საქართველოს ტექნიკური უნივერსიტეტი
GEORGIAN TECHNICAL UNIVERSITY

Approved by
Resolution № 01–05–04/204
of the Academic Council of
GTU dated July 22, 2019

Bachelor's Educational Program

Program Title

კომპიუტერული ინჟინერია
Computer Engineering

Faculty

ინფორმატიკისა და მართვის სისტემების
Informatics and Control Systems

Program Head/Heads

Professor Levan IMNAISHVILI

Qualification to be Awarded and the Extent of the Program in terms of Credit

Bachelor in Computer Engineerings

Will be awarded if at least 240 credits of the educational program are completed.

Teaching Language

Georgian

Prerequisite for Admission to the Program

Only the holder of a state certificate proving complete general education, or an equivalent person enrolled in accordance with the procedure established by Georgia law, shall have the right to study at the Bachelor's Educational Program.

Program Description

The educational program is compiled according to the ECTS system, 1 credit is equal to 25 hours, which includes both contact and independent work hours. The distribution of credits is presented in the curriculum. The educational program lasts 4 years (8 semesters, in the 1st, 2nd and 5th - 8th semesters, 30 credits in each, 29 credits in the 3rd semester, and 31 credits in the 4th semester) and includes a total of 240 credits.

The qualification "Bachelor in Computer Engineering" will be awarded by combining education courses in the main specialty (225 credits) and free components (15 credits) provided by the curriculum of the educational program in case of completion of at least 240 credits.

Program structure. The program consists of compulsory and elective education courses in specialty, general compulsory and elective, free component education courses, compulsory industrial internship and a bachelor's project.

Compulsory courses in the specialty are presented with the capacity of 143 ECTS, elective courses in the specialty - with the capacity of 9 ECTS, general elective courses with the volume of 33 ECTS, general elective courses with the capacity of 25 ECTS, compulsory industrial internship in the specialty - with the capacity of 5 ECTS, introduction to the Bachelor's project with the capacity of 4 ECTS, Bachelor's Project – 6 ECTS and free components – 15 ECTS.

The curriculum structure of the program according to semesters has the following form:

First semester	• Compulsory education courses in the specialty- 15 ECTS; • General compulsory education courses - 10 ECTS; • General elective education courses - 5 ECTS;
Second semester	• Compulsory education courses in the specialty - 10 ECTS; • General compulsory education courses - 10 ECTS; • General elective education courses - 10 ECTS.
Third semester	• Compulsory education courses in the specialty - 16 ECTS; • General compulsory education courses - 8 ECTS; • General elective education courses - 5 ECTS.
Fourth semester	• Compulsory education courses in the specialty - 26 ECTS; • Free components - 5 ECTS.
Fifth semester	• Compulsory education courses in the specialty - 20 ECTS; • Elective education courses in specialty - 5 ECTS; • General compulsory education courses - 5 ECTS
Sixth semester	• Compulsory education courses in the specialty - 25 ECTS; • Free components - 5 ECTS.
Seventh semester	• Compulsory education courses in the specialty - 16 ECTS; • Compulsory Industrial internship in specialty - 5 ECTS; • Introductory course for the compulsory Bachelor's project in the specialty- 4 ECTS; • General elective education courses - 5 ECTS
Eighth semester	• Compulsory education courses in the specialty - 15 ECTS; • Elective education courses in specialty - 4 ECTS; • Introductory course for the compulsory Bachelor's project in the specialty -

	6 ECTS; • Free components - 5 ECTS.
Total in I-VIII semester:	• Compulsory education courses in the specialty - 143 ECTS; • Elective education courses in specialty - 9 ECTS; • Compulsory Industrial internship - 5 ECTS; • Introduction to Bachelor's Project and Bachelor's Project- 10 ECTS; • General compulsory education courses - 33 ECTS • General elective education courses - 25 ECTS • Free components - 15 ECTS.

