RĪGAS TEHNISKĀ UNIVERSITĀTE

Report
on inclusion of the professional bachelor study programme "Smart Power Systems" in the accreditation sheet of a study field

Riga, 2023

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1. Information about the study field

1.1. Aims and objectives of the study field

Riga Technical University (further in the text – RTU) study programmes in the study field "Power, Electrical Engineering and Electrical Technologies" (further in the text – study field) are being developed continually by including in their content methodological materials on the latest technological and applied science achievements. The main goals in the development of the study field, consistent with the overall development strategy of RTU, are the following to be implemented by the organisational units of the study programmes:

- increase of the study process quality;
- excellence in scientific research;
- recognition and infrastructure excellence.

These goals are defined to ensure high-quality scientific research vital to the future of the Latvian national economy and to prepare high-skilled and competitive highly qualified specialists in the fields of power engineering, electrical engineering and electricity technologies demanded on the local and international labour market.

The study programmes in the study field, which are implemented in the accreditation period, will increase the number of electrical engineering specialists for the Latvian national economy, who will have competence in the design and application of electrical equipment, appliances and systems, which are necessary to:

- increase the share of renewable energy sources;
- improve energy efficiency;
- ensure energy security;
- maintain and improve energy market infrastructure.

These tasks are included in the UN Sustainable Development Goals and at EU level papers such as the European Union Energy Union Strategy, in the EC communication "A clean planet for all! A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy"[1], the EC Europe's Green Course initiative[2]. The same tasks are also included in such policy planning and strategy documents of the Republic of Latvia as:

- Sustainable Development Strategy of Latvia until 2030[3];
- National Energy and Climate Plan for 2021-2030[4];
- National Development Plan for 2021-2027[5];
- Strategy for the Low-Carbon Development of Latvia until 2050[6].

It should also be noted that a number of the academic staff members in the field of Power, Electrical Engineering and Electrical Technologies, as well as students, are currently carrying out projects of the national research programme (NRP) "Energy", which are, in essence, a state order for scientific research on the urgent issues of the energy sector.

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018DC0773
[2] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en
[3] https://www.varam.gov.lv/sites/varam/files/content/files/lias_2030_en.pdf
[4] https://likumi.lv/ta/id/312423-par-latvijas-nacionalo-energetikas-un-klimata-planu-20212030-gadam (in Latvian)
[5] https://www.pkc.gov.lv/sites/default/files/inline-files/NAP2027__ENG.pdf
[6] https://faolex.fao.org/docs/pdf/lat200100.pdf

Faculty of Electrical and Environmental Engineering (further in the text – FEEE) is implementing all 11 ongoing Energy NRP projects, four of which correspond directly to the study field.

It follows from the above that the implementation of study programmes in the respective study field is very important for the Latvian economy.

Vertical sub-goals defined in the FEEE strategy include the following:

- high-quality study processes. Competitive graduates in energy, electrical engineering and environmental science fields prepared at internationally acknowledged high-quality study programmes who ensure the development of the Latvian economy, are able to think analytically and creatively, as well as to learn lifelong;
- internationally recognised scientific research. High-quality scientific research in energy, electrical engineering and environmental science sectors that meet the needs of the Latvian economy, as well as the themes of international research programmes;
- sustainable innovation, commercialisation and knowledge transfer in the economy. Effective knowledge transfer process and innovation development environment in cooperation with national and foreign companies.

Whereas, horizontal goals are directly subordinated to the following RTU strategic goals:

- Internationally. Competitive faculty activities in the fields of studies, science and innovation.
- Cross-disciplinarily. Promoting linkages with other academic sectors and specialisations in order to improve the content of studies and promote the flow of innovation in the economy.
- Organisational effectiveness. Effective faculty management ensuring development and the implementation of a modern study and research process.
- Financial effectiveness. Financial autonomy of the faculty and a transparent internal financial system contributing to the development of the faculty.
- Efficiency of infrastructure. A modern study, research and innovation environment with modern technical equipment.

1.2. Study programmes of the study field

1.	Adaptronics (42522)	Professional bachelor study programmes
2.	Computerised Control of Electrical Technologies (42522)	
3.	Adaptronics (47522)	Professional master study programmes
4.	Computerised Control of Electrical Technologies (47522)	
5.	Smart Power Systems (47522)	
6.	Computerised Control of Electrical Technologies (51522)	Doctoral study programmes
7.	Smart Power Systems (51522)	

1.3. Analysis of the compliance of the study programme to be included in the study field's accreditation page with the study field

Energy and energy efficiency represent one of the most important aspects that determine the competitiveness of Latvian companies and economic growth. Thus, changes in the study programmes of the study field, closure of the obsolete study programmes and development of new study programmes are conducted in order to adapt to the development of technologies within the sector and to react to changes in the qualification framework of the Energy sector. In this context, the professional bachelor study programme “Smart Power Systems” (further in the text — the Study programme), which has been implemented since study year 2021/22 together with other study programmes of the study field, fully complies with the strategy of RTU FEEE (until 2020 — Faculty of Power and Electrical Engineering), which is directed towards an internationally known study, research and innovation institution in the sectors of energy, electrical and environmental engineering, ensuring a high-standard study process, internationally recognised scientific research and sustainable innovations, commercialisation and transfer of knowledge in national economy. Overall, this strategy promotes the modernisation of the national economy of the Republic of Latvia, which is directed towards the implementation of innovative solutions in various sectors, which is unthinkable without the participation and contribution of well-prepared electric power engineers.

The Study programme offers bachelor-level education in the Electric Power Engineering, Power Supply, and Electric Machinery and Equipment sub-fields of the Electric Engineering, Electronics, Information and Communication Technology field, and the students can obtain the professional qualification of electric engineer.

The knowledge and skills mastered during the studies enable the students of the study field to develop equipment and systems required in the generation, transmission and distribution of electric power, automation and stepping up of the energy efficiency of the manufacturing, transport, service and household sectors, already during the writing of their graduation papers.

2. Description of the study programme

2.1. Parameters describing the study programme

2.1.1. Parameters of the study programme

1.	Name of the study programme	Viedā elektroenerģētika	
2.	Name of the study programme in English	Smart Power Systems	
3.	Code of the study programme in accordance with the Latvian Education Classification	42522	
4.	Type and level of the study programme	Professional bachelor study programme	
5.	Level of qualification to be acquired (NQF/EQF)	6	
6.	Amount of the study programme (CP, preferably also ECTS)	160 CP (240 ECTS)	
7.	Form, type, and duration of the study programme, as well as the language in which the study programme is implemented		
	full-time, intramural form	4 years	Latvian and English
	part-time, extramural form	5 years	Latvian and English
8.	Place of implementation of the study programme	Azenes street 12/1, Riga	
9.	Admission requirements	Secondary education	
10.	The degree, professional qualification to be awarded or the degree and professional qualification to be awarded	Professional bachelor degree in energy and electrical engineering and electrical engineer professional qualification	
11.	Professional standard, its approval year	Electrical engineer, 2021	
12.	Final examination upon the completion of the study programme	Bachelor thesis with a design project	
13.	Director of the study programme	Aleksandrs Dolgicers, Dr.sc.ing.	

