

## Interdisciplinarity in Practice-Oriented Training of Bachelors in Line with the CDIO Initiative

Saint Petersburg Electrotechnical University "LETI"

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In the context of modern constantly changing realm the successfulness of technical HEIs' graduates is determined not only by their current knowledge, but also by their ability to adapt to these changes. This article is devoted to the efforts of the Saint Petersburg Electrotechnical University "LETI" and namely the Faculty of Information Measurement and Biotechnical Systems (FIMBS) on implementing the CDIO Initiative approaches for development of the required students' competences.

**Key words:** CDIO, engineering education, quality of education, interdisciplinarity, instrumentation technology.

One of the key factors influencing formation of specialists on any stage of educational process is the motivation of a student. Therefore, HEIs that want to increase the demand for their graduates have to pay significant attention to enrolling motivated school graduates, bachelors, master students, and PhDs. Throughout the study process all of these types of students have to have certain understanding of the connection between each step they make and the final result they can achieve; in this case, it is the successful employment [1, p. 166].

### Working with school students

The introduction of a new enrollment procedure in Russian HEIs, which is based on the results of the Unified State Exam, has significantly changed the approach towards enrollees. Previously, in order to apply for admission to university prospective students had to come to an HEI, meet the Admission Board and exam administrators, which gave both enrollees and HEI an opportunity to get to know each other to some extent. The current situation is conceptually different, since the admission becomes accessible even by sending the documents via mail. In this case, the understanding of prospective students' motivation to receive the education in a certain HEI on a certain

major becomes perceptible only during the educational process itself. The solution to this problem is active interaction between an HEI and its prospective enrollees both in the city and in other regions or countries.

LETI, and the Faculty of Information Measurement and Biotechnical Systems in particular, spend significant financial and labor resources on career-guidance activities for enrollees (Fig. 1).

The aim of this process is to get enrollees acquainted with peculiarities of studying at this university and faculty, and to attract to enroll at LETI those prospective students, who are interested in receiving engineering education in this field. By going through a consecutive set of events each prospective student will be able to choose his/her future educational path deliberately and, moreover, foster extra skills of communication, team work, as well we adapt to the upcoming learning process at an HEI [1, p. 167].

### Features of educational process

The optimization of educational process that aims to increase the demand for graduates within the real sector of economy is a complex multifactor problem. The LETI Faculty of Information Measurement and Biotechnical Systems, when solving this problem, focused on the requirements

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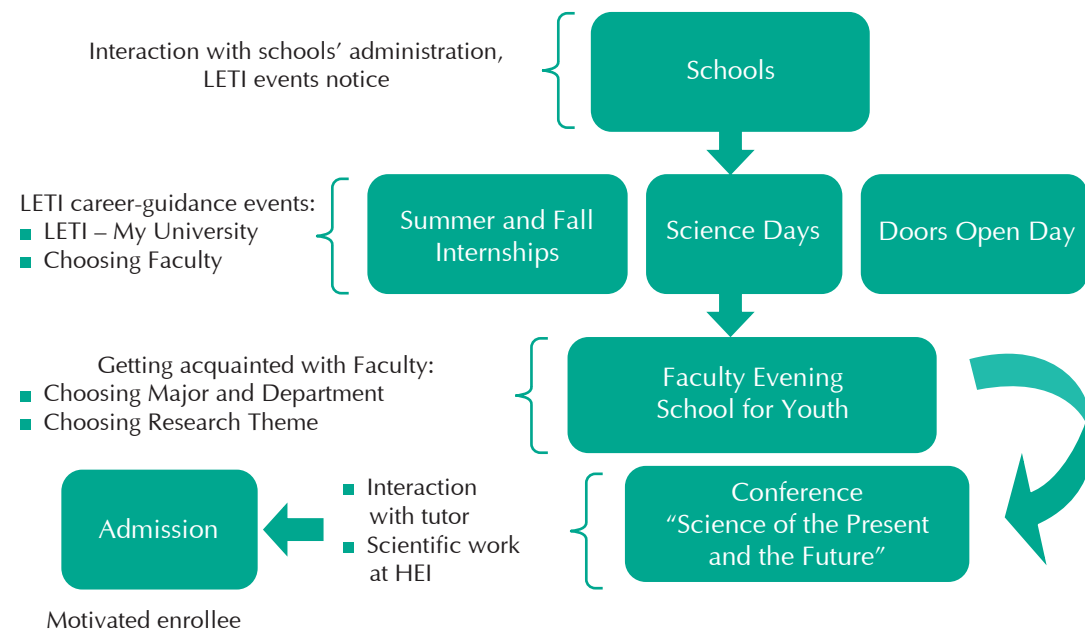


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Fig. 1. Pattern of LETI interaction with school students



towards employees at partner enterprises, such as JSC State Research Center of the Russian Federation Concern CSRI "Elektropribor", JSC "Okeanpribor" and others [2]. These enterprises are leading in the corresponding industrial fields and their requirements for employees serve as best practices for the whole industry.

