



საქართველოს ტექნიკური უნივერსიტეტი  
GEORGIAN TECHNICAL UNIVERSITY

Approved by  
Resolution № 733 of the  
Academic Council of GTU  
Dated July 6, 2012

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Resolution № 01-05-04/172 of the  
Academic Council of GTU  
dated November 26, 2021

## Master's Educational Program

### Program Title

ენერგეტიკა და ელექტროინჟინერია

Energy and Electrical Engineering

### Faculty

ენერგეტიკის

Power Engineering

### Program Head/Heads

Professor Giorgi GIGINEISHVILI

### Qualification to be Awarded and the Extent of the Program in terms of Credits

Master of Energy and Electrical Engineering

Will be awarded in case of completion of 120 credits of the educational program; The volume of the educational component is 90 credits (5 credits are devoted to production practice), and the research component (master's thesis) includes 30 credits.

### Language of Teaching

Georgian

### Prerequisite for Admission to the Program

A person with at least a bachelor's degree or an academic degree equivalent to it, who is enrolled based on the results of the master's exams (common master's exam and exam/examinations determined by GTU), has the right to study in the master's program. Exam questions/tests will be posted on the website of the Study Department of GTU - <https://gtu.ge/Study-Dep/> - at least one

month before the start of the exams. Enrollment in the program without passing the master's exams is possible only according to the rules established by the legislation of Georgia.

## Program Description

Power engineering and electrical engineering is one of the important areas of the country's development, its economic and political stability and security. It includes thermal, hydro and electricity generation, transformation, transmission, distribution and consumption technologies. These technologies use thermal, hydraulic, electrical and electronic devices, devices and machines, the installation, maintenance, testing and operation of which, as well as the implementation of measures to increase the power engineering efficiency of their work, taking into account the ecological and economic aspects of power engineering, require highly qualified specialists who are competitive in the international labor market. The latter is a very urgent task for the country.

When compiling the program, the experience of implementing master's educational programs of similar content in foreign higher educational institutions was taken into account:

1. Czech Technical University.

2. Politecnico di Milano;

<https://eps.leeds.ac.uk/courses/PG/F054/electronic-and-electrical-engineering>

3. Illinois Institute of Technology; <http://bulletin.iit.edu/graduate/colleges/engineering/ece/master-power-engineering/#programrequirementstext>

4. School of Engineering And Applied Science, Washington DC; <https://ece2.drupal.gwu.edu/areas-focus#power>

The program is compiled by the European Credit Transfer and Accumulation System (ECTS). At the Georgian Technical University, 1 credit is equal to 25 hours, which includes both contact and independent work hours. The distribution of credits according to subjects is presented in the curriculum. The program lasts 2 years (4 semesters. 60 credits per year) and includes a total of 120 credits. The content of the program's education courses, teaching methods and the number of credits ensure the achievement of the goal of the master's program.

## Program Structure

The program consists of educational and research components. The volume of the educational component is 90 credits (of which 5 credits are devoted to production practice), and the research component (master's thesis) includes 30 credits.

The **educational component** includes education courses of the content corresponding to the main field of study (compulsory 40 credits, optional 45 credits) and free components (5 credits). Students will complete the study components in the first three semesters, and the research component in the 4th semester. Students will undergo production practice in the 3rd semester at a facility selected in accordance with their chosen concentration and master's thesis topic.

The program includes 7 elective concentrations that students choose from the 2nd semester. The volume of each concentration, including the master's thesis, is 65 credits.

The elective concentrations of the program consist of groups of subjects belonging to thermal energy, electric power, electromechanics, electrical engineering and electronics, power consumption technologies, hydropower, energy economics. Accordingly, when choosing a specific concentration, the master's research object and the topic of the final thesis will be related to one of the listed fields.

## Research component

The research component of the program is the master's thesis. Detailed information on the requirements and evaluation of the research component is provided in the regulations of the Georgian Technical University on the master's degree.

Organization of the educational process, assessment of student achievements, signing of educational and financial agreements with students, accumulation of credits by the student, mobility and other necessary information is provided in the "Instructions for managing the educational process at the Georgian Technical University", which is posted on the GTU website: <https://gtu.ge/Study-Dep/Forms/Forms.php>

### **Program Objective**

The objective of the educational program is:

- Training of a specialist with deep and systematic knowledge of the field of power engineering and electrical engineering in accordance with modern market requirements in energy transformation and/or generation, transmission, distribution, power consumption and digital management technologies;
- To develop the student's skills of critical analysis of processes in energy installations and systems, modeling, evaluation of reliability and energy efficiency of equipment operation, searching for new, original ways to independently solve complex energy problems using the latest research methods and approaches;
- To develop in the student the skills of effective management of energy and/or electrical installations and equipment installation, maintenance and operation processes in a complex, unpredictable work environment, as well as the ability to assess the impact of energy installations on the environment during their operation, taking into account social and professional responsibility.

