

## PHYSICS AND PROFESSIONAL TEACHING IN TECHNICAL UNIVERSITIES

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**Abstract** *¾The course of fundamental physics in technical universities is the important constituent of fundamental education, as the physics is the leader of natural sciences and theoretical basis of modern technology. At the same time the informative variety of physics as educational discipline allows to solve the problems of professional orientation of training. The professional trend of course of physics considerably raises its role in education and support interest of the students in his learning. The correlation between the fundamental course of physics and professional engineering teaching has been discussed. The problem of orientation of courses of physics in technical universities, which at conservation of fundamentality and integrity of physical education, simultaneously includes professional basis of the future specialists training, discovers the solution in the concept of "nuclear" model of physical education. According to this model in course of physics the mandatory invariant "nuclear" is allocated, in which does not depend on a concrete specialization of the future graduate and includes a necessary minimum of a contents, where the main attention is given to its fundamentality and methodological correspondence to the concept of physics education. The fundamental "nuclear" is supplemented by the shell of the professionally directional physical educational information basing a contents of "nuclear" and acts as a kind of a transition from course of physics to the courses of special disciplines. This model is demonstrated in education process of Moscow State Automobile and Road construction institute (technical university).*

**Index Terms** *¾About four, alphabetical order, key words or phrases, separated by commas (for suggestions Preparation of papers, camera-ready, two-column format, ICEE format).*

### INTRODUCTION

The physics remains the leader of modern natural sciences, the theoretical basis of modern engineering and as no any other science, promotes the development of creative thinking forms of specialists. Its rough development in 20 century has resulted in occurrence of the contradiction between physics as a science and a traditional course of the common physics readable till now at many technical universities. The physics stated not as the uniform quite generated science, but as the set of the separate sections overloaded with a huge empirical material, so a little connected among themselves as well as during Newton. As a matter of fact it is the classical physics

with additions of some data from the relativistic and quantum mechanics. Thus the natural aspiration to acquaint with opening and achievements of last years results students only in increase of contents volume in conditions of a growing time trouble. At technical universities students study only one course of physics, which should contain the common physics, elements of the theoretical physics and special submitted from a uniform position. It thus should solve the following problems:

- to inform students logically ordered knowledge of the most common both important laws and models of the description of a nature;
- to approach them to judgment of a physical picture of the world existing at the present stage;
- to use received experience of knowledge for formation of theoretical type of thinking, ability to creative the skills of recognition of the modern scientific and technical information.

The important problem of physical education is formation of natural-science type of thinking trained, their acquaintance with ways and structure of physical modelling of world around. Besides the course of physics creates science axiomatic for the subsequent studying engineering special disciplines. It, obviously, assumes consideration in a course of various levels of the description of objects and processes, fundamentality, integrity and completeness of physical education in baccalaureate program.

At the same time, a substantial variety of physics course allows to solve not only problem of fundamental physical education, but also the task of support the early professional orientation of training. On the other hand, the modern pragmatic approach to the purposes and the maintenance of the maximum technical education, consisting in orientation training to activity in the certain limited area of engineering and technology, assumes probably the big concentration of all (and not just special) education on the future professional work of the specialist.

Also it is necessary to note, that the professional orientation of a course of physics considerably raises its role in engineering training and interest of students in his studying. In this connection there is a problem of such orientation of course of physics in technical universities which at maintenance of fundamentality and integrity of physical education at a level of requirements baccalaureate curricula would ensure bases of professional training of the future specialist. This problem is solved in the concept of

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"nuclear" model of physical education, according to which in a course of physics the invariant nucleus in which fundamental, general educational elements of the contents are integrated is allocated obligatory and substantially. This nucleus acts practically not dependent on concrete specialization of the future graduate. The nucleus includes a necessary minimum of the contents, the main attention is given its fundamentality, systematization and methodology (to conformity of the certain concept of physical education and the contents of a course of physics). The fundamental nucleus of a course is supplemented with an environment of professionally directed physical educational information, basing the contents of a nucleus and the acting as transition from a rate of physics to course of engineering special disciplines.

Adaptation of a course of the common physics to the decision of technical problems is important methodology problem. As a whole, the professional orientation of the course of physics, in our reckoning, assumes the following statutes.

1) Maintenance of physical axiomatic necessary for subsequent studying engineering special disciplines with inclusion, as required, of additional elements of contents in appropriate section and theme of physics. Practical realization of this position in a course of physics of a technical universities, in our opinion, should begin with the analysis of requirements to the purposes, the contents and structure of a course. As the basic sources of requirements act:

- The typical program of baccalaureate training in physics.
- The qualifying characteristic of the expert, working programs of engineering special disciplines.

