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THE ROLE OF MULTISIM 14.0 IN CONDUCTING ELECTRONICS LABORATORY CLASSES

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Abstract. This article analyzes the practical and instructional role of Multisim 14.0 in electronics laboratory classes for cadets. Based on the original article, it examines circuit construction, component libraries, simulation controls, and virtual measuring instruments, including a multimeter, function generator, and oscilloscope. A structured laboratory workflow is proposed, with particular attention to comparing simulated readings with theoretical calculations and recognizing the limits of idealized models. The paper presents a methodological analysis, not a controlled experimental study.
Keywords: Multisim 14.0, virtual laboratory, circuit simulation, SPICE, electronic components, multimeter, function generator, oscilloscope, cadet training.

Annotatsiya. Ushbu maqola kursantlar uchun elektronika laboratoriya mashg'ulotlarida Multisim 14.0 ning amaliy va o'quv rolini tahlil qiladi. Asl maqola asosida u sxema tuzilishi, komponentlar kutubxonalari, simulyatsiya boshqaruv elementlari va multimetr, funksiya generatori va osiloskopni o'z ichiga olgan virtual o'lchash asboblarini o'rganadi. Strukturaviy laboratoriya ish jarayoni taklif etiladi, bunda simulyatsiya qilingan o'qishlarni nazariy hisob-kitoblar bilan taqqoslashga va idealizatsiya qilingan modellarning chegaralarini aniqlashga alohida e'tibor beriladi. Maqolada nazorat ostidagi eksperimental tadqiqot emas, balki metodologik tahlil taqdim etiladi.
Kalit so'zlar: Multisim 14.0, virtual laboratoriya, sxema simulyatsiyasi, SPICE, elektron komponentlar, multimetr, funksiya generatori, osiloskop, kursantlarni tayyorlash.

Аннотация. В данной статье анализируется практическая и учебная роль Multisim 14.0 в лабораторных занятиях по электронике для курсантов. На основе оригинальной статьи рассматриваются вопросы построения схем, библиотек компонентов, управления моделированием и виртуальных измерительных приборов, включая мультиметр, генератор функций и осциллограф. Предлагается структурированный рабочий процесс лабораторных работ, особое внимание уделяется сравнению результатов моделирования с теоретическими расчетами и выявлению ограничений идеализированных моделей. В статье представлен методологический анализ, а не контролируемое экспериментальное исследование.
Ключевые слова: Multisim 14.0, виртуальная лаборатория, моделирование схем, SPICE, электронные компоненты, мультиметр, генератор функций, осциллограф, обучение курсантов.

Introduction

Practical training in radio electronics requires cadets to connect theoretical circuit laws with the construction, measurement, and interpretation of working circuits. Physical laboratory stands remain important, but equipment availability, assembly time, and the risk of damaging components can

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restrict the number of configurations examined during a class. Multisim 14.0 provides a virtual circuit-design environment in which electronic components can be connected and simulated, and their electrical behavior can be inspected using software instruments. The original article describes its interface, component groups, and major measurement tools. The purpose of this paper is to organize those materials into an explicit teaching methodology and to explain what can—and cannot—be inferred from virtual measurements.

Materials and Methods

The study uses descriptive and functional analysis of the Multisim 14.0 environment presented in the source article. The instructional sequence consists of (1) selecting and placing circuit elements, (2) connecting and configuring them, (3) attaching virtual instruments, (4) running simulation, and (5) interpreting and checking results. The interface and instruments shown in Figures 1–5 are reproduced from the supplied original document. No new experimental measurements or participant-based performance data are claimed.

Results

Circuit workspace and assembly. The main workspace contains the schematic editing area, command menus, component selection tools, and simulation controls. A cadet places a component on the schematic, edits its value and label, connects it to other elements, and activates the simulation. The source document emphasizes correct selection of voltage versus current sources and the inclusion of a ground reference in circuits that require it for SPICE analysis. These are useful diagnostic checks when simulation fails or produces unexpected readings.

