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APPLICATION OF MATHEMATICAL CONCEPTS TO EXPLAIN THE ESSENCE OF PHYSICAL PHENOMENA TO STUDENTS OF ENGINEERING DIRECTIONS

Abstract: *The connection between mathematical concepts and physical models, the possibility of increasing the effectiveness of students learning in mathematical disciplines are examined, the interdisciplinary connections of mathematical and physical disciplines are shown.*

Key words: *mathematical concepts, physical phenomena, student learning efficiency, systematization of knowledge.*

Language: *English*

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Introduction

In teaching a mathematics course in engineering directions it is important to show how knowledge of general mathematical concepts and laws is applied in various fields of practical activity. [2]

In presenting the classical course of mathematics, there is no need to waste time explaining the essence of physical processes and phenomena. In this case, it is convenient to consider the same model from the point of view of various branches of mathematics, which allows students to better understand mathematical concepts. [5, 10]

Based on our experience, we can offer the following models:

- uneven rectilinear motion of a material point;
- electricity and electromagnetic processes;
- physical parameters of plane figures and bodies;
- oscillatory movements. [7, 11, 12]

Let us show the connection between the mathematical concepts studied by students of engineering directions and the proposed physical models. [8]

1. **Uneven rectilinear motion of a material point**

1) *Coordinate method* — the location of the point in the Cartesian coordinate system is established for translational motion, and for rotational motion, in the polar coordinate system.

2) *Vectors* - the direction of movement is set.

3) *Vector coordinates* - the change in the position of the point i indicated.

4) *Scalar product of vectors* - the work of constant force acting on a point is calculated.

5) *Equations of a straight line on the plane and in space* - the trajectory of the point is set.

6) *Equation of a line on a plane and in space* - a complex trajectory of a point in a Cartesian or polar coordinate system is specified, a transition is made from a parametric line definition to a Cartesian or polar coordinate system.

7) *Derivative of a function of one variable* - calculates the instantaneous speed of motion of a point.

8) *Higher-order derivatives of a function of one variable* are determined by the instantaneous acceleration of the point.

9) *Extrema functions of one variable; maximum and minimum values of the function in the interval* - resolved extreme optimization problem: computed extreme values of the velocity and acceleration of the point at some time.

10) *Definite integral* - is the path traversed by point; calculates the work of a variable force acting on a point.

11) *Differential equations* - process model, including the equations of motion of a point on the axis is compiled.

2. Electricity and electromagnetic processes

1) *Solving systems of linear equations* - the conditions that lead to the process Kirchhoff's laws are determined.

2) *Vectors, operations on vectors* - the direction of change of electric and magnetic fields, specifying the currents and voltages in electric circuits is given; their resultant is found.

3) *Scalar product of two vectors* is the magnetic flux through an arbitrary surface.

4) *Vector product of two vectors* is determined by torque forces in the magnetic field; the vector density of electromagnetic energy.

5) *System of linear inequalities* is the number of electrical appliances in a circuit and their working.

6) *Continuity of a function, break points* - investigates changes in pulse current in the circuit are investigated.

7) *Derivative of a function of one variable* - instantaneous value of the electromotive force of the magnetic field, electric current in the resonant circuit as a change in charge are calculated.

8) *Extrema of functions of one variable; maximum and minimum values of the function in the interval* - extreme optimization tasks are resolved: the values of resistance of electrical appliances are determined.

9) *Scalar field and its characteristics* - scalar electric and magnetic fields and their characteristics: the surface and level line, the directional derivative, gradient are investigated.

10) *Definite integral* - the motor capacity variable is calculated.

11) *Complex functions of a real variable* - the vector diagrams in the complex plane are built.

12) *Multiple integrals* - system of charged conductors are considered.

13) *Theory of vector fields* - electrostatic and magnetic fields and their characteristics: flux, divergence, rotor, circulation are investigated.

14) *Equations of mathematical physics* - transient processes in electric lines are described.

15) *Theory of probabilities* - the action of electrical appliances is characterized; exponential law of reliability of the instrument is described.

16) *Mathematical statistics* - sample characteristics are calculated, confidence intervals in electrical circuits.

17) *Operational calculus* - deals with single pulses of current "rectified" currents, offset currents. [13, 14]

3. The physical parameters of plane figures and bodies

1) *Method of coordinates on the plane and in space* - the location of the figure or body is determined.

2) *Straight line equation in plane and in space* - the elements of the sides of a plane figure are analytically described.

3) *Second order curves* - the elements of the parties and properties of flat shapes are analytically described.

4) *Curves in polar coordinates* - the elements of the parties and properties of flat shapes are analytically described.

5) *Equation of plane* - the verge of the body is analytically described.

6) *Second order surfaces* - the elements that limit the body are analytically described.

7) *Derivative of a function of one variable* - linear inhomogeneous density of a thin rod, heat capacity of the body is calculated.

8) *Definite integral* - the squares of plane figures, volumes of solids of revolution, surface area of solids

of revolution, the force of fluid pressure on the plate are calculated.

9) *Double integral* - the area of plane figures, volumes of solids, surface areas of bodies, mass of plane figures, the static moments and the moments of inertia of plane figures, the coordinates of the center of gravity of plane figures are calculated.

10) *Triple integral* - the volumes of bodies, masses of bodies, static moments and moments of inertia of bodies, coordinates of the center of gravity of bodies are calculated.

4. Oscillatory movements

1) *The derivative of the function of one variable* - the current strength in the oscillatory circuit is located.

2) *Complex functions of the real variable* - harmonic oscillations in the oscillatory circuit are described.

3) *Differential equations* - models of the simplest oscillatory processes are built.

4) *Rows* — periodic processes in acoustics, non-sinusoidal currents in electrical circuits, and the addition of oscillations are described.

As a result of the research in this direction, we came to the conclusion that all the issues discussed had the following features:

- show the origin of concepts, justify the need for the introduction of concepts, the logic of their development;
- rely on sensory perception and on clear physical representations;
- use the theoretical facts obtained from related disciplines in the course of mathematics;
- create the possibility of a problematic nature of training, that is, the identification of problem situations, the mathematization of the physical process, the solution of relevant problems that necessitate the study of a new theory;
- a method of a formalized approach as one of the undoubted advantages of the mathematical apparatus as applied to solving specific engineering and other problems in various fields of knowledge. [3]

The topics discussed provide interdisciplinary connections between mathematical disciplines and various physics courses. They create an opportunity to increase the effectiveness of student learning, systematize their knowledge, the ability to apply this knowledge in the studied disciplines. [6, 8]

We recommend the proposed physical models for study not only at the undergraduate level, but also in master's programs. [4, 9]

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