NEW METHODOLOGICAL APPROACH TO TEACHING ALTERNATING CURRENT

Karimov A.M.
Navoi State Pedagogical Institute
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Abstract. *This article describes new methodological foundations for the development of skills that will increase the initiative of students' logical thinking using modern educational technologies.*

Keywords: *learning, technology, thinking, alternating current, voltage, resistance, phase difference, method, cube.*

Currently, much attention is paid to the use of innovative technologies in all areas of the educational process of our Republic. The main factor in the use of innovative technologies is the development of new content of education, the use of new teaching methods, the development of the organizational and technological basis of education and the development of comprehensive and professional skills of the student. based on the conditions for its implementation. Such practical actions require new methodological approaches in the education system, which will certainly increase the effectiveness of education. To this end, below we will describe the learning material of the topic "***A new methodological approach to teaching alternating current***" on a new methodological basis.

It is known that the phenomena in a circuit with alternating current are different than in a circuit with direct current. A direct current circuit has only one resistance, while an alternating current circuit has multiple resistances due to different phenomena. When passing through an alternating current circuit, its losses occur not only due to a thermal phenomenon, but also due to the following phenomena, i.e. resistance arising in the conductor [1,2]:

- due to the phenomenon of hysteresis formed in iron cores;
- due to the formation of vortex currents (Foucault currents) in iron cores;
- due to the phenomenon of surface effect in conductors.

If the frequency is high or the conductor is thick, the alternating current will tend to flow through the surface of the conductor. That resistance increases.

As a result of the change in current, the existing inductance in the electrical circuit creates an inductive electromotive force (IEF). This induced IEF is always opposed by a self-induced IEF. This resists the change in induced IEF, i.e. resistance arises. This resistance is called inductive reactance ($R_L = \omega L$). Also, as a result of a change in current, the capacitance in the circuit is electrified or deelectrified, and therefore changes the value of the current, i.e. resistance arises. This resistance is called capacitive reactance ($R_c = \frac{1}{\omega C}$). If a circuit that converts electrical energy into another form of energy, for example, thermal energy, is called active resistance ($R = R_0(1+\alpha t)$. Thus, the IEF in an alternating current circuit is affected by 3 different resistances. In this case, there is an active voltage drop ri due to active resistance, as well as an inductive voltage drop $L\dfrac{di}{dt}$ due to inductive resistance and a capacitive voltage drop $\dfrac{1}{C}\int idt$ due to capacitive resistance. Therefore, this induced IEF is used to reduce these three voltages, i.e.

$$e = ri + L\frac{di}{dt} + \frac{1}{C}\int idt$$

This equation characterizes simple alternating current circuits.

Now imagine a vector diagram of a circuit consisting of active resistance (*R*), inductive resistance (*L*), capacitive resistance (*C*) (fig. 1). The vector diagram shows that the magnitudes of sinusoidal currents are related to each other. And this is called the IEF triangle.

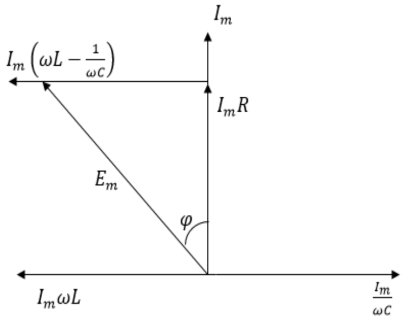


fig. 1

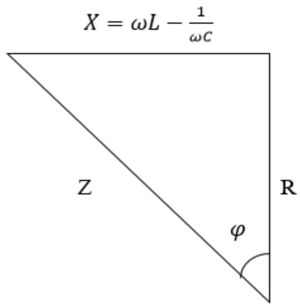


fig. 2

If we divide each side of the IEF triangle by , then we get a resistance triangle (fig. 2). One side of the triangle of resistance is called active resistance R, and the other is called reactance $X = \omega L - \dfrac{1}{\omega C}$. Reactance is equal to subtracting capacitive reactance from inductive reactance. *Z* is the impedance and *φ* is the phase difference.

Due to the phase difference, the reactance value can be calculated. If the reactance is zero, then the phase difference is also zero. When current passes through the reactance, no heat is generated.

If the inductive resistance in the electrical circuit is greater than the capacitive one, then a phase difference will appear between the current and the IEF, and the current will lag behind the IEF. When the capacitive reactance is greater than the inductive reactance, a phase difference occurs and the current exceeds the IEF.

To find the phase difference *φ*, you can derive several formulas from the resistance triangle:

$$\frac{R}{Z} = Cos\varphi \quad ; \quad \frac{X}{Z} = Sin\varphi \quad ; \quad \frac{X}{R} = tg\varphi = \frac{\omega L - \dfrac{1}{\omega C}}{R}.$$

These formulas are of great importance when calculating an electrical circuit.

The work done by an alternating current source is different at different times. For example, *dA* = *Udq* is the work done by the amount of electricity *dq* passed in time *dt* (at potential *U*). If we take into account that *dq* = *idt*, then *dA* = *Uidt*. From this formula we obtain *dA/dt* = *P* = *Ui*. This power is called instantaneous power.

Periodic changes in alternating current with alternating voltage naturally cause periodic changes in power. But such a rapidly changing periodic power is not very convenient for assessing the energy state of alternating current devices. For this reason, to assess this situation, the average power over the period was taken. This power is called active power, i.e. *P* = *I U cos φ* where *cos φ* is called the power factor.

