Volume 2, Issue 12, December 2024 ISSN (E): 2938-3757

INTEGRATION OF GENERAL PHYSICS COURSE WITH HIGHER MATHEMATICS COURSE

Mahliyo Dilmurodovna Sobirova
Computer Science and Information Technology
Department Master Chirchik State Pedagogical University

Dilmurod Gulomovich Akhmedjonov
Head of the Department of Informatics Teaching Methodology
Chirchik State Pedagogical University, UZ Doctor of Technical Sciences,

Abstract
The article discusses the role and significance of mathematics in teaching physics. The authors emphasize the need to master the modern mathematical apparatus in order to successfully master physics. Methods of mathematical modeling of physical phenomena, including the use of differential equations, are described. Particular attention is paid to the inductive approach in the study of Maxwell's equations and their significance in the generalization of physical laws. The concept of model-algorithm-design for analyzing and describing physical processes is also discussed.

Keywords: Physics teaching, mathematical modeling, differential equations, Maxwell's equations, mathematical apparatus, inductive approach, vector algebra, electrodynamics, integral form, physical concepts.

ИНТЕГРАЦИЯ КУРСА ОБЩЕЙ ФИЗИКИ С КУРСОМ ВЫСШЕЙ МАТЕМАТИКИ

Махлиё Дилмуродовна Собирова
Магистрант кафедры Информатика и информационные технологии
Чирчикского государственного педагогического университета

Дилмурод Гуломович Ахмеджонов
Заведующий кафедрой Методика обучения информатике
Чирчикского государственного педагогического университета,
доктор технических наук,

Аннотация:
в статье рассматривается роль и значение математики в преподавании физики. Авторы подчеркивают необходимость владения современным математическим аппаратом для успешного освоения физики. Описаны методы математического моделирования физических явлений, включая использование дифференциальных уравнений. Особое

внимание уделено индуктивному подходу при изучении уравнений Максвелла и их значению в обобщении физических законов. Также обсуждается концепция модель-алгоритм-дизайн для анализа и описания физических процессов.

Ключевые слова: преподавание физики, математическое моделирование, дифференциальные уравнения, уравнения Максвелла, математический аппарат, индуктивный подход, векторная алгебра, электродинамика, интегральная форма, физические концепции.

Introduction

There is an opinion that since physics is a science of ideas and experiments, it can be taught without a strict mathematical apparatus, and that a very modest mathematical training is sufficient to introduce the main ideas and explain the experiments. We hold a different view: in order to master the general course of physics, a student must not only know the modern mathematical apparatus, but also be able to apply it.

What are the functions of mathematics in teaching physics? Obviously, the same as in physics. Mathematics is the language of physics. As in any other activity, a person needs a special language in order to think and explain something to others. Mathematics is such a language for physics, and it allows you to think in a special, extremely clear and flexible international language. As R. Feynman very figuratively pointed out, "Mathematics is not just another language. Mathematics is a language plus reasoning, it's like language and logic together. Mathematics is a tool for thinking. It concentrates the results of many people's precise thinking. With the help of mathematics one statement can be connected to another." (1. p. 40)

The most common method of studying physical phenomena using mathematical methods is modeling these phenomena in the form of differential equations. This is explained by the fact that it is sufficient to know only local connections and not to need information about the entire phenomenon as a whole. For example, when calculating the equations of a pendulum's oscillations, we do not start with the apparent fact that a pendulum brought out of equilibrium moves vibratingly, but simply with the fact that the reflecting force is proportional to displacement.

$$\vec{F} = -k \cdot \Delta\vec{X}$$

As a result, an equation is obtained, the solution of which is of a vibrational nature. This solution allows for a qualitative and quantitative analysis of the oscillatory system as a whole. Therefore, this mathematical model allows us to study the phenomenon in general, predict its development, and quantify the changes occurring in it over time. It was precisely in this way that the wave propagation of electromagnetic disturbances was discovered: from the local properties of the phenomenon to the equations, and from the equations to the description of the phenomenon as a whole.

When studying the section "Physical foundations of mechanics," it is necessary to have an understanding of the fundamentals of vector algebra, about the derivative, the simplest differentiation rules, the indefinite and definite integral and the ability to integrate the simplest differential equations. When considering the rotational motion of a solid body and gravity, it is

Volume 2, Issue 12, December 2024 **ISSN (E):** 2938-3757

Web of Technology: Multidimensional Research Journal
webofjournals.com/index.php/4

necessary to know the partial derivative, the gradient, the scalar, vector and double vector product of the vectors, the flow of the vector, the circulation of the vector.

