

METHODS OF VIRTUAL ORGANIZATION OF RESEARCH, PRACTICAL AND LABORATORY ACTIVITIES IN PHYSICS

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ABSTRACT

This article analyzes the problems that arise in the process of research, practical and laboratory work of students in physics, as well as the advantages and solutions of these problems using virtual software, and the possibility of performing practical and laboratory work using Multisim. and information on methods.

Keywords: Research, practical skills, practical training, laboratory work, virtual, software, electrical circuit.

INTRODUCTION

The main task of education today is to develop students' knowledge and skills to apply this knowledge in practice. In this regard, it is important to carry out independent research, practical and laboratory work in the study of physics [1].

By engaging students in teaching and research activities, they first develop inquisitive activity and independent research activities; secondly, this activity, which is formed in the student, serves as a basis for new successes in the future, that is, they are manifested in active research, rationalization, and later in inventive activity. There is a strong demand in our society for such personnel, and such personnel are considered competitive [1,2].

In schools, students' teaching and research activities are usually carried out in the form of extracurricular activities, and STEAM is a form of education [3,4]. However, there are a number of challenges in engaging students in extracurricular activities. One of them is that the material and technical supply of educational institutions is not in good condition, that is, they are not provided with the necessary tools and equipment. The second is that students are required to adhere to safety regulations when working with power tools. This, in turn, allows students to focus on certain areas, such as high voltages, high-power electromagnetic waves, and so on. in the field of science, which limits their ability to conduct free research as they wish.

In addition, distance learning is developing rapidly and distance learning is now available online. This method of teaching creates problems for self-study laboratory classes and extracurricular research. This problem can be solved with the help of training laboratories and the use of virtual laboratories in teaching and research activities [5].

Materials and methods

One way to solve this problem is to use virtual laboratory work. Virtual labs are modern training manuals that are much cheaper and completely safer than experiments with real elements, tools, and equipment. Virtual labs provide students with:

- to study complex physical phenomena in an understandable way;
- to "investigate" an event, even if it is difficult to conduct a real experiment or absolutely impossible at the level of human capabilities;
- stop and continue the experiment to analyze the intermediate results and possible changes around it;
- study the phenomenon in dynamics (ie, observe its development in space and time);
- to perform an action that is impossible in a full-scale experiment - to change the spatio-temporal dimensions of the phenomenon;
- to ensure the necessary conditions for the experiment and the parameters of the system of objects under study, without fear of its condition, as well as the safety of the elements of the experimental setup;
- to accompany the model experiment with visual interpretation of the constant relationships between the parameters of the system under study (in the form of dynamic graphs, diagrams, etc.);
- to study the phenomenon in a "pure" form, to accurately reflect the conditions necessary for its occurrence;
- to draw students' attention to the main point of the event being studied due to the multimedia impact and thus contribute to a deeper understanding of its essence.
- When using interactivity as a function of the new learning environment, new advantages are added to the previously mentioned advantages of virtual experimentation:
 - to ensure an active approach to education aimed at developing the main components of the educational process of schoolchildren;
 - his motivational-needs area (especially interest in reading), his ability to plan, execute and control his actions;
 - developing the independence of students' learning activities, which determines their success in learning;
 - to organize educational and research work without excessive costs and completely safe, to expand the boundaries of research;
 - creating conditions for students' creative activity.

One such virtual laboratory program is the Multisim software package from National Instruments (NI). The presence of a large library of modern tools in the software package allows you to design, experiment and research electronic devices that range from simple to very complex [6,7,8]. Such a tool is ideal for teaching and research activities, as it is possible to remove any restrictions on elements and tools. This allows students to research their ideas on a large scale, to conduct research as much as they want without fear of the possibility of failure of electrical equipment due to errors, to build new ones without hesitation, to measure modern control. allows you to use as many devices as you want.

Another advantage of using a Multisim software complex is that it does not require the use of laboratory rooms equipped with modern equipment [6]. If the student has a computer, he / she will be able to install Multisim software and conduct research and study activities in a convenient place. This is especially important in today's world of online learning. The opportunities of this program can be used for demonstrations, laboratory classes and research work on topics related to the "Electrical" section of physics.

As an example, we will use the NI Multisim program to study the generation, transmission and distribution of electricity. It is not possible to conduct a demonstration on this topic directly in the classroom, and this is considered life-threatening due to the use of excessive voltage.