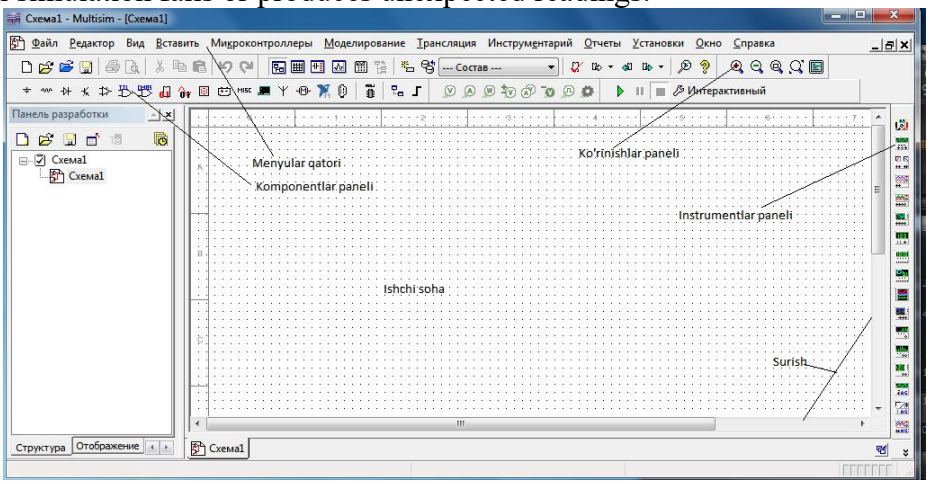


Figure 1. Multisim circuit workspace and main interface elements

Component database. The program organizes parts into functional groups, including Sources, Basic, Diodes, Transistors, Analog, TTL, CMOS, MCU Module, Advanced Peripheral, Miscellaneous Digital, Mixed, and Indicators. The source also distinguishes Master, User, and Corporate databases. Selecting a component creates a schematic instance whose parameters can be modified for the current design. This structure helps learners relate component classification to practical circuit functions.

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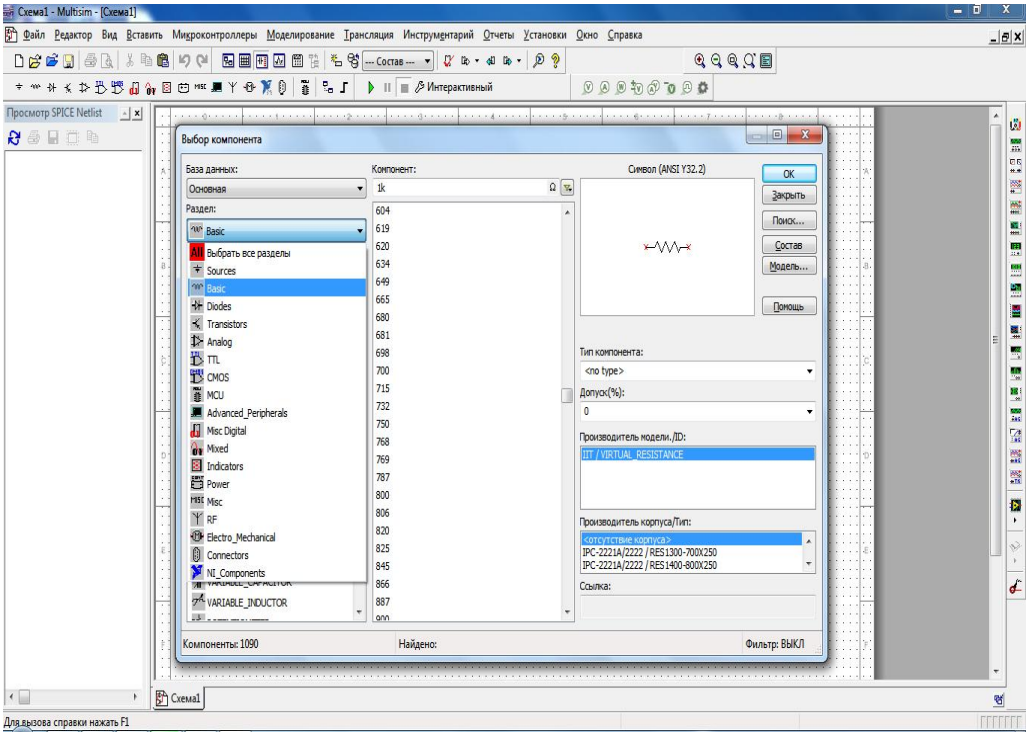


Figure 2. Component selection and placement window

Virtual multimeter. The virtual multimeter is used to inspect voltage, current, and resistance under suitable measurement conditions. A teaching exercise may begin with a 12 V DC source and a 1 kΩ resistor: Ohm's law predicts I = U/R = 12 mA. Increasing the resistance to 2 kΩ predicts 6 mA. These values are theoretical illustrations for simulation-based checking, not measurements reported in the original article. Cadets should verify connection topology and instrument mode before comparing results.

