საქართველოს ტექნიკური უნივერსიტეტი
GEORGIAN TECHNICAL UNIVERSITY

Approved by
GTU Academic Board
Resolution # 733
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April 02, 2018

Doctorate Educational Program

Name of program

ენერგეტიკა და ელექტროინჟინერია
Energy and Electrical Engineering

Faculty

ენერგეტიკისა და ტელეკომუნიკაციის
Power Engineering and Telecommunication

Head of the Program

Professor Tengiz Jishkariani

Qualification to be awarded

Doctor in Energy and Electrical Engineering ენერგეტიკის და ელექტროინჟინერიის დოქტორი *Shall be awarded in case of performing no less than 180 credits of the educational program*

Language of Instruction

Georgian

Prerequisite for admission to the program

Diploma certifying Master's or equivalent academic degree. The following shall be considered: existence of scientific publications; Participation in scientific conferences; Other documents and materials related to teaching/research activities (certificates, diplomas, patents, etc.). Interview with Faculty Temporary Commission

Description of the program

The program is elaborated with ECTS system, 1 credit equals 25 hours, which means the contact and independent work hours. The credit distribution is presented in the program curriculum. The program lasts for 3 years (6 semesters) and covers 180 credits. Teaching component - 60 credits. Out of 60 credits, 5-5 credits are allocated for "Academic Writing and Scientific Research Methods", "Teaching Methods" and "Assistant of Professor"; 15-15 credits – special courses related to the doctoral thesis topic and the first and second thematic seminars. 120 credits are allocated for research component, namely: 30 credits are assigned to the first and second prospectus, 60 credits - first, second and third colloquiums, and 30 credits - the completion and defense of the thesis. The academic semester covers 20 weeks, from which a classroom classes are conducted for 15 weeks and one week is allocated to the midterm exams. The XVII week is a period of preparation for final exams, which are held on the XVIII-XIX week. XX week, if necessary, is allocated to the additional exams. The additional exam is conducted after the final exam in 5-day interval.

Teaching component

The first semester covers two 5-credit and 10-credit teaching courses, as well as 15-15 credits first and second thematic seminars. The topic of the seminar should be dedicated to actual issues of the field/subfield and it should not be a part of the dissertation topic. The main objective of the thematic seminar is to provide doctoral students with knowledge based on the latest achievements of the specific field/subfield within the relevant research community.

The second semester covers one 5-credit teaching course and 5-credit "assistant of professor".

The maximum score of the midterm assessment is 60 points, out of which: Maximum score of the midterm exam is 30 points, minimum competency limit - 15 points, The maximum score of current activity is 30 points, minimum competence limit - 15 points; The maximum score of the final / additional exam is 40 points, minimum competence limit - 20 points. The additional exam is conducted after the final examination at least 5-day interval.

Research component

Compulsory elements of the program research component: Dissertation research project/Prospectus -1 (10 Credits), Dissertation research project/Prospectus - 2 (20 Credits), Theoretical/experimental research/Colloquium -1 (15 Credits), Theoretical/experimental research/Colloquium - 2 (15 credits), Theoretical/experimental research/Colloquium - 3 (30 credits) and "completion and defense of dissertation" - 30 credits. The assessment of all research components are made once in the session period and each component is assessed with maximum 100 points.

PhD Research Project / Prospectus is the result of research and analysis, the draft of the dissertation thesis that the doctoral student should complete within one year from the start of the study. Doctoral student prepares two prospectuses. The first prospectus should cover the novelty and the actuality of the research topic, the logical explanation and the justification of the scientific and practical values of the selected topic. Doctoral student should know what types of resources (literature, statistics) should he/she use and where to find these resources. In the second Prospectus, the PhD student should develop the research problems, methodology and the main issues of the research.