## Learning Outcomes/Competences (general and professional)

- On the basis of deep and systematic knowledge describes thermal, hydro, electromagnetic and mechanical processes in technological systems and installations of electricity generation and/or transmission, distribution and consumption;
- Critically examines the methods of ensuring the electromagnetic compatibility of the microprocessor and electronic receivers of the digital protection of the power supply system; modern methods of energy system operation reliability, effective mode management and monitoring; economic and environmental effects of the operation of energy and electrical installations;
- Deeply explains the logic of automatic management in the field of electrical engineering; modern ways and methods of energy and/or electrical equipment analysis and diagnostics; functions and methods of power supply reserving, energy audit, management in the field of energy;
- In order to monitor and manage the progress of technological processes, actively uses the SCADA system, the methods of analysis and modeling of energy and/or electrical installations and systems' functioning modes, collects, interprets and innovatively synthesizes information characteristic of the field;
- Independently calculates thermal and/or hydromechanical, electrodynamic, management, stability, protection parameters and technical-economic indicators in order to determine the optimal operating characteristics of electric power systems and/or power/electrical installations and to assess the feasibility of further modernization;
- Determines the degree of damage in energy and/or electric machines, devices and systems and organizes installation, repair and rehabilitation works in order to eliminate them, taking into account labor safety and environmental requirements;
- Based on the critical analysis of the obtained information and research results, formulates justified conclusions in terms of the reliability and efficiency of operation of the electric power system, energy and/or electrical equipment, taking into account the engineering tasks of optimization and energy saving;
- Uses the latest methods of experiment planning and results processing to purposefully conduct research works in the field of power engineering and electrical engineering and presents his/her own conclusions/research results to both the academic and professional community in compliance with academic ethics standards;
- Independently plans further study directions and directs the process of developing/enhancing his/her own learning.

In relation to the learning outcomes of the program, by overcoming groups of subjects focused on a connected topic, the learning outcomes of each concentration are concentrated in the following narrow direction:

### **Concentration 1-thermal energy**

- On the basis of deep and systematic knowledge, describes the current processes in thermal energy installations, explains the methods of their intensification and optimization of the functioning of these installations; He/she also discusses the issues of cogeneration, climate change and energy security.
- Independently calculates the characteristics of thermal energy installations; On the basis of the analysis of the obtained information and research results, he/she formulates substantiated conclusions about the operation of thermal power plants and increasing the efficiency of their

work, taking into account the optimization, energy saving and environmental engineering tasks.

- In the field of energy and electrical engineering, he/she determines the directions of knowledge improvement, based on the theoretical and experimental studies and the processing of their results, he/she prepares a report in compliance with the norms of academic ethics and presents it to both academic and professional society.

### **Concentration 2-electric power networks and systems**

- On the basis of in-depth knowledge of the processes taking place in electric power networks and systems, he/she explains the basic principles of system modeling and simulation, the methods of operation reliability, energy efficiency, optimization and analysis of electrical modes.
- According to the results of the simulation, using modern software packages, independently analyzes the established modes of the electric power system, transient processes, and the static and dynamic stability of the system and formulates justified conclusions, solves the tasks of relay protection and system automation of electric power systems and networks.
- In the field of power engineering and electrical engineering, he/she determines the directions of knowledge improvement, based on the conducted theoretical and experimental studies and the processing of their results, he/she prepares a report in compliance with the norms of professional ethics and presents it to both academic and professional society.

### **Concentration 3-electromechanics**

- On the basis of deep and systematic knowledge, explains the methods of analysis of operation modes of electrical machines and devices and mathematical modeling using modern software tools; also, discusses issues of construction, automatic management and regulation of electric machines and devices.
- On the basis of critical analysis of data, formulates substantiated conclusions about the reliability and efficiency of operation of electric machines and devices in different modes, adjustment of operational parameters and feasibility of repairs; independently plans repair, testing and normal operation measures in accordance with technical safety and environmental norms.
- In the field of power engineering and electrical engineering, independently conducts the process of deepening one's own learning, based on the conducted theoretical and experimental studies and the processing of its results, prepares a report in compliance with the standards of academic ethics and presents it to both the academic and professional society.

### **Concentration 4-electrical engineering and electronics**

- On the basis of deep and systematic knowledge, describes the power and control schemes of electrical devices, as well as modern ways and methods of analyzing, designing, constructing and diagnosing microprocessor systems, accounting nodes and electrotechnical devices.
- Performs technical diagnostics of electrotechnical devices and installations using modern measuring tools and computer software packages; checks electricity quality indicators; based on the critical analysis of the received data, determines the effectiveness of electrotechnical and electronic devices, optimal parameters and ways to eliminate damage.

