Possibilities of Using the Electronics Workbench Multisim Software in Studying Electrical and Chemical Engineering

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Annotation: This article explores the possibilities of using the Electronics Workbench Multisim program in the study of electrical engineering and circuit engineering. Today, the implementation of experiments and test works in real conditions requires a lot of expenses, as well as compliance with technical safety rules. Taking into account these elements, the use of Electronics Workbench Multisim software is playing a positive role in solving these problems with its user-friendly interface and equipment.

Keywords: electrical engineering, schematic engineering, virtual laboratory, Electronics Workbench, PC, interface, measuring instruments.

Nowadays, it is necessary to conduct tests and experiments in the process of studying electrical engineering and electronics in the field of energy. But it's no secret that carrying out experiments and tests creates serious difficulties. Today's requirement is that a good teaching laboratory room should have modern measurement equipment and qualified personnel who can maintain it in working order. It is a very difficult issue for educational institutions to maintain such a laboratory in an up-to-date condition.

In recent years, the tools for calculating electrical and electronic circuits have changed and developed quite rapidly. In particular, the logarithmic ruler used in the early 70s of the last century was replaced by calculators and mini electronic calculators in the second half of the 70s. Instead of mini electronic computers, by the mid-80s, personal computers (PCs) with constantly increasing computing power and capabilities began to be used. Software for personal computers for the analysis of electronic circuits is not only in the direction of the development of algorithms of calculations and methods of numerical analysis, but also for conducting experiments with various types of circuits (analog, digital, digital-analog, pulse, etc.) has also developed in the direction of creating a user-friendly interface that allows creating environments.

It should be noted here that the achievements in the field of creation of the user interface of PC were so impressive that they led to a sharp change in the methodological approach to the research of circuits. The use of a personal computer has led to the creation of virtual laboratories as an alternative to traditional educational laboratories. A virtual laboratory, in general, is a numerical calculation program with an interface that simulates the actions (work) of a researcher in a real laboratory. With the help of numerical methods of calculations on modern personal computers with high speed and a large amount of memory, it is possible to study even complex models with an accuracy that is not inferior to the accuracy of the results obtained in experiments on real objects.

The process of studying electrical engineering and electronics is concerned with the analysis and research of these unmistakable circuits. The computer should facilitate this process as much as possible. The virtual environment should implement a laboratory with sufficient conditions for conducting experiments on electrical and electronic circuits on a computer, and the accuracy of the obtained results should not be less than the accuracy of the results obtained in real conditions.

Of course, the Modeling process should be as close as possible to the real process, that is, it should include the processes of creating circuits, connecting measuring instruments and an oscilloscope, parameters of circuit elements, and setting operating modes and obtaining results. One of the programs that gives the user such opportunities is the Electronics Workbench Multisim program. Despite the fact that it is based on the professional modeling program PSPICE, the Electronics Workbench Multisim program has the most convenient interface (Fig. 1). The presence of such tools as an ammeter, voltmeter, multimeter, generator and oscillograph ensures that the research process is natural and understandable.

The presence of modern tools in the program gives the user the opportunity to conduct simple and very complex experiments. Such a tool is ideal for teaching, as it allows you to remove any restrictions on elements and tools. In addition, the Electronics Workbench Multisim program can serve as a training (trainer) for learning the principles of operation of real electronic and measuring instruments and circuits.

Modeling and obtaining results in the Electronics Workbench program is characterized by its speed and convenience. But to get the right results, the user should master the rules and methods of working with the program and have the skills to apply them to study and research the processes in electronic circuits.

Currently, one of the ways of improving laboratory supplies is to transfer them to a computer basis. Electronics Workbench Multisim software is used to model electrical and electronic circuits. Despite its relatively small size, it contains a large number of models of real elements. It is an integrated package that includes a schematic editor and SPICE simulator.
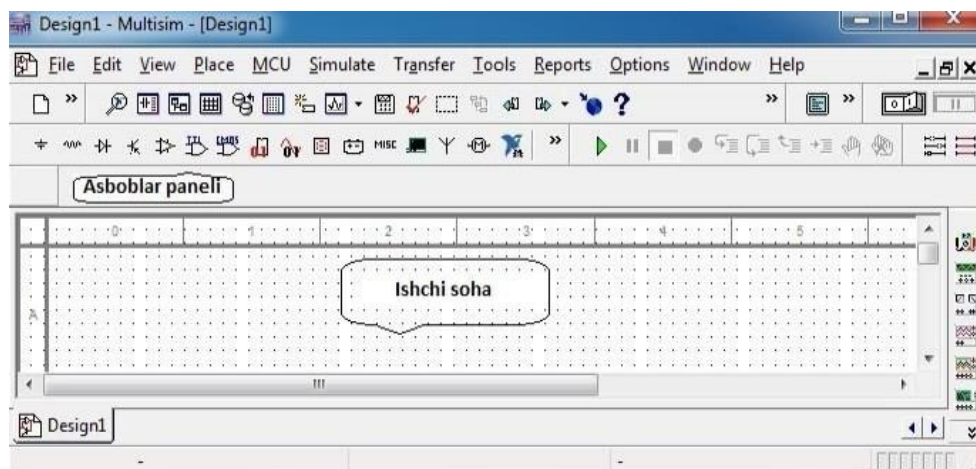