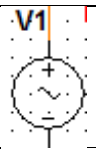



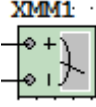

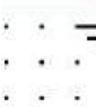

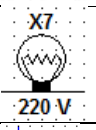
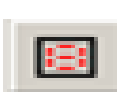
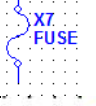



RESULT AND DISCUSSION

Objective: To study the generation, transmission and distribution of electricity.

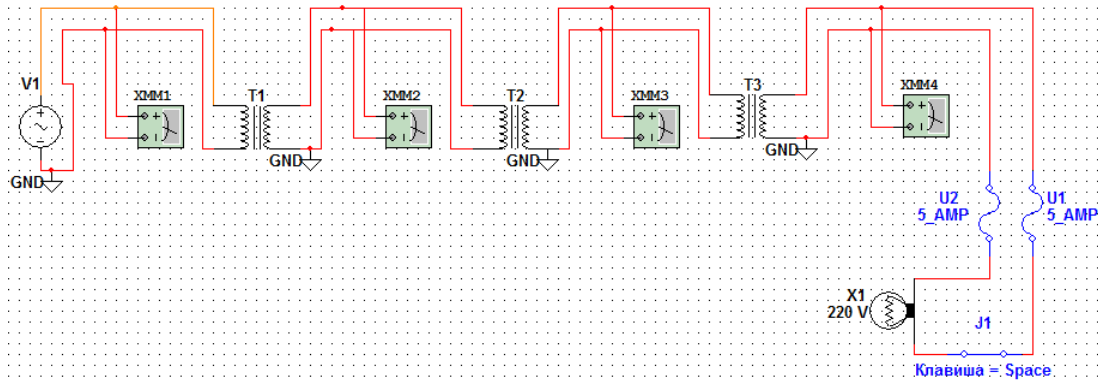
Virtual elements: alternating current source, transformers, multimeters, switch, light bulb, storage.

Procedure:

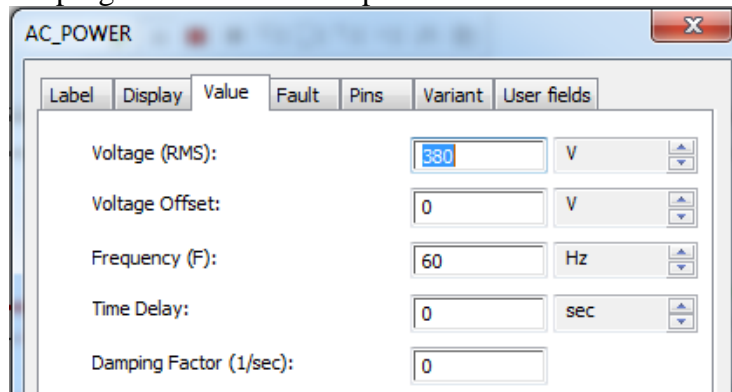
1. Run the Multisim program.
2. From the toolbar, locate the AC power supply, transformer, multimeter, switch, light bulb, storage, listed in the table, and place them in the program workspace.

DEMONSTRATION EXPERIENCE. To study the generation, transmission and distribution of electricity				
Name of the element	Appearance	Button menu	Family	Calling
Alternating current source			POWER_SOURCE S	AC_POWER
3 Transformers			TRANSFORMER	TS_IDEAL
4 Multimeters				Мультиметр
Ground connection			POWER_SOURCE S	GROUND
Virtual lamp			VIRTUAL_LAMP	LAMP_VIRTUAL
2 Storages			SCH_CAP_SYMS	FUSE
Key			SWITCH	SPST

3. Use the mouse to connect the elements of the chain as shown in the picture.



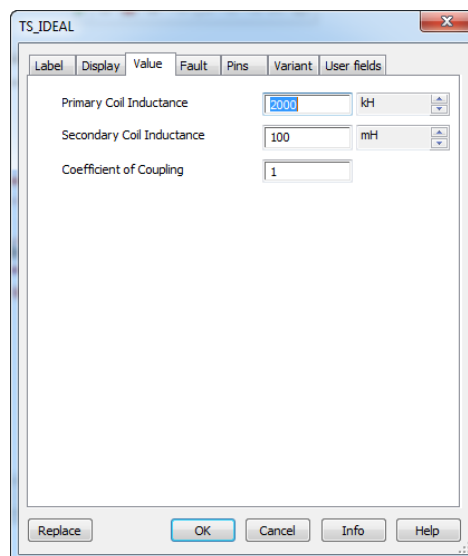
4. Set the AC power supply to 380V. To do this, hover your mouse over the AC power icon in the program window workspace and double-click the left mouse button.



From the window that appears, set the power supply to 380V and click OK.