The section "Molecular Physics and Thermodynamics" uses the same mathematical apparatus. In addition, it is necessary to know about a curvilinear integral, the condition of its independence from the integration path, as well as knowledge of the basic concepts and definitions of probability theory and mathematical statistics.

When studying electrodynamics, the concepts of divergence, circulation, rotor are necessary, and it is desirable that they be written using the Hamiltonian operator, which is widely used in optics, atomic and molecular physics, solid state physics. In the "Vibrations and waves" section, second-order differential equations, as well as functions of a complex variable are used.

The final stage of studying the fundamentals of electrodynamics in the course of general physics is the study of Maxwell's equations. This means that the study of electrodynamics in the general physics course proceeds mainly through an inductive path - based on the analysis of a number of simple experimental facts (electricity of bodies, interaction of charged bodies and conductors with current, electromagnetic induction phenomenon, etc.), certain specific laws are formed, which are then generalized in Maxwell's equations. Therefore, the main path here is from the particular to the general, which does not exclude some elements of deduction. This path is recommended by the program and accepted by the vast majority of textbooks for higher education. Of course, there is also a possible other way of postulating Maxwell's equations and deriving from them all the positions of electromagnetism.

However, it seems that such an approach is more suitable for studying physics at a higher level, in particular, in the course of theoretical physics or in a special course.

In the inductive approach, Maxwell's equations serve as generalizations of the Ostrogradsky-Gauss theorem for electric and magnetic field vectors, the law of total current, and the Faraday law of electromagnetic induction. In the integral form in the International System of Units, they have the following form:

$$\oint_S E_S \cdot ds = -\frac{d\Phi}{dt} \qquad (1)$$

This relationship expresses the quantitative relationship between the changing magnetic field $\vec{B}$ and a vortex electric field $\vec{E}$ and is one of the fundamental equations in Maxwell's theory.

When an electric field changes, a magnetic field appears around it. Therefore, a changing electric field is a displacement current.

There are three types of currents.

1. The ordered motion of charges is current. (Current creates free electrons in metals) $J = \frac{q}{t}$
2. The induction current arises when the variable magnetic field intersects the closed circuit.

$$\varepsilon_i = -\frac{\Delta\Phi}{\Delta t}$$

3. Displacement current is a variable electric field. A variable magnetic field creates a variable electric field. Displacement current density will be:

$$j_C = \frac{dD}{dt}$$

$\vec{D}$ is the electrostatic induction vector. Let's write the law of total current:

$$\oint_{\ell} H_S dS = J \quad \text{полн}$$

ℓ is the length of the closed loop inside the wire through which the current is shaded. S is the area of the closed loop.

$$J_{\text{полный}} = \int_S j_{\text{полный}} \quad ds = \int_S jds + \int_S \frac{dD}{dt} ds$$

$$\int_S \frac{dD}{dt} ds = \frac{d}{dt} \int_S D \cdot ds = \frac{dN}{dt}$$

N – the flow of the electrostatic displacement vector.

So:

$$J_{\text{полный}} = J + \frac{dN}{dt}$$

$$\oint H_S dS = J + \frac{dN}{dt} \qquad (2)$$

To these equations, we need to add two equations expressing the Ostrogradsky-Gauss theorem for electric and magnetic fields:

$$\oint_S \bar{D} : d\bar{S} = q \qquad (3)$$

$$\oint_S \bar{B} d\bar{S} = 0 \qquad (4)$$

Added to this are the fields' vector ratios:

$$\vec{D} = \varepsilon\varepsilon_0 \vec{E} \qquad (5)$$

$$\vec{B} = \mu\mu_0 \vec{H} \qquad (6)$$

$$\vec{j} = \chi \vec{E} \qquad (7)$$

Equations (1-7) form a system of Maxwell's equations.

They are the most general equations for electric fields.

Note that the quantities ε, μ и χ they are included in Maxwell's equations as material constants, i.e., as given quantities characterizing the properties of the medium.

Web of Technology: Multidimensional Research Journal
webofjournals.com/index.php/4

Volume 2, Issue 12, December 2024 **ISSN (E):** 2938-3757

References:
1. Фейнман Р. Характер физических законов. /Пер. с англ. под ред. Я.А. Смородинского/ - М. МИР, 1968. – 232 с.
2. С.Г. Калашников “Электричество” Изд. “Наука” Москва 1964 г.– 660 с.