In the Bachelor's educational program, "Computer Engineering" involves practical and laboratory work along with the lecture teaching of a number of education courses. Laboratory work is carried out in the form of computerized laboratory stands and virtual laboratory work. In addition, a significant share of practical training is also conducted in computer classes and using specialized computer equipment. The number of such education courses in the educational program is 24. This is important in terms of demonstrating the application of theoretical issues in practice. Also, along with the lecture, practical or laboratory forms of teaching, a number of courses also involve the implementation of a course project, which allows the student to develop the ability to synthesize small hardware or software objects based on theoretical and practical knowledge. The number of such education courses is 7, which are distributed in different semesters.

It is compulsory for the student to undergo Industrial internship, which helps to develop the skills of applying theoretical knowledge in practice.

It is also compulsory for the student to complete a Bachelor's project, which involves designing a certain device, system from the field of computer engineering. The student completes the Bachelor's project during two semesters, corresponding to two education courses: "Introduction to the Bachelor's project" with the capacity of 4 ECTS and "Bachelor's project" with the capacity of 6 ECTS. Thus, the Bachelor project has a total of 10 ECTS. Dividing the Bachelor's project over two semesters allows the student to pay more attention to the analysis of theoretical or practical issues of the past and current education courses while synthesizing the object to be designed.

The student has complete freedom in choosing an education course from the free components.

The educational program "Computer Engineering" was developed taking into account the advanced trends of modern educational programs of famous universities - "Computer Engineering" and "Computer Systems Engineering".

(University of Newcastle (Australia), Computer Systems Engineering https://www.newcastle.edu.au/degrees/bachelor-of-computer-systems-engineering-honours

- University of Alaska Anchorage, Computer Systems Engineering https://www.uaa.alaska.edu/academics/college-of-engineering/departments/computer-science-and-engineering/degree-programs-cse/computersystemsengineering-bs.cshtml
- Northwestern Polytechnic University, Computer Systems Engineering https://www.npu.edu/academics/school-of-engineering/bachelor-of-science-in-computer-systems-engineering
- University of Michigan, Computer engineering https://ece.engin.umich.edu/academics/undergraduate-programs/computer-engineering/
- Arizona State University, Computer Systems Engineering https://webapp4.asu.edu/programs/t5/majorinfo/ASU00/ESCSEBSE/undergrad/false
- Georgia Institute of Technology, https://www.ece.gatech.edu/computer-engineering-degree
- San Diego State University, Computer Engineering https://electrical.sdsu.edu/undergraduate/compengr

Program Objective

Computer engineering focuses on the theoretical and practical issues of analyzing and designing complex digital systems. It covers a very wide range of digital technologies, from supercomputers and computer systems to microcircuits. It can be said that at the current stage of high technology development, computer engineering plays a decisive role in the fields of digital technologies and applied nature. Therefore, the demand for computer engineering specialists in the labor market is very high and constantly growing.

The objective of the educational program is to prepare highly qualified specialists who meet the requirements of the labor market, who will be able to maintain and develop the knowledge gained through the educational program and respond to the latest challenges in the field. Therefore, the specific objectives of the educational program are:

- To provide graduates with the technical, engineering knowledge and skills to succeed in the field of computer engineering.
- To prepare highly qualified specialists of computer engineering, who will be equipped with the knowledge of the development and operation of digital devices and systems.
- To provide graduates with the skills to effectively use computer engineering methods and tools in other fields.
- To create a solid foundation for the graduates to continue their studies at the next level and for continuous professional development.