2.1.2. The aim of the study programme

The goal of the Study programme is to train a new generation of graduates in the field of electric power systems and networks, electric power transmission and distribution, regimes, stability and reliability, by active introduction of smart technologies, namely:

- optimal control technologies, adaptable to the energy market as well as production, transmission, distribution, consumption, and energy saving;
- expertise in energy demand and saving, techniques of efficient energy use in construction, manufacturing, the primary sector, and transport;
- development and integration of various control systems and energy efficiency models.

2.1.3. Objectives of the study programme

The main task of the Study programme is to train qualified specialists for successfully addressing future problems:

- monitoring and management of work regimes for all the participants involved in the processes of energy generation, transmission and consumption (producers, traders, large and small consumers);
- quick response to changes in various parameters of the power system and reliable transmission in the transmission and distribution networks, with a large share of generated wind and solar power;
- achievement of an effective and state-of-the-art decentralized control of a distributed power system;
- educational work among passive consumers (the small consumers of renewable energy resources), converting them into active participants of the demand response process as prosumers, to ensure effective implementation of the benefits gained.

2.1.4. Achievable learning outcomes

After completing the Study programme, the students will be prepared to work:

- at electrotechnical enterprises that generate, transmit and distribute electricity and manufacture electrical equipment for the national economy;
- at industrial enterprises, at enterprises of agricultural production and processing, designing, research, consulting, services and transport which use modern process equipment with sophisticated automated electrotechnical equipment, for successfully solving future problems.

The graduate of the Study programme:

<u>Knowledge:</u>

- has acquired in-depth knowledge in electric power engineering and electrical engineering;
- knows the basics of electric power supply, electrical networks and system control or electrical machines and devices;
- is able to work as high-level specialists in the field of smart power energy systems;
- has acquired skills in the fundamentals of scientific research work;
- for further studies at the master level.

<u>Skills:</u>

- is able to organise maintenance and renewal repairs, reconstruction and unscheduled repairs, alignment and testing of sophisticated electrical equipment and its automatic control systems, examination, diagnostics, operation and troubleshooting of electrical installations and electrical equipment;
- is able to find and apply solutions on the basis of knowledge in science, engineering, technology and mathematics;
- is able to identify, formulate, analyse and solve problems in the field of engineering;

- is able to effectively work individually, in groups and in multidisciplinary environment, being able to start lifelong learning;
- is able to effectively communicate with representatives from the engineering circles and society as a whole.

Competences:

- is able to lead and supervise works in implementing a construction concept and designing, installation (construction) works for medium-voltage and low-voltage power transmission lines and equipment, conduct feasibility studies, develop the engineering solution part of a construction design, plan and organise the work of other specialists;
- is able to develop a system, components or processes in order to meet specific needs, develop and conduct experiments in order to analyse and interpret data.

2.2. Actuality of the study programme

2.2.1. Justification of the creation of the study program, compliance with the trends of the industry in Latvia, the European Union and the world

The Study programme was developed and licensed in 2021, considering the experience in developing the professional master study programme “Smart Power Systems” as well as the opinion of experts in the field, so that the above master study programme could become a logical continuation of Study programme. Along with a scientific bachelor’s degree, the graduates of the Study Programme also obtain a corresponding professional qualification, “Electric Engineer” (the professional standard (has been updated on August 11, 2021), which has been developed in compliance with the advice and suggestions of specialists active in the field.

Considering that the study programmes and study methods of the previous generation are outdated, it was vitally necessary not only to renew the study materials but also to review the teaching methods at the conditions of continuous increase of the information flow as well as to review the development of the industry, considering the present situation in the power industry not only in Latvia but also worldwide, as well as the forecasts and possible scenarios for the development of the power industry. Thus, two study programmes will be closed down in 2022, namely, the academic bachelor study programme and the first level professional higher education study programme, replacing them with a joint and optimized professional bachelor study programme.

Reacting to the climate change and the wish to gain independence from imported fossil fuel, there is an acute need to increase the share of electricity obtained from renewable sources, which is one of the reasons why electrical networks are being transformed into smart grids. The Study programme takes all due account of this factor as an important global tendency characteristic of the modern electric power sector, additionally considering the demand of the industry for qualified electric power engineering specialists, to provide the enterprises operating in the sector with the required employees in the field of electric power generation and supply and the related field of energy construction. At present, there are no comparable study programmes in Latvia.

Considering the conditions for changes in the education model, which prescribe transition from reproductive forms and study methods to individual

and creative ones, it was necessary to make improvements and search for effective forms for ensuring self-fulfilment and formation of skills for the self-development and self-education of the students. Because of this, the main goal was to develop a modernized study programme, based on the transformation of the master-level study programme for studies in the field of smart power systems, considering the needs of the involved manufacturers for future specialists within a certain education profile and ensuring the students with a better level of flexibility, provided by exchange study trips to European partner universities with the possibility to obtain a professional bachelor diploma.

The Study programme modernization process was implemented in accordance with European experience in the creation of interdisciplinary study programmes and harmonized with the Bologna Agreement. Study programme is corresponded to European educational standards; it is adjusted to the current requirements of the industry and has made it possible to diminish the present fragmentation of study programmes by merging two directions: the academic bachelor study programme and the first level professional higher education study programme.

The current priority of the development of the global power engineering industry is the designing of smart energy systems (SES), which results in an intersectoral approach being introduced, integrating the achievements of electric power technologies and information technologies. Besides, the global task of building SES is all-encompassing and contains a number of sub-goals related to effective power supply to buildings and adaptive control of the power systems of different countries. All of these sub-goals are interlinked and require consideration of their mutual influence and assessment of risks to ensure sustainable development in the whole power engineering industry. Therefore, for the Study programme to maintain its relevance in the long term, the structure of the Study programme will make it possible to form new specializations, reacting to changes in the demands of various industries. Much attention will also be paid to continuous improvement of the study process and ensuring quality of materials during Study programme implementation. To achieve the best results, a multistage evaluation will be conducted. All the changes are discussed and confirmed at the commission of the study field and submitted for confirmation at the Council of the faculty.

The administration of the Study programme is planning to continuously improve the study processes, considering the suggestions of the students, graduates, and the industry. The Study programme has been formed and is implemented in close cooperation with those representatives of the industry who are members of the Latvian Association of Power Engineers and Energy Constructors (LEEA), the improvement of the study content will take place in cooperation with students by way of surveying at the end of each term, with an evaluation of the content of the study courses taught during the term and the quality of their implementation.

2.2.2. Outline of the content of the study programme

Since the Study programme was developed by considering the thoughts of experts in the field, the requirements of the employment market, and based on the national education standard in the relevant sphere of higher education, it is capable of identifying the needs of the power industry and offering the use of smart technologies for economical and effective consumption of electricity, integrating the knowledge obtained in the field of modern electric power

systems into the study process, ensuring the topicality of the study course content and its correspondence to the needs of the industry and the labour market as well as the current tendencies in science. The specialization directions form the basis for master studies and independent work in related industries, conducting scientific and applied research. In addition, the Study programme is aimed at the employees of electric power and electric engineering enterprises who wish to deepen their theoretical knowledge as well as obtain and develop research skills in the field of electric power engineering.