Figure 1. Interface of the Electronics Workbench Multisim complex

The Electronic WorkBench program has a large library containing signal generators, oscillographs, testers, semiconductor devices and microcircuits from many well-known companies in the world (Motorola, Philips, Toshiba, etc.). With its help, it is possible to analyze electrical circuits, analog and digital circuits. ammeters

After assembling the test circuit from ready-made elements, the Electronic WorkBench program connects the mathematical models of each of its components and transfers it to the form of a system of nonlinear differential equations. Based on them, he builds a system of nonlinear algebraic equations, solves them numerically using the improved Newton-Raphson method, and transmits the obtained results to measuring instruments connected to a chain or a two-beam oscillograph. In addition, the program also has a graphic analyzer. An oscillograph and a graphic analyzer record

the processes that occur in electrical circuits in their memory and provide the opportunity to analyze them in detail later.

Modeling using the Electronics Workbench software complex.

➢ The design and development of modern electrical and electronic devices requires great precision and thorough analysis. In addition, due to the large volume and complexity of the work to be performed, computer technologies are used;

➢ The Electronics Workbench software complex is one of the tools for software design and simulation of electrical circuits. It can be used in enterprises designing electric circuits and electronic devices and in higher educational institutions;

➢ Working with Electronics Workbench does not require deep knowledge of computer technology. The interface of the program can be mastered in a few hours.

As mentioned above, the Electronics Workbench program can also be used in the modeling process. The structural scheme of the computer modeling program is presented in Figure 1. The database of circuit elements contains information about many elements - resistors, capacitors, coils, diodes, transistors, microcircuits and other elements. Each element in the database has its equivalent schema and parameter description.

The necessary elements are obtained (called) from the database to enter the scheme of the device. The conditional symbol, name (type) and basic parameters of the element are displayed on the screen. Elements are connected to each other with wires. An internal description of the scheme is created in the modeling program. It contains the elements in the scheme, the order numbers of the nodes to which each element is connected, the parameters of each element and the order numbers of the nodes, the parameters of each element and other necessary additional information.

Nodes of the scheme are automatically assigned sequential numbers. The body of the circuit is usually assigned the sequence number 0.
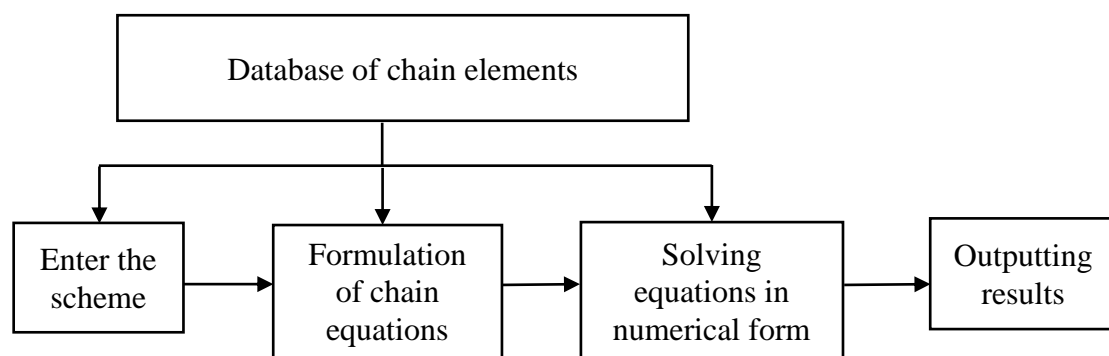

Figure 2. Structural scheme of computer modeling software

Formulation of equations for the chain is based on Ohm's law, and equations of connections are based on Kirchhoff's laws. It uses the internal description of the scheme and the equivalent schemes of the elements. To reduce the number of equations in the modeling program, the method of node voltages and the method of circuit currents are mainly used. The algorithm for constructing chain equations is very simple. For example, the process of creating node equations consists of creating equations for the circuit nodes (except the node connected to the body) and considering the conductances connected to each node. Viewing contours sequentially allows you to construct contour equations. The parameters of the elements needed to create the equation are taken from the database.

Solving chain equations is done using numerical methods. It is solved separately for different types of signals to reduce computations. In most cases, chains are calculated in the following modes:

➢ in constant current (DC mode);

➢ in small harmonic effects (AC mode);

➢ in transition mode (Transiet mode);

In the transient mode, currents and voltages can change in a complex manner and reach large values where a nonlinear regime occurs.

When solving nonlinear equations, nonlinear characteristics of elements are also obtained from the database.

Output of results is carried out in modern computer modeling programs in the form of graphics (graphs, diagrams, pictures, etc.) and text. The obtained results can be output to the monitor screen, printer or written to a file.

In conclusion, it can be said that the role of virtual laboratories for conducting tests and experiments in the process of studying electrical engineering and electronics is invaluable. Because personal computers are used instead of expensive laboratory equipment required for experimental work. Today, it shows that it is effective in terms of economic efficiency and technical safety.

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