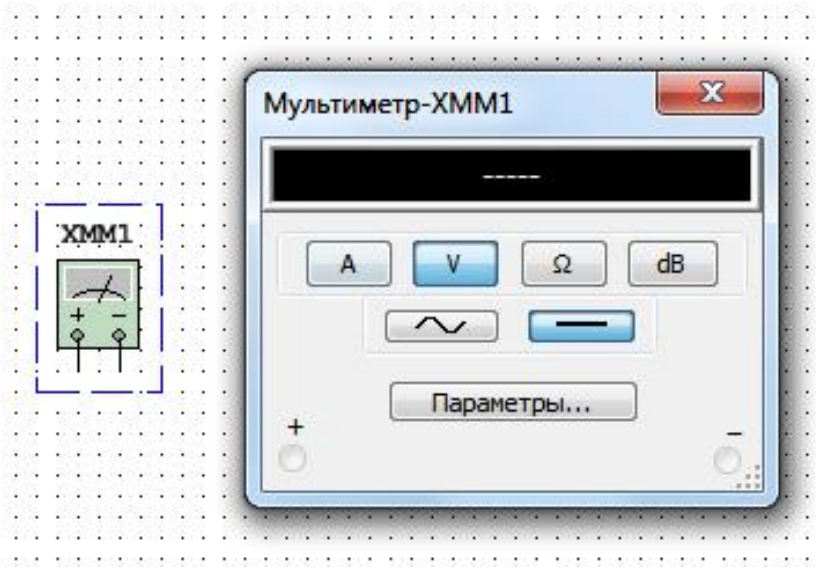


Figure 3. Multimeter controls and instrument icon

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Function generator. The source describes a generator capable of producing periodic waveforms and allowing adjustments to frequency, amplitude, duty cycle, and offset, depending on the selected waveform. A practical task is to apply different input frequencies to an RC circuit and observe the response. For an ideal capacitor, capacitive reactance is $X_c = 1/(2\pi fC)$; therefore, at fixed capacitance, reactance decreases as frequency rises. This relation gives cadets a theoretical prediction to test in the simulator.