Theoretical/experimental research/Colloquium - PhD student starts work on Colloquium in the second academic year, the third semester. The work to be presented on the Colloquium should be part of the doctoral thesis. The first and second Colloquium should be no less than 20 pages without appendix. The main goal of the Colloquium is to systemize the doctoral student's knowledge, presentation of the conducted work, to develop the ability of creative thinking, to communicate with the scientific community. Colloquium should reflect the justified results of theoretical/experimental research. The

doctoral student should demonstrate the volume and depth of the particular issue, present the obtained and expected results, analyze the publications prepared or published in refereed journals. The work to be presented as the third Colloquium must be no less than 40 pages without appendix. In the third Colloquium the preliminary discussion of the dissertation work takes place. The doctoral candidate's work on the colloquium is mainly conducted in consultation with the supervisor and in the format of independent work. For the purpose of final assessment, the chairperson of the faculty dissertation board creates a commission comprising 5-9 members, including the representatives of the academic staff of the direction/field.

Completion and defense of the dissertation thesis is a main part of the research component. The completed dissertation should present the result of independent scientific-research work of the doctoral student. It should reflect scientifically proved new results of the theoretical/experimental research conducted by the doctoral candidate. The Component - "The Completion and defense of dissertation thesis" considers preliminary defense of the thesis at the extended session of the academic department, where it is appropriate to invite qualified professionals of the respective field. The Doctoral student presents the main provisions of his work and the obtained results, clearly articulates the actuality of the dissertation work, scientific innovation, practical value, problems raised in the dissertation work and ways of their solution. Preliminary defense results are recorded in the protocol. The completed dissertation and its public defense process is evaluated by the Dissertation Commission consisting of 7-9 members in the third year of teaching, in the sixth semester. Procedures for presenting the dissertation thesis, its public defense and final assessment are established by the Academic Council of the University - "Regulations of Dissertation Board and Doctoral Studies". http://gtu.ge/Learning/doq_debuleba.php

The purpose of the program

The aim of the doctoral program is to prepare the doctor equipped with wide and enhanced knowledge, systematic vision of problems, based on fundamental research required for scientific-research, project-construction, manufacturing-technological, organizational-management and educational fields.

Learning outcomes / competences (general and sectoral)

A) **Knowledge and understanding** - knowledge based on the latest achievements in the field of production, transmission, distribution and consumption of electric and thermal energy, that enable to extend the existing knowledge or use innovative methods (at the standard level required for a rrefereed publication). Through re-thinking and partial re-evaluation of the knowledge in the field of energy and electrical engineering, the doctoral candidate will apprehend the renewed scope of knowledge;

B) **Ability to apply knowledge into practice** – Plans independently, implement and superve innovative research in the field of energy and electrical engineering; Develops new research and analytical methods and approaches oriented on the creation of new knowledge in the field of production, transmission, distribution and consumption of electric and thermal energy that can be reflected in international refereed publications.

C) **Making judgments** - will have ability of critical analysis, synthesis and evaluation of new, complex and contradictory ideas and approaches in the field of energy and electrical engineering. Will have ability to make the right and effective decision for solving problems in the process of production, transmission, distribution and consumption of electric and thermal energy;

D) **Communication skills** – will have ability to provide a reasonable, clear and effective presentation of complex and controversial information, to get involved in the thematic polemic with the international scientific community on the basis of accumulated and newly gained knowledge in the different fields of energy and electrical engineering;

E) Learning skills – Based on the knowledge of latest achievements in the energy sector, will have ability to develop and implement new ideas in the process of creation of sustainable and efficient energy base in Georgia, optimal management and development of energy systems and facilities, in the process of elaborating energy policy and its gradual implementation.