The result of these actions is the design of curriculum in such a way that by graduating any of the educational stages a graduate is in demand by the labor market, i.e. the graduate possesses the required competences (Fig. 2).

Bachelor graduate, in such case, has a choice: either to continue education on a Master level, or, having received plentiful practical skills, to get employed on a position, adequately corresponding with his/her qualification. A Master program graduate, having a higher level of qualification, can get employed to a conceptually different type of job positions or can continue his/her education as a PhD student. PhD school at LETI is the highest cycle of education that allows fostering

competences required for scientific and research activities as well as pedagogy.

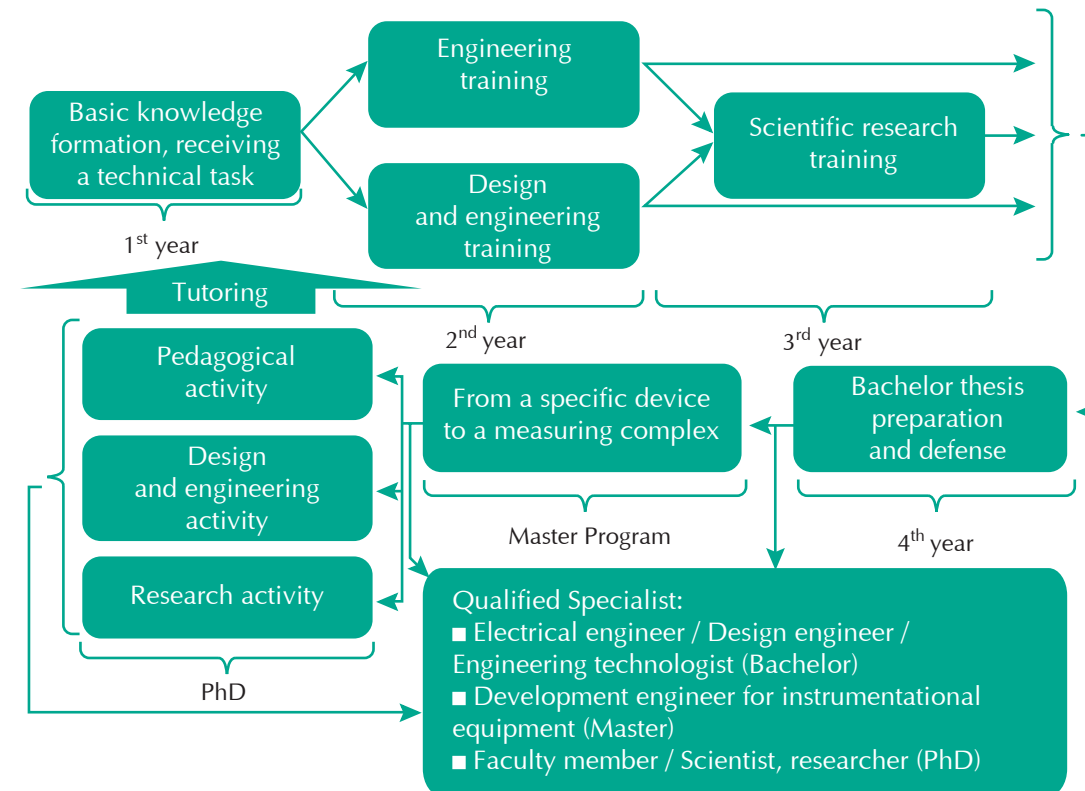
The Bachelor cycle of education is set in such a way that as a result there are three types of graduates with prevailing engineering, design engineering or research skills. Training of each type of Bachelor graduates differs significantly; that assures fostering proper competences. The common feature of Bachelor studies at FIMBS LETI is the suballocated approach to thesis preparation. First-year students get acquainted with departments and educational process (in the framework of an all-faculty course "Introduction to Specialty") and by the end of the first year students receive technical tasks for their theses on agreed themes.

**From technical task to real market**

This commonly consists of a set of sections, among which are:

1. **State-of-the-art analysis**
  - 1.1. Marketing research
2. **Technical instrument description**
  - 2.1. Mathematical model
  - 2.2. Electric circuit description