Learning Outcomes/Competencies

The learning outcomes of the Bachelor's educational program "Computer Engineering" correspond to the goals of the program and include the basic knowledge, skills, responsibility and autonomy provided for in the content:

- Understands and critically analyzes the fundamental theses of natural and engineering sciences, as well as technology and mathematics, which he/she uses to identify problems related to the specialty, formulate and determine ways to solve them.
- Knows a wide range of tasks in the field of computer engineering, which includes a critical understanding of hardware and software theories and principles and the latest aspects of knowledge.
- Identifies, formulates, analyzes and solves theoretical and practical problems in various fields with hardware and software tools in accordance with predetermined guidelines.
- Designs (including research elements), integrates and implements computer systems, embedded systems, computer networks, computer systems for managing technological processes in accordance with predetermined guidelines.
- Performs debugging and servicing of computer systems, embedded systems, computer networks, technological process management computer systems, as well as computer network administration.
- Knows digital technologies, hardware and software tools and uses synthesis methods to implement reliable, ergonomic and safe systems.
- Communicates ideas, existing problems and solutions with specialists and non-specialists in forms appropriate for the context, using information and communication technologies.
- Leads development-oriented professional activities effectively in a team and multidisciplinary context.
- Understands the responsibility of making professional decisions based on ethical norms.
- In the conditions of rapid development of technologies, determines the need for further education, makes decisions independently for the purpose of professional and career development.

Methods of achieving learning outcomes (teaching-learning)

☒ Lecture ☒ Seminar (group work) ☒ Practical ☒ Laboratory
☒Practice ☒ Course work/Project ☒ Consultation ☒ Independent work

In the educational process, depending on the specifics of a particular study course program, the following teaching-learning methods are used, which are given in the relevant education course programs (syllabi):

- **Verbal or oral method.** By means of this method the teacher conveys knowledge to the students during the lecture, explains the study material.
- **Demonstration method.** Using this method, the lecturer visually presents the educational material through a projector, among them demonstrates the functionality of software products, demonstrates tests and experiments on special computerized stands.
- **Practical work.** Gradual study of theoretical material by solving specific tasks, which is the basis for developing habits of independent use of theoretical material. In some education courses, practical work is carried out in computer classes or using special laboratory equipment.
- **Laboratory work**. In the laboratory, the student conducts an experiment and conducts research using special equipment. During laboratory studies, the student learns how to set up, adjust and operate the equipment. The main education courses of the specialty include laboratory work.
- **Group (collaborative) work**. Teaching using this activity involves dividing students into groups and giving them learning tasks during practical lessons or course projects. Group members work on the issue individually and simultaneously share their opinions with the rest of the group. Depending on the set task, it is possible to redistribute functions among the members during the work of the group.
- **The course project** involves dividing the students into groups and giving each group a course project. The content of the course project involves the creation of the architecture, scheme, structure or architecture of a device, system, database or computer program, and in the case of software products - its realization. The design process is a combination of theory and practice. The course project is an independent work of the student, but is carried out under the guidance of the teacher. The members of the group divide the individual issues of the project task, work on the project individually and simultaneously share their opinions with the rest of the group members. Depending on the set task, it is possible to redistribute functions among the members during the work of the group. This strategy ensures maximum involvement of all students in the learning process.
- The purpose of **the seminar** (group work) is to give students an opportunity to deepen the topics studied during the lecture. Under the instruction of the teacher, a student or a group of students will find and process additional information, prepare a report. At the seminar, reports will be heard, discussions will be held, and conclusions will be made. The head teacher of the seminar coordinates the purposeful management of these processes.
- **Industrial internship** serves to deepen and strengthen the knowledge acquired by the student. It develops the ability to apply knowledge in practice, to use methods specific to the studied subject to solve problems. It combines all the teaching methods that form the practical skills of the student. In this case, the student independently performs this or that action based on the acquired knowledge.
- **Bachelor's project.** It is the final stage of the bachelor's degree and its purpose is to systematize the theoretical and practical knowledge gained in the specialty and to provide a justified solution to a specific technical problem. The work should reveal the level of mastery of the elements of research methods and experiments related to the issues raised, and the student's readiness for independent work in the conditions of future professional activity. The implementation of the project is led by an experienced teacher.