The analysis of these sources shows, that, as a rule, requirements to the contents of physical education on the part of various special disciplines in many respects are blocked and, as a whole, will well be coordinated to requirements of the baccalaureate program. So, for example, the similar analysis which has been carried out by us for a specialties "Automobile construction", allows to conclude, that the basic physical axiomatic used at a statement special disciplines corresponds to traditional sections of the course of physics: " Physical bases of the mechanics ", " the Electricity and magnetism ", " Statistical physics and thermodynamics ", " Physics of fluctuations and waves ".

Nevertheless, for more full axiomatic maintenance of engineering special disciplines frequently there is a necessity of introduction of additional elements of the contents. For example, in the course of physics for automobile construction specialty in section "Mechanics" the stipulate more detail consideration of friction force was introduced. Sometimes necessity of axiomatic maintenance of special disciplines causes not only entering of additional elements into the contents of a course of physics, but also change of its structure and a sequence of a statement of the contents.

2. Consideration of professionally significant questions in course of physics. Professionally significant questions are considered in a course of physics as individual appendices of fundamental physical laws as examples of action of these laws in a nature, technical devices. Thus the attention of students concentrates on the leading part of physical knowledge in understanding of the mechanism of the natural phenomena and functioning of technical devices, the fundamental base for the subsequent formation of skills of forecasting of working professionally significant systems is pawned on the basis of physical laws.

As shows our experience, use of similar examples essentially raises interest trained in studying physics as evidently shows its importance not only in fundamental education, but also in professional training the expert.

3) An establishment of connections and unification of a terminology with special disciplines. The usual practice of teaching of special disciplines, and also the existing educational literature, as a rule, almost do not include direct references to the appropriate sections and themes of a of physics. It results to that the physical axiomatics on which special disciplines base during their statement, remains veiled that, in turn, causes underestimation by students, and some teachers of special disciplines, a role of physical education in system of preparation of experts in a concrete specialty. Therefore the important component of a professional orientation of a course of physics is revealing and presentation trained substantial, semantic and other connections between elements of the contents of a course of physics both the appropriate sections and themes of special disciplines, and also unification of a terminology, designations etc.

4) Professional orientation a physical practical work. Practical realization of this position assumes first of all creation of a set of physical problems, having the expressed professional orientation (certainly, for those sections of a course where it is possible and pertinent). These problems may be used on practical occupations, in examinations, and more developed - as tasks to course works on physics (if they are stipulated by the curriculum).

In the Moscow Automobile and Road Construction technical university we teach the future engineer should be able to solve technical problems with use of physical principles of action and processes.

Let's consider, for example, a problem of consumption and manufacture of energy, which is directly connected to fundamental physical laws. First of all, it is laws of thermodynamics. The first law speaks about that energy, as well as a matter, are not destroyed and not created, but only turn from one kind to another. The second law of thermodynamics establishes in what direction there are these transformations: in a direction of increase entropy-measures of the disorder and chaos. The law of increasing of entropy is one of organic laws of a nature. Speed of increase is determined alive nature and basically by mankind. All development of the industry is connected to increase of use

of energy that is accompanied by huge growth and an exhaustion of natural sources. The second law allows transferring only an insignificant part of heat in work. Therefore it is important to explain to future engineers, that in power systems and on transport processes of direct burning of fuel with allocation of heat and subsequent its ineffective transformation to other kinds of energy completely should disappear. Ecological crisis and an exhaustion of mineral stocks stimulates search of new renewed energy sources for transport of the future. To number such it is possible to attribute all renewed sources as a result of which it is possible to receive an electricity: geothermal energy and hydrogen sources, a solar energy, nuclear reactions of division and synthesis. The electric power the most accessible and non-polluting kind of energy and an opportunity of its application on transport are developed now in all advanced countries. It elecromobile with battery or with an inductive feed and transport on magnetic suspension brackets, automobiles on hydrogen and so on. Design of new non-polluting transport systems demands information base of the physical phenomena and laws: a law of electromagnetism, the phenomenon electromagnetic induction, bases semi-conductor photoelectric devices etc. This is the " shell" contents for the given course of physics.

We believe, that realization of the considered principles of physical education in technical universities should promote essential raising of a level fundamental and professional training of specialists, a importance of physical education in becoming the specialist of the future engineering.

### REFERENCES

- [1] Ipolitova , G. , "Title" , *Physical maintenances for progressive technology*), Moscow, MADL, 1998