



Developing Professional Competence Of Engineers Through The Integration Of Physics And General Professional Disciplines

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ABSTRACT

This article highlights the importance of integrating physics and electrical engineering for developing professional competencies in engineering education. The article analyzes the main theoretical foundations of physics and its connections with electrical engineering. It describes the integration between physics and electrical engineering, the role of physical knowledge in developing engineers' practical and analytical skills, as well as in effectively solving engineering problems.

Keywords:

Physics, electrical engineering, integration, engineering, energy.

Introduction: For students studying in the field of energy, the following aspects of electrostatics are particularly important: Analysis of electrical circuits based on the law of conservation of electric charge; Coulomb's law and electrostatic field concepts help in understanding voltage and distribution processes in electrical devices. The potential and strength of the electrostatic field play an important role in understanding dielectric materials and electrical safety issues in electric power engineering.

Energy engineering is one of the crucial foundations of modern society, encompassing the design and management of electricity generation, transmission, and distribution systems. In this field, numerous physical laws play a significant role, with the electrostatics section being particularly important. Electrostatics, a branch of physics that studies the interaction of static charges, is applied in many practical aspects of energy engineering.

Literature review. In the article "Improving the Effectiveness of Teaching the Electrostatics Section of Physics to Students in the Field of Energy Education" by researcher E. Vohidov, information is provided on teaching the

electrostatics section of physics to energy engineering students using innovative technologies.

Main Part. The electrostatics section of physics serves as a theoretical foundation for energy engineering and has extensive practical applications. The reliable and safe operation of electricity generation, transmission, and storage systems depends on a thorough understanding of electrostatic laws. Therefore, electrostatics is one of the essential fundamental sciences for every energy engineer. For energy engineering students, understanding electric fields and electrical distribution systems is crucial. Electrostatics helps students study the formation of electric fields, their strength, and range of influence. This knowledge is applied in the following areas[2].

Increasing the efficiency of electrical distribution systems;

Selection of electrical insulation materials by calculating the electric field strength;

Studying the behavior of dielectrics in an electric field;

Analyzing power and power factor[3].

Teaching based on interdisciplinary integration plays an important role in helping electrical engineering students acquire professional competence. This interdisciplinary approach to teaching aids students in becoming skilled specialists in their profession.

For instance, teaching physics and electrical mechanics through integration helps future energy engineers gain professional competence. There is an interconnection between physics and electrical mechanics. For example, by thoroughly understanding the "Fundamental laws of direct current, Ohm's law for a part of a circuit and a complete circuit, Kirchhoff's rules, work and power of current, and Joule-Lenz law" in physics, students establish a solid foundation for comprehending electrical mechanics. When studying topics such as "Achieving energy efficiency by increasing the power factor" in electrical mechanics, the knowledge acquired in physics proves crucial. A student who has mastered the concept of power in physics will find it easier to grasp the power concepts presented in electrical mechanics. Work and power of current. By mastering the "Joule-Lenz Law," students create a foundation for a good understanding of Electromechanics. When studying the subject "Ensuring energy saving by increasing the power factor" in electrical mechanics, the knowledge gained in physics was considered important.

For example, in industrial enterprises, the main consumers of reactive power are three-phase asynchronous motors, transformers, power transmission lines, and gas-discharge lamps. Asynchronous motors consume 65-70% of the reactive power, three-phase transformers in the power supply system consume 15-25%, while power transmission lines, reactors, gas-discharge lamps, and other consumers account for 5-40% [4].

In the field of electrical mechanics, we will present the concept, problem, and solution related to power.

Reactive power is the power generated when current flows through the inductive and capacitive elements of an electrical circuit. The

dynamics of reactive power changes are expressed by the reactive power coefficient [4]:

$$\operatorname{tg}\varphi = \frac{Q}{P}$$

where: Q - reactive power, P - active power, φ - angle between voltage and current vectors.

Although Q fully characterizes the operating modes of electrical consumers, in practice, the power factor is used more frequently:

$$\cos\varphi = \frac{P}{S}$$

where: S - apparent power

The power factor is a coefficient that characterizes how much of the total power is utilized for useful work. If the consumer's power factor decreases, the total power in the network increases, i.e. [3,4]:

$$P_t = \frac{P}{\cos\varphi}$$

and with unchanged values of P and U indicators:

$$I_p = \frac{P}{\sqrt{3} U \cos\varphi}$$

The reactive current value increases, which leads to an increase in operational costs, i.e., electricity losses in the network increase:

$$\Delta P = 3RI_p^2 = \frac{RP^2}{U^2 \cos^2\varphi}$$

where, R - is the active resistance of one phase of a three-phase device.

To avoid changes in electricity losses, it is necessary to increase the cross-sectional area of transmission lines, which leads to increased consumption of non-ferrous metals.

Problem. Power is supplied to hydromechanical devices via cable. The voltage in the network is and . Determine how much the cross-sectional area of the cable wire will change when the voltage is changed to .

Solution. The current value for:

$$I_p = \frac{P}{\sqrt{3} U \cos \varphi} = \frac{1500 \cdot 10^3}{1,73 \cdot 6000 \cdot 0,85} = 170 A$$

When , with unchanged:

$$I_p = \frac{P}{\sqrt{3} U \cos \varphi} = \frac{1500 \cdot 10^3}{1,73 \cdot 6000 \cdot 0,6} = 241 A$$

From the reference tables [6], we determine that for (), the cross-sectional area of the cable wire is (permissible current value), and for , the cross-sectional area of the cable wire is (permissible current value).

Therefore, as can be seen from the presented theoretical information, problem, and solution, to have a good understanding of "Electrical Mechanics," it is also necessary to have a good grasp of "Physics." The electrostatics section of physics is a fundamental source of knowledge for energy engineers. This section is important for future energy engineers, as it is crucial in their professional activities.

In improving energy efficiency in electromechanical systems, the laws and terms of physics play a crucial role. For example, in electromechanical systems, energy loss in the form of heat can reduce efficiency. Therefore, according to Joule-Lenz's law, it is necessary to minimize heat generation. Excess heat in the system leads to energy loss, so we aim to minimize heat to increase energy efficiency. Ohm's law demonstrates the role of resistance in controlling electric current. If resistance can be optimized, excess energy consumption in the system is reduced, which contributes to energy savings. Additionally, Lenz's law helps reduce energy consumption in electromagnetic induction processes and increase system efficiency, as it generates a current opposing changes in the magnetic field, which is utilized to minimize energy losses. Consequently, the integration of these two disciplines is considered very important in energy engineering[5].

Conclusion: The integration of physics and electrical mechanics serves as an important

factor in improving the quality of engineering education. Interdisciplinary integration allows students to transform theoretical knowledge into practical skills and contributes to the formation of professional competence in preparation for the engineering profession. Through the integration of disciplines, engineers' skills in analytical thinking, designing technical systems, problem-solving, and developing technical solutions are enhanced. We believe that applying the integration of physics and electrical mechanics in the educational process will help strengthen the professional and practical knowledge of engineers, which will increase their competitiveness in the labor market.

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