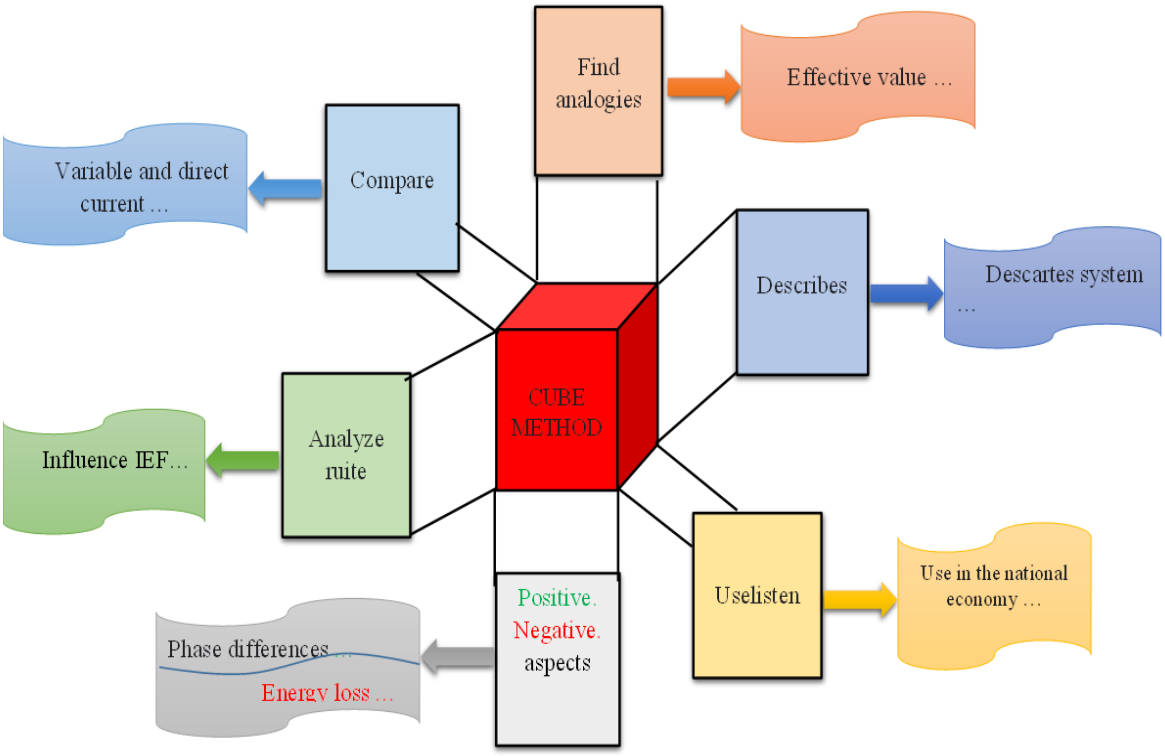
If $\varphi = 0$, then $\cos \varphi = 1$. In this case, the average power will have the greatest value.

If $\varphi = 90^0$, then $\cos \varphi = 0$. In this case, the average power will be zero.

So, if the angle φ is small, cos φ will be large. As a result, the average power in terms of current and voltage itself is large. In this case, the work done in the chain will also be great. Therefore, it is necessary to increase cos φ for efficient use of electrical devices. To do this, it is important to reduce the phase difference between current and voltage.

In the final part of the lesson, we will use the unique aspects of the interactive ***CUBE*** method [3] logic to further strengthen students' knowledge of the topic and express independent thoughts (rice. 3).

The advantage of this interactive method is that it has six sides, and on each side it is written: find analogies, describe, compare, analyze, use, useful and negative aspects. From such words, students independently interpret their knowledge on the topic. As a result, the number of active students will increase from passive listeners due to the discussion and initiative of students on this educational technology.



Rice. - 3. Logic diagram using the GUBE method

Students independently think logically and explain what they have learned on the topic, from the words written on the faces of the cube, i.e.:

Find analogies - learners deduce an analogy between the effective values of a sinusoidal current and IEF;

Describe - The student graphically describes the position of the magnetic flux, voltage and current in a Cartesian coordinate system;

Compare - The student compares the effective value of alternating current directly with the direct current formula;

Analyze - the student analyzes the effect of existing resistances on the IEF in an alternating current circuit.

Use **-** the student knows that alternating current is widely used in the national economy due to the ease of its production and use.

Positive aspects - it is useful for students to know that the power in an alternating current circuit depends not only on the strength of current and voltage, but also on the phase difference between them.

Negative aspects - it is useful for students to know that the power in an alternating current circuit depends not only on the strength of current and voltage, but also on the phase difference between them.

Thus, the analysis of ideas about the characteristics of alternating currents using the new methodological foundations of modern educational technologies will certainly increase the initiative of students' logical thinking.

REFERENCES

1. A.I. Khonboboev and N. A. Khalilov. General electrical engineering and fundamentals of electronics. T. Uzbekistan. 2000
2. F. E. Evdokimov. General electrical engineering and fundamentals of electronics. T. Uzbekistan. 1995
3. A.M. Karimov, Sh.O. Toshpulatova. The use of innovative technologies in teaching physics. Toshkent. T. 2017