Upon analysing compliance with Regulation No. 512 of the Cabinet of Ministers of the Republic of Latvia, "Regulation on the State Standard of Second Level Professional Higher Education", dated August 26, 2014, it can be concluded that the Study programme complies with all the requirements set. Annex 3.6. contains a comparison of the Study programme with the requirements of the education standard.

According to the assessment of the workgroup that developed the professional standard (PS) "Electrical Engineer" 215101 (level 6 of professional qualification, which corresponds to level 6 of the Latvian qualification framework), it was concluded that the Study programme ensures full-fledged correspondence of the educational content to the requirements set by the professional standard in the mentioned occupations and corresponds to those requirements that have been suggested and set by the leading enterprises in the field, during the development of the professional standard. Annex 3.7. contains a comparison of the Study programme with the requirements of the professional standard.

The processes of Study programme development and reviewing is regulated by the "Procedure for Registering, Developing and Amending a Study Programme", which determines in detail the sequence of actions and the persons involved, starting from the preparation of the application regarding the development of a new study programme to the procedure of closing down the study programme. The procedure has been harmonized with the normative acts valid in the country regarding the licensing of study programmes and making amendments to them.

The compulsory study courses provide the students with knowledge in their speciality field and develop skills needed for engaging in professional activity. The compulsory elective (specialization) study courses are intended for the future specialists to deepen their knowledge in the speciality chosen. The humanities and social studies unit contains study courses that develop communication and social skills. In the compulsory part of the Study programme for foreign student study course VSL711 "Latvian for Foreign Students" is included, this decreases the volume of free elective part from 6 CP to 5 CP. The study process is concluded by an internship and a national examination, which includes defending a bachelor thesis.

To successfully achieve the Study programme results, the planning of the implementation of study courses follows a certain sequence. The Study Programme will be implemented in the form of full-time intramural studies, using both traditional implementation modes (lectures, seminars, laboratory work, etc.) and newer, IT-based solutions. Individual work is an important study form in bachelor studies.

In addition:

- within the study courses taught, the students is have the opportunity to write study reports on subjects proposed by the lecturers. In this way, the students are learning to independently obtain information that is of

interest to them as well as obtain skills for defending their bachelor thesis;
- there are opportunities for the students themselves to choose the subject of their report according to the contents of the study course, subject to approval by the lecturer;
- students can choose the subject of their bachelor thesis themselves, subject to approval by the thesis supervisor.

An especially important part is the implementation of the internship within the Study programme. The Study programme provides for an internship in the amount of 20 CP. Considering the goals, tasks and expected study results, the internship is to be conducted at companies in the electric power engineering and energy construction fields, where students can master the necessary skills. It should be pointed out that most of the above companies are also capable of providing internship to foreign students (in English).

The plans of the Study programme are added in Annex 3.8.

2.2.3. Enumeration and justification of the changes made in the study programme since the licensing

The Study programme is new and after the first term of its approbation (in the reporting period until December 2022), the following less changes to its contents were made with the aim of further improvement:

1. Changes to the part A1 “General Education Study Courses”:
   1.1. the volume has been changed from 12 CP to 14 CP;
   1.2. study course SDD701 “Innovative Product Development and Entrepreneurship” (4 CP) has been replaced with course SDD700 “Innovative Product Development and Entrepreneurship” (6 CP) (description of the study course is attached in Annex 3.5).
2. Changes to the part A.2 “Field-Specific Theoretical Basic and IT Study Courses”:
   2.1. the volume has been changed from 37 CP to 39 CP;
   2.2. study course DMS212 “Probability Theory and Mathematical Statistics” (2 CP) has been included.
3. Changes to the part A.3 “Field-Specific Professional Study Courses”:
   3.1. the volume has been changed from 51 CP to 49 CP;
   3.2. study course EES727 “Fundamentals of Control Systems” (2 CP) has been removed.
4. Changes to the part B1 “Field-Specific Study Courses”:
   4.1. study course DMS212 “Probability Theory and Mathematical Statistics” (2 CP) has been removed;
   4.2. study course EES727 “Fundamentals of Control Systems” (2 CP) has been included.
5. Changes to the part B6 “Languages”:
   5.1. study courses VIL169 “The Latvian Language” (2 CP) and HVD230 “The English Language” (1 CP) has been removed;
   5.2. study course HVD216 “The English Language” (2 CP) has been included.

The above changes were mostly made for the purpose of fully ensure the compliance of the Study programme with the requirements of state education and the occupational standard.

When making the changes to the descriptions of the study courses within the Study programme, the short-term recommendations of experts within the

licensing process were observed and the changes were described in detail in Annex 3.4, namely:

- in the study course EEM212 “Electrical Machines” for part-time extramural studies, the number of contact hours was increased; in the study course HVD101 “The English Language” for part-time students, tests were added; in the study courses HVD108 “The German Language” and DMS212 “Probability Theory and Mathematical Statistics” for part-time studies, the number of contact hours and independent work hours was increased/indicated. All these changes made a positive impact on the quality of the study process, providing the students with more possibilities to receive teaching staff consultations and to better understand the fundamentals of the study course;
- in the study courses EEE202 “Electron devices”, DMF101 “Mathematics”, DIM205 “Supplementary Mathematics (for Electrical Engineering)”, literature sources in English were added, which made possible a wider scope of available literature for local students and made easier the organisation and implementation of the study process for foreign students;
- in the study courses HVD108 “The German Language”, HSP378 “Politology”, HPS120 “Basics of Communication”, EES225 “Basic Signal Theory”, literature sources have been numbered. Also, the numbering of literature sources in the study courses EEI795 “Semiconductor Converters in Power Engineering”, DMS212 “Probability Theory and Mathematical Statistics”, ĶVĶ732 “Chemistry for Engineers” was put in order. These changes will make these sources more convenient to use in the study process.

The descriptions of all the corresponding study courses are appended in Annex 3.4.

In addition, taking into account that the Study Programme has been developed to replace two earlier programmes, provisions have been made to take over those students from the closed study programmes who have not graduated by the beginning of academic year 2022/23. These students can continue their studies within the Study programme according to an individual plan, confirmed by a ruling issued at a meeting of the Control and Optimization Department of the FEEE.

2.2.4. Analysis and assessment of statistical data on students of the study programme and comparison with the planned number of students within the licensing procedure

In the overview period, the number of students in the Study programme is not large (see Table No.1, Annex 3.1.), which can be explained, firstly, by the short period of implementation, then, by economic difficulties (COVID-19 and the energy crisis) as well as by the overall unfavourable demographic situation in the country. Also, it should be noted that there is negative publicity from the old study programmes of the power and electrical engineering study direction, whose low competitiveness had a negative impression with secondary school graduates. Yet on the whole, the trend is positive, especially among those already employed in the industry. There has been a sharp increase in the number of enrolled students in part-time extramural studies (from 6 to 30

students in year 1) whereas the number of enrolled students in the daytime department remains practically unchanged (68 vs. 63 students in year 1).

Because the Study programme has been in place since academic year 2021/2022 and provides for 4–5 years of studies, it is still impossible to analyse the trends in the number of graduates.

As can be seen from Table No.3, Annex 3.1., the dropout rate in the overview period shows a trend towards diminishing. The most frequent dropout reasons are being unenrolled for underachievement, lack of funding, change of place of residence (moving abroad) and choosing a different occupation. There have been no cases when students fail to renew their enrolment after a study break (academic leave). There are cases when study in other school has served as a reason for unenrolment.