F) Values – Has ability to evaluate his/her own and others attitudes towards values and contribute to the establishment of new values. Observe norms of professional values, ethics and moral, which is necessary condition to establish close contacts, have relation and achieve consent and unanimity with company executives, technical personnel, investment and commercial banks, business circles, municipal bodies, state structures and public representatives, international and local organizations, partners, etc.;

Forms and methods of learning outcomes

☒ Lecture ☒ Seminar (team working) ☒ Practice work ☒ Laboratory
☒ Scientific-thematic seminar ☒ Independent work ☒ Consultation ☒ Research component ☒ Dissertation format ☒ Protect dissertation

Based on the specificity of the particular course, the appropriate activities of teaching-learning methods are used that are depicted in the course programs (syllabus):

1. **Discussion / debate -** one of the most common methods of interactive teaching. Discussion process increases the quality and activity of student engagement. Discussions can be overcome in the debate and this process is not limited to the questions asked by the teacher. It develops a student's ability to reason and to justify his opinion.
2. **Case study** – The teacher discusses particular cases with students and they will learn the issue thoroughly. For example, in the field of engineering security it can be a particular accident or catastrophe in political science, for example, the analysis of the Karabakh problem (Armenian-Azerbaijani conflict), etc.
3. **Brain storming -** This activity promotes formation and expression of the radically different opinion, idea within the premises of the topic. The mentioned activity contributes to the development of a creative approach to the problem. Use of the method is effective in the existence of 2 large number groups of students and consists of several main stages:
   - Determining problem / issue in creative perspective; Making note without criticizing the ideas expressed by the listeners in a certain period of time (mainly on the board);
   - Determining assessment criteria to state the relevance of the idea with the aim of the research;
   - Assessing selected ideas according to the predetermined criteria;
   - Selecting the ideas that are most relevant to the issue, by the method of exclusion;
   - Identifying the idea having the highest assessment, as the best means revealing the solution of the problem.
4. **The deduction method** determines the form of transmission of any knowledge, which is a logical process of finding new knowledge based on general knowledge, i.e. the process is going from general to particular.
5. **Analysis Method -** Helps dissolve the learning material as part of one whole component. This will simplify detailed coverage of individual issues within a difficult problem.
6. **Synthesis** implies the creation of one whole by grouping separate issues. This activity contributes to the development of the ability to see the problem as a whole;
7. **Verbal or oral method -** Narration, speaking, etc. belong to this activity. In this process, the teacher represents the teaching material verbally, explains the teaching material, and the students perceive and acquire the material by listening, remembering and apprehending.
8. **Written work method**, which implies the following types of activities: making extracts and records, summarizing material, composing the theses, composing/writing abstract or essay etc.
9. **Explanatory method** – is based on the discussion around the given issue, a teacher gives particular example being discussed in details within framework of the topic.
10. **Action-oriented teaching -** requires the involvement of the teacher and the student in the teaching process, where the practical interpretation of the theoretical material is taken into consideration.

11. **Elaboration and presentation of the project** - While working on the project, the student uses acquired knowledge and skills to solve the real problem. The project enhances student motivation and responsibility. The work on the project involves planning, research, practical activity and the stages of presenting the results in accordance with the selected issue. The project is considered to be implemented if its results are presented in a clear and convincing way. It can be performed individually, in couples or in groups. At the same time the project can be made within the frames of one subject or several subjects (integration of the subjects); After completion, the project will be presented to a wide audience.

Student knowledge assessment system

Assessment system is based on a 100-point scale.
Assessment of Teaching Component:

Positive grades:

- **(A)** - Excellent - the rating of 91-100 points;
- **(B)** – Very good - - the rating of 81-90 points
- **(C)** - Good - the rating of 71-80 points
- **(D)** - Satisfactory - the rating of 61-70 points
- **(E)** - Enough - the rating of 51-60 points

Negative grades:

- **(FX)** - Did not pass - 41-50 points of rating, which means that the student needs more work to pass the subject and is given the right to take the additional exam once with independent work;
- **(F)** – Failed - 40 points and less, which means that the work carried out by the student is not enough and he/she has to learn the subject from the beginning.

