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Multisim Based Projects

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Abstract: In the field of Electrical Engineering students' education, the experiments including hardware and software components have an important role. Students mostly gain theoretical knowledge with some or none actual experience, so the development of various simulations if the actual hardware is unavailable can in some part satisfy the need for the practice. In this paper, we elaborated the topic of creating simulations of real analog circuits in Multisim software, and their analysis with NI Elvis II+ hardware platform. The students were interviewed about their opinion on these simulations, and their answers confirm ed their satisfaction with the realized experiments.

I. INTRODUCTION

Every theoretical analysis of the systems can be complicated for the students of engineering if they are not familiar with software simulations of these systems or actual hardware components. National Instruments' Multisim software package is easy to use and achieves real time simulation of analog circuits. This software is accompanied by NI Elvis II+ hardware device which can be used in laboratory while exercising the simulations, measurements, and designs of real life systems. The aforementioned device, together with LabView and Multisim, can be used as an excellent replacement for many other laboratory devices, such as digital multimeters, oscilloscopes, Bode analysers, function generators, etc. The idea of the experiments given in this paper is to familiar students with certain analog circuits' mode of operation. Furthermore, they are meant to pro vide an answer to question if the software simulations are sufficient compared to actual hardware simulations, and to facilitate the study and understanding of theoretical concepts of these circuits.

II. ANALOG CIRCUITS

The students throughout their entire education get in touch with the systems comprised of analog circuits, and that's the reason for studying these circuits. Since passive and active electronic elements are relatively cheap nowadays, the exhibition exercises with real circuits are feasible, involving the students' activities regarding the oscilloscope measurements and tracking of the signals emerging in these systems . For every circuit realized in this paper, whether in Multisim software or with real elements, the passive and active electronic elements were used, such as resistors, capacitors, and operational amplifiers (LM 741 circuit s).

A. NON-INVERTING OP-AMP

A non-inverting amplifier is an op-amp circuit configuration that produces an amplified output signal and this output signal of the non-inverting op-amp is in-phase with the applied input signal.

In other words, a non-inverting amplifier behaves like a voltage follower circuit. A non-inverting amplifier also uses a negative feedback connection, but instead of feeding the entire output signal to the input, only a part of the output signal voltage is fed back as input to the inverting input terminal of the op-amp.

The high input impedance and low output impedance of the non-inverting amplifier make the circuit ideal for impedance buffering applications.

Non-inverting operational amplifier The Fig. shows the realization of the non-inverting operational amplifier in Multisim. The realization of the non-inverting operational amplifier in Multisim The Fig. clearly shows the function generator and the oscilloscope that is connected to the output of the amplifier and to the function generator. In this way, the oscilloscope will display two signals for their comparison. The oscilloscope display shows the output.

the oscilloscope displays two signals: (1) output signal from the amplifier, and (2) input signal to the amplifier (function generator signal), with frequency of 100Hz and amplitude of 1 V.

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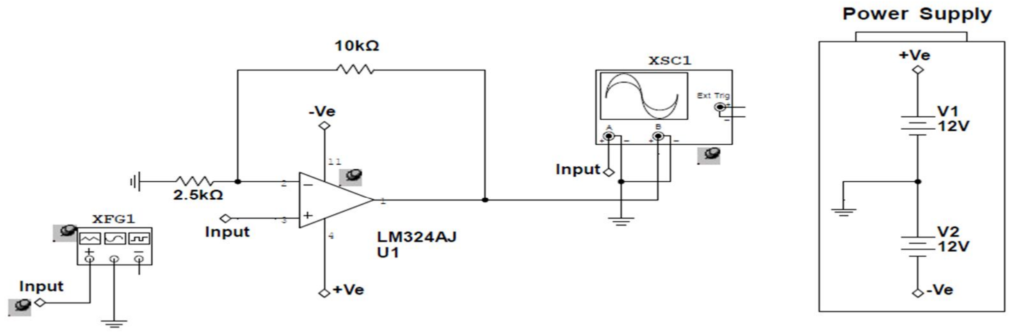
Non-Inverting Opamp Configuration