Regarding foreign students, we see interest in the Study programme from Ukraine and the Asian region. Regrettably, because of the war in Ukraine, the mobility of Ukrainian high school graduates is limited but involvement of students from Asia is hampered by economic crisis.

It is to be hoped that over time, as the Study programme becomes more recognisable in the world and the economic situation in the target regions improves, there will be a greater involvement of foreign students, which could have a positive influence on the total number of students.

Table No.1. Forecast number of students in the Study programme

	2021/ 2022	2022/ 2023	2023/ 2024	2024/ 2025	2025/ 2026
Students					
Intramural	70 (68)	66 (63)	83	86	86
Extramural	5 (6)	34 (30)	42	44	44
Foreign students, %	0% (0%)	20% (1.1%)	25%	30%	30%

The table No.1. shows the forecast numbers of students at the moment of Study programme licensing, together with real numbers regarding study years 2021/22 and 2022/23 (in brackets). The indicated number of students was chosen in such way as to be able to ensure the required quality of studies, taking into account long-term experience with the existing RTU study programmes. As can be seen from the table No.1., due to the above reasons, the tentative numbers are by an average of 3...10% higher than the real ones. At present, the situation is at its worst with foreign students (instruction in English), which has been caused by the Covid-19 travelling restrictions.

2.2.5. Graduate employment prospects

The Study programme is intended for potential/current employees of electric power and electric engineering enterprises who wish to obtain or deepen theoretical knowledge as well as to develop their research skills in the field of power engineering. It is aimed towards providing the needs of the electric power systems and networks at the Latvian and foreign employment markets as well as the needs of the power utilities field with the required specialists. The

activities to be conducted during the development and approbation of the Study programme (for example, involvement of the industry) and the results to be thus achieved (the competitive graduates) are optimal and contribute to the solution of the existing problem related to the competences of the young professionals and their ability to adapt to the new tendencies.

Traditionally, higher education graduates are mainly employed by commercial enterprises and other large organizations. At present, these employers are often not fully content with pre-existing academic bachelor study programme “Power and Electrical Engineering”, which is often due to a considerable gap between the hopes of the enterprises and the skills, knowledge and wishes of the students. One of the consequences of this disagreement is that enterprises and organizations should more actively interact with higher education institutions and set special requirements regarding the development of study courses and the politics of higher education overall. Still, many entrepreneurs start their dialogue with HEIs only at the stage of hiring employees. Without doubt, this point is too late to cater to their hopes. The enterprises have to be by the side of the students all through their studies from the first day.

Study programme is aimed towards the achievement of its main goals and main tasks, i.e. preparation of the young professionals not only for processing a large flow of information but also for a creative approach to the development of the industry and problem-solving according to the problems and challenges faced by the industry, which will make the graduates of the Study programme competitive in the field of the industry and in rapidly developing directions of science. All of these results are achievable during the Study programme. Therefore, the goals set in the study course descriptions are intricately linked to the results to be achieved by the overall Study programme and the study courses are interlinked and complement one another so that the planned results could be achieved after the completion of the Study programme.

It is also important to point out that two-sided training process will result in a well-educated, motivated, and future-oriented engineering expert whereas the enterprises will support such graduates and provide them with information about career opportunities and provide financial support/scholarships during their education. On the one hand, this will attract ambitious secondary-school students and, on the other hand, support students with less personal (family) financial resources. Extensive support could be linked to the student’s obligation to work at the enterprise before signing the agreement.

In this regard, upon replacing the academic teaching forms (when enterprises admit students only for summer practice or for full-time employment) with professional ones, the shape of the cooperation between the enterprises and the students have been changed in the following ways:

- part-time work: students work at an enterprise and study full-time in parallel;
- the students’ work is recognized as part of their studies and is assessed within the final assessment process;
- combination of work and studies - for a period of one study term or longer, the students can work and afterwards return to their studies within Study programme.

The readiness of enterprises to allow students to apply their knowledge in practice is proved by the existing cooperation agreements with a number of enterprises regarding the provision of placement: JSC “Augstsprieguma Tikls” (High Voltage Network), JSC “Latvenergo”; also, there is a cooperation

agreement with the Latvian Association of Power Engineers and Energy Constructors (LEEA) about finding placement during the study process, considering the possibilities of the members of the Association.

Emphasizing that the standard of training of qualified power engineering specialists is particularly important to ensure the enterprises in the industry with the required employees both in the field of electric power generation and supply and in the related field of energy construction, the Study programme has been created by implementing the following priorities:

- the Study programme corresponds to the requirements of the employment market, based on the national educational and professional standard in the corresponding field of higher education and qualification;
- the creative self-expression of the students is promoted, with the main criterion consisting in the scientific work of the students, which is oriented towards topical problems related to society and the industry;
- the education process outside the classroom is organized;
- feedback from the employees and from society regarding the education results, in order to train well-qualified electric power engineering specialists and ensure the enterprises within the industry with the required employees both in the field of electric power generation and supply and in the related field of energy construction.

When developing the Study programme, due account has been taken of a number of characteristic and important global development tendencies in the field of power engineering, including the development and increasing spread of renewable energy generation technologies, the digitalization of the operation of power systems and of the elimination of faults, the increase in the spread of distributed generation and microgeneration, the modernization of the internal power networks of buildings and digitalization, electromobility, etc.

One more important aspect that substantiates the importance of Study programme consists in the foreseeable development tendencies on a regional level that are related to the expected change in the management model of the power transmission system in the Baltic States as they discontinue the synchronous operation with the power transmission systems of Russia and Belarus and integrate for synchronous operation with the electric power system of the countries of the European Union.

2.3. Resources and provision

2.3.1. Characterization and assessment of study bases, science bases (if applicable), informational bases (including libraries), material and technical bases and financial bases

The implementation of the Study programme is mainly taking place at 12/1 Azenes Street, at the premises of the FEEE, which is part of the Kipsala campus.

The Study programme is implemented by means of the infrastructure, the research basis, and the material and technical basis of the RTU FEEE, including computer rooms, lecture rooms and laboratories. For the needs of the Study programme, all the necessary informational, material, and technical resources have been provided, which are available both within the study field and at the HEI as a whole. All the classrooms intended for the study process are equipped with multimedia technology: computers with connection to the

Internet, loudspeaker systems, projectors, etc. The most important role in providing methodological and informational means to the students is played by the university Scientific library. The students and the teaching staff also have access to other RTU infrastructure elements: canteens and cafes (which are to be found at each building complex), photocopying units, student hotels, sports and recreation centres, a swimming pool, etc. Vending machines with drinks and snacks are in place.

The infrastructure and the materials and technical facilities, thanks to a high degree of digitization, allows increasing the competitiveness of the university, ensures high-quality efficient work as well as accessibility of information, integrating information technology (IT) solutions into the administrative, study and research processes of the university, providing the students as well as the administrative and academic staff with modern, reliable, secure and united IT infrastructure and high-quality IT services.