5. To set the virtual lamp to 220V voltage and 100Wt power, move the mouse over the virtual lamp icon in the application window workspace and press the left button twice. From the resulting window, set the operating voltage of the lamp to 220V and 100W, and click OK.

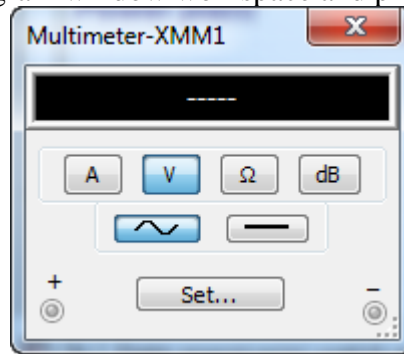
6. We change the inductance of the first winding of the first transformer to 2000 kH. To do this, hover the mouse over the first transformer icon in the program window workspace and press the left button twice.



In the resulting window, set the first coil to 2000kH and click OK.

7. In the same way as above, the first windings of the second and third transformers are set to 2.85 kH and 0.2 kH, respectively.

8. Set all multimeters to measure AC voltage. To do this, hover the mouse over each multimeter icon in the program window workspace and press the left button twice.



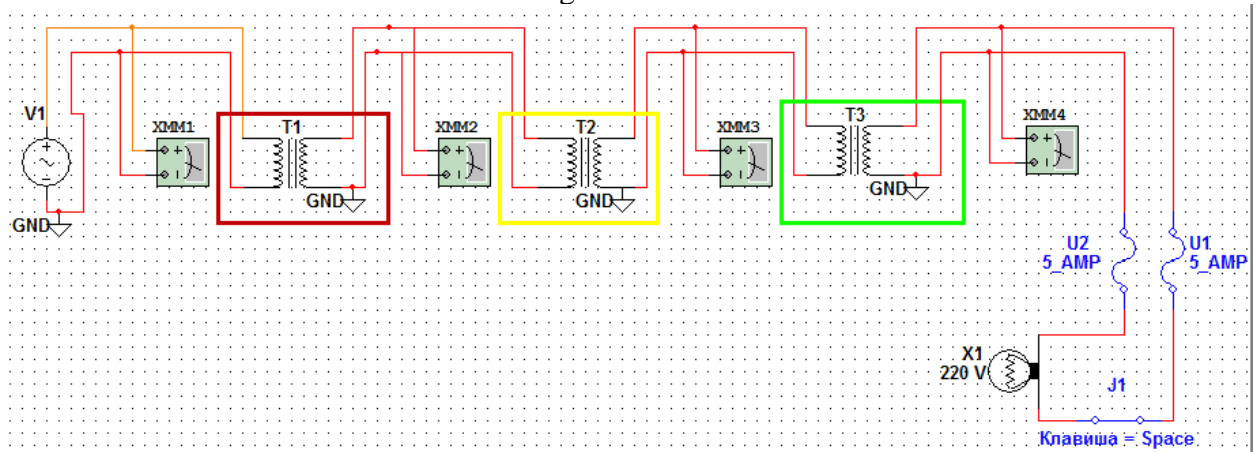
In the window that appears, click the buttons shown in the picture and click OK to finish.