- In the field of power engineering and electrical engineering, he/she determines the directions of knowledge improvement, based on the conducted theoretical and experimental studies and the processing of their results, he/she prepares a report in compliance with the norms of professional ethics and presents it to both academic and professional society.

#### **Concentration 5-electricity technologies**

- On the basis of deep and systematic knowledge, describes in detail the electromagnetic processes taking place in the power elements of electrotechnological installations and complexes, AC frequency-regulated asynchronous electric drives and power supply systems.
- Based on the critical analysis of the information received from the digital devices for protection, recording, parameter control and management of the power supply network, formulates reasonable conclusions about the technical condition of the power supply network and determines the conditions of electromagnetic compatibility.
- In the field of power engineering and electrical engineering, he/she determines the directions of knowledge improvement, prepares a report/presentation based on the conducted theoretical and experimental researches and the processing of its results for both the academic and professional society in compliance with the norms of professional ethics.

#### **Concentration 6-Hydroenergy**

- On the basis of deep and systematic knowledge, he/she describes the mathematical models of the river runoff and the ways of regulation, the calculations of the nodes of hydroturbines, the methods of identifying the factors causing possible accidents or failures of hydropower facilities.
- Independently calculates the main hydrological and hydropower parameters of the river and plans the installation, maintenance, repair, and effective operation measures of the hydropower plants, taking into account the factors of technical safety and environmental impact.
- In the field of power engineering and electrical engineering, he/she determines the directions of knowledge improvement, prepares a report based on the theoretical and experimental studies and the processing of its results in compliance with the standards of academic ethics and presents it to the general public.

#### **Concentration 7-Energy supply and economic aspects of power engineering**

- Discusses in depth the issues of power supply of technological complexes and its reservation, reliability of power system operation modes, effective management and energy security.
- Actively uses modern methods of forecasting complex problems in the field of electric energy, calculating capital investments, operation and maintenance costs, environmental impact assessment, and effective planning of activities.
- Based on the conducted theoretical and experimental studies and the processing of their results, he/she prepares a report in compliance with the norms of professional ethics and presents it to both academic and professional society. In the field of power engineering and electrical engineering, he/she independently conducts his/her own learning process.

## Methods of Achieving Learning Outcomes (teaching-learning)

Lecture  Seminar (group work)  Practical  Laboratory  Practice  Course work/Project  Master's Thesis  Consultation  Independent work

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

Discussion/debate, Cooperative learning, Collaborative work, Problem-based learning (PBL), Case study, Brain storming, Demonstration method, Inductive method, Deductive method, Method of analysis, Synthesis method, Verbal or oral method, Writing work method, Explanatory method, Activity-based learning, Project development and presentation.

## 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.

In case of FX in the component of the educational program, GTU is obliged to schedule an additional exam at least 5 days after the announcement of the results of the final exam.

The number of points obtained in the final assessment is not added to the grade received by the student in the additional exam.

The grade obtained on the additional exam is the final grade and is reflected in the final grade of the educational program component.

In case of receiving 0-50 points in the final evaluation of the educational component, taking into account the evaluation received at the additional exam, the student is assigned an F-0 score.

The system of evaluation of education component and qualification paper is described in detail in the instructions for managing the educational process of the Georgian Technical University and in the syllabi of the education courses.

Research component: completion and defense of the master's thesis - a person who has completed all the educational components provided by the educational program will be allowed to defend the master's thesis. The completed master's thesis is the result of the independent scientific-research work of the master's student. Submission, public defense and evaluation of the completed master's thesis are performed once. Evaluation is done with 100 points. The evaluation rule and procedure are determined by the "Rule for evaluation of the scientific-research component of the master's education program" approved by the academic council of the university on August 14, 2020, by Resolution No.

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**Fields of employment**

<p>Graduates will be able to find employment in relevant state (Ministry of Economy and Sustainable Development, relevant public law legal entities included in its system and sub-departmental institutions) and private sector institutions; in energy companies such as: thermal and hydroelectric plants, electrical systems, and distribution companies; also, water supply systems of cities and regional centers; metro and railway; electrotechnological complexes; energy equipment diagnostics and certification centers; natural gas supply systems; operational and service centers of thermal energy systems; gas station compressor stations; main pipeline systems of natural gas, oil and petroleum products and their pumping and compressor stations; energy equipment installation, repair, construction firms and manufacturing enterprises.</p>
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**Opportunities for continuing education**

<p>Doctoral educational programs</p>
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**Human and material resources needed to implement the program**

<p>The program is fully provided with human capital of relevant qualifications and the necessary material resources.</p>
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**Number of attached syllabi: 82**