In order to ensure simple and effective identification of IT users, an IT user identity management system has been introduced, which means that a unique electronic identity is made and maintained for each IT user, and it is valid in all the information systems. In addition, a user session management system is ensured in the IT system, which means that, after the unified login to the RTU information systems, the IT users do not have to undergo repeated authentication. This provides a user experience with a united integrated information system without the need to memorize various identification data and to input them repeatedly when implementing various IT use scenarios.

For all the IT users, a centralized portal is in place, namely, ORTUS (https://ortus.rtu.lv), which functions as a united digital gateway, gathering information from all the components of the RTU information systems and ensuring the users with convenient and simple use and convenient access to the whole catalogue of IT services at one place.

To effectively administer the study process, there is a centralized Studies Management System, which ensures digital provisions for the study life cycle, including an electronic Register of Study Programmes (its public part is available at https://stud.rtu.lv/rtu/vaaApp/sprpub), preparation of study agreements, enrolment of applicants on the study programmes, a Register of Study Courses (its public part is available at https://stud.rtu.lv/rtu/discpub/list?english=true), compilation of individual study plans for students, preparation of ordinances, implementation of the study courses and the studies on the whole, entering of grades, promotion of students to higher courses, awarding of qualifications, administration of payments, management of information about the official accommodation facilities, preparation of diploma information, etc. This system serves as one of the cornerstones in the administration of the study process at RTU.

In order to ensure effective implementation of the study process, the Moodle e-study environment is used, in which all the binding information is prepared in an automated manner (study courses, users, groups, access rights, etc.). This system ensures student–instructor communication. Instructors place various electronic materials onto the system, including tests, home assignments, information about the progress of certain study courses, etc. At the ORTUS portal, students can also see their financial information, make requests for documents (references, academic transcripts of grades, copies of agreements, etc.).

Since 2007, more than 130,000 unique study course sites have been generated in the RTU e-study environment. Students can connect and access electronic study aids at any time and place.

Digitization of classrooms and schedules has been carried out to ensure efficient premises management and study planning (https://telpas2.rtu.lv (in Latvian); https://nodarbibas.rtu.lv/?lang=en). Every RTU student and instructor can see their schedule, with information about the place and time of the class, the instructor's name, the room number, the name of the class and the type of class (i.e. lecture, laboratory class, etc.). In addition to making work more convenient for users, the system considerably facilitates the process of planning classes and compiling schedules as well as optimizes room occupancy and the efficiency of the use of rooms.

To make administrative work efficient, there are also electronic HR management and document management systems, which ensure the turnover of office and HR documents at RTU (https://docs.rtu.lv/ (in Latvian)). Electronic approval of documents and electronic signature functionality have been introduced, thus diminishing the turnover of printed documents and considerably improving the speed of document turnover. Starting from the 2019 autumn admissions, electronic signing of student agreements is ensured. Since 2016, RTU graduates have been receiving their grade transcripts in the form of an electronically signed document.

For quality assurance, there is a digital system for student surveys, which ensures quality monitoring regarding the implementation of study courses and study programmes, which takes place every term. Based on the results of the quality monitoring, regular measures are taken for improving the study programmes and processes.

To ensure additional convenience for the RTU students, instructors, and other staff, RTU is hiring Microsoft Windows and Microsoft Office software, which provides all the IT users with access to the most recent Microsoft software. Among other things, RTU students can use licensed operating system Windows and the Microsoft Office productivity package for their study needs. All the IT users have access to the Microsoft Office 365 cloud computing platform with a data storage space of 1 TB per person as well as access to various additional cooperation and productivity tools (Microsoft Teams, SharePoint Online, Forms, OneNote, OneDrive, Outlook, etc.). RTU students, academic staff and other staff have access to e-mail accounts provided by the University.

To support science processes, a centralized Science Support System is provided which records all the information about publications, patents, commercialization applications, doctoral theses, RTU scientific journals, scientific staff, etc. The system ensures access to information according to the *Open Access* principle.. RTU students and academic staff also have centralized access to scientific software.

RTU has fast optical internet and a broad infrastructure of wireless network with more than 400 access points, including the Eduroam international service. To ensure fast and convenient communication, desk telephones and mobile communication are ensured.

To ensure stable and reliable operation of the information technology, continuous monitoring of the IT infrastructure and systems is carried out, which results in proactive control of incidents. Backup copies are formed for data.

An information system security policy is in place, whose main aim is the security of using the RTU information systems, implementing and maintaining

a sufficient body of measures for mitigating potential or real damage or eliminating it. The implementation of the IT security policy encompasses security checks, supervision of the data transmission network as well as preventive measures. Regular trainings for IT users are organized on the subject of IT security and protection of personal data. Automated management of security incidents is in place, along with risk management. Statistics show that the number of IT security incidents has considerably diminished over the last five years.

The IT User Support Centre provides IT user support, by applying a one-stop approach to process applications based on ITIL guidelines. Since 2007, the IT User Support Centre has processed and resolved more than 160,000 IT user applications.

Library plays an important role in the provision of methodological guides and educational resources to students. RTU Scientific Library (SL) (https://www.rtu.lv/en/studies/scientific-library) is a library of national importance, which has acquired its status in the process of library accreditation. The SL provides the necessary information to ensure RTU study process and research activities, as well as provides library, bibliographic and information services to RTU students, academic and general staff. The Library holds more than 1.3 million printed documents and e-resources in RTU industry specific databases. The Library stock is located at the Central Library, the Study Material Subscription, the Chemistry Branch, the Transport Branch and Study and Research Centres in Daugavpils, Liepāja, Cēsis and Ventspils.

In 2016, considerable investments were made for the development of the SL infrastructure. Additional space (2240 m^2) was built. The total space of the SL premises is 6393 m^2, thereof 3417 m^2 of reader service rooms. 713 work places are available. There are four group rooms and six individual booths, a reading complex for rare books, and a conference hall. The SL is accessible to users with special needs.

To improve the work of the SL and to provide for the informational needs of the study and research work, a Library Council has been formed, which makes decisions about the replenishment of the library stock with printed items and the subscriptions to the required databases. The Library Council has approved the “Policy for Acquiring Resources for RTU SL”, which defines the basic principles for forming the library stock and its development according to the fields of RTU studies and scientific activity.

After the SL receives its funding from RTU, it calculates funding for the information resources for each study programme. The collection is replenished taking into account the recommendations of the heads of the study programme and researchers, in compliance with the allocated funding. By contacting the SL Collection Development Department regarding replenishment of collection, the desired editions can be ordered at the Library website by filling out an order form (https://www.rtu.lv/lv/studijas/biblioteka/pakalpojumi-3 (in Latvian)) or an application form, contacting by phone 67089353, or visiting the Library at 5-105 Paula Valdena Street. The SL offers a guide, which includes websites of various Latvian and foreign publishing houses and bookstores for searching publications and e-resources.

Database subscription agreements are concluded both directly with the supplier and through the Cultural Information Systems Centre, which is the Latvian national representative for the international non-profit organization Electronic Information for Libraries (EIFL, http://www.eifl.net/). The EIFL Licensing Programme offers libraries of state importance to subscribe to

internationally recognized databases at a significantly reduced subscription fee that is not offered to individual subscribers, thus saving the financial resources of libraries.
Every month, the list of the newly-received literature is published in the SL newly-received literature bulletin (https://www.rtu.lv/lv/studijas/biblioteka/jaunieguvumi) (in Latvian&English).