Assessment of Scientific-Research Component/Components:

a) Excellent (summa cum laude) - excellent work
b) Very good (magna cum laude) - the result is above all requirements;
c) Good (cum laude) - the result exceeds the requirements;
d) Average (bene) - the result meets all the requirements;
e) Satisfactory (rite) - the result meets the requirements despite the shortcomings,
f) Inadequate (insufficienter) - the result does not meet the set-out requirements due to significant shortcomings;
g) Completely unsatisfactory (sub omni canone) - the result does not meet requirements.

Field of employment

Doctoral program graduates will be able to work and achieve success in scientific-research and educational-scientific institutions, high schools, in designing offices and consulting bureaus in manufacturing organizations, in laboratories, in separate scientific-research centers and similar organizations, industrial and commercial enterprises of industrial enterprises and agricultural areas, public organizations, governmental structures, consulting firms and agencies, international organizations, energy companies, state-governing bodies, thermal and hydro power plants.

Human and material resources necessary for the implementation of the program

Professors of the Faculty of Energy and Telecommunication will lead the implementation of the training courses envisaged by the Doctoral Program and carry out the activities provided by the Research Component

Research works will be conducted at the faculty laboratories and research centers:

- Laboratory of renewable energy and energy efficient technologies;
- Training Center "Schneider Electric-Telasi";
- Study-scientific laboratory of high-temperature thermoelectric equipment;
- Electrical Engineering, Complex and Electrical Supply Scientific-Engineering Center;
- Technical Technical Diagnostics and Energy Efficiency Study-Scientific Center
- Scientific-Engineering Center of Electricity
- Bioenergy Technology Research Center.

The program will be implemented by the following academic staff:

1. **Gia Arabidze**, Professor, Doctor of Technical Sciences - Thermal Energy and Energy Efficiency;
2. **Giorgi Gigineishvili**, Associate Professor, Candidate of Technical Sciences - Theoretical and Energy Efficiency;
3. **Evtikhi Machavariani**, Professor, Candidate of Technical Sciences - Theoretical and Energy Efficiency;
4. **Omar Kighuradze**, Professor, Doctor of Technical Sciences, Theoretical and Energy Efficiency;
5. **Nodar Kevkhishvili**, Professor, Candidate of Technical Sciences - Thermal Energy and Energy Efficiency;
6. **Tengiz Jishkariani**, Professor, Doctor of Technical Sciences - Theoretical and Energy Efficiency;
7. **Temur Mikiashvili**, Professor, Doctor of Technical Sciences - Thermal Energy and Energy Efficiency;
8. **Guram Makharadze** Professor, Candidate of Technical Sciences - Electric Power Engineering and Electro-mechanics;
9. **Shalva Nachkebia**, professor, Doctor of Technical Sciences - Electric Power Engineering and Electro-mechanics;
10. **Mikheil Rukvadze**, Professor, Candidate of Technical Sciences - Electric Power Engineering and Electro-mechanics;
11. **Ramin Chikhladze**, Professor, Candidate of Technical Sciences - Electric Power Engineering and Electro-mechanics;
12. **Iakir Bijamov**, Professor, Doctor of Technical Sciences - Electric Power Engineering and Electro-mechanics;
13. **Demur Kokhreidze**, Professor, Candidate of Technical Sciences - Electric Power Engineering and Electro-mechanics;
14. **David Japaridze**, Professor, Candidate of Technical Sciences - Management of Fuel-Energy Fields;
15. **Maka Gudiashvili**, Associate Professor, Candidate of Economics, Management of Fuel-Energy Fields;
16. **Nanuli Samsonia**, Professor, Candidate of Economics, Management of Fuel-Energy Fields;
17. **Lali Bochorishvili**, Professor, Candidate of Economics Sciences, Management of Fuel-Energy Fields;
18. **Simon Nemsadze**, Professor, Candidate of Technical Sciences, Electrotechnics and electronics;
19. **Tengiz Museliani**, Professor, of Technical Sciences; **Electrical Engineering and Electronics**
20. **Badur Chunashvili**, Professor, Doctor of Technical Sciences, Power Consumption Technologies;

21. **Konstantine Tsereteli**, Professor, Candidate of Technical Sciences, Power Consumption Technologies;

22. **Archil Vashakidze**, Professor, Doctor of Technical Sciences, Power Consumption Technologies;

23. **Yuri Lomidze**, Professor, Doctor of Technical Sciences - Hydro-energy and Major Pipeline Systems.