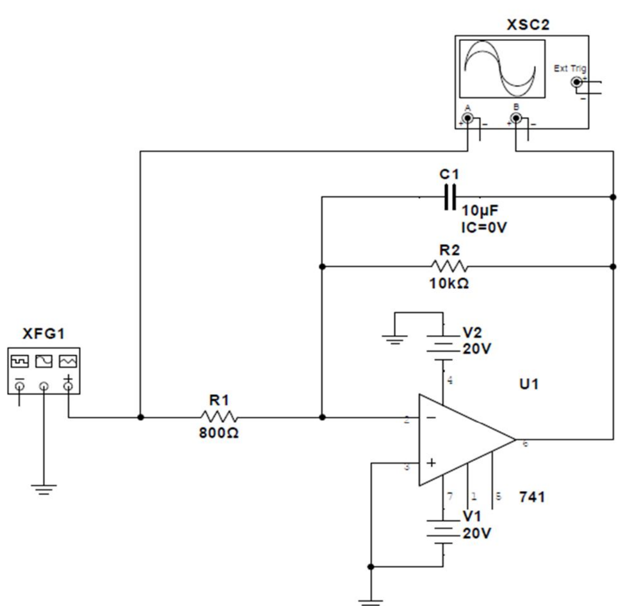
B. Integrator

An integrator in measurement and control applications is an element whose output signal is the time integral of its input signal. It accumulates the input quantity over a defined time to produce a representative output.

Integration is an important part of many engineering and scientific applications. Mechanical integrators are the oldest application, and are still used in such as metering of water flow or electric power. Electronic analogue integrators are the basis of analog computers and charge amplifiers. Integration is also performed by digital computing algorithms.

Integrator The Fig. shows the realization of the integrator in Multisim. The realization of the integrator in Multisim The input signal is square wave and has the frequency of 50 Hz and amplitude of 10 V. Duty cycle is 50%, and the rise/fall time of the input signal is 10ns. The output signal is sawtooth wave and this is shown in Fig. that shows the oscilloscope readings

Integrator Circuit



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C. Power Supply

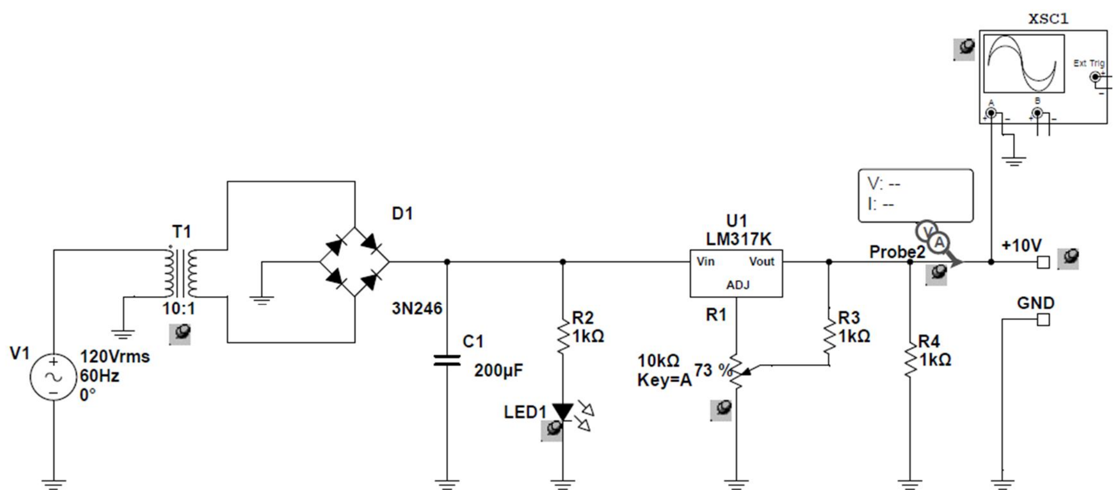
A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are separate standalone pieces of equipment, while others are built into the load appliances that they power. Examples of the latter include power supplies found in desktop computers and consumer electronics devices. Other functions that power supplies may perform include limiting the current drawn by the load to safe levels, shutting off the current in the event of an electrical fault, power conditioning to prevent electronic noise or voltage surges on the input from reaching the load, power-factor correction, and storing energy so it can continue to power the load in the event of a temporary interruption in the source power (uninterruptible power supply).

