

## Resistance measurement by applying it Wheatstone bridge

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**Abstract:** In the process of teaching the subject is provided in addition to the graphic visualization, volumetric visual aids, benefits, educational films, and also multimedia clarity. The computer is a versatile learning tool, it allows you to create applications from students not only knowledge and skills but also to develop the personality of students to meet her educational interests. With the help of IT proficiency achieves good results.

**Key words:** *Simulation technology in the educational process; Physics; techniques drawing by solving techniques; Demonstration and development of thinking; Decision problems; Research; Resistance measurement using the Wheatstone bridge; Using IT*

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### 1. Introduction

In his address to the nation on January 27, 2012 year, "Socio-economic modernization - main direction of development of Kazakhstan" the President of Republic Kazakhstan Nursultan Nazarbayev noted that one of the most important tasks of socio-economic modernization is "the creation of an effective system of training and employment assistance"; to do this widely adopted "in learning advanced techniques and technologies" ([www.bnews.kz](http://www.bnews.kz)).

In this regard, to the forefront of educational development educational programs of secondary, technical and vocational, secondary and higher education with regard to the integration of their content, which is one of the principles of state policy in the field of education?

The rapid development of information technology leads to a significant restructuring of the information environment of modern society, opening up new possibilities of social progress which is reflected primarily in the field of education.

New generation of teachers must be able to select a qualified and apply exactly the technology that fully comply with the content and objectives of studying a particular discipline, contribute to the achievement of harmonious development of students based on their individual characteristics. But this should not be exaggerated capabilities of computers, since the transfer of information - it is not a transfer of knowledge, culture, information

technology, and therefore provide a very effective teachers, but aids.

*Information technology training* - is a pedagogical technology using special methods, software and hardware (movies, audio and video, computers, telecommunications networks) to work with the information (Matros et al., 2001).

Information and computer technology can be used in the learning process in three ways:

I - as a "penetrating" technology (the use of computer-based training on specific topics, sections for individual didactic problems);

II - as the main defining the most significant of the used technology in teaching;

III - as monotehnologiya (when training, management training process, including all types of diagnostics and monitoring, based on the use of the computer.)

In the context of the modernization of education modern, educational technology is inconceivable without widespread use of new information technologies - computer. Great interest to the modern computer systems is the basis of motivational training activities (Nurkasymova, 2006)

Information and computer technologies allow to fully disclosing pedagogical, didactic function as learning techniques inherent in them to realize potential; they become the basis of modern education, ensuring the necessary level of quality, variability, differentiation and individualization of training and education.

First of all, it is necessary to introduce a method of computer-esteem from a psychological point of view. Computer training has a great motivational

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potential. If the computer program is written correctly, the computer can help the teacher to individualize and differentiate the learning process, while the trainees will feel the constant presence of a friendly instructor - machines.

**2. Theory and method of measurement**

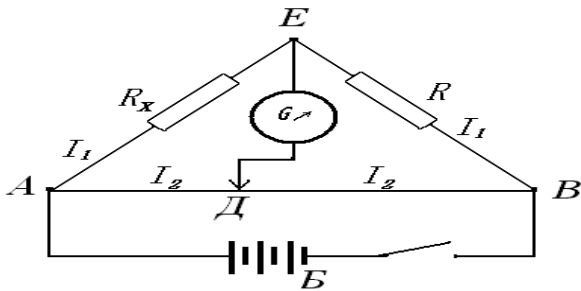
Wheatstone bridge is designed to measure resistance. It consists of a slide wire AB, a sensitive galvanometer and two resistors - known and unknown:  $R_0$  and  $R_x$  (Fig. 1).