24. **Grigol Khelidze**, Professor, Doctor of Technical Sciences - Hydro-energy and Major Pipeline Systems.

25. **Lena Shatakishvili**, Associate Professor, Candidate of Technical Sciences - Hydro-energy and Major Pipeline Systems.

26. **Dimitri Namgaladze**, Professor, Doctor of Technical Sciences - Hydro-energy and Major Pipeline Systems.

Number of attached syllabuses: 4

№	Study and Research Components	Precondition to admission	ECTS credits					
			I Year		II Year		III Year	
			Semeste					
			I	II	III	IV	V	VI
1	Academic writing and scientific research methods	N/A	5	-	-	-	-	-
2	Teaching methods	N/A	5	-	-	-	-	-
3	Assistant of Professor	N/A		5	-	-	-	-
4	Energy Security – Electric power engineering	N/A	10	-	-	-	-	-
5	Energy Security - Oil and Gas	Energy Security – El. energy	-	5	-	-	-	-
6	First thematic seminar	N/A	-	-	15	-	-	-
7	The second thematic seminar	First thematic seminar	-	-	-	15	-	-
Research component								
1	Dissertation Research Project / Prospectus - 1	N/A	10	-	-	-	-	-
2	Dissertation Research Project / Prospectus - 2	Dissertation Research Project / Prospectus - 1		20	-	-	-	-
3	Theoretical / experimental research / colloquium - 1	Dissertation Research Project / Prospectus - 2	-	-	15	-	-	-
4	Theoretical / experimental research / colloquium - 2	Theoretical / experimental research / colloquium - 1	-	-	-	15	-	-
5	Theoretical / experimental research / colloquium - 3	Theoretical / experimental research / colloquium - 2	-	-	-	-	30	-
6	Completion of the dissertation, defense		-	-	-	-	-	30
		Total in semester	30	30	30	30	30	30
		Total in year:	60		60		60	

Total:	180

Map of learning outcomes

№	Learning component	Knowledge and understanding	Use knowledge in practice	Judgment skills	Communication skills	Learning skill	Values
1	Academic writing and scientific research methods	+	+	+	+	-	-
2	Teaching methods	+	+	+	+	-	+
3	Energy Security – Electric power engineering (Special course -1)	+	+	+	-	+	-
4	Energy Security - Oil and Gas (Special course -2)	+	+	+	-	+	-

Program curriculum

№	Subject code	Learning component	ESTS credit/hours	Hours						
				Lecture	Seminar (working in group)	Practical work	Laboratory	Course paper/project	Semi-semester exam	Final exam	Independent work
1	HEL10712G1-L	Academic writing and scientific research methods	5/125	15	30	-	-	-	2	2	76
2	EDU10912G1-L	Teaching methods	5/125	15	30	-	-	-	2	2	76
3	EET49402G1-LSK	Energy Security – Electric power engineering (Special course -1)	10/250	30	30	-	-	15	1	2	173
4	EET49502G1-LS	Energy Security - Oil and Gas (Special course -2)	5/125	15	30	-	-	-	1	1	78

Head of the program Jemal Beridze

Head of Quality Assurance Service of
Faculty of Power Engineering and Telecommunication Nikoloz Abzianidze

Dean of the faculty Gia Arabidze

Approved by
Faculty of Power Engineering and telecommunication
At the Faculty Board Meeting
03.07.2012.

Head of the Faculty Board Gia Arabidze

Agreed with
Quality Assurance Service of GTU Irma Inashvili

Modified by
Faculty of Power Engineering and telecommunication
At the Faculty Board Meeting
27.03.2018 (Protocol №2)

Head of the Faculty Board Gia Arabidze