All power supplies have a power input connection, which receives energy in the form of electric current from a source, and one or more power output connections that deliver current to the load. The source power may come from the electric power grid, such as an electrical outlet, energy storage devices such as batteries or fuel cells, generators or alternators, solar power converters, or another power supply. The input and output are usually hardwired circuit connections, though some power supplies employ wireless energy transfer to power their loads without wired connections. Some power supplies have other types of inputs and outputs as well, for functions such as external monitoring and control

A regulated power supply is an embedded circuit it converts unregulated AC (Alternating current) into a constant DC

-the output from the regulated power supply limits .the output from the regulated power supply may be alternating or unidirectional but is nearly always DC.

Variable Power Supply 1.75 V - 13 V



D. Kirchoff's Current Laws

This law, also called Kirchhoff's first law, Kirchhoff's point rule, or Kirchhoff's junction rule (or nodal rule), states that, for any node (junction) in an electrical circuit, the sum of currents flowing into that node is equal to the sum of currents flowing out of that node; or equivalently:

The algebraic sum of currents in a network of conductors meeting at a point is zero.

Recalling that current is a signed (positive or negative) quantity reflecting direction towards or away from a node, this principle can be succinctly stated as:

where n is the total number of branches with currents flowing towards or away from the node.

The law is based on the conservation of charge where the charge (measured in coulombs) is the product of the current (in amperes) and the time (in seconds). If the net charge in a region is constant, the current law will hold on the boundaries of the region.[2][3]

This means that the cur rent law relies on the fact that the net charge in the wires and components is constant

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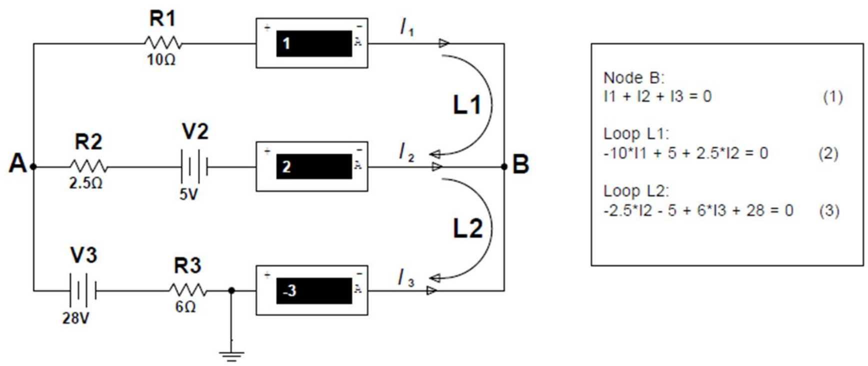
Kirchhoff Current Laws



