Marmara University
Electrical and Electronics Engineering Department
Spring 2021
EE 3012 – Electronics II
Simulation Project - Due June 11, 2021

Arithmetic Multiplication Function Using OpAmps

The objective of this project is to design and test (by simulation) a basic analog arithmetic multiplier circuit using opamps. The output of the multiplier is given by

$$v_o = k\,(v_{i1} \cdot v_{i2})$$

where k is a constant and v_{i1} and v_{i2} are two independent analog input signals. This multiplier can then be used to generate many more arithmetic operations circuits.

One method to achieve analog signals multiplication is to use opamps to implement the log-antilog concept. First, log circuits are used to find the log of each of the inputs separately. Second, these two results are added using an adder circuit. Finally, an antilog circuit is used to generate the required output.

The required tasks of this project are as follows.

1) Design and test the log function circuit separately.
2) Design and test the antilog function circuit separately.
3) Design and test the multiplication function circuit (MFC).
4) Use the MFC to implement division of two input signals.
5) Use the MFC to implement the square of an input signal.

The bonus tasks of this project are as follows.

1) Use the MFC to implement the square-root of an input signal (1%).
2) Use the MFC to implement the cube of an input signal (1%).
3) Use the MFC to implement an interesting function of your choice (1%). (But not a combination of the above functions)

Instructions

- Use discrete components plus the IC741 only.
- Use LTspice only.
- All component types and values should be "real" (i.e., available in market). Use the values such that the output signal is clear and with reasonable amplitude.
- Each student will submit an individual work.
- Submissions should be in a formal report format, with an introduction, theoretical analysis, design details, analysis of results and validations, and conclusions.
- IMPORTANT. In the analysis of results and validations section, include simulation tests of at least three (3) different function types as inputs (linear, sinusoidal, etc., with possible combinations). In each case, give the output waveform and compare to theoretical expectations with detailed discussions. Such analysis will carry most of the project mark.
- In case of copied work (circuits, figures, results, etc., even partially), all parties will get nulls.

Show all work and analysis
Only pdf files are acceptable
Late submissions are checked but not graded
Copied submissions represent academic dishonesty and are disqualified