Slidewire is mounted on a uniform line of plastic thread along which can move sliding contact D. Consider the circuit area without ED. We close the key K. Then the wire AB current flows along it to be an observer uniform potential drop on the value of  $\varphi_A$  (at point A) to a value of  $\varphi_B$  (at point B). In the chain of AEB current flows  $I_1$  and the potential drop will occur from  $\varphi_A$  to  $\varphi_B$  (the resistance  $R_x$ ). Obviously the potential at point E is intermediate between the values of  $\varphi_E$  and  $\varphi_A \varphi_B$ . Therefore, the segment AB can always find a point D potential is equal to the potential  $\varphi_D \varphi_E$  at E:

$$\varphi_E = \varphi_A$$

If between points E and D included galvanometer, in this case, the current through it will not go,

$$\varphi_E - \varphi_A = 0 \tag{1}$$



**Fig. 1:** Schematic diagram of a Wheatstone bridge

$$\frac{\Delta R_x}{R_x} = \frac{\Delta R}{R} + \frac{\Delta l_1}{l_1} + \frac{\Delta l_1}{l - l_1} = \frac{\Delta R_x R l_1 (l - l_1) + \Delta R l_1 R_x (l - l_1) + \Delta l_1 R_x R (l - l_1) + \Delta l_1 R_x R l_1}{R_x R (l - l_1)} \tag{8}$$

It is evident that it will be a minimum when the denominator (Eq. 8) is maximized. Find the maximum condition for the function

$$\frac{df(l_1)}{dl_1} = Rl - 2Rl_1 = 0 \tag{9}$$

whence,

$$l_1 = \frac{l}{2}$$

Thus, the error will be minimum when the zero current through the galvanometer (assuming equilibrium) A slider on the middle D lidewire ( $l_1 = l_2$ ). In this case the formula (Eq. 7) takes form:

$$R_x = R_0 \tag{10}$$

Condition (Eq. 9) should be taken into account when performing research.

**3. Research**

This situation is called Equilibrium Bridge. We show that the equilibrium condition of the bridge is given by:

$$\frac{R_x}{R_0} = \frac{r_{AB}}{r_{DB}} \tag{2}$$

Indeed, based on the second Kirchhoff's law for closed loop sum of the voltage drops equals the sum of the electromotive forces:

$$\sum_{i=1}^n I_i r_i = \sum_{i=1}^n \varepsilon_i \tag{3}$$

We write these conditions for contours AED and EBD bridge at equilibrium:

$$I_1 R_x - I_2 r_{AB} = 0 \tag{4}$$

$$I_1 R_0 - I_2 r_{DB} = 0 \tag{5}$$

Whence we obtain (Eq. 2)

Since resistance sections AD and DB proportion to their length  $l_1$  and  $l_2$ , then

$$\frac{R_x}{R_0} = \frac{l_1}{l_2} \tag{6}$$

or

$$R_x = R_0 \frac{l}{l - l_1} \tag{7}$$

where  $l - l_1 = l_2$

If the resistance of the slide wire sections of 10-20 Ohm Wheatstone bridge

of the type described is usually applied for measuring small impedances (from 1 to 1000 Ohm).

We find, for any position of the engine Slidewire measurement error will be minimal. Relative error of the formula:

1. Collect electrical circuit as (Fig. 1), in which as known resistance resistor  $R_0$  is taken.
2. Measure resistance  $R_{x1}$   $R_{x2}$  and at least each 3 times.
3.  $R_{x1}$  and  $R_{x2}$  Connect series and measure the total resistance (at least 3 times).
4.  $R_{x1}$  and  $R_{x2}$  Connect parallel and measure the total resistance (at least 3 times).
5. Calculate the mean resistances  $R_{x1}$  and  $R_{x2}$ , absolute and relative measurement error. Present the result of taking into account the absolute error.
6. Check the formula:

$$R_{\text{series}} = R_{x1} + R_{x2} \tag{12}$$

$$R_{\text{parallel}} = \frac{R_{x1} \cdot R_{x2}}{R_{x1} + R_{x2}} \tag{13}$$

As a result, to compare the mean values of  $R_{x1}$  and  $R_{x2}$ , obtained as a result of these measurements and the values of resistors R and R parallel serial computed by formulas (Eq. 11) and (Eq. 12).

Theoretical information precede the experiment allows students to solve specific problems on this topic. During the experiment, the student learns to apply IT and processing methods of measurements and acquire skills reporting on the work.

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