Subscribed databases (https://www.rtu.lv/en/studies/scientific-library/electronic-resources):

- ProQuest Ebook Central Academic Complete, Wiley Online Library, SpringerLink e-books, ACM Digital Library, IEEE Xplore Digital Library, Academic Search Complete EBSCOhost, Applied Science & Technology Source EBSCOhost, Business Source Ultimate EBSCOhost, eBook Academic Collection EBSCOhost, MasterFILE Reference eBook Collection EBSCOhost, MasterFile Premier EBSCOhost, eBook Open Access Collection EBSCOhost, Open Dissertations EBSCOhost.
- The SL also has access to databases funded by the Ministry of Education and Science: ScienceDirect Freedom Collection, SCOPUS (Elsevier), Web of Science (Clarivate).
- Latvian databases: LETA, Letonika, Latvijas standartu datubāze (available only on library premises).

Since 2016, the use of the SL databases has been increasing. The number of e-resources lent has increased from 75391 to 525194 items per year.
The SL new premises have made it possible to expand the range of services available to users. Since the opening of the new premises, the number of library visits increased from 103,825 to 691,200. The SL Central Library is open to users from Monday to Friday (https://www.rtu.lv/writable/public_files/RTU_2_rtu_library.pdf). There is a 24h reading room. At the request of students, during the session in December 2019 and January 2020, five central Library floors with a collection were available to users 24h. During the summer the Central Library is open every working day with reduced opening hours.

The last copy of the oldest editions that comply with RTU profile is stored in the SL repository. They are always available to users.

The on-duty librarian helps find the necessary resources. More detailed information and consultations are provided by bibliographers (information specialists). The SL has librarians responsible for particular fields of science (https://www.rtu.lv/lv/studijas/biblioteka/nozaru-informacija (in Latvian)).

Searching for SL resources is ensured by the PRIMO Discovery search tool). It allows searching for the information in the library catalogue, subscribed databases, as well as in databases created by the SL. Searching for the information in the Union catalog, one can simultaneously obtain information about the available resources in 13 libraries in Latvia.

Both the electronic catalogue and RTU portal ORTUS can be used to reserve the library resources remotely. Remote access to databases is also provided. Since the introduction of RFID technology, users have been able to use five book-dispensing self-service vending machines and return books to a book-sorting vending machine around the clock.

The SL provides students, academic staff and other interested parties with different types of individual consultations and group training in information literacy (https://www.rtu.lv/lv/studijas/biblioteka/lietotaju-apmacibas (in Latvian)).

Editions that are not available in the SL are delivered through an interlibrary subscription or international subscription. Internet access is provided throughout the SL. The SL provides copying, scanning, printing and binding services, as well as there is a self-service canteen.

The methodological support of the Study programme includes textbooks, methodological guidelines for laboratory work, journal publications in Latvian, English, and Russian, equipment catalogues, normative documents in the field of electric power engineering, EU directives, international standards, etc. Students can receive the methodological support at the RTU Scientific Library, which has a sufficient number of books, magazines, and other literature as well as sufficient space in the reading rooms. The UDK 621.3 compartment of the library stock has more than 500 copies of study aids and textbooks: 147 titles in Latvian, 101 titles in Russian, and 203 titles in English.

Specific means include the Protection Relay and Automation Laboratory, the Laboratory of Electric Power Supply Systems, the Laboratory of the Electric Part of Power Plants and Substations, the Laboratory of Power Plants, Networks and Systems as well as the Electric Wiring and Lighting Laboratory, which are intended for the following activities:

1. The Laboratory of Electric Power Supply Systems is oriented towards regime-controlling and emergency automation devices for distribution networks. At the laboratory benches, there are modern protection relays and automation devices with functional testing equipment. The equipment of the laboratory allows students to obtain knowledge as to the structure of the emergency automation system at the distribution network level.
2. The Laboratory of the Electric Part of Power Plants and Substations is equipped with network protection and control apparatus: protection switches and fuses, current transformers, voltage transformers and circuit-breakers as well as medium-voltage switchgear. The equipment of the laboratory allows students to get acquainted with modern network protection and control devices, to obtain the knowledge necessary to organize connection and maintenance operation and to assess the condition of devices.
3. The Electric Wiring and Lighting Laboratory is equipped with a goniophotometer, a spherical spectrometer, fluorescent lamp ballast analysers, luxmeters and other measuring devices in the field of lighting, which make it possible to conduct lighting measurements and analyse the characteristics of various light sources, from incandescent bulbs to modern luminescent lamps, induction-type lamps, high-pressure mercury lamps, high-pressure and low-pressure sodium lamps, and LED lamps. The laboratory has a large collection of various light sources. Students have the opportunity to get acquainted with the present technological level in the field of lighting and the development tendencies, to obtain practical skills of measurements and analysis within the field of lighting technology.
4. The Protection Relay and Automation Laboratory offers students emergency protection and automation equipment. The laboratory is equipped with relay testing devices ISA T1000 and RTDS64, power system transient process computer simulation software is installed on the computers, the results of the simulation can be uploaded to the testing devices, conducting test operation of the equipment to be tested at any emergency mode. The laboratory equipment allows students to obtain knowledge regarding the structure of the emergency automation system of a power system and its functioning.

5. The equipment of the Laboratory of Power Plants, Networks and Systems includes computers with software for calculating a normal and emergency mode of a power system, as well as an analogous power system model. The laboratory makes it possible to obtain practical knowledge in modelling power system modes as well as supports a wide range of study courses and graduation papers.

The study process is mainly ensured by the Control and Optimization Department of the Institute of Power Engineering of the Faculty of Electrical and Environmental Engineering, its teaching staff, and ancillary staff. In addition, the Department of Electric Machinery and Apparatus of the Institute of Industrial Electronics and Electrical Engineering is involved, which is ensure the study and methodological work, form and renew the description of study courses, ensure the implementation of appropriate study courses, supervision of bachelor thesis, and conduct other activities related to the study, methodological, and scientific work.

The Study programme is implemented, inviting teaching staff from the following institutions:

- The Department of Labour and Civil Protection of the Institute of Labour and Civil Protection;
- The Department of Language for Special Purposes of the Institute of Applied Linguistics;
- The Department of Chemistry;
- The Department of Geomatics;
- The Department of Innovation and Business Administration of the Institute of Business Engineering and Management.

In addition, it has to be pointed out that the work is done in close cooperation with colleagues from the research centre of the Institute of Power Engineering of RTU FEEE, as well as the Department of Electric Machinery and Apparatus of the Institute of Industrial Electronics and Electrical Engineering, which will make it possible to use the infrastructure intended for the investigation of the power transmission and distribution system, power system automation, electric machinery and apparatus as well as renewable energy (for example, the wind generator and the solar panels on the roof of the building of the FEEE).

The RTU financing from the state general budget is formed by base financing for studies according to the list of study programmes and the number of students. This financing consists of means for utility payments, taxes, infrastructure maintenance (including the provision of data to the Register of Students and Graduates), purchase of inventory and equipment and the salaries of the staff as well as financing for scientific activity.

The tuition fees of the Study programme are summarized in Table No.2.