- **The method of written work,** which involves the following actions: making extracts and notes, drawing up laboratory protocols, summarizing material, drawing up theses, a project report, etc.
- **Consultation**– with the assistance of the teacher, the student can master the habits of independent work, properly conduct work on educational literature and other sources, and can understand the issues raised during independent work.
- **Independent work.** The student actively uses the main and supplementary literature to study the issues discussed in the lecture, practical and seminar. Also uses methodological instructions to prepare the next laboratory work. The student works independently on the processing of project issues.
- **Explanatory method**. It is based on reasoning around the given issue. When presenting the material, the teacher cites a specific example, which is discussed in detail within the given topic.
- **Action-oriented learning**. For the purpose of practical interpretation of the theoretical material, which is manifested in the preparatory classes for practical and laboratory work, the teacher performs examples in the form of a sample and discusses them, where the students are actively involved.
- **The analysis method** is needed for the analysis of the results of the conducted experiments (analysis of the functioning of electronic circuits, devices, systems, analysis of the functionality of software products, etc.), so that the student can prepare a summary report of the work performed, analyze the purpose of breaking down the educational material into its constituent parts as a whole.
- **The synthesis method** involves grouping separate issues to form a single whole. This method helps to develop the ability to see the problem as a whole. It is especially effective during the implementation of projects (new schemes, devices, systems, software products).
- **Discussion/debates**. Group discussion-analysis of the issue, when the pros and cons of the explanation proposed by the students will be distinguished.
- **Case studies**. During practical lessons, the teacher discusses specific objects and cases with the students, which helps the students to be able to set and solve the problem themselves.
- **Inductive method** - defines a form of transfer of any knowledge, when the course of thought in the learning process is directed from facts to generalization, that is, when conveying material, the process proceeds from specific to general.
- **Deductive method** - defines a form of transfer of any knowledge, which is a logical process of discovering new knowledge based on general knowledge, that is, the process proceeds from the general to the specific.
- **Cooperative teaching**. It is a teaching strategy where each member of the group is obliged not only to learn by himself, but also to help his/her teammate to learn the subject better. Each member of the group works on the problem until all of them have mastered the issue.
- **Brain storming**. This activity means promoting the formation and expression of as many, preferably radically different, opinions and ideas about a specific issue/problem within the topic. Assessing the generated ideas against pre-defined criteria and selecting those ideas that are most relevant to the problem at hand through elimination.

Elements of **E-learning** will also be used in the educational program: in some education courses, the teacher will deliver learning materials and assignments to the student and receive the completed assignments by means of Moodle. Also, in some courses where assessments include testing, the Moodle tool will be used.

Student's Knowledge Assessment System

The student's knowledge is assessed on a 100-point scale.

Positive grades are:

- **(A)-**Excellent - 91-100 points;
- **(B)-**Very Good – 81-90 points;
- **(C)-**Good – 71-80 points;
- **(D**)-Satisfactory – 61-70 points;
- **(E)-**Sufficient – 51-60 points.

Negative grades are:

- **(FX)** - Failed to pass – 41-50 points, which means that the student needs more work to pass and is allowed to take an additional exam once with independent work;
- **(F)** - Failed - 40 points or less, which means that the work done by the student is insufficient and he/she will have to study the subject again.

Fields of Employment

The program allows graduates to be employed:

- In state and private structures whose activities require the use of digital technologies in business processes, machinery and technological processes.
- In companies whose activities are focused on the development of computer systems and embedded systems hardware and software and their services.
- In companies whose activities are focused on implementation, administration and service of computer networks.
- In all those organizations where the use of a wide range of digital technology tools is required.

Opportunities for continuing education

Graduates are given the opportunity to continue their studies at Master's degree programs.

Human and material resources needed to implement the program

The program is provided with adequate human and material resources. For additional information, please find the attached documentation.

Number of attached syllabi: 72