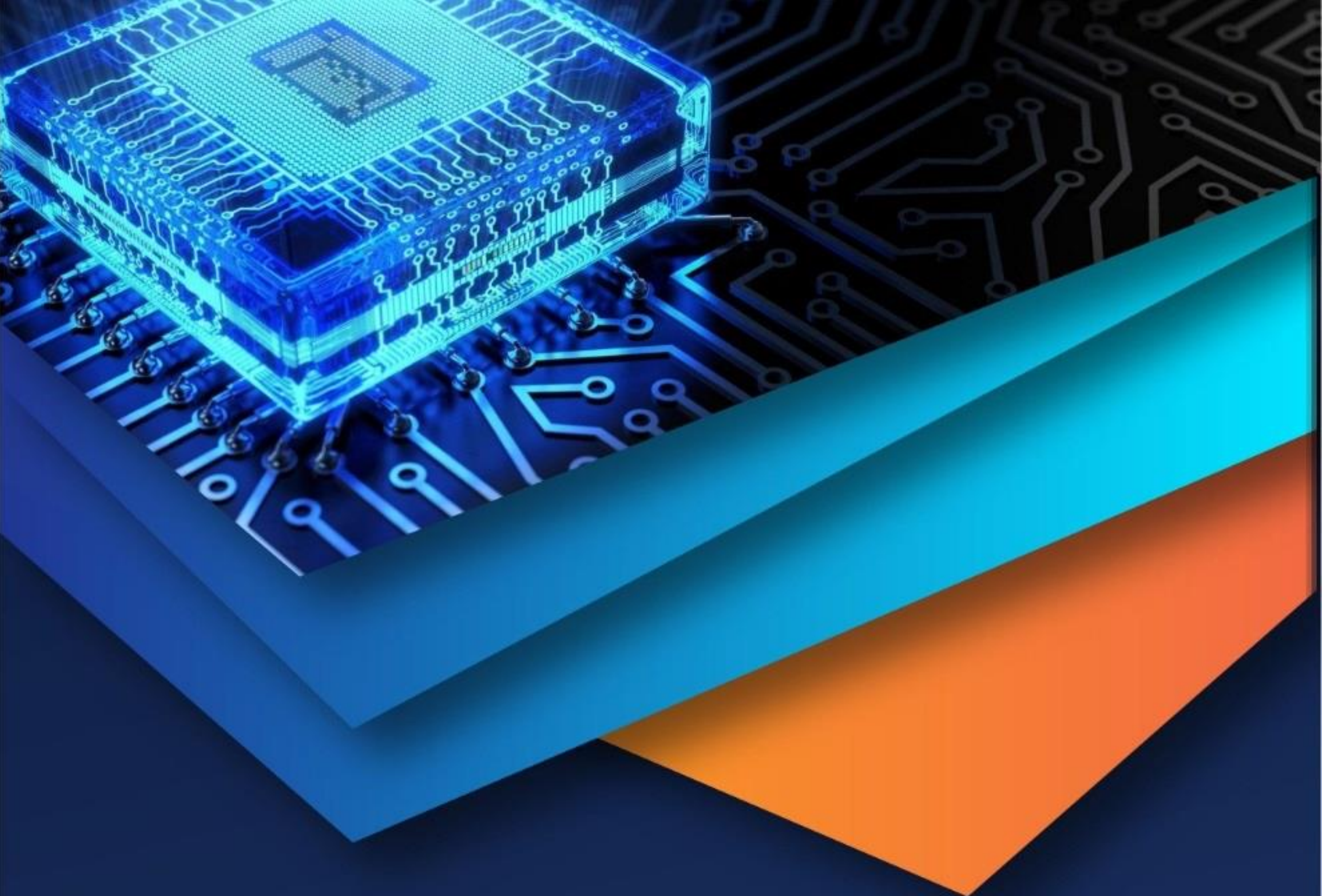
III. CONCLUSION

The students of Electrical Engineering nowadays have more theoretical knowledges than practical ones in the subjects of their primary interests. This is the motivation for this paper, to give the students more hands-on experience with real hardware devices and their usage through hardware and software simulations. Several experiments were realized that used actual hardware components, NI Elvis II+ platform, and NI Multisim simulation software. All experiments were conducted successfully. The students of Power Engineering and Computer Engineering were interviewed about their view on these experiment

As it turned out, students gave positive feedback on these simulations, and answered that they would need almost equal amount of software simulations and experiments with actual hardware devices. This was the result that was anticipated and we'll gladly move on with bringing some more experiments for students' practical exercises

REFERENCES

[1] Wikipedia, Multisim 14.2



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