Table No.2. Enrolment plan for the Study programme for academic year 2022/2023*

	Length of studies in full-time / part-time (extramural) studies, years	Yearly tuition, euro	Beginning of studies
Citizens of the Republic of Latvia**	4.0/5.0	2800 € /1650 €	Autumn
Member states of the EU (European Union), EFTA	4.0/5.0	2800 € /1650 €	Autumn

(European Free Trade Association) and EU candidate countries			
Members of the CIS (Commonwealth of Independent Countries), Georgia, Turkmenistan, Ukraine	4.0/5.0	2850 € /1680 €	Autumn
Citizens of other countries	4.0/5.0	2970 € /1750 €	Autumn

** The tuition depends on the citizenship of the student. The size of the yearly tuition is unchangeable over the whole study period until the exmatriculation.*
*** The total number of state-financed study places for citizens of the Republic of Latvia is 30.*

In addition to the subsidies from the state, the teaching staff of the departments also write EU projects, which, if successful, make it possible to attract additional financing, thus improving the material basis of the laboratories and allowing to create new methodological study aids.

2.3.2. During the reporting period, analysis of changes in the composition and qualifications of teaching staff and evaluation of these changes

The implementation of the Study programme is ensured by RTU academic staff from a number of structural units — professors and teachers with a doctoral degree, each of which is an expert within a field. To ensure the implementation of the Study programme, teaching staff from foreign partner HEIs are invited as well as, for more practical classes, professionals in the field. The study process involves guest lecturers — specialists from the industry and enterprises, who, within corresponding study courses, could provide specific knowledge and share their experience.

The qualifications of RTU academic staff correspond to the requirements for implementing the study courses of the Study programme. The qualifications of the teaching staff are continuously improved, as are the methodological and scientific materials authored by them. Additionally, Table No.3 shows some examples of qualification-enhancing events.

Table No.3. Examples of qualification-enhancing events

No.	Teacher	Courses and seminars
1.	Diāna Žalostība	28.03.2022.-12.05.2022. Further professional training programme “Python Programming Language” (160 hours)/ RTU (European Social Fund project “Improvement of the Professional Competence of Employees”), Riga, Latvia 06.2021.-09.2021. Mastering Energy and Power System Optimization in GAMS (16 hours)/ Optimization team, on-line (Udemy) 10.2022.-11.2022. Introductory course in Matlab (Part 2) (16 hours), RTU
2.	Romāns Petričenko	29.03.2022.-17.05.2022. Data Analysis and Preparation of Reports by Means of Python

3.	Oļegs Borščevskis	Specialised Certification Centre of Latvian Power Engineers and Energy Constructors, competence-developing seminar “Uninterrupted Power Supply Equipment and Emergency Lighting (2021) Further training course programme “Modelling of Construction Information, its Practical Implementation in an Enterprise and Best Practice”, 8 academic hours, within the project “Training programme for practical use of construction information modelling within the designing and construction process: development and training” (2021) The Green Deal – Renewable Energy Sources, Distributed Generation, Development of Electric Car Charging Network” (2022)
4.	Sergejs Kovaļenko	Solar Energy Basics an online non-credit course authorized by The State University of New York and offered through Coursera (2020) Wind Energy an online non-credit course authorized by Technical University of Denmark (DTU) and offered through Coursera (2020)
5.	Oļegs Linkevičs	Topical Aspects in the Field of Hydrogen for an Energy Enterprise. Training programme, offered by JSCLatvenergo (2022)
6.	Inga Zicmane	European Social Fund project ”Strengthening the Academic Staff of Riga Technical University in Fields of Strategic Specialisation”, No. 8.2.2.0/18/A/017: specialised training for academic staff. Seminar “Digital Multimedia Skills, Digital Ethics” (2022) Certificate of completion “Implementation of green and digital technologies in international educational environment” (Erasmus+UA). 3ESTC Credits series of workshops (2022)
7.	Aleksandrs Dolgicers	Teaching method conference “Adapting the Study Content to an Uncertain Situation” (2022)

On the whole, within the reporting period, the academic staff involved in the Study programme are inclined towards broadening their research interests, professional improvement as well as continual improvement and development of the study courses that they are teaching.

The qualifications of the academic staff involved in the implementation of the Study programme correspond to the desirable results of the Study Programme as well as the implementation of the goals and tasks of the FEEE. The teaching staff are professionals in their scientific field who have proved their competence in research within the field and in using e-environment in the study process, and have participated in international projects as well as developed materials and study aids.

According to the tasks of the Study Programme, the primary criteria by which teaching staff is selected are as follows:

- knowledge about the recent achievements and participation in scientific and research projects in their field;
- state-of-the-art teaching skills in the relevant field;
- experience working with foreign students.

In the reporting period, the teaching staff in the scientific as well as the academic field is undergoing steady development. Compared with last year, the share of professors and associate professors has increased by 2%.

Also, there have been minor changes in the teaching staff, due to a drop in the number of teaching staff (caused by retirement, completion of PhD studies, etc.), an increase in the number of ordinary teaching staff (teachers who have exceeded the retirement age and have not been re-elected). The number of teaching staff with a PhD degree has increased by 2%.

As can be seen from Table No. 4, the Study programme is still characterised by a large share of young academic staff (70% of the staff are under the age of 50) and staff qualifications that ensure the required theoretical and research potential (80% of the staff have an engineering degree of Dr.Sc.Ing. or PhD).

Table No.4 Indicators characterising the academic staff

No	Indicators	Quantity (at the beginning/end of the reporting period)	Percentage relation (at the beginning/end of the reporting period)
1.	Academic positions:		
1.1.	Professors	9 / 9	15 / 15
1.2.	Associate professors	18 / 18	28 / 30
1.3.	Associate Professors	13 / 11	20 / 18.33
1.4.	Lecturers	7 / 6	11 / 10
1.5.	Researchers, assistants, senior laboratory assistants	8 / 5	12 / 8.33
1.6.	Guest lecturers	2 /2	3 / 3.33
1.7.	Leading researchers, researchers	7 / 6	11 /10
1.6.	Ordinary teaching staff	0 / 3	5 / 5
	In total:	65 / 60	
2.	Scientific degrees:		
2.1.	Doctors of science	51 / 48	78 / 80
2.1	PhD students, Masters	14 / 12	22 / 20
	In total:	65 / 60	
3.	By age:		
3.1.	25 - 30	11 / 9	17 / 15
3.2.	31 - 40	17 / 17	26 / 28.5
3.3.	41 - 50	17 / 16	26 / 26.5
3.4.	51 +	20 / 18	31 / 30
	In total:	65 / 60	

In addition, it has to be noted that the teaching staff regularly receive further training, and their teaching materials and scientific results are being improved and developed. For example, this goal has been kept in mind when involving the Study field in European Social Fund project “Strengthening the Academic Staff of Riga Technical University in Fields of Strategic Specialisation”, No. 8.2.2.0/18/A/017.

Usually, within the RTU study programmes, there is mobility of knowledge, as exchange of experience both at the local and international levels, which is possible mainly due to the ERASMUS+ (European Community Action Scheme for the Mobility of University Students and Teaching Staff) mobility programme. Mobility of this kind makes it possible to form closer relationships with professionals at other higher education institutions and the communication of knowledge to students provides them with new career opportunities to continue full-fledged activity in science and in the academic environment, therefore such mobility is frequently used. Yet, since the reporting period of the Study programme has basically coincided with Covid - 19 restrictions for travelling, no-one of the teaching staff or the students have used this opportunity over the last two years.

