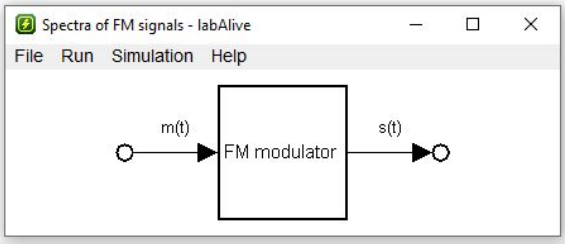


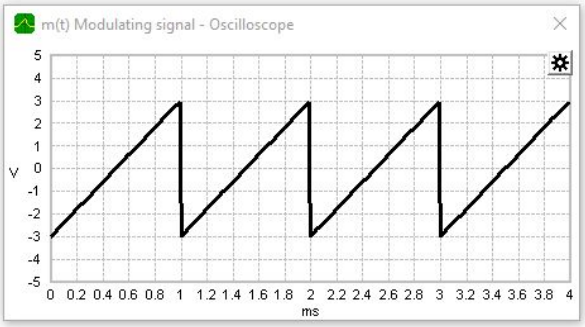


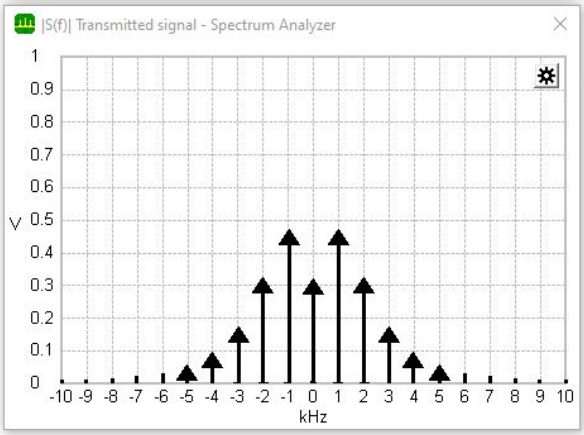




SAWTOOTH

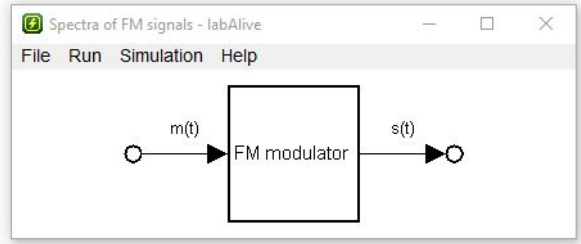


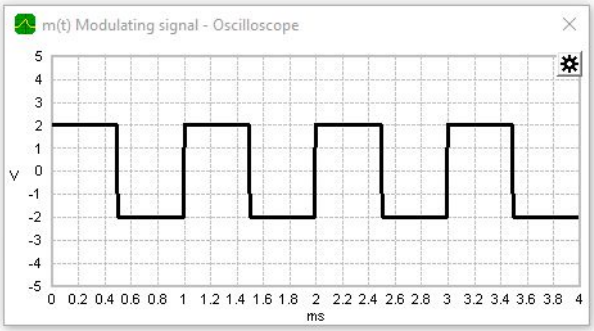


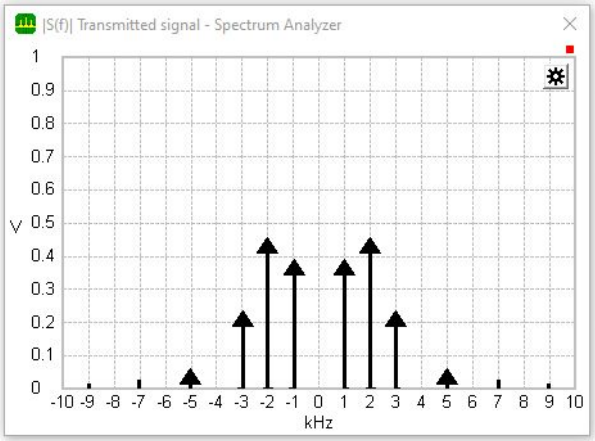


SQUARE

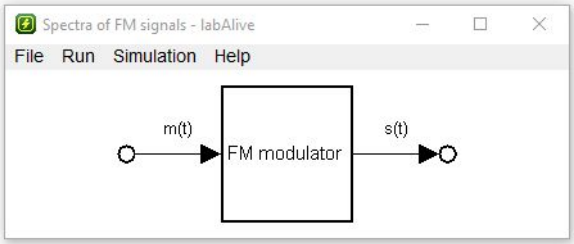
1) Carrier Frequency Disappears

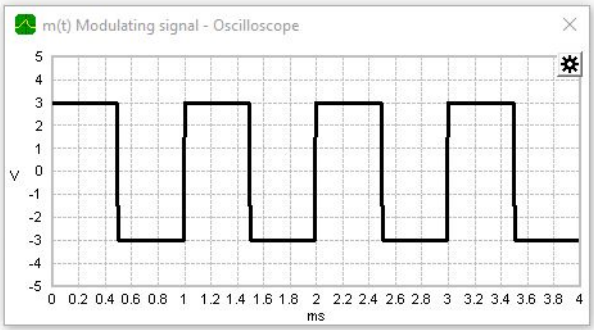


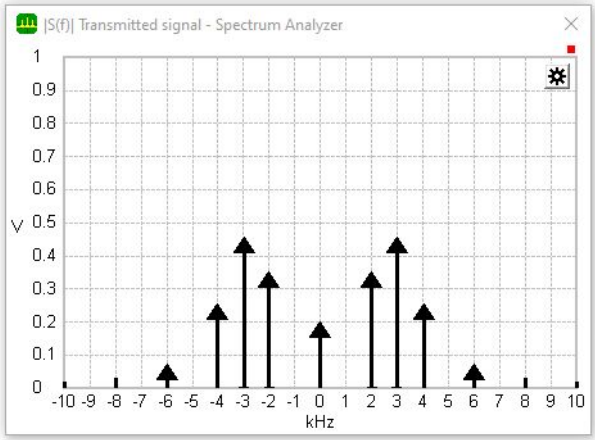


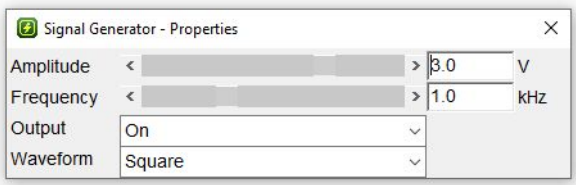


2) 2nd Band Disappears









3) Third Band Disappears