9. Leave the key disconnected.

10. Let's start the simulation process.

11. We monitor the readings of all multimeters. It is important to pay attention to the voltage from which transformer.

12. Connect the key with the mouse or the <BLACK> button on the keyboard and watch the light bulb.

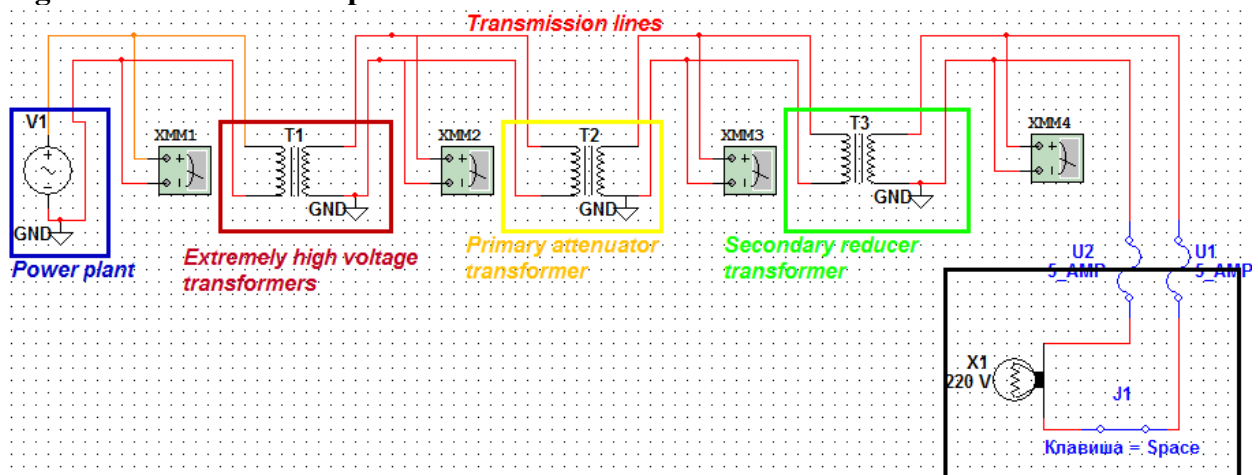


13. We will stop the simulation process



14. We draw conclusions based on the results of the experiment.

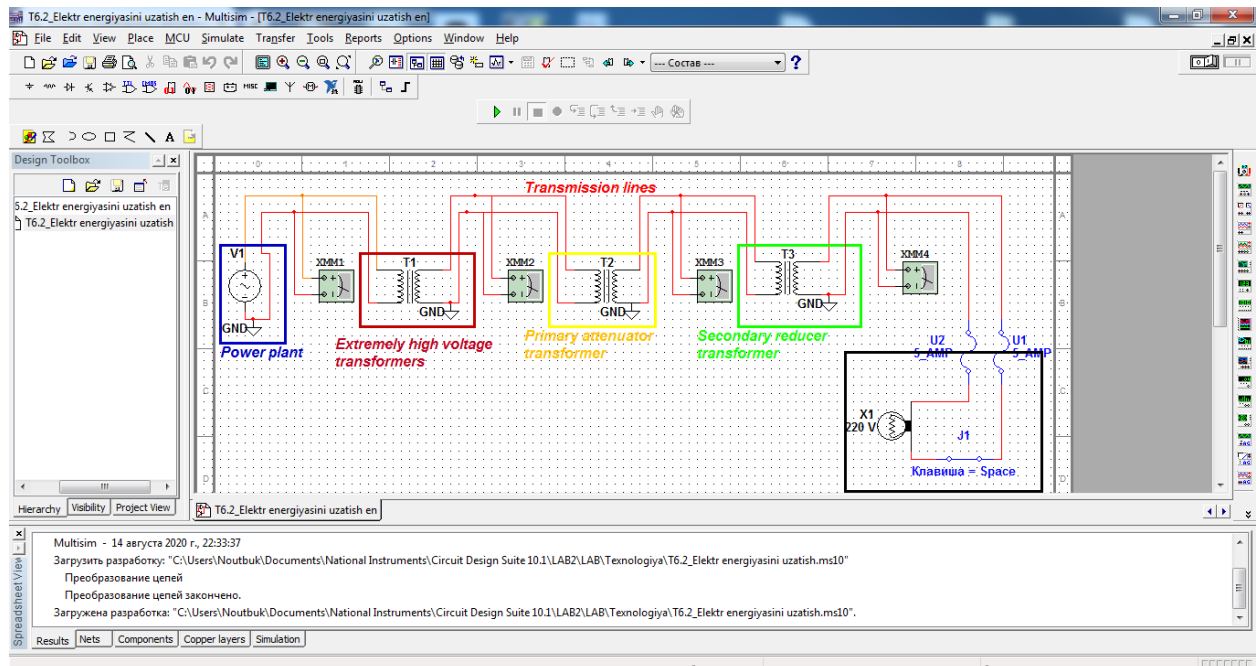
It would be more appropriate to make changes to the design of the experimental scheme to give students a clearer picture.



Using the drawing tools in the multisim program, the desired shapes are drawn and text is written, colors are selected.



In the process of drawing a circuit diagram on this topic, students have the opportunity to learn the elements of the genealogy, the English names of tools, to design a circuit diagram to be built, to ask for help (communication) from each other. As a result, students will be able to learn how to transmit electricity over long distances using step-up and step-down transformers, and will be able to monitor the input and output voltages of each transformer using direct measuring devices.



CONCLUSION

The use of virtual laboratories in the teaching of physics ensures that students consolidate their theoretical knowledge and apply it in practice. We would also like to emphasize that in the use of virtual laboratory work, it is advisable to put it into practice by completing them, rather than replacing real work with virtual work. The activities of students in the school related to virtual laboratories should be managed and corrected by teachers using new innovative technologies.

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