2.3.3. Specify and provide the justification as to whether the degrees are awarded in view of the developments and findings in the field of science or artistic creation

The implementation of the Study Programme is ensured by RTU academic staff from a number of structural units — professors and teachers with a doctoral degree, each of which is an expert within a field. To ensure the implementation of the Study programme, teaching staff from foreign partner HEIs are invited as well as, for more practical classes, professionals in the field. The study process involves guest lecturers — specialists from the industry and enterprises, who, within corresponding study courses, could provide specific knowledge and share their experience.

The content and formation of the study courses is the responsibility of the elected academic staff of RTU. As a rule, the study course is implemented by a team of teaching staff led by the study programme director and the responsible instructor, possibly involving professionals in the field, doctoral students, and guest lecturers.

The qualifications of all the teaching staff involved in the implementation of the Study programme fully comply with the Study programme implementation conditions and the provisions of normative acts and ensure achievement of the goals of the Study programme and the corresponding study courses as well as study results. The qualifications of the teaching staff are continuously improved, as are the methodological and scientific materials authored by them.

The findings of various earlier and future studies, the models developed in them as well as the experience gained in the cooperation with international partners is form a basis, intricately linked to the state of the art in science and the topical needs of the industry, for teaching the students on the subject of issues related to the compilation and solution of optimization problems in smart power systems. To form in-depth understanding, the students will have to, within a study assignment, independently compile and solve the example of a power system optimization problem. On the other hand, during the lectures and the practical work, the students will use computer software (for example, MATLAB and Excel), implementing various techniques for solving optimization

problems (e.g. linear, non-linear, dynamic programming, the Monte-Carlo method, etc.). The teaching staff have gained considerable experience in the practical use of these methods, solving various topical power system optimization problems in cooperation with the industry, for example, optimization of the operating modes of hydropower plants, optimal choice of equipment, simulation of electricity market operation and consumption elasticity at the conditions of uncertainty, etc.

The high demand for power and electrical engineering specialists in Latvia and abroad as well as the globally increasing importance of scientific research in the field of power and electrical engineering set ever new requirements regarding the contribution of the implementation of the Study programme as a basic factor for sustainable development and excellence. In this connection, particular attention needs to be paid to scientific research. This has more to do with the content, organisation, and practical implementation of master and doctoral programmes, and fully complies with the goal of RTU and the study field to provide science-based studies resulting in students capable of full-fledged management of national or local government bodies or various types of enterprises, as well as ensuring the development of society, education, and business administration in compliance with international, Latvian national and society interests as well as the state of the art in science. At the same time, the students of the bachelor study programme:

- are involved in research work during the development of their bachelor papers and can work in research projects if appropriate funding is available (for example, in a project competition involving RTU teaching staff and students);
- have the opportunity to participate, on a voluntary basis, in research conducted by the academic staff of the Institute of Power Engineering, thus becoming better acquainted with the research process.

In addition, it has to be pointed out that in the reporting period, the qualitative and quantitative indicators of research activity are sufficiently high, thus ensuring sustainability to the development of the Study programme. Attention is focused on publishing scientific articles in sources included in the SCOPUS and Web of Science databases, since exactly these publications allow obtaining more funds for further research and promote effective functioning and development of the Study programme. The teaching staff of the Study programme use the research results and findings of both their own and their colleagues' research, referring to them and linking them to other international studies and findings, i.e. the scientific research is matched to the study process, and its implementation contributes:

- the development of Latvia towards a technologically oriented and knowledge-based society: https://www.pkc.gov.lv/sites/default/files/inline-files/NAP2027_apstiprin%C4%81ts%20Saeim%C4%81.pdf (in Latvian);
- Provision of higher education according to the national vision: http://www.aip.lv/informativie_zinojumi_5.htm (in Latvian);
- Orientation towards the development of innovative branches of engineering science: https://www.em.gov.lv/lv/media/10258/download (in Latvian);
- Provision of opportunities to use knowledge-intensive technologies in industries of national importance that provide a high added value:

https://likumi.lv/ta/id/322468-par-zinatnes-tehnologijas-attistibas-un-inovacijas-pamatnostadnem-20212027-gadam (in Latvian).

2.4. Implementation of the recommendations received in the licensing of the study programme

2.4.1. Assessment of the fulfilment of the plan regarding the implementation of the recommendations provided by study programme licensing experts and the assessment of the impact of the given recommendations on the study quality or the improvement of the study process within the study programme

The experts have given recommendations for improving the descriptions of several study courses as well as the Study programme, which are mainly related to the following:

1. Modernisation of the material and technical basis (including laboratories).
2. Improvement of the content and implementation of the Study programme, precise matching of the Study programme with master-level studies, as well as reviewing the correspondence of the Study programme to the new version of the professional standard.
3. Implementation of additional measures to successfully involve foreign students in professional studies in Latvia.
4. Signing of additional internship agreements with enterprises in the field.
5. More extensive involvement of guest lecturers – representatives of enterprises.

Recommendations have been implemented either fully or is in progress continued.

Full information about the fulfilment of the plan for implementing the recommendations of Study programme licensing experts and the impact of the recommendations on the quality of the studies or the improvement of processes is shown in Annex 3.4. Descriptions of the advanced study courses are attached in the Annex 3.5.

The experts have also recommended renewing the professional standard "Electrical Engineer" and after updating the standard, reviewing the compliance of the Study programme with the approved version of the professional standard, as well as awarding the professional qualification upon graduation. This recommendation has been fully implemented. The renewed professional standard was approved on August 11, 2021 and the professional qualification of an electrical engineer is awarded after the completion of the Study Programme.

3. List or Annexes

Annex	No.
Statistical data on the students since the start of the study programme implementation	3.1.
Basic information on the teaching staff involved in the implementation of the study field	3.2.
Confirmation of the higher education institution/ college that the teaching staff members to be involved in the implementation of the study programme have at least B2-level knowledge of a related foreign language according to European language levels (see the levels under www.europass.lv), if the study programme or any part thereof is to be implemented in a foreign language, or at least B2-level knowledge of the Latvian language, if the study programme or any part thereof is to be implemented in the Latvian language, and a teaching staff member has not acquired the secondary or higher education in the Latvian language	3.3.
Review of implementation of recommendations	3.4.
Information about the improvements made	3.5.
Assessment of the compliance of the study programme with the State Education Standard	3.6.
Assessment of the compliance of the study programme with the Professional Standard	3.7.
Curriculum of the study programme for all intended forms of implementation of the study programme	3.8.
Sample of study agreement	3.9.
Sample of the supplement of diploma to be issued for the acquisition of the study programme	3.10.
Document confirming that the higher education institution/ college will provide the students with the options to continue the acquisition of education in another study programme or at another higher education institution/ college (a contract with another accredited higher education institution/ college), in case the implementation of the study programme is discontinued.	3.11.
Document confirming that the higher education institution/ college guarantees to the students a compensation for losses if the study programme is not accredited or the licence of the study programme is revoked due to the actions of the higher education institution/ college (actions or failure to act) and the student does not wish to continue the studies in another study programme.	The information has not changed