Fig. 2. Structure of educational process



2.3. Design and engineering aspects

2.4. Test results

3. **Work safety**

3.1. Health and safety protection

3.2. Environmental protection

4. **Economic aspects**

4.1. Feasibility study

4.2. Business plan

**Conclusion**

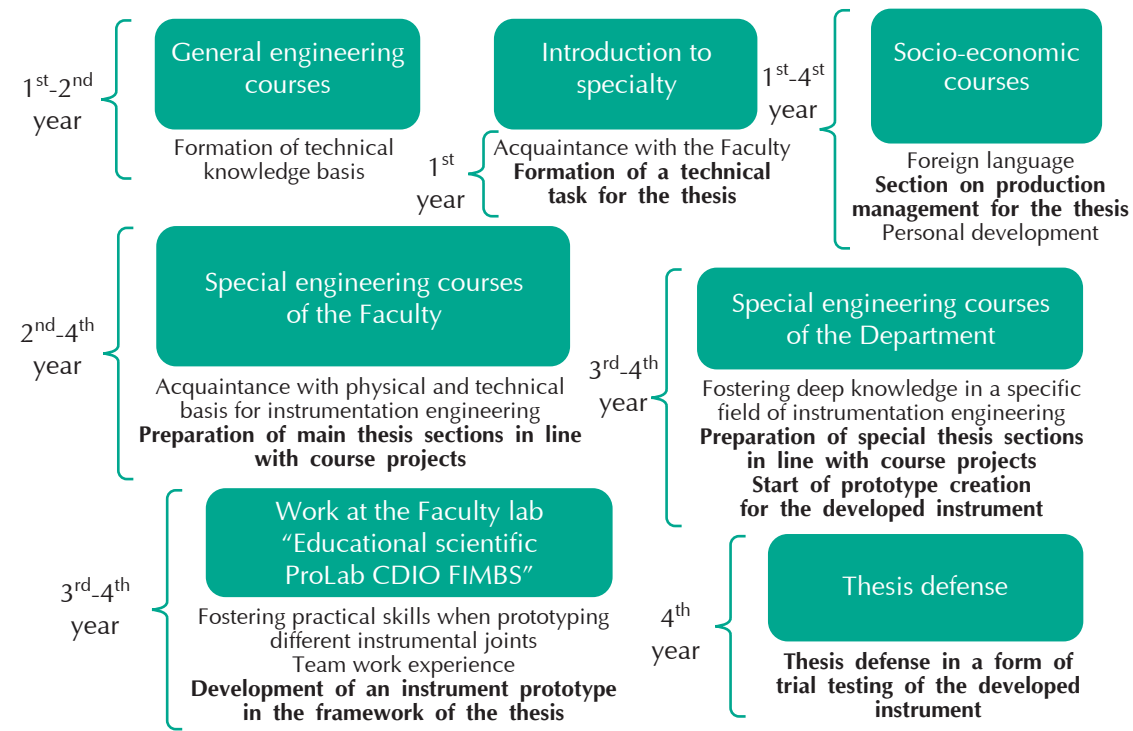
**References**

Students are supposed to work consecutively on each of these sections in line with preset technical tasks for their theses (Fig. 3) [1, p. 169]. For instance, while learning the ecology course a student has to conduct a course work that will later become a 3.2. part of the thesis. Course works and individual home tasks, in this case, are not devoted to some abstract calculations, by serve as one or the other part of a thesis.

Thus, on each study year students attend various educational modules both technical and other courses that allow preparing thesis sections consecutively up to the final year of study. At the final year students create prototypes of the developed measuring instruments. Thesis defense in this case is held in a form of trial testing of the developed instrument.

The result is the formation of an integrated structure of knowledge and skills: within the process of measuring instruments' development students have to apply the knowledge from various courses (not only the technical ones). By these means the interdisciplinary approach according to the CDIO principles in practice-oriented learning of Bachelors is achieved. The same approach, in a slightly different form, is disseminated on Master and PhD students. For instance, the

Fig. 3. Connecting thesis sections with study courses



latter ones perform as tutors for Bachelor students working on projects; therefore, PhD students improve their pedagogical skills.

#### "Educational scientific ProLab CDIO FIMBS"

Project prototyping is conducted in the framework of the "Educational scientific ProLab CDIO FIMBS" project (Fig. 4) – a practice-oriented laboratory of the Faculty of Information Measurement and Biotechnical Systems. The lab's foundation has been actively supported by the previously mentioned partner enterprises of the Faculty [1, p. 170-171].

Laboratory aims at solving a number of issues relevant for FIMBS::

- Pre-commissioning procedures and prototyping of instruments developed within Bachelor theses.
- Scientific and research activities of Master students.
- Design and engineering centers for PhD students.

- Cooperation with industry.
- Enrollee involvement in projects in the framework of career-guidance events of the Saint Petersburg Electrotechnical University "LETI".

An important aspect of the FIMBS lab practice-oriented work is the interaction between different scientific fields and learning of some common aspects regarding instrumentation technology as a whole [1, p. 168]. This is especially important considering the fact that the Faculty works at the intersection of sciences: classical engineering, biology, chemistry, medicine, and, therefore, forms a new field of science and technology – "Biotectonics" [3].

In 2016 a pilot Project has been launched that confirmed the viability of the proposed approach. In the framework of the Project, 3rd-year students of Bachelor programs conducted Project work on "Design and development of a prototype for registering human's physiological indicators" (Fig. 5).

Fig. 4. Lab logo

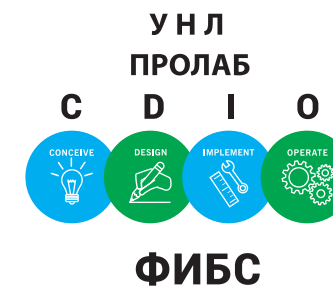


Fig. 5. Working on the Project prototype



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