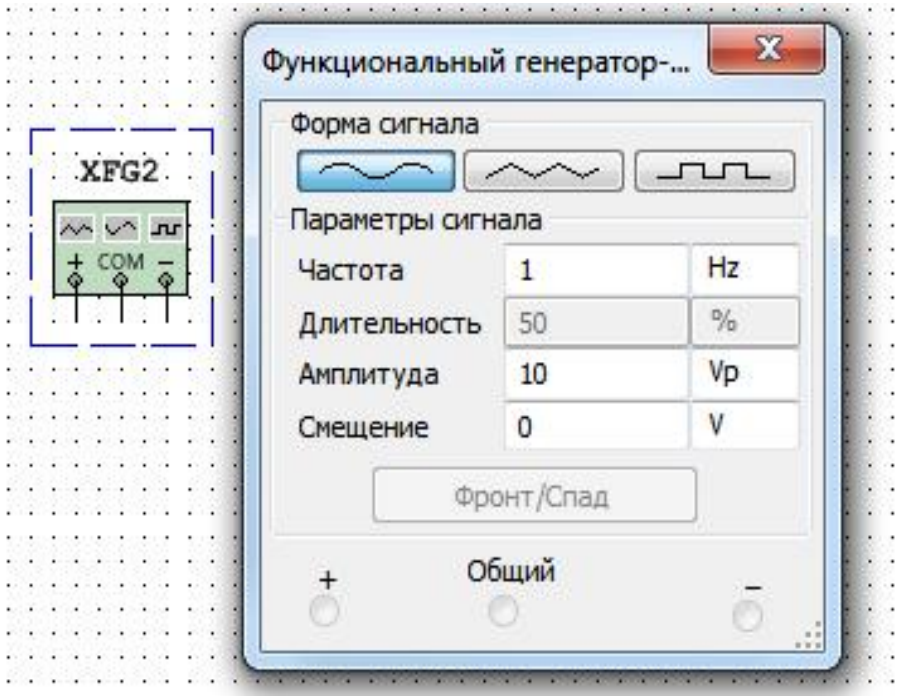


Figure 4. Function generator controls

Oscilloscope. The original article identifies two-channel, four-channel, and other oscilloscope options and describes waveform inspection through the graphical interface. The oscilloscope makes voltage variation over time visible. If the measured period is $T = 0.02$ s, the calculated frequency is $f = 1/T = 50$ Hz. Comparing the calculated value with the generator setting provides a simple check of signal interpretation. In two-channel measurements, cadets may also compare waveform amplitudes and timing relationships.

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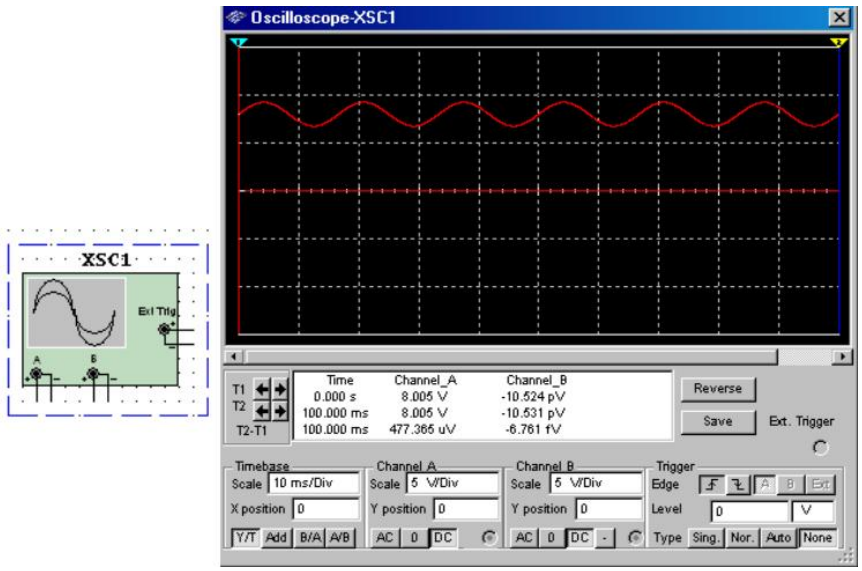


Figure 5. Two-channel oscilloscope interface

Proposed analysis record. For each laboratory circuit, cadets should document the circuit objective, selected components and values, instrument connections, expected theoretical values, observed simulation readings, discrepancies, and a reasoned conclusion. This procedure converts a software demonstration into an evidence-based laboratory exercise.

Discussion

The main instructional benefit of Multisim 14.0 is repeatability: cadets can change one parameter at a time and immediately inspect how the modeled circuit responds. Virtual instruments also make transient waveforms and measurement relationships easier to discuss in class. The component database encourages systematic selection and comparison of electronic parts. Nevertheless, simulation results depend on the selected models, numerical settings, and assumptions. Real circuits may differ because of tolerances, contact resistance, temperature, noise, and instrument loading. Therefore, simulation should prepare learners for physical assembly rather than be presented as a complete substitute for it.

A blended laboratory model is recommended: first calculate the expected circuit behavior, then assemble and test it in Multisim, and finally—where equipment is available—repeat the measurements on a physical stand. Differences between calculated, simulated, and physical results can form the basis for technical discussion. The supplied article provides descriptions and screenshots of software functions, but no measured learning gains; claims about increased training effectiveness require a separate pedagogical experiment.

Conclusion

Multisim 14.0 can support electronics laboratory classes by allowing cadets to construct schematics, configure components, simulate circuit behavior, and use virtual instruments to examine electrical quantities. The five original figures illustrate the workspace, component selection, multimeter, function generator, and oscilloscope. The most defensible instructional use is a structured workflow that links theoretical prediction, virtual measurement, interpretation, and subsequent practical verification. Further classroom research would be needed to quantify effects on cadets' accuracy, speed, or technical competence.

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